

MINISTRY OF HEALTH OF UKRAINE

**DANYLO HALYTSKY
LVIV NATIONAL MEDICAL UNIVERSITY**

**DEPARTMENT OF BIOLOGICAL
CHEMISTRY**

**MCQs
in biochemistry**

(SECOND EDITION)

for the students of medical faculty

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The guide was prepared for the students of the medical faculty, who study according to the specialty “General Medicine” in English language. The book may also be helpful for the students of Dentistry and Pharmacy faculties.

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FOREWORD

Biological chemistry is a fundamental medical discipline. The understanding of the processes of proteins, carbohydrates, lipids and water turnover as well as the role of vitamins, trace elements and regulatory mechanisms in the organism is the background for the interpretation of the laboratory indices in health and disease in clinical practice.

The obtaining of the proper knowledge, based on the use of the different methodological approaches, in particular test control, is one of the main tutorial elements for the students of the higher educational medical institutions worldwide.

Aimed at the improvement of the students' knowledge and assisting them in preparation to the practical classes, final exam and Integrated State Qualification Exam, that contains Krok-1, the department prepared a guide, which includes main multiple choice questions according to the Biochemistry course programme.

The guide was elaborated according to educational and qualification characteristics and educational-professional programmes of the training of specialists in compliance with the Standard of the Higher Education of Ukraine (the second masters' level).

The multiple choice questions are distributed into 2 main chapters according to the programme of 2 semesters, matching the title and content of the relevant topic. Hence, the first semester chapter includes multiple choice questions to 16 topics, devoted to general assignments of biochemistry, enzymology, bioenergetics, turnover of carbohydrates, lipids and amino acids. The 2nd chapter contains 18 topics on the study of DNA and RNA composition, processes of DNA replication, RNA transcription, molecular mechanisms of the effect of hormones, digestion and vitaminology as well as issues of functional biochemistry, e.g. biochemistry of blood, liver, water and minerals turnover, biochemical composition of muscular and connective tissues.

The authors hope that the use of this guide will improve the level of students' knowledge and score in exams.

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I SEMESTER

TOPIC №1. AN OBJECT AND ASSIGNMENTS OF BIOCHEMISTRY, ITS PRINCIPAL TRENDS AND PARTS. OBJECTIVES AND METHODS OF BIOCHEMICAL INVESTIGATION; THEIR CLINICAL AND DIAGNOSTIC SIGNIFICANCE

1. A patient has been hospitalized with provisional diagnosis of virus B hepatitis. Serological reaction based on complementation of antigen with antibody chemically bound to peroxidase or alkaline phosphatase has been used for disease diagnostics. What is the name of the applied serological reaction?

- A. Enzyme-linked-immunosorbent assay
- B. Radioimmunoassay technique
- C. Immunofluorescence test
- D. Complement fixation test
- E. Immobilization test

2. In investigation of serum proteins various physical and physico-chemical methods can be used. In particular, serum albumins and globulins can be separated by the method of:

- A. Electrophoresis
- B. Polarography
- C. Dialysis
- D. Spectrography
- E. Refractometry

3. Labelled amino acids alanine and tryptophan were injected to a mouse in order to study localization of protein synthesis in its cells. The labelled amino acids will be accumulated around the following organelles:

- A. Ribosomes
- B. Smooth endoplasmic reticulum
- C. Cell center
- D. Lysosomes
- E. Golgi apparatus

4. In course of practical training students studied a stained blood smear of a mouse with bacteria phagocytosed by leukocytes. What cell organelle completes digestion of these bacteria?

- A. Lysosomes
- B. Mitochondrion
- C. Granular endoplasmic reticulum
- D. Golgi apparatus
- E. Ribosomes

5. Healthy parents have got a fair haired, blue-eyed girl. Irritability, anxiety, sleep and feeding disturbance developed in the first months of the infant's life. Neurological examination revealed developmental lag. What method of genetic investigation should be used for the exact diagnosis?

- A. Biochemical
- B. Cytological
- C. Gemellary
- D. Genealogical
- E. Population-statistical

6. A cell with vitamin E deficiency had been affected by ionizing radiation. This induced an intensified release of hydrolytic enzymes into the cytoplasm and thus a complete destruction of intracellular structures – autolysis. What organelle has caused this phenomenon?

- A. Lysosomes
- B. Endoplasmic reticulum
- C. Golgi complex
- D. Microbodies
- E. Mitochondrion

7. In case of many infectious diseases patient's blood may contain antigens of causative agents. What reaction should be applied provided that the level of antigenemia is low?

- A. Enzyme-linked immunosorbent assay
- B. Agglutination test
- C. Indirect hemagglutination test
- D. Latex agglutination test
- E. Immunoelectrophoresis

8. A doctor examined a patient with recurrent aphthous stomatitis with concomitant candidosis and decided to eliminate a possibility of HIV-infection. What examination can help to clear the situation up and make a provisional diagnosis?

- A. Immune-enzyme analysis
- B. Gel precipitation reaction
- C. Reaction of hemagglutination inhibition
- D. Reaction of hemagglutination
- E. Phase-contrast-microscopy

9. For determination of DNA synthesis in the cell usually is used measurement of incorporation of H³-thymidine into cellular biopolymers. The next type of analysis is used in this specific case.

- A. Radioisotope method
- B. Polymerase chain reaction (PCR)
- C. Electrophoresis
- D. Radioimmunoassay
- E. Affinity chromatography

10. Structure of proteins includes proteinogenic amino acids. What is the position of the amino group in the structure of these amino acids?

- A. α -position
- B. β -position
- C. γ -position
- D. δ -position
- E. ϵ -position

11. Determination of proportion between protein fractions in blood plasma or serum has an important clinical and diagnostic significance. The following routine method for obtaining results of this sort is most frequently used in clinical laboratories:

- A. Salting out with neutral salts
- B. Absorption chromatography
- C. Precipitation with strong acids
- D. Electrophoresis in agar gel or on acetyl-cellulose films

E. Immunoprecipitation

12. Protein preparations from human blood plasma are frequently used in clinical medicine for treatment of many diseases. Fractionation of blood plasma and preparation of distinct protein fractions is achieved by the next method:

- A. Fractional precipitation with ammonium sulfate
- B. Fractional precipitation with ethanol by Cohn YI method
- C. Precipitation with salts of heavy metals
- D. Electrophoresis in agarose gel
- E. Ultracentrifugation

13. Doctor, before prescribing of parenteral protein nutrition made laboratory study electrophoretic of spectrum of blood serum proteins. What physicochemical properties of proteins are used in this method?

- A. Ability to be charged
- B. Viscosity
- C. The inability to denature
- D. Hydrophilicity and swelling
- E. Optical activity

14. In biochemical laboratories different methods are used for fractionation of protein mixtures. Specify the method that is based on the difference of net charge of the protein molecule:

- A. Electrophoresis
- B. Gel filtration
- C. Affinity chromatography
- D. Ion Chromatography
- E. Ultracentrifugation

15. The patient is in the department of "artificial kidney". Specify the method that is used to purify blood of its low molecular weight compounds:

- A. Dialysis
- B. Denaturation
- C. Salting-out
- D. Hydrolysis
- E. Electrophoresis

16. The method of salting-out is used for the fractionation of blood serum proteins in clinical practice. Name compounds which are used for this method?

- A. Salts of heavy metals
- B. Detergents
- C. Acids
- D. Salts of alkali metals
- E. Alkalis

17. Determination of C-reactive protein (CRP) in blood plasma is conducted with the use of antisera, containing specific antibodies against CRP. What type of analytical method is used in this case?

- A. Immunoprecipitation
- B. Polarography
- C. Spectrophotometry
- D. Electrophoresis

E. Chromatography

18. Chose from listed below methods ONE, which is used for fractionation of protein mixtures and isolation of individual proteins (enzyme, hormone, toxin etc).

- A. Affinity chromatography
- B. Precipitation with nitric acid
- C. Boiling of extracts
- D. Proteolysis
- E. Radioimmunoassay

19. Which electrode to the protein particle will move during electrophoresis, if its isoelectric point is 4.0, and the pH for buffer solution is 5.0?

- A. Anode
- B. Calomel electrode
- C. Cathode
- D. Silver electrode
- E. Platinum electrode

20. Lysosomes are membrane-bound cellular organelles found in many animal cells and most plant cells, which have the following functional significance:

- A. Degradation of complex biomolecules (proteins, nucleic acids, oligosaccharides etc.)
- B. Production of energy (biosynthesis of ATP)
- C. Post-translational modification of proteins
- D. Oxygen consumption by the cell (respiration)
- E. Cell movement

21. Blood plasma proteins serve many different functions, including transport of lipids, hormones, vitamins and minerals in activity and functioning of the immune system. Other blood proteins act as enzymes, complement components, protease inhibitors or kinin precursors. In determination of blood plasma proteins concentrations, the following technics is most convenient and most frequently used in laboratory practice:

- A. Colorimetry
- B. Polarography
- C. Electrophoresis
- D. Precipitation with strong acids
- E. Precipitation by salts of heavy metals

22. Detection of protein in biological fluids, e.g. in urine, blood or saliva is achieved with the following methodical approach:

- A. Precipitation with strong inorganic or organic acids
- B. Amino acid analysis after acid hydrolysis of sample.
- C. Immunoprecipitation with specific antiserum
- D. Determination of optical density at 280 nm
- E. Polarimetry

25. Most hormones are present in the circulating blood in extremely low concentrations, some as low as one millionth of a microgram (one picogram) per ml. In determination of concentration of hormones in blood the next method is routinely used in clinical laboratory investigations:

- A. Immunoenzymatic assay
- B. Immunoprecipitation

- C. Chromatography
- D. Spectrophotometry
- E. Polarography

26. The biochemical method using the movement of charged particles towards one of the electrodes under the influence of an electrical field and used to separate molecules according to their charge and shape is:

- A. Electrophoresis
- B. Gel filtration
- C. Molecular sieving
- D. Gas liquid chromatography
- E. Spectrometry

27. Which is the best technique to separate oxygenated normal hemoglobin A (HbA) from oxygenated sickle cell hemoglobin (HbS), assuming no protein aggregation?

- A. Native gel electrophoresis
- B. Colorimetry
- C. Gel filtration
- D. Affinity chromatography
- E. Ultracentrifugation

28. Separation of molecules according to their molecular mass is achieved by the following chromatographic method:

- A. Gel filtration chromatography
- B. Ion exchange chromatography
- C. Adsorption chromatography
- D. Partition chromatography
- E. Affinity chromatography

29. The cellular organelles called "suicide bags" are known to contain more than 60 different hydrolytic enzymes that digest large molecules are:

- A. Lysosomes
- B. Ribosomes
- C. Nucleolus
- D. Golgi's bodies
- E. Mitochondria

30. Measurement of one important chemical molecule which stores genetic information has come to play a major role in the field of criminology, with applications that have provided impacts extending to proof of innocence or guilt in a crime. Which of the following molecules is this:

- A. Nuclear DNA
- B. Messenger RNA
- C. Euchromatin
- D. Heterochromatin
- E. Ribosomal RNA collected in nucleoli

31. The biuret test, also known as Piotrowski's test, is based on the reaction with copper (II) ion which forms mauve-colored coordination complexes in an alkaline solution. Biuret reaction is specific for:

- A. -CONH-linkages
- B. -CSNH₂ group

- C. $-(NH)NH_2$ group
- D. $-SH$ groups
- E. All of these

32. Protein purification is a series of processes intended to isolate one or a few proteins from a complex mixture, usually cells, tissues or whole organisms. Protein purification is vital for the characterization of the function, structure and interactions of the protein of interest. The purification process may separate the protein and non-protein parts of the mixture, and finally separate the desired protein from all other proteins. Which of the following techniques purifies proteins:

- A. Ion exchange chromatography
- B. Photocolorimetry
- C. Polarography
- D. Fluorescent analysis
- E. Immunoenzyme assay

33. Solubility of proteins usually depends on the structure of the molecule. The solubility of the protein in water (and other polar solvents) depends on number of hydrophilic amino acids (arginine, lysine, aspartic acid, and glutamic acid) it contains. Those amino acids have a polar side chain which allows them to be more soluble in water. The solubility of most proteins is lowered at high salt concentrations is called as:

- A. Salting out process
- B. Salting in process
- C. Isoelectric focussing
- D. Affinity chromatography
- E. None of these

34. Amino acid analysis provides a measure of true protein quantities. It gives detailed information about the amino acid composition of protein/peptide hydrolysates, free amino acids in cell culture media and of free amino acids in serum, plasma, urine, and intracellular free amino acids. Chose the method, which is used in amino acid analysis of proteins:

- A. Affinity chromatography
- B. Gel electrophoresis in polyacrylamide
- C. Colorimetry
- D. Ion exchange chromatography
- E. Polarography

35. Many techniques used in biochemistry are based on interaction between analyte and light. It can be change of color or intensity of light, luminescence, fluorescence, change of rotation of polarised light or light scattering. Indicate optical methods of investigation, which are used in clinical biochemistry:

- A. Photocolorimetric
- B. Affinity chromatography
- C. Salting out
- D. Electrophoresis
- E. Immunoenzyme assay

36. A 29-year-old man comes to his doctor with symptoms of HIV infection. The doctor orders several confirmatory tests, for one of them a protein sample is taken and is run on electrophoretic PAG gel, causing it to separate by size and charge. The protein than

transferred to a membrane, and labeled antibody is added to allow visualization of this protein. Which of the following tests was described?

- A. Western blot
- B. Immunoenzyme assay
- C. Polymerase chain reaction
- D. Northern blot
- E. Ion exchange chromatography

37. Hexokinase catalyzes phosphorylation of glucose in the 6th carbon position, which is the first reaction of glycolysis in the liver, a unique hexokinase type known as glucokinase catalyzes this step. A researcher wishes to determine whether other tissues, in addition to liver, express glucokinase. Which of the following techniques would be most useful in determining if glucokinase exists in a tissue?

- A. Western blot
- B. Southern blot
- C. Polymerase chain reaction
- D. Northern blot
- E. Ion exchange chromatography

38. A 65-year-old woman complains to her physician because of recent weight loss without change in diet. Her pulse is 101/min and blood pressure is 129/80 mm Hg. Ocular examination reveals ophthalmopathy (exophthalmos). Which of the following tests would be most useful in understanding the etiology of this patient's diagnosis?

- A. Enzyme-linked immunosorbent assay
- B. Gel electrophoresis
- C. Southern blot
- D. Polymerase chain reaction
- E. Fluorescence in situ hybridization

39. A biochemical laboratory is actively investigating a novel compound that possesses chemotherapeutic properties. After the drug is administered to a culture of cancer cells, microscopic evaluation shows cells arrested with condensed chromatids visible. Which of the following intracellular targets is most likely inhibited by the drug?

- A. Centromere
- B. Topoisomerase
- C. Electron transport chain
- D. Microfilament
- E. Lysosomes

40. A 21-year-old woman with no known pathological conditions presents to her physician to have titers drawn in order to prove that she is up to date on her vaccination before she enters the medical university. Which of the following ELISA tests would indicate that this woman has been vaccinated against hepatitis B?

- A. Antibodies to hepatitis B surface
- B. Antibodies to hepatitis B core antigen
- C. Hepatitis B surface
- D. Antibodies to hepatitis B envelope antigen
- E. Hepatitis B surface antigen

TOPIC № 2. STRUCTURE AND PHYSICO-CHEMICAL PROPERTIES OF ENZYMES. STUDY OF MECHANISMS AND KINETICS OF ENZYMATIC REACTION.

1. When investigating human saliva it is necessary to assess its hydrolytic properties. What substance should be used as a substrate in the process?
 - A. Starch
 - B. Proteins
 - C. Fats
 - D. Fiber
 - E. Amino acids
2. There are several groups of molecular mechanisms playing an important part in the pathogenesis of insult to cells which contributes to the pathology development. What processes are stimulated by proteolytic damage mechanisms?
 - A. Enzyme inhibition
 - B. Lipid peroxidation
 - C. Phospholipase activation
 - D. Osmotic membrane distension
 - E. Acidosis
3. In a patient was detected disorder in digestion of proteins in stomach and small intestines. What group of enzymes may cause this disorder?
 - A. Proteinases
 - B. Amylase
 - C. Lipase
 - D. Lyases
 - E. Aminotransferases
4. Cytochemical investigation revealed high content of hydrolytic enzymes in the cytoplasm. This phenomenon indicates the activity of the following organelles:
 - A. Lysosomes
 - B. Endoplasmic reticulum
 - C. Mitochondria
 - D. Polysomes
 - E. Cell center
5. Protective function of saliva is based on several mechanisms, including the presence of enzyme that has bactericidal action and causes lysis of complex capsular polysaccharides of staphylococci and streptococci. Name this enzyme:
 - A. Lysozyme
 - B. α -amylase
 - C. Oligo-1,6-glucosidase
 - D. Collagenase
 - E. β -glucuronidase
6. Enzymes (biological catalysts) are used as pharmacologic preparations. What is the mechanism of enzyme action in the biochemical reactions?
 - A. They reduce the energy of reaction activation
 - B. They increase the energy of reaction activation
 - C. They inhibit the reaction process
 - D. They change the constant of the reaction rate
 - E. They change the reaction order

7. In intact cell, the free energy change ($\Delta G'$) associated with an enzyme-catalyzed reaction is frequently different from the standard free energy change (ΔG°) of the same reaction because in the intact cell the

- A. Activation energy is different
- B. Reaction is always near equilibrium
- C. Enzyme may be regulated allosterically
- D. Reactants are not at 1 M concentrations
- E. Reaction may be catalyzed by more than one enzyme

8. After the addition of an extract of pancreatic gland to the tube with starch solution a blue coloration of the sample with iodine have disappeared, which indicates on starch hydrolysis. What pancreatic enzyme is involved in this reaction?

- A. Amylase
- B. Chymotrypsin
- C. Lipase
- D. Trypsin
- E. Aldolase

9. A 3-year-old boy in good health began having generalized seizures consisting of a sudden turning of the head to the left, tonic posturing of the left arm, and loss of awareness for 1 to 2 minutes. The patient was successfully treated with the anticonvulsant phenytoin (dilantin). Dilantin is a substrate that binds to and is metabolized by an enzyme in the liver. Which one of the following statements best describes the relationship between an enzyme, substrate, and product?

- A. All the active sites of the enzyme are saturated with substrate at high substrate concentrations
- B. Enzyme–product complexes enhance substrate binding
- C. At high substrate concentrations, substrate–substrate interaction interfere with enzyme activity
- D. At low substrate concentrations, none of the enzyme is found in the ES complex.
- E. Significant product formation results in activation of the reaction

10. Ethylene glycol, the major ingredient in antifreeze, is occasionally consumed by alcoholics as a substitute of true alcohol beverages. In metabolism of ethylene glycol a highly toxic aldehyde is produced, much more toxic than acetaldehyde, produced from ethanol. Ethanol is often administered as a treatment in cases of ethylene glycol poisoning. What is the most likely reason that ethanol is an effective treatment for ethylene glycol poisoning?

- A. Alcohol dehydrogenase (ADH) exhibits a much lower Michaelis constant (K_m) for ethanol than for ethylene glycol
- B. Ethanol is an allosteric effector of ADH in addition to being a substrate
- C. Ethanol combines with a toxic product formed by the reaction of ADH with ethylene glycol and converts it to a harmless product
- D. Acetaldehyde, which is produced by the reaction of ADH with ethanol, is of therapeutic value
- E. Ethanol induces another enzyme which effectively metabolize ethylene glycol

11. The molecular absorption coefficient (extinction coefficient) of NADH at 340 nanometers is 6,220 liters per mole per centimetre, whereas that of NAD⁺ at 340 nanometers is 0. What absorbance will be observed when light at 340 nanometers

passes through a 1-centimeter cuvette containing 10-micromolar NADH and 10-micromolar NAD?

- A. 0.062
- B. 0.031
- C. 0.124
- D. 0.31
- E. 0.62

12. Which one of the following ailments, seen by an emergency room physician, is most likely caused by enzyme denaturation?

- A. A 34-year-old man diagnosed with a gastrinoma complaining of diarrhea for 2 weeks
- B. A 58-year-old man with chest pain and shortness of breath with increased activity
- C. An 18-year-old boy presenting with a sore throat and fever of 101°F; he has small minimally tender anterior cervical lymph nodes and a red pharynx
- D. A 48-year-old woman complaining of knee pain after twisting her leg playing tennis
- E. An 18-month-old boy with a 4-day history of symptoms of an upper respiratory infection presenting with fever, irritability, and pulling at his left ear for the past 24 hours

13. Enzymes and catalysts both affect the rate of a reaction. Choose a correct statement about common features of enzymes and inorganic catalysts.

- A. Acceleration of thermodynamically permitted reactions
- B. High selectivity to type of catalyzed reaction
- C. Specific dependence on substrate concentration
- D. Dependence of activity on pH of medium
- E. Dependence on the presence of cofactors

14. Enzymes are catalysts. They are usually proteins, though some RNA molecules act as enzymes too. Enzymes accelerate the rate of reactions by:

- A. Decreasing the energy of activation
- B. Increasing the energy of activation
- C. Increasing the equilibrium constant of reactions
- D. Decreasing the free energy change of the reaction
- E. Decreasing the equilibrium constant of reactions

15. Enzymes are actually made up of 1000s of amino acids that are linked in a specific way to form different enzymes. The enzyme chains fold over to form unique shapes and it is these shapes that provide the enzyme with its characteristic chemical potential. Active centre of enzyme can be defined as follows:

- A. Site on the enzyme molecule, which binds substrate and provides its further transformation.
- B. Part of the molecule, which easily splits from apoenzyme.
- C. Nonprotein component of enzyme molecule
- D. Site for binding of allosteric effector.
- E. Whatever part of polypeptide chain of enzyme molecule.

16. The active site is the region of an enzyme where substrate molecules bind and undergo a chemical reaction. The active site consists of residues that form temporary bonds with the substrate (binding site) and residues that catalyse a reaction of that

substrate (catalytic site). Chose the amino acid, which is frequently involved in formation of active centre in different enzymes.

- A. Histidine
- B. Leucine
- C. Proline
- D. Valine
- E. Glycine

17. According to International Union of Biochemistry (IUB) classification enzymes are divided into six major classes. What type of reactions presented below is catalyzed by hydrolases (third class)?

- A. $A-B + H_2O = A-OH + B-H$
- B. $AH_2 + B = A + BH_2$
- C. $A+B+ATP = A-B + ADP + P_i$
- D. $A-B = A + B$
- E. $A-R-B = A-B-R$

18. Enzymes can function both inside cells (intracellular) or outside cells (extracellular). The best examples of extracellular enzymes (exoenzymes) are:

- A. Digestive enzymes
- B. Nucleases
- C. Dehydrogenases
- D. Transferases
- E. Reductases

19. Hydrolases or hydrolytic enzymes split the molecule by addition of water, e.g. sucrose is hydrolyzed into fructose and glucose by adding water in presence of enzyme sucrase. In cell, hydrolytic (digestive) enzymes are found mainly in:

- A. Lysosomes
- B. Mitochondria
- C. Ribosomes
- D. Nucleus
- E. Vacuoles

20. The citric acid cycle also known as the TCA cycle or the Krebs cycle – is a series of chemical reactions used by all aerobic organisms to release stored energy through the oxidation of acetyl-CoA derived from carbohydrates, fats, and proteins, into adenosine triphosphate (ATP) and carbon dioxide. The enzymes of the citric acid cycle are located in:

- A. Mitochondrial matrix
- B. Extramitochondrial soluble fraction of the cell
- C. Nucleus
- D. Endoplasmic reticulum
- E. Lysosomes

21. Enzymes and catalysts both affect the rate of a reaction. Enzymes differ from inorganic catalysts by the next property:

- A. Thermolability
- B. Acceleration of reaction equilibrium achievement
- C. Sensitivity to catalyst poisons
- D. Thermostability
- E. No selectivity to type of catalyzed reaction

22. With the exception of a small group of catalytic RNA molecules, all enzymes are proteins. Their catalytic activity depends on the integrity of their native protein conformation. What happens with enzymes at 90 °C?

- A. Denaturation
- B. Hydrolysis
- C. Alteration of primary structure
- D. Alteration of tertiary structure
- E. Tight binding of substrate in active site

23. Some enzymes require no chemical groups for activity other than their amino acid residues (simple enzymes). Others (conjugated) require an additional chemical component called a cofactor. As cofactors of enzymes the most frequently met are the next compounds:

- A. Vitamins, modified by cell enzymes (vitamin derivatives)
- B. Native vitamins
- C. Hormones, e.g. thyroxine
- D. Carbohydrates
- E. Polynucleotides

24. Enzymes are affected by changes in pH. It can have an effect of the state of ionization of acidic or basic amino acids. The pH optima of most of the enzymes is:

- A. Between 6 and 8
- B. Between 1 and 3
- C. Between 4 and 6
- D. Between 8 and 12
- E. Above 12

25. Enzymes are not machines. They are firm and forceful, yet slightly fluid, meaning that they can undergo shape changes. Chose the correct statement about allosteric site of enzyme:

- A. It modulates reversibly enzymatic activity after binding with ligand
- B. It is identical with active centre.
- C. It serves for attachment of enzyme to biomembrane
- D. It irreversibly inhibits enzymatic activity after binding with ligand
- E. It induces chemical modification of enzyme molecule

26. Enzymes can function both inside cells (intracellular) or outside cells (extracellular). The example of extracellular enzyme is:

- A. Pancreatic amylase
- B. Hexokinase
- C. Glucose-6 phosphatase
- D. Glucokinase
- E. Aconitase

27. An enzyme that catalyzes the conversion of an aldose sugar to a ketose sugar would be classified as one of the:

- A. Isomerases
- B. Oxidoreductases
- C. Transferases
- D. Hydrolases
- E. Liases

28. In the cell, enzymes are located in subsequent organelles, providing their specific functioning. Note enzymes located in lysosomes.

- A. Cathepsins and glucosaminidase
- B. Fatty acid synthesis enzyme complex
- C. Enzymes of protein biosynthesis
- D. Enzymes of urea synthesis
- E. Glycogen synthetase and branching enzyme

29. Specificity of action is an important property of enzymes which differs them from inorganic catalysts. Chose from listed below enzymes ONE which exhibits selectivity to stereochemical epimers of substrate:

- A. Urease
- B. Aminopeptidase
- C. Trypsin
- D. Alcohol dehydrogenase
- E. Lactate dehydrogenase

30. Pepsin is an enzyme, produced in the stomach, that in the presence of hydrochloric acid splits proteins into proteoses and peptones. Pepsin has the following pH optimum for enzymatic activity:

- A. pH 1,5
- B. pH 5,1
- C. pH 7,5
- D. pH 8,0
- E. pH is non significant

31. Hydrolases are enzymes that catalyse the hydrolytic cleavage of C-O, C-N, C-C and some other bonds. Chose from listed below enzymes, ONE which represents class hydrolases:

- A. Pepsin
- B. Aldolase
- C. Glucokinase
- D. Phenol oxidase
- E. ATP synthase

32. The code number of each individual and well characterized enzyme according to enzyme commission numerical code (EC) contains the following numbers of digits:

- A. Four
- B. Two
- C. Three
- D. Five
- E. Six

33. Sometimes enzymes will not function properly without some extra components. Such enzymes are called conjugated enzymes. Their extra components (coenzymes) are:

- A. Heat stable, dialyzable, non protein organic molecules
- B. Soluble, colloidal, protein molecules
- C. Structural analogue of enzymes
- D. Different forms of enzymes
- E. Inorganic catalists

34. The specific action of an enzyme with a single substrate can be explained using a Lock and Key analogy first postulated in 1894 by Emil Fischer. Lock and 'Key model implies that:

- A. The active site is complementary in shape to that of the substrate
- B. The active site is flexible and adjusts to substrate
- C. The active site requires removal of PO_4 group
- D. The active site is not changed
- E. Substrates change conformation prior to active site interaction

35. Mitochondrial marker enzymes are enzymes that can only be found in mitochondria. So when you detect one of them, you also detect a mitochondria. Which of the following is a mitochondrial marker:

- A. Succinate dehydrogenase
- B. Aldolase
- C. Amylase
- D. Pyruvate dehydrogenase
- E. DNA-polymerase

36. The main function of enzymes is to catalyze chemical reactions, thus being an organic catalysts, enzymes have many common properties with inorganic catalysts. Which of the following is not true regarding enzymes?

- A. They are destroyed after the completion of the reaction they catalyse
- B. They catalyze only a particular type of reaction
- C. They remain active even after separation from the source
- D. They are irreversibly destroyed at high temperature
- E. Their activity depends on the pH of the solution

37. Enzymes are usually named by adding the suffix to the main part of the substrate on which they act EXCEPT:

- A. Trypsin
- B. Sucrase
- C. Maltase
- D. Lactase
- E. Nuclease

38. In active centre of enzymes which catalyze hydrolysis of substrate (hydrolases) usually is present the next amino acid residue:

- A. Histidine
- B. Leucine
- C. Phenylalanine
- D. Proline
- E. Valine

39. Michaelis-Menten constant is defined as the substrate concentration (expressed in moles/l) to produce half-maximum velocity in an enzyme catalysed reaction. Michaelis-Menten constant (K_m) reflects the next property of enzyme:

- A. Affinity to substrate
- B. Sensitivity to pH of medium
- C. Thermolability
- D. Affinity to a product of reaction
- E. Sensitivity to competitive inhibitors

40. Michaelis-Menten constants of two enzymes are $1,3 \times 10^{-5}$ M/l and $2,3 \times 10^{-3}$ M/l subsequently. Indicate true statement about the affinity of these enzymes to substrate.

- A. The first enzyme has higher affinity to substrate
- B. Enzymes possess equal affinity to substrate
- C. The second enzyme has higher affinity to substrate
- D. For decision an information on concentration of enzyme is needed
- E. Data are incomplete and it is impossible to draw a conclusion

41. According to international convention (EC) as a unit of enzymatic activity is accepted 1 catal, which can be defined as:

- A. Quantity of enzyme which transform 1 mole of substrate in 1 second
- B. Quantity of enzyme which transform 1 umole of substrate in 1 minute
- C. Quantity of enzyme which transform 1 umole of substrate in 1 second
- D. Activity of 1 mg of pure enzyme
- E. Number of substrate molecules transformed in 1 minute

42. The Michaelis-Menten equation describes how reaction velocity varies with substrate concentration. Michaelis-Menten constant corresponds to:

- A. Substrate concentration at which reaction rate is half maximal
- B. Optimal pH for activity of enzyme
- C. Enzyme concentration, which provides half maximal velocity of reaction
- D. Concentration of substrate, at which rate of reaction reach maximal value
- E. Ionic strength of medium favoring maximal activity of enzyme

43. An esterase is a hydrolase enzyme that splits esters into an acid and an alcohol in a chemical reaction with water called hydrolysis. An esterase has an active site that:

- A. Contains a hydrophobic recognition site
- B. Contains a thiol
- C. Contains a thiamine pyrophosphate cofactor
- D. Is very similar to that of trypsin
- E. Shows allosteric control

44. Alcohol dehydrogenase (ADH) requires NAD^+ for catalytic activity. In the reaction catalyzed by ADH, an alcohol is oxidized to an aldehyde as NAD^+ is reduced to NADH and dissociates from the enzyme. The NAD^+ is functioning as a (an):

- A. Coenzyme-prosthetic group
- B. Apoenzyme
- C. Coenzyme-cosubstrate
- D. Cofactor
- E. Heterotropic effector

45. A 65-year-old man is being treated by a doctor for rheumatoid arthritis over the past two years. The patient previously took medications Hydroxychloroquine (Plaquenil) daily, but currently he did not find it helpful, because of ithe ntense knee and finger pain. To better control the patient's symptoms, the rheumatologist begins a medication that increased plasma homocysteine. That changes in the enzyme kinetics of the biochemical pathway disrupted by this patient's most likely new medication is best described by which of the following statements?

- A. Increases the Michaelis-Menten constant
- B. Decreases maximum reaction rate
- C. Significantly decreases the Michaelis-Menten constant

- D. Increases maximum reaction rate
- E. Slightly decreases the Michaelis-Menten constant

46. A nondiabetic man consumes a carbohydrate-rich meal. His fasting glucose rises to 20 mmol/l. What enzyme characteristic enables to maintain postprandial glucose level despite ingesting a high carbohydrate load?

- A. The high V_{max} of glucokinase
- B. The high V_{max} of hexokinase
- C. The high K_m of glucokinase
- D. The low K_m of glucokinase
- E. The long half-life of hexokinase

Topic № 3. REGULATION OF ENZYMATIC ACTIVITY AND MECHANISMS OF ENZYMOPATHIAS. MEDICAL ENZYMOLOGY.

1. The first-aid center has received a victim of a traffic accident diagnosed with closed displaced fracture of the middle third of the thigh. For repositioning of bone fragments the patient received 10 ml of 2% dithylinum solution intravenously, which resulted in prolonged period of apnea and muscle relaxation. What enzyme is deficient, resulting in such pharmacogenetic enzymopathy?
 - A. Pseudocholinesterase
 - B. Uridine diphosphate glucuronyltransferase
 - C. Glucose 6-phosphate dehydrogenase
 - D. Methemoglobin reductase
 - E. N-acetyltransferase
2. Blood test of the patient revealed albumine content of 20 g/l and increased activity of lactate dehydrogenase isoenzyme 5 (LDH 5). These results indicate a disorder of the following organ:
 - A. Liver
 - B. Kidneys
 - C. Heart
 - D. Lungs
 - E. Spleen
3. A patient suffering from gout was prescribed allopurinol. What pharmacological property of allopurinol provides its therapeutic effect?
 - A. Competitive inhibition of xanthine oxidase
 - B. Acceleration of nitrogen-containing substances excretion
 - C. Acceleration of pyrimidine nucleotides catabolism
 - D. Deceleration of pyrimidine nucleotides salvage
 - E. Acceleration of nucleic acids synthesis
4. A 15-year-old boy has been diagnosed with acute viral hepatitis. What blood value should be determined to confirm acute affection of hepatic cells?
 - A. Aminotransferase activity (AST, ALT)
 - B. Unconjugated and conjugated bilirubin content
 - C. Erythrocytes sedimentation rate (ESR)
 - D. Cholesterol content
 - E. Protein fraction content
5. A 50-year-old woman diagnosed with cardiac infarction has been delivered into an intensive care ward. What enzyme will be the most active during the first two days?
 - A. Aspartate aminotransferase
 - B. Alanine aminotransferase
 - C. Alanine aminopeptidase
 - D. LDH4
 - E. LDH5
6. A 46-year-old female patient has continuous history of progressive muscular (Duchenne's) dystrophy. Which blood enzyme changes will be of diagnostic value in this case?
 - A. Creatine phosphokinase
 - B. Lactate dehydrogenase

- C. Pyruvate dehydrogenase
- D. Glutamate dehydrogenase
- E. Adenylate cyclase

7. A patient is diagnosed with cardiac infarction. Blood test for cardiac specific enzymes activity was performed. Which of the enzymes has three isoforms?

- A. Creatine kinase
- B. Lactate dehydrogenase
- C. Aspartate transaminase
- D. Alanine transaminase
- E. Pyruvate kinase

8. Name the drug that inhibits excretory function of pancreas during treatment of acute pancreatitis:

- A. Contrykal (Aprotinin)
- B. Allochol
- C. Panzynom
- D. Pancreatin (Mezym forte)
- E. Festal

9. For biochemical diagnostics of myocardial infarction it is necessary to measure activity of a number of enzymes and their isoenzymes. What enzymatic test is considered to be the best to prove or disprove the diagnosis of infarction in the early period after the chest pain is detected?

- A. Creatine kinase isoenzyme CK-MB
- B. Creatine kinase isoenzyme CK-MM
- C. LDH1 lactate dehydrogenase isoenzyme
- D. LDH2 lactate dehydrogenase isoenzyme
- E. Aspartate aminotransferase cytoplasmic isoenzyme

10. 6 hours after the myocardial infarction a patient was found to have elevated level of lactate dehydrogenase in blood. What isoenzyme should be expected in this case?

- A. LDH1
- B. LDH2
- C. LDH3
- D. LDH4
- E. LDH5

11. Researchers isolated 5 isoenzymic forms of lactate dehydrogenase from the human blood serum and studied their properties. What property indicates that the isoenzymic forms were isolated from the same enzyme?

- A. Catalyzation of the same reaction
- B. The same molecular weight
- C. The same physicochemical properties
- D. Tissue localization
- E. The same electrophoretic mobility

12. Blood of a 12-year-old boy presents low concentration of uric acid and accumulation of xanthine and hypoxanthine. This child has genetic defect of the following enzyme:

- A. Xanthine oxidase
- B. Arginase
- C. Urease

- D. Ornithine carbamoyl transferase
- E. Glycerol kinase

13. A 49-year-old driver complains about unbearable constricting pain behind the breastbone irradiating to the neck. The pain arose 2 hours ago. Objectively: the patient's condition is grave, he is pale, heart tones are decreased. Laboratory studies revealed high activity of creatine kinase and LDH1. What disease are these

symptoms typical for?

- A. Acute myocardial infarction
- B. Acute pancreatitis
- C. Stenocardia
- D. Cholelithiasis
- E. Diabetes mellitus

14. On the 2-3rd day after stomach resection intestinal peristalsis wasn't restored. What is to be administered for stimulation of gastrointestinal tract?

- A. Proserin
- B. Prasosin
- C. Cyclodole
- D. Atropine sulfate
- E. Acetylcholine

15. A patient presents high activity of LDH 1,2, aspartate aminotransferase, creatine phosphokinase. In what organ (organs) is the development of a pathological process the most probable?

- A. In the heart muscle (initial stage of myocardium infarction)
- B. In skeletal muscles (dystrophy, atrophy)
- C. In kidneys and adrenals
- D. In connective tissue
- E. In liver and kidneys

16. 12 hours after an acute attack of retrosternal pain a patient presented a jump of aspartate aminotransferase activity in blood serum. What pathology is this deviation typical for?

- A. Myocardium infarction
- B. Viral hepatitis
- C. Collagenosis
- D. Diabetes mellitus
- E. Diabetes insipidus

17. The high level of lactate dehydrogenase (LDH) isozymes concentration showed the increase of LDH-1 and LDH-2 in a patient's blood plasma. Point out the most probable diagnosis:

- A. Myocardial infarction
- B. Skeletal muscle dystrophy
- C. Diabetes mellitus
- D. Viral hepatitis
- E. Acute pancreatitis

18. Succinate dehydrogenase catalyses the dehydrogenation of succinate. Malonic acid $\text{HOOC} - \text{CH}_2 - \text{COOH}$ is used to interrupt the action of this enzyme. Choose the inhibition type:

- A. Competitive
- B. Allosteric
- C. Non-competitive
- D. Limited proteolysis
- E. Dephosphorylation

19. Marked increase of activity of MB forms of CPK (creatine phosphokinase) and LDH-1 was revealed by examination of the patient's blood. What is the most probable pathology?

- A. Myocardial infarction
- B. Hepatitis
- C. Rheumatism
- D. Pancreatitis
- E. Cholecystitis

20. To a 62-year-old man Disulfiram (Antabuse) was recommended in a course of the alcoholism treatment. On which type of enzyme (aldehyde dehydrogenase) inhibition mechanism of this drug action is based?

- A. Irreversible
- B. Competitive
- C. Noncompetitive
- D. Feedback
- E. Allosteric

21. A patient consulted a doctor about sunburns, decreased visual acuity. His hair, skin and eyes are not pigmented. He has been diagnosed with albinism. The patient presents with the following enzyme deficiency:

- A. Tyrosinase
- B. Arginase
- C. Carbonic anhydrase
- D. Histidine decarboxylase
- E. Hexokinase

22. Growth of some cancer cells is caused by a certain growth factor. Treatment of leukemia involves applying an enzyme that destroys this essential factor. Specify this enzyme:

- A. Asparaginase
- B. Glutaminase
- C. Succinate dehydrogenase
- D. Citrate synthetase
- E. Aspartate aminotransferase

23. A patient was found to have an increased blood serum LDH-1 activity. In which organ is the pathological process localized?

- A. Heart
- B. Liver
- C. Kidneys
- D. Stomach
- E. Muscles

24. Some insecticides are poisons for humans because they block irreversibly the activity of very important enzyme in nervous tissue. It is:

- A. Acetylcholine esterase
- B. Pyruvate kinase
- C. Cytochrome oxidase
- D. ATP synthase
- E. Lactate dehydrogenase

25. A patient has been diagnosed with alkaptonuria. Choose an enzyme that can cause this pathology when deficient:

- A. Homogentisic acid oxidase
- B. Phenylalanine hydroxylase
- C. Glutamate dehydrogenase
- D. Pyruvate dehydrogenase
- E. Dioxyphenylalanine decarboxylase

26. A 15-year-old boy has been diagnosed with acute viral hepatitis. What blood value should be determined to confirm acute affection of hepatic cells?

- A. Aminotransferase activity (AST, ALT)
- B. Unconjugated and conjugated bilirubin content
- C. Erythrocytes sedimentation rate (ESR)
- D. Cholesterol content
- E. Protein fraction content

27. After laboratory investigation in blood of patient an increase of LDH activity was detected, which is characteristic symptom of heart, liver or kidney diseases. What additional biochemical investigation must be performed in differential diagnostics?

- A.** Determination of LDH isozymes
- B. Estimation of blood glucose level
- C. Ketone bodies level in blood
- D. Determination of blood cholesterol level
- E. Amylase activity in blood

28. In a course of tuberculosis treatment a patient was administered isoniazide - a structural analogue of nicotinamide and pyridoxine. What type of inhibition by mechanism of action exhibits isoniazide?

- A. Competitive
- B.** Noncompetitive
- C. Allosteric
- D. Irreversible
- E. Uncompetitive

29. During the surgery after injection of a drug, which cause the myorelaxation, in patient happens a prolonged stop of respiration (more than 5 min). What enzyme insufficiency may be responsible for this accident?

- A. Acetylcholine esterase
- B. Catalase
- C. Glucose-6-phosphate dehydrogenase
- D. Monoaminoxidase
- E. Acetyl-transferase

30. A 42-year-old man with gout presents with high content of uric acid in blood. The patient was prescribed allopurinol to lower the concentration of uric acid. Allopurinol is a competitive inhibitor of the following enzyme:

- A. Xanthine oxidase
- B. Adenosine deaminase
- C. Adenine phosphoribosyl transferase
- D. Hypoxanthine phosphoribosyl transferase
- E. Guanine deaminase

31. A patient has been admitted to the contagious isolation ward with signs of jaundice caused by hepatitis virus. Which of the symptoms given below is strictly specific for hepatocellular jaundice?

- A. Increase of ALT, AST level
- B. Hyperbilirubinemia
- C. Bilirubinuria
- D. Cholemia
- E. Urobilinuria

32. A patient who had been taking diclofenac sodium for arthritis of mandibular joint developed an acute condition of gastric ulcer. Such side effect of this medicine is caused by inhibition of the following enzyme:

- A. Cyclooxygenase-1 (COX-1)
- B. Cyclooxygenase-2 (COX-2)
- C. Lipoxygenase
- D. Phosphodiesterase
- E. Monoamine oxidase

33. In recognition of hepatitis the determination the following enzymes activity in blood has diagnostic significance:

- A. Amino transferases
- B. Amylase
- C. Lactate dehydrogenase
- D. Aldolase
- E. Creatin kinase

34. There is increased activity of AST, LDH1, LDH 2, and CPK in the patient's blood. Pathological process most likely occurs in the:

- A. Heart
- B. Skeletal muscles
- C. Kidneys
- D. Liver
- E. Adrenal glands

35. For biochemical diagnostics of cardiac infarction it is necessary to determine activity of a number of enzymes and their isoenzymes in the blood. What enzyme assay is considered to be optimal for confirming or ruling out cardiac infarction at the early stage, after the patient develops thoracic pain?

- A. Creatine kinase MB isoenzyme
- B. Creatine kinase MM isoenzyme
- C. LDH1 isoenzyme
- D. LDH5 isoenzyme
- E. Cytoplasmic isoenzyme of aspartate aminotransferase

36. A patient is diagnosed with pancreatitis. Starch decomposition disturbance occurs in the patient's intestine due to deficiency of the following pancreatic enzyme:

- A. Amylase
- B. Trypsin
- C. Chymotrypsin
- D. Lipase
- E. Carboxypeptidase

37. A patient has myocardial infarction. The first several hours of such medical condition will be characterized by significant increase of activity of the following enzyme in his blood serum:

- A. Creatine phosphokinase
- B. Lactate dehydrogenase-4
- C. Aspartate aminotransferase
- D. Lactate dehydrogenase-5
- A. Alanine-aminotransferase

38. A 60-year-old man consulted a doctor about an onset of chest pain. In blood serum analysis showed a significant increase in the activity of the following enzymes: creatine kinase and its MB-isoform, aspartate aminotransferase. These changes indicate the development of the pathological process in the following tissues:

- A. Cardiac muscle
- B. Lungs
- C. Skeletal muscles
- D. Liver
- E. Smooth muscles

39. A 50-year-old woman with myocardial infarction has been delivered to the intensive care unit. Which enzyme's activity will be most increased during the first two days?

- A. Aspartate aminotransferase
- B. Alanine aminotransferase
- C. Alanine aminopeptidase
- D. LDH 4
- E. LDH 5

40. Pharmaceuticals, containing mercury, arsenic or other heavy metals, are inhibiting enzymes, possessing sulfhydryl groups. What amino acid is used for reactivation of these enzymes?

- A. Cysteine
- B. Histidine
- C. Isoleucine
- D. Aspartic acid
- E. Glycine

41. In a patient with complaints on pain in cardiac area a myocardial infarction was recognized after estimation of enzymes activity in blood. Indicate, please, what enzyme activities were determined?

- A. LDH, creatine kinase, aminotransferase
- B. Amylase, lipase, phosphatase
- C. Peptidase, arginase, glucokinase
- D. Trypsin, lysozyme, citrate synthase
- E. Aldolase, succinate dehydrogenase, hexokinase

42. Ambulance delivered a patient to the hospital with a preliminary diagnosis "acute pancreatitis". What enzyme activity must be estimated in blood and urine in order to support this diagnosis?

- A. Alpha-amylase
- B. AIAT (GPT)
- C. AsAT (GOT)
- D. Gamma-amylase
- E. Lactate dehydrogenase

43. In blood serum of a patient a marked increase in activity of trypsin, alpha-amylase and lipase was detected. What disease can be suggested?

- A. Acute pancreatitis
- B. Cholestasis
- C. Chronic hepatitis
- D. Malignant tumors
- E. Insecticide poisoning

44. In blood serum of a patient a marked increase of activity of creatine phosphokinase and lactate dehydrogenase was detected. What disease can be suggested as a cause?

- A. Myocardial infarction
- B. Acute pancreatitis
- C. Chronic pancreatitis
- D. Hemolytic jaundice
- E. Nephrosis

45. In blood serum of a patient a high activity of isozyme LDH-1 was detected. In what organ pathological changes occur?

- A. Heart
- B. Liver
- C. Skeletal muscles
- D. Pancreas
- E. Kidney

46. In a patient a preliminary diagnosis of myocardial infarction was proposed. A characteristic feature of this disease is a marked increase in blood in the first 24 hours of the next enzyme:

- A. Creatine-phosphokinase
- B. Arginase
- C. Catalase
- D. Glc-6-P dehydrogenase
- E. Alpha-amylase

47. During investigation of gastric secretory function was detected decrease of hydrochloric acid content in gastric juice. What enzyme activity will decrease in this case?

- A. Pepsin
- B. Lipase
- C. Hexokinase
- D. Amylase
- E. Carboxypeptidase

48. In dietology in cases of children milk intolerance a milk is used in which lactose content is diminished enzymatically. What enzyme is used for this purpose?

- A. β -galactosidase
- B. α -glucosidasde
- C. α -amylase
- D. β -glucosidase
- E. β -amylase

49. In cases of chronic pancreatitis a decrease of trypsin production and secretion is observed. Digestion and absorption of what substances is injured in this case?

- A. Cleavage of proteins
- B. Cleavage of polysaccharides
- C. Cleavage of nucleic acids
- D. Cleavage of disaccharides
- E. Cleavage of lipids

50. In a patient the disorder of proteins digestion in stomach and small intestine is observed. What enzymes insufficiency cause this disorder?

- A. Peptidases
- B. Oxido-reductases
- C. Amylases
- D. Lipases
- E. Aminotransferases

51. Phosphororganic compound diisopropyl-fluorophosphate is a dangerous toxin as it inhibits cholinesterase. What is the mechanism of this inhibition?

- A. Irreversible
- B. Reversible
- C. Competitive
- D. Uncomoetitive
- E. Noncompetitive

52. In malignant tumor of prostata a marked increase in activity of the next enzyme in blood serum is observed:

- A. Acid phosphatase
- B. Lactate dehydrogenase
- C. Aldolase
- D. Alanyl aminotransferase
- E. Alkaline phosphatase

53. Different forms of lympholeukoses are effectively cured with enzyme preparation called as:

- A. Asparaginase
- B. Plasmin
- C. Tissue plasminogen activator (tPA)
- D. Hyaluronidase
- E. Streptokinase

54. A 15-month-old child showed weakness and retarded motor skills. It was detected a genetic disease which results from a mutation in the gene coding for the enzyme hexosaminidase A (β -N-acetylhexosaminidase) is called what?

- A. Tay-Sachs disease

- B. Lesch-Nyhan syndrome
- C. Huntington disease
- D. Amyotrophic lateral sclerosis
- E. Neurofibromatosis

54. A 48-year-old male patient has very high levels of serum cholesterol. A medications (statins) are prescribed that are directed at the rate-limiting step of cholesterol biosynthesis. Which of listed biochemical reactions is affected by such drugs?

- A. Inhibits the enzyme β -hydroxy- β -methylglutaryl-CoA reductase
- B. Stimulates phosphorylation of the β -hydroxy- β -methylglutaryl-CoA reductase enzyme
- C. Decreases the stability of the β -hydroxy- β -methylglutaryl-CoA reductase protein
- D. Binds cholesterol preventing it from being absorbed by the intestine
- E. Directly prevents the deposition of cholesterol on artery walls hydroxymethylglutaryl-CoA reductase

55. Irreversible inhibitors are usually toxic compounds, which covalently bind with the enzymes and inactivate them. Which of the following inhibitors is an irreversible one:

- A. Iodoacetate
- B. Malotate
- C. Methanol
- D. Allopurinol
- E. Acetylsalicylic acid

56. 45 years old male patient was delivered to the hospital with a preliminary diagnosis "acute pancreatitis". The zymogens of the proteolytic pancreatic enzymes were converted to their catalytically active forms prematurely, inside the pancreatic cells and attack the pancreatic tissue itself. What are these enzymes?

- A. Trypsin, chymotrypsin
- B. Sucrase, amylase
- C. Ribonuclease, pepsin
- D. Amylase, lipase
- E. DNA-ase, aminopeptidase

57. For biochemical diagnostics of myocardial infarction it is necessary to measure activity of a number of enzymes and their isoenzymes. What enzymatic test is considered to be the best to prove or disprove the diagnosis of infarction in the early period after the chest pain is detected?

- A. Creatine kinase isoenzyme CK-MB
- B. Creatine kinase isoenzyme CK-MM
- C. LDH1 lactate dehydrogenase isoenzyme
- D. LDH2 lactate dehydrogenase isoenzyme
- E. Aspartate aminotransferase cytoplasmic isoenzyme

58. A 10-year-old boy presents with vomiting, sweating, drooling, and a decreased heart rate. His friends state that he was in a cornfield when it was sprayed by a crop duster. The chemical being sprayed was an organophosphate derivative that covalently binds to acetylcholinesterase and inactivates the enzyme. What type of inhibition is being displayed?

- A. Irreversible
- B. Competitive
- C. Noncompetitive

- D. Allosteric
- E. Feedback

59. Rotenone is a naturally occurring chemical that is used primarily as a fish poison. It is a reversible competitive inhibitor of reduced NADH dehydrogenase. Which of the following combinations describes the effects of rotenone on the kinetics of NADH-dehydrogenase?

- A. The K_m increases while the V_{max} remains unchanged
- B. The K_m decreases while the V_{max} remains unchanged
- C. The K_m increases while the V_{max} decreases
- D. The K_m remains the same and the V_{max} remains unchanged
- E. The K_m remains the same while the V_{max} decreases

60. A 70-year-old man was delivered to the hospital with chest pain during the past 11 hours. Serum creatine kinase (CK) activity was measured at hospitalization time (day 1) and later once daily. On day 2 he experienced cardiac arrhythmia. Normal cardiac rhythm was reestablished. He had no relapse of arrhythmia over the next several days. His chest pain reduced and he was released on day 10. Which one of the following is most consistent with the data presented?

- A. The patient had damage to his skeletal muscle on day 2.
- B. The patient had a myocardial infarction 48 to 64 hours prior to admission
- C. The patient had a myocardial infarction on day 2.
- D. The patient had angina prior to admission
- E. The data do not permit any conclusion concerning myocardial infarction prior to, or after, admission to the hospital

TOPIC № 4. THE ROLE OF COFACTORS, VITAMINS AND THEIR COENZYME FORMS IN ENZYME CATALYSIS.

1. Coenzyme A participates in numerous important metabolic reactions. It is a derivative of the following vitamin:
 - A. Pantothenic acid
 - B. Thiamine
 - C. Niacin
 - D. Calciferol
 - E. Ubiquinone
2. Malaria is treated with structural analogs of vitamin B₂ (riboflavin). These drugs disrupt the synthesis of the following enzymes in plasmodium:
 - A. FAD-dependent dehydrogenase
 - B. Cytochrome oxidase
 - C. Peptidase
 - D. NAD-dependent dehydrogenase
 - E. Aminotransferase
3. A 36-year-old female patient has a history of B₂-hypovitaminosis. The most likely cause of specific symptoms (epithelial, mucosal, cutaneous, corneal lesions) is the deficiency of:
 - A. Flavin coenzymes
 - B. Cytochrome A1
 - C. Cytochrome oxidase
 - D. Cytochrome B
 - E. Cytochrome C
4. After an extended treatment with sulfanamides a patient has developed macrocytic anemia. Production of active forms of the following vitamin is disrupted in such a condition:
 - A. Folic acid
 - B. Thiamine
 - C. Riboflavin
 - D. Pyridoxine
 - E. Cyanocobalamin
5. A number of diseases can be diagnosed by evaluating activity of blood transaminases. What vitamin is one of cofactors of these enzymes?
 - A. B₆
 - B. B₂
 - C. B₁
 - D. B₈
 - E. B₅
6. A patient has an increased pyruvate concentration in blood, most of it is excreted with the urine. What kind of avitaminosis has this patient?
 - A. B₁
 - B. E
 - C. B₃
 - D. B₆
 - E. B₂

7. Vitamin B₁ deficiency causes disturbance of oxidative decarboxylation of α -ketoglutaric acid. This leads to the impaired synthesis of the following coenzyme:

- A. Thiamine pyrophosphate
- B. Nicotinamide adenine dinucleotide
- C. Flavine adenine dinucleotide
- D. Lipoic acid
- E. Coenzyme A

8. On the ground of clinical presentations a patient was prescribed pyridoxal phosphate. This medication is recommended for correction of the following processes:

- A. Transamination and decarboxylation of amino acids
- B. Oxidative decarboxylation of ketonic acids
- C. Desamination of purine nucleotides
- D. Synthesis of purine and pyrimidin bases
- E. Protein synthesis

9. In clinical practice tuberculosis is treated with isoniazid preparation – that is an antivitamin able to penetrate into the tuberculosis bacillus. Tuberculostatic effect is induced by the interference with replication processes and oxidation-reduction reactions due to the buildup of pseudo-coenzyme:

- A. NAD
- B. FAD
- C. FMN
- D. TDP
- E. CoQ

10. In case of enterobiosis acrifine – the structural analogue of vitamin B₂ – is administered. The synthesis disorder of which enzymes does this medicine cause in microorganisms?

- A. FAD-dependent dehydrogenases
- B. Cytochrome oxidases
- C. Peptidases
- D. NAD-dependent dehydrogenases
- E. Aminotransferases

11. To a patient suffering from tuberculosis isoniazide was administered. Some time later he copalites on general weakness, disorders of vision, coordination. Application of what vitamin may be useful for elimination of noted side effects?

- A. Vitamin B₆
- B. Vitamin A
- C. Vitamin B₂
- D. Vitamin C
- E. Vitamin E

12. In a patient is suffering from painfulness along a great nerv trunks. His blood plasma analysis revealed the increase of pyruvate concentration. The insufficiency of which of the following vitamins may induce these symptoms?

- A. Vitamin B₁
- B. Vitamin C
- C. Vitamin B₆
- D. Vitamin K

E. Vitamin PP

13. Malignant hyperchrome anemia, or Birmer's disease, is a pathological state caused by the deficiency of vitamin B₁₂. What chemical element is a constituent of the structure of this vitamin?

- A. Cobalt.
- B. Molybdenum.
- C. Zinc.
- D. Iron.
- E. Magnesium.

14. In a patient with frequent intraorgan and mucosal bleeding in urine were detected proline and lysine. Deficiency of what vitamin cause a damage of their hydroxylation?

- A. Vitamin C
- B. Vitamin A
- C. Vitamin K
- D. Vitamin D
- E. Vitamin E

15. Treatment of many diseases involves use of cocarboxylase (thiamine pyrophosphate) for supplying cells with energy. What metabolic process is activated in this case?

- A. Oxidizing decarboxylation of pyruvate
- B. Glutamate deamination
- C. Amino acids decarboxylation
- D. Decarboxylation of biogenic amines
- E. Detoxication of harmful substances in liver

16. A patient's blood shows an increased concentration of pyruvate which is excreted with urine for the most part. This is typical for the following vitamin deficiency:

- A. B₁
- B. E
- C. B₃
- D. B₆
- E. B₂

17. Pyruvic acid as an intermediate metabolite of carbohydrate, lipid and amino acid metabolism can undergo oxidative decarboxylation. The cause of this process is the lack of the following nutrient in the diet:

- A. Thiamine
- B. Pyridoxine
- C. Ascorbic acid
- D. Citrine
- E. Pangamic acid

18. According to the clinical signs, pyridoxal phosphate was prescribed to a patient. For the correction of what biochemical processes is this drug recommended?

- A. Transamination and decarboxylation of amino acids.
- B. Synthesis of purines and pyrimidines.
- C. Oxidative decarboxylation of ketoacids.
- D. Deamination of amino acids.
- E. Protein synthesis.

19. Para-aminobenzoic acid is believed to be an inhibitor in biosynthesis of the next vitamin in bacteria:

- A. Folic acid
- B. Biotin
- C. Pantothenic acid
- D. Cobalamin
- E. Pyridoxine

20. In blood of a patient an increased concentration of pyruvate is detected .as well as significant quantities of this substance in urine. What avitaminosis was developed in a patient?

- A. B₁ avitaminosis
- B. B₆ avitaminosis
- C. B₂ avitaminosis
- D. D avitaminosis
- E. C avitaminosis

21. Hydroxylation of endogenous substrates and xenobiotics requires a donor of protons. Which of the following vitamins can play this role?

- A. Vitamin C
- B. Vitamin P
- C. Vitamin B₆
- D. Vitamin E
- E. Vitamin A

22. A child manifests epileptic seizures caused by vitamin B₆ deficiency. This is conditioned by the decrease of the 7-aminobutyrate level in the nervous tissue which acts as an inhibiting neurotransmitter. The activity of which enzyme is decreased in this case?

- A. Glutamate decarboxylase.
- B. Alanine aminotransferase.
- C. Pyridoxal kinase.
- D. Glutamate dehydrogenase.
- E. Glutamate synthetase

23. A chronic alcoholic develops severe memory loss with marked confabulation. Deficiency of which of the following vitamins would be most likely to contribute to the neurologic damage underlying these symptoms?

- A. Thiamine
- B. Folic acid
- C. Niacin
- D. Riboflavin
- E. Vitamin B₁₂

24. Beriberi is a classical example of thiamine deficiency. Active form of this vitamin is synthesized by an enzyme belonging to the following group:

- A. Transferases
- B. Oxidoreductases
- C. Hydrolases
- D. Lyases
- E. Isomerase

25. There is a group of biochemical reactions that have a special set of enzymes and coenzymes. They are involved in amino acid metabolism and also play roles in nucleotide metabolism. This group of reactions is referred to as one-carbon metabolism because what they have in common is the transfer of one-carbon groups. One-carbon group transfer reactions are catalyzed by enzymes, which coenzyme is:

- A. Tetrahydrofolic acid
- B. Retinal
- C. Coenzyme A
- D. Flavin mononucleotide
- E. Pyridoxal phosphate

26. Lipoic acid, also known as α -lipoic acid is an organosulfur compound derived from caprylic acid (octanoic acid). Lipoic acid is a cofactor of the following enzyme complex:

- A. Pyruvate dehydrogenase
- B. Lactate dehydrogenase
- C. Cytochrome oxidase
- D. Succinate dehydrogenase
- E. Transketolase

27. CoA-SH performs a vital role by transporting acetyl groups from one substrate to another. The precursor of CoA is:

- A. Pantothenate
- B. Riboflavin
- C. Pyridoxamine
- D. Thiamin
- E. Biotin

28. There was an increase of the pyruvate level in the patient's blood and urine. What kind of avitaminosis developed in this case?

- A. B₁ avitaminosis.
- B. E avitaminosis.
- C. B₃ avitaminosis.
- D. B₂ avitaminosis.
- E. B₁₂ avitaminosis.

29. NAD⁺ is a coenzyme that catalyzes a variety of oxidation-reduction reactions. Which of the following substance is involved in biosynthesis of NAD⁺:

- A. Adenine
- B. Flavine
- C. Ribitol
- D. Pyridoxine
- E. Deoxyribose

30. Many enzymes contain small molecules or metal ions that participate directly in substrate binding or in catalysis. The following statements describe coenzymes and prosthetic groups:

- A. Some enzymes contain organic molecules that are derived from vitamins and that are essential for activity. These molecules are called prosthetic groups
- B. Some enzymes contain metal ions such as zinc or copper that are essential for their activity

- C. Coenzymes are small polypeptides that are involved in transfer reactions catalysed by enzymes
- D. Coenzymes are required in some enzyme-catalysed reaction as carriers of acyl groups or phosphate groups
- E. Coenzymes are required in some enzyme-catalysed oxidation-reduction reactions involving hydrogen transfer

31. Thiamine pyrophosphate (TPP) is a coenzyme form of thiamine (vitamin B₁), formed by the action of thiamine diphosphotransferase. Select the metabolic process with which TPP is mostly associated:

- A. Decarboxylation of α -ketoacids
- B. Biosynthesis of collagen
- C. Biosynthesis of amino acids
- D. Oxidation of fatty acids
- E. Biosynthesis of prothrombin

32. Pyridoxal phosphate (PLP) is the active form of vitamin B₆ (pyridoxine). PLP can be synthesized from the pyridoxine by phosphorylation and oxidation to the aldehyde. Pyridoxal phosphate is the coenzyme of enzymes:

- A. Aminotransferases
- B. Reductases
- C. Synthetases
- D. Dehydrogenases
- E. Isomerases

33. Biocytin (carboxybiotin) is an active form of biotin (vitamin H). Like lipoic acid, biotin is converted to its coenzyme form biocytin by formation of a covalent amide bond to the nitrogen of a lysine residue. Biocytin as a cofactor participates in the following metabolic reactions:

- A. Incorporation of CO₂ into molecules of metabolites (carboxylation)
- B. Decarboxylation of pyruvate
- C. Oxidation of fatty acids
- D. Transfer of phosphate groups (kinase reaction)
- E. Production of H₂O₂ (oxidase reaction)

34. Biochemical functions of water soluble vitamins are realized due to their transformation to coenzymes. What coenzyme is formed by vitamin PP?

- A. NAD (nicotinamide adenine dinucleotide)
- B. FMN (flavinmononucleotide)
- C. FAD (flavin adenine dinucleotide)
- D. Pyridoxal phosphate
- E. Thiamine pyrophosphate

35. Which of the following plays a key role in one-carbon metabolism, and is essential for the biosynthesis of the purines and the pyrimidine, thymine?

- A. Folic acid
- B. Biotin
- C. Riboflavin
- D. Pantothenic acid
- E. Ascorbic acid

36. Nicotinamide adenine dinucleotide (NAD) is a cofactor found in all living cells. The next substance involved in biosynthesis of NAD:

- A. Vitamin PP
- B. Deoxyribose
- C. Flavine
- D. Ribitol
- E. Pyridoxine

37. Vitamin C exists in forms of ascorbic acid and dehydroascorbic acid. Ascorbic acid participates in reactions of:

- A. Hydroxylation
- B. Decarboxylation
- C. Redox
- D. Acyl transfer
- E. Decarboxylation

38. Tetrahydrofolic acid (THF) is synthesized from folic acid by the enzyme dihydrofolate reductase. What vitamin is precursor of tetrahydrofolic acid?

- A. Vitamin B₁₂
- B. Vitamin B₂
- C. Vitamin B₆
- D. Vitamin C
- E. Vitamin D

39. The flavin coenzymes participate in many redox reactions responsible for energy production. What vitamin is precursor of flavin mononucleotide (FMN)?

- A. Vitamin B₂
- B. Vitamin A
- C. Vitamin B₆
- D. Vitamin C
- E. Vitamin D

40. Main functions of TPP are to catalyze oxidative decarboxylation of α -keto acids (pyruvic, α -ketoglutaric) and to serve as a coenzyme for pentose phosphate pathway (PPP). Which of the following symptoms would be seen in a patient with a severe deficiency of thiamine?

- A. A decreased level of transketolase activity in red blood cells
- B. An increased clotting time of blood
- C. A low level of cell transaminase activity
- D. Xerophthalmia
- E. A decrease in blood level of pyruvate and lactate

41. Pantothenic acid is the amide of pantoic acid and β -alanine. Pantothenic acid is a precursor of which of the following coenzyme:

- A. Coenzyme A
- B. FAD
- C. NADP
- D. Coenzyme Q
- E. SAM (S-adenosylmethionine)

42. A 1-month-old male showed abnormalities of the nervous system and lactic acidosis. Enzyme assay for pyruvate dehydrogenase (PDH) activity on extracts of

cultured skin fibroblasts showed 5% of normal activity, with a low concentration (1×10^{-4} mM) of thiamine pyrophosphate (TPP), but 80% of normal activity when the assay contained a high (0.4 mM) concentration of TPP. Which one of the following statements concerning this patient is most correct?

- A. Administration of thiamine is expected to reduce his serum lactate concentration and improve his clinical symptoms
- B. Elevated levels of lactate and pyruvate in the blood reliably predict the presence of PDH deficiency
- C. The patient is expected to show disturbances in fatty acid degradation
- D. A diet consisting of high carbohydrate intake would be expected to be beneficial in this patient
- E. Alanine concentration in the blood is expected to be less than normal.

TOPIC № 5. METABOLIC PATHWAYS AND BIOENERGETICS. TRICARBOXYLIC ACID CYCLE AND ITS REGULATION

1. A patient was administered into hospital with a diagnosis diabetes mellitus type I. In metabolic changes the decrease of oxaloacetate synthesis rate is detected. What metabolic pathway is damaged as a result?

- A. Tricarboxylic acid cycle
- B. Glycolysis
- C. Cholesterol biosynthesis
- D. Glycogen mobilization
- E. Urea synthesis

2. Substrate phosphorylation is a process of phosphate residue transfer from macroergic donor substance to ADP or some other nucleoside diphosphate. What enzyme of tricarboxylic acid cycle participates in reaction of substrate phosphorylation.

- A. Succinyl CoA synthase (Succinyl thiokinase)
- B. Citrate synthase
- C. Succinate dehydrogenase
- D. Fumarase
- E. Alpha-ketoglutarate dehydrogenase complex

3. Examination of a patient revealed II grade obesity. It is known that he consumes a lot of sweets and rich food, has sedentary way of life. That's why anabolic metabolism has the priority in his organism. Which of the following pathways is amphibolic?

- A. Cycle of tricarboxylic acids
- B. Glyconeogenesis
- C. Lipolysis
- D. Glycolysis
- E. Fatty acids oxidation

4. In a patient are manifested symptoms of intoxication with arsenic compounds. What metabolic process is damaged taking into account that arsenic containing substances inactivate lipoic acid.

- A. Oxidative decarboxylation of α -ketoglutarate
- B. Fatty acids biosynthesis
- C. Neutralization of superoxide anions
- D. Coupling of oxidation and phosphorylation
- E. Microsomal oxidation

5. Mitochondria are subcellular organelles and are present in a cytoplasm of every cell except mature red blood cells, bacteria, blue-green algae. What method is used principally for their isolation?

- A. Differential centrifugation
- B. Gel-filtration
- C. Chromatography
- D. Electrophoresis
- E. Spectrophotometry

6. A biochemistry graduate student isolates all the enzymes of the TCA cycle and adds oxaloacetate and acetyl CoA, including the appropriate energy precursors, cofactors, and water. Which of the following will not be a direct product of his experiment?

- A. ATP

- B. GTP
- C. NADH
- D. CO₂
- E. FADH₂

7. A 24-year-old woman presents with diarrhea, dysphagia, jaundice, and white transverse lines on the fingernails (Mee lines). The patient is diagnosed with arsenic poisoning, which inhibits which one of the following enzymes?

- A. α -ketoglutarate dehydrogenase
- B. Isocitrate dehydrogenase
- C. Citrate synthase
- D. Malate dehydrogenase
- E. Succinate dehydrogenase

8. Enzymes of tricarboxylic acids cycle oxidize acetyl-CoA and produce 3 molecules of reduced NAD and one molecule of reduced FAD. Where are localized these enzymes?

- A. In mitochondrial matrix
- B. On plasma membrane
- C. On external mitochondrial membrane
- D. In cell cytoplasm
- E. On inner mitochondrial membrane

9. A 2-year-old boy has damaged energy exchange due to inhibition of oxidation processes and ATP synthesis. There is the decrease of Citric acid cycle metabolites content in his blood, too. It was proposed to think about probable inhibition of succinate dehydrogenase in boy's tissues as the reason of his state. Name the inhibitor for this enzyme:

- A. Malonate
- B. Aspartate
- C. Malate
- D. Glutamate
- E. Citrate

10. Vitamin B₁ (thiamine) deficiency will cause the decrease of the rate of Citric Acid Cycle because one enzyme system in this process is in need of its derivative as coenzyme TPP. Name it:

- A. Alpha-ketoglutarate dehydrogenase complex
- B. Isocitrate dehydrogenase
- C. Citrate synthase
- D. Pyruvate dehydrogenase complex
- E. Malate dehydrogenase

11. Pyruvic acid supplies energy to cells through the TCA cycle when oxygen is present (aerobic respiration). Before pyruvic acid enters the TCA cycle it must be converted to:

- A. Acetyl CoA
- B. Citrate
- C. Lactate
- D. α -Ketoglutarate
- E. Succinate

12. The number of molecules of ATP produced by the total oxidation of acetyl CoA in tricarboxylic acid cycle is:

- A. 12
- B. 6
- C. 8
- D. 10
- E. 15

13. Most of the metabolic pathways are either anabolic or catabolic. Which of the following pathways is considered as “amphibolic” in nature?

- A. TCA cycle
- B. Glycogenesis
- C. Glycolytic pathway
- D. Lipolysis
- E. Pentosophosphate pathway

14. The TCA cycle is a pathway designed to burn away carboxylic acids as two moles of CO₂. TCA cycle to be continuous requires the regeneration of:

- A. Oxaloacetic acid
- B. Pyruvic acid
- C. α-oxoglutaric acid
- D. Malic acid
- E. Succinic acid

15. Malate dehydrogenase is an enzyme that reversibly catalyzes the oxidation of malate to oxaloacetate. Malate dehydrogenase is an enzyme dependent from the presence of which of the following cofactors:

- A. NAD⁺
- B. TPP
- C. Coenzyme A
- D. NADP
- E. FMN

16. Which from listed below substances is used as an inhibitor in studies of TCA cycle functioning?

- A. Malonate
- B. NAD
- C. Aconitate
- D. ATP
- E. Isocitrate

17. Conversion of α-ketoglutarate to succinyl CoA occurs through oxidative decarboxylation is catalyzed by α-ketoglutarate dehydrogenase complex. α-Ketoglutarate dehydrogenase complex contains derivative which of the following vitamins:

- A. Thiamine
- B. Folic acid
- C. Retinol
- D. Pyridoxine
- E. B₁₂

18. How many moles of NADH+H⁺ are produced in process of oxidation of 0,25 mole of acetyl-CoA in tricarboxylic acid cycle?

- A. 0,75

- B. 0,25
- C. 0,1
- D. 0,5
- E. 1,0

19. This is the only citric acid cycle enzyme that is tightly bound to the inner mitochondrial membrane. It is an FAD dependent enzyme, which catalyzes the conversion of succinate to fumarate. Which of the following is this enzyme:

- A. Succinate dehydrogenase
- B. Fumarase
- C. Aconitase
- D. Citrate synthase
- E. Isocitrate dehydrogenase

20. Phosphorylated compounds with high ΔG° values of hydrolysis have higher phosphate group transfer potentials than those compounds with lower values. Which of the following phosphorylated compounds would you expect to liberate the least free energy on hydrolysis?

- A. AMP
- B. ATP
- C. ADP
- D. Phosphoenolpyruvate
- E. Phosphocreatine

21. Tricarboxylic acid cycle (TCA) generates so called reduced equivalents – reduced forms of NAD^+ and FAD which are used in:

- A. Respiratory chain of enzymes in mitochondria
- B. Synthesis of fatty acids
- C. Biosynthesis of ATP by substrate phosphorylation
- D. Biosynthesis of ATP by oxidative phosphorylation
- E. Biosynthesis of purine nucleotides

22. TCA cycle enzymes are regulated by: substrate availability, product inhibition, allosteric inhibition or activation by other intermediates. Which of the following substances allosterically activate isocitrate dehydrogenase

- A. ADP
- B. FADH_2
- C. $\text{NADH} + \text{H}^+$
- D. ATP
- E. Mg^{2+}

23. In the TCA cycle one phosphorylated compounds with high ΔG° value of hydrolysis is produced directly. Substrate level phosphorylation in TCA cycle is in step:

- A. Succinate thiokinase
- B. Isocitrate dehydrogenase
- C. Malate dehydrogenase
- D. Aconitase
- E. Succinate dehydrogenase

24. Phosphorylated compounds with high ΔG° values of hydrolysis have higher phosphate group transfer potentials than those compounds with lower values. Which of

the following compounds would you expect to liberate the highest free energy on hydrolysis?

- A. Phosphoenolpyruvate
- B. ATP
- C. ADP
- D. AMP
- E. Phosphocreatine

25. How many moles of FADH_2 are produced in process of oxidation of 0,25 mole of acetyl-CoA in tricarboxylic acid cycle?

- A. 0,25
- B. 0,1
- C. 0,5
- D. 1,0
- E. 1,5

26. Which of the following enzymes tricarboxylic acid cycle catalyze the reaction:

Acetyl-CoA + oxaloacetate \rightarrow *citrate + CoASH*:

- A. Citrate synthase
- B. Succinate dehydrogenase
- C. Fumarase
- D. Aconitase
- E. Isocitrate dehydrogenase

27. TCA cycle (Krebs cycle, citric acid cycle) is the most important metabolic pathway for the energy supply to the body. What substance is the main fuel material for TCA cycle?

- A. Acetyl-CoA
- B. Succinyl-CoA.
- C. Glucose
- D. Amino acids
- E. Fatty acids

28. The TCA cycle is a pathway designed to burn away carboxylic acids as two moles of CO_2 . Which of the following statements regarding TCA cycle is true?

- A. It is amphibolic in nature
- B. It is an anaerobic process
- C. It occurs in cytosol
- D. It contains no intermediates for gluconeogenesis
- E. It occurs in nucleus

29. Three enzymes of TCA cycle, which are known as allosteric and regulation cycle functioning. Which of the listed below is an allosteric one:

- A. Isocitrate dehydrogenase
- B. Malate dehydrogenase
- C. Succinate dehydrogenase
- D. Fumarase
- E. Aconitase

30. Out of 12 mols of ATP formed in TCA cycle, 1 molecule of ATP can be formed at "substrate level" by which of the following reaction?

- A. Succinyl-CoA \rightarrow Succinic acid

- B. Citric acid → Isocitric acid
- C. Isocitrate → Oxaloacetate
- D. Succinic acid → Fumarate
- E. Fumarate → Malate

31. A central intermediate of protein, lipid, and carbohydrate metabolism, which delivers the acetyl group to the citric acid cycle to be oxidized for energy production is:

- A. Acetyl-CoA
- B. Succinyl-CoA
- C. Oxaloacetate
- D. Citrate.
- E. Lactate

32. Succinyl coenzyme A synthetase (also known as succinyl-CoA synthetase or succinate thiokinase or succinate-CoA ligase) is an enzyme that catalyzes the reversible reaction of succinyl-CoA to succinate. This reaction requires:

- A. GDP
- B. CDP
- C. ADP
- D. NADP⁺
- E. NAD⁺

33. Anaplerotic reactions are chemical reactions that form intermediates of a metabolic pathway. An anaplerotic reaction which sustains the availability of oxaloacetate is the carboxylation of:

- A. Pyruvate
- B. Glutamate
- C. Aconitate
- D. Citrate
- E. Succinate

34. There are three main stages of catabolism in the enzymatic degradation of complex bioorganic compounds in humans. In the first stage the reactions occur according to the mechanism:

- A. Hydrolysis
- B. Reduction
- C. Phosphorylation
- D. Oxidation
- E. Carboxylation

35. Reactions, metabolites of which may be included both in catabolic and anabolic processes, belong to:

- A. Amphibolic
- B. Catabolic
- C. Exergonic
- D. Endergonic
- E. Anabolic

36. Oxidation of acetyl-CoA in Krebs cycle plays an important role in the energy supply of each of these cells (tissues, organs), except:

- A. Red blood cells
- B. Muscle

- C. Brain
- D. Kidney
- E. Liver

37. How many ATP molecules can be formed in the citric acid cycle without electron transport chain in the substrate phosphorylation reaction only?

- A. 1
- B. 12
- C. 11
- D. 2
- E. 3

38. Anabolic pathways are involved in the synthesis of larger and more complex compounds from smaller precursors. What is the class of enzymes associated only with anabolic pathways, only:

- A. Ligase
- B. Transferase
- C. Isomerase
- D. Oxidoreductase
- E. Lyase

39. In the 1st stage of catabolic processes biomolecules such as, carbohydrates, fats, and proteins are broken down into their individual monomer units: carbohydrates into simple sugars, fats into fatty acids and glycerol, and proteins into amino acids. Catabolic stage I reactions for organic compounds in human organism is located in in:

- A. Digestive tract
- B. Any place of human body
- C. Rough EPR
- D. Ribosome
- E. Cellular membrane

40. The rat poison fluoroacetate reacts with oxaloacetate to form fluorocitrate. Fluorocitrate inhibits aconitase, leading to the accumulation of citrate. Ingestion may result in convulsions, cardiac arrhythmias, and eventually death. Fluoroacetate is found as non-competitive inhibitor for:

- A. Aconitase
- B. Citrate synthetase
- C. Succinate dehydrogenase
- D. Alpha-ketoglutarate dehydrogenase
- E. Malate dehydrogenase

TOPIC 6. BIOLOGICAL OXIDATION AND OXIDATIVE PHOSPHORYLATION. MECHANISMS OF ATP SYNTHESIS.

1. The process of metabolism in the human body produces active forms of oxygen, including superoxide anion radical. This anion is inactivated by the following enzyme:

- A. Superoxide dismutase
- B. Catalase
- C. Peroxidase
- D. Glutathione peroxidase
- E. Glutathione reductase

2. Cyanide is a poison that causes instant death of the organism. What enzymes found in mitochondria are affected by cyanide?

- A. Cytochrome oxidase (aa_3)
- B. Flavin enzymes
- C. Cytochrome b_5
- D. NAD^+ -dependent dehydrogenase
- E. Cytochrome P-450

3. Those organisms which in the process of evolution failed to develop protection from H_2O_2 can exist only in anaerobic conditions. Which of the following enzymes can break hydrogen peroxide down?

- A. Peroxidase and catalase
- B. Oxygenase and hydroxylase
- C. Cytochrome oxidase, cytochrome B_5
- D. Oxygenase and catalase
- E. Flavin-dependent oxidase

4. A patient who was previously ill with mastectomy as a result of breast cancer was prescribed radiation therapy. What vitamin preparation has marked radioprotective action caused by antioxidant activity?

- A. Tocopherol acetate
- B. Ergocalciferol
- C. Thiamine chloride
- D. Riboflavin
- E. Folic acid

5. Oval and round organelles with double wall are seen at the electron micrograph. The outer membrane is smooth, the inner membrane folded into cristae contain enzyme ATPase synthetase. These are:

- A. Mitochondria
- B. Golgi complex
- C. Lysosomes
- D. Centrioles
- E. Ribosomes

6. Barbiturates are used as soporifics. These substances, similarly to rotenone, are tissue respiration inhibitors. What complex level do these compounds suppress respiratory chain at?

- A. $NADH$ -coenzyme Q reductase
- B. Cytochrome oxidase
- C. Cytochrome C reductase

- D. Adenosine triphosphate synthetase
- E. Succinate dehydrogenase

7. During the necropsy of a 20-year-old girl a pathologist concluded that the death of the patient had resulted from poisoning by cyanides. The activity of what enzyme is mostly inhibited by cyanides?

- A. Cytochrome oxidase
- B. Malate dehydrogenase
- C. Heme synthase
- D. Aspartate aminotransferase
- E. Lactate dehydrogenase

8. Infant death occurs due to cyanide poisoning. What is the biochemical mechanism of cyanides' unfavorable action on the molecular level?

- A. Inhibition of cytochrome oxidase
- B. Chemical bounding to the substrates of TCA
- C. Blockage of succinate dehydrogenase
- D. Inactivation of oxygen molecule
- E. Inhibition of cytochrome b

9. The production of thyroid hormones is stimulated under thyrotoxicosis. It leads to body weigh loss, tachycardia, and rise of psychic irritability. Choose the biochemical mechanism by which thyroid hormones affect the tissue bioenergetics from the listed below:

- A. Uncoupling of oxidation and oxidative phosphorylation
- B. Blockage of mitochondrial respiratory chain
- C. Activation of substrate level phosphorylation
- D. Blockage of substrate level phosphorylation
- E. Activation of oxidation and oxidative phosphorylation

10. Cyanides are extremely dangerous poisons as they irreversibly block respiratory chain of enzymes. At which point is arrested electron transport in presence of cyanides?

- A. Cytochrome oxidase
- B. NADH₂-ubiquinon reductase
- C. Succinate dehydrogenase
- D. Ubiquinon-cytochrome c reductase
- E. Respiratory complex III enzymes

11. High resistance of "winter-swimmers" (so-called "walruses") to low temperatures is explained by increased production of certain hormones that stimulate the processes of biological oxidation and heat formation in the cells through the uncoupling of mitochondrial electron transfer and the oxidative phosphorylation. Choose the name of these hormones:

- A. Thyroid hormones
- B. Glucagone
- C. Adrenaline
- D. Insulin
- E. Corticosteroids

12. When hydrogen peroxide solution is administered to bleeding wounds, it is broken up by one of the blood enzymes. Point out this enzyme:

- A. Catalase

- B. Monoamine oxidase
- C. Cytochrome oxidase
- D. Aspartate aminotransferase
- E. Lactate dehydrogenase

13. Natural peptides can carry out various functions. What biologically active peptide is one of the main antioxidants and carries out coenzyme functions?

- A. Glutathione
- B. Bradykinin
- C. Oxytocin
- D. Releasing hormone (Liberine)
- E. Anserine

14. Oligomycin antibiotic is prescribed to the patient with tuberculosis. What mitochondrial process is slowed down by this medicine?

- A. Oxidative phosphorylation
- B. Substrate-linked phosphorylation
- C. Microsomal oxidation
- D. Lipid peroxidation
- E. Oxidative decarboxylation

15. Inhibitors of one of the amides metabolism enzymes are used to treat depression. What enzyme inhibition has such an effect?

- A. Flavin adenine dinucleotide (FAD)-
- B. containing monoamine oxidase (MAO)
- C. Acetylcholinesterase
- D. Formylkynureninase (Arylformamidase)
- E. Kynurenine 3-hydroxylase

16. It is known that some chemical compounds uncouple the tissue respiration and oxidative phosphorylation. Name one of these compounds:

- A. 2,4-dinitrophenol
- B. Carbon monoxide
- C. Antimycin A
- D. Lactic acid
- E. Acetyl-CoA

17. In the complex treatment of periodontitis, tocopherol was used. What effect causes the healing properties of this vitamin?

- A. Antioxidant
- B. Antiphlogistic
- C. Antialergic
- D. Osteotropic
- E. Prooxydant

18. There are various diseases that cause sharp increase of active oxygen, leading to cell membranes destruction. Antioxidants are used to prevent it from happening. The most potent natural antioxidant is:

- A. Alpha-tocopherol
- B. Glucose
- C. Vitamin D
- D. Fatty acids

E. Glycerol

19. In the process of metabolism human body produces active oxygen forms, including superoxide anion radical O_2^- . This anion is inactivated by the following enzyme:

- A. Superoxide dismutase
- B. Catalase
- C. Peroxidase
- D. Glutathione peroxidase
- E. Glutathione reductase

20. Newborn children have a special brown adipose tissue, in which fuel oxidation serves not to produce ATP, but to generate heat to keep the newborn warm. Which substance from this tissue serves as a natural uncoupler of oxidative phosphorylation?

- A. Thermogenin
- B. Rothenon
- C. Cyanide
- D. Hydrogen sulfide
- E. Thyroxin

21. Uncoupling of respiration from oxidative phosphorylation assumes biological significance in brown adipose tissue of newborns. Which natural uncoupler is located in this tissue?

- A. Thermogenin
- B. Rothenon
- C. Cyanide
- D. Hydrogen sulfide
- E. Thyroxin

22. Activation of membrane lipid peroxydation is one of the basic mechanisms of membrane structure and functions damage as well as the death of a cell. The cause of this pathology is:

- A. Vitamin E deficiency
- B. B_{12} -hypervitaminosis
- C. B_1 -deficiency
- D. B_1 -hypervitaminosis
- E. B_{12} -deficiency

23. Researches of the latest decades established that immediate "executors" of cell apoptosis are special enzymes called caspases. Generation of one of them proceeds with participation of cytochrome C. What is its function in a normal cell?

- A. Enzyme of respiratory chain of electron transport
- B. Enzyme of tricarboxylic acid cycle
- C. Enzyme of beta-oxidation of fatty acids
- D. Component of H^+ ATP system
- E. Component of pyruvate-dehydrogenase system

24. Microscopic analysis of human heart cells revealed some oval organellas, their tunic being formed by two membranes: the external one is smooth, and the internal one forms crista. Biochemical analysis determined the presence of ATP synthetase enzyme. What organellas were analysed?

- A. Mitochondrions
- B. Lysosomes

- C. Ribosomes
- D. Endoplasmic reticulum
- E. Centrosomes

23. 53-year-old, previously successful man recently lost his job and is under investigation for racketeering. His wife returns home to find him slumped over the steering wheel of his idling car in the closed garage. He is unresponsive and has a cherry color to his lips and cheeks. Which of the following is inhibited by the carbon monoxide in the car's exhaust fumes?

- A. Cytochrome oxidase
- B. Complex I of the ETC
- C. The ATP-ADP antiporter
- D. The F₀ component of the F₀-F₁ ATPase
- E. The F₁ component of the F₀-F₁ ATPase

24. A cell has been treated with a substance that blocks nucleotide phosphorylation in the mitochondrion. What process of cell activity will be disturbed in the first place?

- A. ATP resynthesis
- B. Synthesis of mitochondrial proteins
- C. Oxidative phosphorylation
- D. Integration of functional protein molecules
- E. Fragmentation of big mitochondrion into lesser ones

25. A patient complains about attacks of labored breathing, dizziness. He works at a chemical plant producing hydrocyanic acid. The described symptoms might be associated with dysfunction of the following enzyme:

- A. Cytochrome oxidase
- B. Lactate dehydrogenase
- C. Succinate dehydrogenase
- D. Catalase
- E. Pyruvate dehydrogenase

26. Potassium cyanide that is a poison came into a patient's organism and caused death a few minutes after it. The most probable cause of its toxic effect was abnormal activity of:

- A. Cytochrome oxidase
- B. Catalase
- C. ATP-synthetase
- D. NADP-H-dehydrogenase
- E. Haemoglobin synthesis

27. An 8-year-old boy is seen by an ophthalmologist for vision difficulties, and the physician notices a slowing of the boy's eye movements. The phthalmologist finds ophthalmoplegia and pigmentary retinopathy and suspects the child has Kearns-Sayre syndrome. Assuming that the defect in this disorder is due to a mutation in complex II of the ETC, electron transfer from which substrate would be impaired?

- A. Succinate
- B. α -Ketoglutarate
- C. Isocitrate
- D. Malate
- E. Pyruvate

28. A scientist is studying oxidative phosphorylation in intact, carefully isolated mitochondria. Upon adding an oxidizable substrate, such as pyruvate, a constant rate of oxygen utilization is noted. The scientist then adds a compound that greatly enhances the rate of oxygen consumption. This compound is most likely which one of the following?

- A. Dinitrophenol
- B. Carbon monoxide
- C. Antimycin
- D. Cyanide
- E. Rotenone

29. Redox potential is the ability of a substance to accept electrons (to be reduced) or to lose them (to be oxidized). The oxidation-reduction system having the highest redox potential is:

- A. NAD^+/NADH
- B. Ubiquinone OX/RED
- C. Fe^{3+} cytochrome a/ Fe^{2+}
- D. Fe^{3+} cytochrome b/ Fe^{2+}
- E. Fe^{3+} cytochrome c_1 / Fe^{2+}

30. Cytochromes are electron carriers containing heme. Which of the following is the correct sequence of cytochrome carriers in respiratory chain:

- A. Cyt b → cyt c_1 → cyt c → cyt aa₃
- B. Cyt b → cyt c → cyt c_1 → cyt aa₃
- C. Cyt aa₃ → cyt b → cyt c → cyt c_1
- D. Cyt b → cyt aa₃ → cyt c → cyt c
- E. Cyt aa₃ → cyt c_1 → cyt c → cyt b

31. If the reducing equivalents enter from NAD^+ in the respiratory chain, the phosphate:oxygen ratio (P:O) is:

- A. 3
- B. 1
- C. 2
- D. 4
- E. 5

32. ATP synthesis is totally blocked in a cell. How will the value of membrane rest potential change?

- A. It will disappear
- B. First it will increase, then decrease
- C. It will be considerably increased
- D. It will be slightly increased
- E. First it will decrease, then increase

33. Oxidases catalyze the removal of hydrogen from a substrate using oxygen as a hydrogen acceptor. An example of oxidases is:

- A. Cytochrome oxidase
- B. Lactate dehydrogenase
- C. Malate dehydrogenase
- D. Succinate dehydrogenase
- E. Fumarase

34. Most of hydrogen atoms (protons and electrons) involved in process of tissue respiration are transported to the respiratory chain by the next compound:

- A. $\text{NADH} + \text{H}^+$
- B. $\text{NADPH} + \text{H}^+$
- C. FMNH_2
- D. FADH_2
- E. Pyruvate

35. Activity of what enzyme can be detected due to the color development of benzidine after its oxidation?

- A. Phenol oxidase
- B. Lactate dehydrogenase
- C. Cytochrome c
- D. Aldehyde dehydrogenase
- E. Peroxidase

36. Some of the free energy released in the mitochondrial electron transport chain can be harnessed to the formation of ATP. How many moles of ATP can be formed per a pair of electrons transferred from reduced FAD to oxygen?

- A. 2
- B. 0
- C. 1
- D. 3
- E. 4

37. An electron transport chain (ETC) is a series of complexes that transfer electrons from electron donors to electron acceptors via redox (both reduction and oxidation occurring simultaneously) reactions, and couples this electron transfer with the transfer of protons across a membrane. The sequence of the redox carriers in respiratory chain is:

- A. $\text{NAD} \rightarrow \text{FMN} \rightarrow \text{CoQ} \rightarrow \text{cyt b} \rightarrow \text{cyt } c_1 \rightarrow \text{cyt c} \rightarrow \text{cyt } aa_3 \rightarrow \text{O}_2$
- B. $\text{FMN} \rightarrow \text{CoQ} \rightarrow \text{NAD} \rightarrow \text{cyt b} \rightarrow \text{cyt } aa_3 \rightarrow \text{cyt } c_1 \rightarrow \text{cyt c} \rightarrow \text{O}_2$
- C. $\text{NAD} \rightarrow \text{FMN} \rightarrow \text{CoQ} \rightarrow \text{cyt } c_1 \rightarrow \text{cyt c} \rightarrow \text{cyt b} \rightarrow \text{cyt } aa_3 \rightarrow \text{O}_2$
- D. $\text{NAD} \rightarrow \text{FMN} \rightarrow \text{CoQ} \rightarrow \text{cyt b} \rightarrow \text{cyt } aa_3 \rightarrow \text{cyt } c_1 \rightarrow \text{cyt c}$
- E. $\text{FMN} \rightarrow \text{NAD} \rightarrow \text{CoQ} \rightarrow \text{cyt b} \rightarrow \text{cyt } aa_3 \rightarrow \text{cyt } c_1 \rightarrow \text{cyt c}$

38. Most of protons and electrons which are further involved into mitochondrial respiratory chain are supplied from the next metabolic pathways:

- A. Tricarboxylic acid (TCA) cycle
- B. Glycolysis
- C. Pyruvate dehydrogenase complex
- D. Cleavage of proteins
- E. Oxidation of fatty acids

39. Enzymes of respiratory chain perform oxidation of substrates and transfer of reductive equivalents to oxygen with production of water molecules. Where they are located?

- A. On inner mitochondrial membrane.
- B. On cytoplasmic membrane
- C. In cytoplasm
- D. On outer mitochondrial membrane
- E. In nucleus

40. The component of respiratory chain enzymes cytochrome oxidase (cytochrome $a+a_3$), operates as a transporter of:

- A. Electrons
- B. Cations
- C. Protons**
- D. Anions
- E. Hydrogen

41. Which of the following enzyme complex serves as a point of entry for most of the electrons generated by the action of the citric acid cycle:

- A. Complex I
- B. Complex II
- C. Complex III
- D. Complex IV
- E. ATP synthase

42. Reducing equivalents are transferred from the carrier molecules to the electron transport chain in complex I or complex II, and the flow of electrons is coupled to extrusion of H^+ across the inner mitochondrial membrane. Reducing equivalents from succinate enter the mitochondrial respiratory chain at:

- A. FAD
- B. NAD
- C. Coenzyme Q
- D. Cyt c
- E. Cyt b

43. What reaction conditions are needed for oxidation of pyrocatechin by molecular oxygen in presence of phenoloxidase and production of oxidation products with brown color?

- A. In presence of pyrocatechin and potatoe juice
- B. After boiling of potatoe juice
- C. Absence of pyrocatechin
- D. In presence of Na_2S
- E. In strong acidic medium

44. Which of the following actions describes the uncoupling of oxidative phosphorylation in a mitochondrial system?

- A. The phosphorylation of ADP stops but oxygen uptake continues
- B. The phosphorylation of ADP to ATP accelerates
- C. The phosphorylation of ADP continues but oxygen uptake stops
- D. Oxygen uptake stops
- E. Produced ATP is not translocated across inner membrane to cytoplasm

45. Some hormones are acting as uncouplers of oxidative phosphorylation. Choose from listed below hormones one which is considered as the best uncoupler.

- A. Thyroxine
- B. Norepinephrine
- C. Testosterone
- D. Insulin
- E. Cortisol

46. The next process occurs in suspension of mitochondria with ruptured inner membrane and provided with malate and oxygen
- Transport of electrons along enzymes of respiratory chain
 - Phosphorylation of ADP
 - Decrease of pH in the external medium
 - Increase of pH in mitochondrial matrix
 - Oxydative phosphorylation will take place
47. The chemical inhibiting oxidative phosphorylation, a dependent on the transport of adenine nucleotides across the inner mitochondrial membrane is:
- Oligomycin
 - Atractyloside
 - Dinitrophenol
 - Pentachlorophenol
 - Puromocine
48. Which of the listed below compounds is considered to be a natural uncoupler of oxidative phosphorylation
- Thermogenin
 - Progesteron
 - Succinic acid
 - Sapogenin
 - Stearic acid
49. Hydrogen peroxide is harmful and extremely toxic to living cells. Chose an enzyme which is used by cells for neutralization of hydrogen peroxide:
- Glutathione peroxidase
 - Cytochrome oxidase
 - NADP-H₂-oxidase
 - Cyclooxygenase
 - Monoamine oxidase
50. Superoxide anion is generated in course of tissue respiration and is a strong oxidant, possessing a harmful effect. What enzyme is involved in neutralization of this compound?
- Superoxide dismutase
 - Xanthine oxidase
 - Monoamine oxidase
 - Peroxidase
 - Catalase
51. CO is extremely dangerous poison as it irreversibly blocks respiratory chain of enzymes. At which point is arrested electron transport in presence of CO?
- Cytochrome oxidase
 - NADH₂-ubiquinon reductase
 - Succinate dehydrogenase
 - Ubiquinon-cytochrome c reductase
 - Respiratory complex III
52. Rotenone is a compound that occurs naturally in several plants and it has been used as abroad spectrum insecticide and pesticide. Rotenone inhibits the respiratory chain at:

- A. FMN → coenzyme Q
- B. NAD → FMN
- C. Coenzyme Q → cyt b
- D. Cyt b → Cyt c₁
- E. Cyt c₁ → Cyt a₃

53. Some hormones are acting as uncouplers of oxidative phosphorylation. Chose from listed below hormones one considered as potent uncoupler.

- A. Thyroxine
- B. Norepinephrine
- C. Testosterone
- D. Insulin
- E. Cortisol

54. A muscle biopsy specimen from a patient with a rare disorder, Luft disease, showed abnormally large mitochondria that contained packed cristae when examined in the electron microscope. Basal ATPase activity of the mitochondria was seven times greater than normal. From these and other data it was concluded that oxidation and phosphorylation were partially uncoupled. Which of the following statements about this patient is correct?

- A. The patient shows hypermetabolism and elevated core temperature
- B. The rate of electron transport is abnormally low
- C. The proton gradient across the inner mitochondrial membrane is greater than normal
- D. ATP levels in the mitochondria are greater than normal
- E. Cyanide would not inhibit electron flow

TOPIC № 7. STUDIES ON GLYCOLYSIS – OXIDATION OF CARBOHYDRATES UNDER ANAEROBIC CONDITIONS

1. People, who for a long time remained in hypodynamic state, develop intense pain in the muscles after a physical exertion. What is the most likely cause of this pain?
 - A. Accumulation of lactic acid in muscles
 - B. Intensive breakdown of muscle proteins
 - C. Accumulation of creatinine in muscles
 - D. Decreased content of lipids in muscles
 - E. Increased content of ADP in muscles
2. Blood test of the patient revealed albumine content of 20 g/l and increased activity of lactate dehydrogenase isoenzyme 5 (LDH₅). These results indicate disorder of the following organ:
 - A. Liver
 - B. Kidneys
 - C. Heart
 - D. Lungs
 - E. Spleen
3. Human red blood cells contain no mitochondria. What is the main pathway for ATP production in these cells?
 - A. Anaerobic glycolysis
 - B. Aerobic glycolysis
 - C. Oxidative phosphorylation
 - D. Creatine kinase reaction
 - E. Cyclase reaction
4. When blood circulation in the damaged tissue is restored, lactate accumulation stops and glucose consumption decelerates. These metabolic changes are caused by activation of the following process:
 - A. Aerobic glycolysis
 - B. Anaerobic glycolysis
 - C. Lipolysis
 - D. Gluconeogenesis
 - E. Glycogen biosynthesis
5. Untrained people often have muscle pain after sprints as a result of lactate accumulation. This can be caused by intensification of the following biochemical process:
 - A. Glycolysis
 - B. Gluconeogenesis
 - C. Pentose phosphate pathway
 - D. Lipogenesis
 - E. Glycogenesis
6. Diseases of respiratory system and circulatory disorders impair the transport of oxygen, thus causing hypoxia. Under these conditions the energy metabolism is carried out by anaerobic glycolysis. As a result, the following substance is generated and accumulated in blood:
 - A. Lactic acid
 - B. Pyruvic acid

- C. Glutamic acid
- D. Citric acid
- E. Fumaric acid

7. 6 hours after the myocardial infarction a patient was found to have elevated level of lactate dehydrogenase in blood. What isoenzyme should be expected in this case?

- A. LDH₁
- B. LDH₂
- C. LDH₃
- D. LDH₄
- E. LDH₅

8. Researchers isolated 5 isoenzymic forms of lactate dehydrogenase from the human blood serum and studied their properties. What property indicates that the isoenzymic forms were isolated from the same enzyme?

- A. Catalyzation of the same reaction
- B. The same molecular weight
- C. The same physicochemical properties
- D. Tissue localization
- E. The same electrophoretic mobility

9. Some students developed myodynia after continuous physical activity during physical education. The reason for such condition was accumulation of lactic acid in the skeletal muscles. It was generated in the students' bodies after activation of the following process:

- A. Glycolysis
- B. Gluconeogenesis
- C. Pentose-phosphate cycle
- D. Lipolysis
- E. Glycogeny

10. After a sprint an untrained person develops muscle hypoxia. This leads to the accumulation of the following metabolite in muscles:

- A. Lactate
- B. Ketone bodies
- C. Acetyl CoA
- D. Glucose 6-phosphate
- E. Oxaloacetate

11. Cytoplasm of the myocytes contains a lot of dissolved metabolites resulting from glucose oxidation. Name the metabolite that turns directly into lactate:

- A. Pyruvate
- B. Oxaloacetate
- C. Glycerophosphate
- D. Glucose-6-phosphate
- E. Fructose-6-phosphate

12. A patient presents high activity of LDH_{1,2}, aspartate aminotransferase, creatine phosphokinase. In what organ (organs) is the development of a pathological process the most probable?

- A. In the heart muscle (initial stage of myocardium infarction)
- B. In skeletal muscles (dystrophy, atrophy)

- C. In kidneys and adrenals
- D. In connective tissue
- E. In liver and kidneys

13. As a result of exhausting muscular work a worker has largely reduced buffer capacity of blood. What acidic substance that came to blood caused this phenomenon?

- A. Lactate
- B. Pyruvate
- C. 1,3-bisphosphoglycerate
- D. 3-phosphoglycerate
- E. –

14. A 7-year-old girl has signs of anemia. Laboratory examination revealed pyruvate kinase deficiency in erythrocytes. What process disturbance plays the main role in anemia development?

- A. Anaerobic glycolysis
- B. Oxidative phosphorylation
- C. Tissue respiration
- D. Peroxide decomposition
- E. Amino acids desamination

15. Desulfiram is widely used in medical practice to prevent alcoholism. It inhibits aldehyde dehydrogenase. Increased level of what metabolite causes aversion to alcohol?

- A. Acetaldehyde
- B. Ethanol
- C. Malonyl aldehyde
- D. Propionic aldehyde
- E. Methanol

16. The high level of Lactate Dehydrogenase (LDH) isozymes concentration showed the increase of LDH-1 and LDH-2 in a patient's blood plasma. Point out the most probable diagnosis:

- A. Myocardial infarction
- B. Skeletal muscle dystrophy
- C. Diabetes mellitus
- D. Viral hepatitis
- E. Acute pancreatitis

17. A patient presents with hypoxia. What metabolic process activates when oxygen supply is insufficient?

- A. Anaerobic glycolysis
- B. Urea cycle
- C. Pentose-phosphate pathway
- D. Oxidative decarboxylation of keto acids
- E. Tricarboxylic acid cycle

18. A patient was found to have an increased blood serum LDH-1 activity. In which organ is the pathological process localized?

- A. Heart
- B. Liver
- C. Kidneys

- D. Stomach
- E. Muscles

19. Under anaerobic conditions during glycolysis ATP is synthesized by the way of substrate phosphorylation. This process uses energy of other highenergy compounds. Specify one of such compounds:

- A. Phosphoenol pyruvate
- B. Glucose 6-phosphate
- C. Lactate
- D. Pyruvate
- E. Glucose

20. Red blood cells for proper function need energy in form of ATP. What process provides the red blood cell with required amount of ATP?

- A. Anaerobic glycolysis
- B. Aerobic oxidation of glucose
- C. Tricarboxylic acid cycle
- D. β -oxidation of fatty acids
- E. Pentosophosphate pathway

21. During consumption of cakes or sweets in mixed saliva a transient increase in lactate level takes place. Activation of what biochemical process causes this effect?

- A. Anaerobic glycolysis
- B. Tissue respiration
- C. Aerobic glycolysis
- D. Gluconeogenesis
- E. Microsomal oxidation

22. Glycolysis - a universal pathway in the living cell. The enzymes of glycolysis are located in the:

- A. Cytoplasm of every living cell
- B. Cytoplasm of red blood cell only
- C. Mitochondria of striated muscle cell
- D. Nuclei of liver cells
- E. Lysosomal vesicles

23. The enzyme pyruvate kinase catalyses the transfer of high energy phosphate from phosphoenol pyruvate to ADP. Pyruvate kinase requires ___ ions for maximum activity:

- A. Mg^{2+}
- B. Ba^{2+}
- C. Fe^{2+}
- D. Br^-
- E. Cl^-

24. A 58-year-old man is brought to emergency after he was found unconscious. Examination of patient revealed general weakness, hypoglycemia, blood pH = 7,24. Hypoglycemia is likely related to his alcohol use. Excessive intake of ethanol increases the ratio:

- A. $NADH/NAD^+$
- B. $NADPH/NADP^+$
- C. $NAD^+/NADH$
- D. $FADH_2/FAD$

E. FAD/FADH₂

25. Under anaerobic conditions ATP are synthesized. ATP is produced by the process of:

- A. Substrate phosphorylation
- B. Oxidative phosphorylation
- C. Photosynthetic phosphorylation
- D. Transfer of phosphate group from fructose-bisphosphate upon ADP
- E. Deamination of amino acids

26. Lactate dehydrogenase is an oligomeric molecule which contains the next number of subunits:

- A. Four
- B. Three
- C. Two
- D. Six
- E. Eight

27. Which of the following statements about the glycolytic intermediate, fructose-6-phosphate is correct?

- A. In glycolysis fructose-6-phosphate is an aldol but is not itself split by the aldol reaction until phosphorylated to fructose-1:6-bisphosphate
- B. In glycolysis fructose-6-phosphate is converted to glucose-6-phosphate and can then be split by the aldol reaction into an aldehyde and a ketone
- C. In glycolysis fructose-6-phosphate is an aldol so once phosphorylated to fructose-1:6-bisphosphate cannot be split by the aldol reaction into an aldehyde and a ketone
- D. In glycolysis fructose-6-phosphate is formed from glucose-6-phosphate and is split by the aldol reaction into an aldehyde and a ketone
- E. –

28. Glucokinase can be characterized by one of the next statements:

- A. It has a much higher Michaelis constant (K_m) for glucose than does hexokinase
- B. ATP is activator of this enzyme
- C. The reaction that this enzyme catalyses produces a high energy phosphate
- D. It is the major regulatory enzyme of glycolysis
- E. It is located in mitochondria

29. Most of the reactions of glycolysis are reversible. However, the three steps are irreversible. Specify these enzymes:

- A. Hexokinase, phosphofructokinase and pyruvate kinase
- B. Pyruvate kinase, phosphoglycerate kinase, phosphoglycerate mutase
- C. Phosphofructokinase, phosphohexose isomerase, enolase
- D. Glucokinase, enolase, phosphoglycerate mutase
- E. Phosphohexose isomerase, phosphoglycerate mutase, hexokinase,

30. One mole of glucose in glycolytic pathway in anaerobic conditions produces:

- A. Two moles of lactate
- B. Three moles of lactate
- C. Four moles of lactate
- D. One moles of lactate

E. Five moles of lactate

31. In some anaerobic bacteria the pyruvate produced by glycolysis is converted to the ethyl alcohol (alcoholic fermentation). What is the biological significance of this process?

- A. NAD⁺ replenishment
- B. Lactate production
- C. ADP production
- D. Providing the cells with NADPH
- E. ATP production

32. Which of the following enzyme-catalysed reactions has a product containing a newly formed high energy phosphate bond?

- A. 2-Phosphoglycerate to phosphoenolpyruvate
- B. 3-Phosphoglycerate to 2-phosphoglycerate
- C. The phosphorylation of glucose
- D. Dihydroxyacetone phosphate to glyceraldehydes phosphate
- E. Fructose-1,6-bisphosphate to glyceral-dehydres-3-phosphate and dihydroxyacetone phosphate

33. The following is an enzyme required for glycolysis:

- A. Pyruvate kinase
- B. Pyruvate dehydrogenase
- C. Pyruvate carboxylase
- D. Glucose-6-phosphatase
- E. Glycerokinase

34. As a result of anaerobic glycolysis glucose is converted to:

- A. Lactic acid
- B. Citric acid
- C. Glycogen
- D. Succinic acid
- E. Acetoacetic acid

35. Chose the correct statement of phosphofructokinase properties:

- A. AMP is an activator of this enzyme
- B. The reaction that this enzyme catalyzes produces a high energy phosphate bond without the involvement of ADP or ATP
- C. It is not regulatory enzyme of glycolysis
- D. The substrate of this enzyme is glucose-6-phosphate
- E. This enzyme catalyzes the interconversion of dihydroxyacetone phosphate and glyceraldehydes-3-phosphate

36. Alcoholic fermentation occurs in yeast and several bacterial species. In this process product of pyruvate decarboxylation is:

- A. Acetaldehyde
- B. Ethanol
- C. Lactate
- D. Phosphoenolpyruvate
- E. Glucose

37. Which of the following is a substrate for aldolase activity in glycolytic pathway?

- A. Fructose-1,6- biphosphate
- B. Glucose-1,6-biphosphate
- C. Glucose-6-phosphate
- D. Fructose-6-phosphate
- E. Glyceraldehyde-3-phosphate

38. The oxidation of lactic acid to pyruvic acid requires the following vitamin derivative as the hydrogen carrier:

- A. NAD⁺
- B. FAD
- C. FMN
- D. Coenzyme A
- E. Lithium pyrophosphate

39. Glycolysis is also referred to as:

- A. Embden-Meyerhof-Parnas pathway
- B. Lineweaver-Burk pathway
- C. Krebs-Henseleit pathway
- D. Chargaff pathway
- E. Watson-Crick pathway

40. The combination of subunits in lactate dehydrogenase molecule makes it possible to create the next number of isoenzymes:

- A. Five
- B. Four
- C. Six
- D. Three
- E. Eight

41. Which of the following enzymes is not involved in glycolysis:

- A. Glucose oxidase
- B. Glucokinase
- C. Hexokinase
- D. Aldolase
- E. Enolase

42. Anaerobic oxidation of glucose to lactate is regulated by appropriate enzymes. What enzyme is the major regulator of this process?

- A. Phosphofructokinase
- B. Enolase
- C. Glucose-6-phosphate isomerase
- D. Lactate dehydrogenase
- E. Aldolase

43. During glycolysis fructose-1,6-biphosphate is decomposed by the enzyme:

- A. Aldolase
- B. Hexokinase
- C. Enolase
- D. Fructokinase
- E. Disphosphofructophosphatase

44. Which mammalian cell does not have aerobic pathway of glucose catabolism?

- A. Red blood cell
- B. Nerve cell
- C. Sperm cell
- D. Ovum
- E. Liver cell

45. The irreversible reactions of glycolysis include that catalyzed by:

- A. Phosphofructokinase
- B. Phosphohexose isomerase
- C. Fructose-bisphosphate aldolase
- D. Glyceraldehyde-3-phosphate dehydrogenase
- E. Phosphoglycerate kinase

46. In yeast cells occurs a process which is similar to glycolysis – alcohol fermentation. In course of this process through several stages from pyruvate is produced:

- A. Ethanol
- B. Acetaldehyde
- C. Lactate
- D. Pyruvate
- E. Glyceraldehyde

47. The major metabolic product produced under normal circumstances by erythrocytes and by muscle cells during intense exercise is recycled through liver in the Cori cycle. The metabolite is:

- A. Lactate
- B. Alanine
- C. Oxaloacetate
- D. Glycerol
- E. NADH

48. A 24-year-old man presented with symptoms of shortness of breath, weakness and fatigue. His hemoglobin level was 7g/dl. Red blood cell isolated from the patient showed abnormally low-level of lactate. A deficiency of which of the following enzymes would be the most likely cause for patient's anemia?

- A. Pyruvate kinase
- B. Glucokinase
- C. Hexokinase
- D. Phosphofructokinase
- E. Phosphoglucose isomerase

49. Which out of the following enzymes cleaves a carbon-carbon bond in the pathway of glycolysis?

- A. Aldolase
- B. Glyceraldehyde-3-phosphate dehydrogenase
- C. Enolase
- D. Phosphoglycerate mutase
- E. Phosphoglycerate kinase

50. Phosphoglycerate kinase functions in carbohydrate metabolism to produce ATP via:

- A. Substrate level phosphorylation
- B. Oxidative phosphorylation
- C. Oxidative decarboxylation

- D. Phosphorolysis
- E. Oxidative deamination

TOPIC № 8. GLUCOSE OXIDATION UNDER AEROBIC CONDITIONS AND ALTERNATIVE METABOLIC PATHWAYS OF MONOSACCHARIDES METABOLISM

1. A 7-year-old child presents with marked signs of hemolytic anemia. Biochemical analysis of erythrocytes determined low concentration of NADPH and reduced glutathione. What enzyme is deficient in this case leading to the biochemical changes and their clinical manifestations?
 - A. Glucose-6-phosphate dehydrogenase
 - B. Hexokinase
 - C. Fructokinase
 - D. Pyruvate kinase
 - E. Lactate dehydrogenase
2. A patient, who has been subsisting exclusively on polished rice, has developed polyneuritis due to thiamine deficiency. What substance is an indicator of such avitaminosis, when it is excreted with urine?
 - A. Pyruvic acid
 - B. Malate
 - C. Methylmalonic acid
 - D. Uric acid
 - E. Phenyl pyruvate
3. It is known that pentose-phosphate pathway actively functions in the erythrocytes. What is the main function of this metabolic pathway in the erythrocytes?
 - A. Counteraction to lipid peroxidation
 - B. Activation of microsomal oxidation
 - C. Neutralization of xenobiotics
 - D. Oxidation of glucose into lactate
 - E. Increase of lipid peroxidation
4. An infant, who was on synthetic formula feeding, developed signs of vitamin B₁ deficiency. What reactions does this vitamin take part in?
 - A. Keto acids oxidative decarboxylation
 - B. Amino acids transamination
 - C. Amino acids decarboxylation
 - D. Proline hydroxylation
 - E. Redox reactions
5. It has been determined that one of a pesticide components is sodium arsenate that blocks lipoic acid. Enzyme activity can be impaired by this pesticide. Name this enzyme:
 - A. Pyruvate dehydrogenase complex
 - B. Microsomal oxidation
 - C. Methemoglobin reductase
 - D. Glutathione peroxidase
 - E. Glutathione reductase
6. When blood circulation in the damaged tissue is restored, lactate accumulation stops and glucose consumption decelerates. These metabolic changes are caused by activation of the following process:
 - A. Aerobic glycolysis
 - B. Anaerobic glycolysis

- C. Lipolysis
- D. Gluconeogenesis
- E. Glycogen biosynthesis

7. Fructosuria is known to be connected with inherited deficiency of fructose-1-phosphate aldolase. What product of fructose metabolism will accumulate in the organism resulting in toxic action?

- A. Fructose 1-phosphate
- B. Glucose 1-phosphate
- C. Glucose 6-phosphate
- D. Fructose 1,6-biphosphate
- E. Fructose 6-phosphate

8. A patient has an increased pyruvate concentration in blood, most of it is excreted with the urine. What kind of avitaminosis has this patient?

- A. B₁
- B. E
- C. B₃
- D. B₆
- E. B₂

9. A 3 year old child with fever was given aspirin. It resulted in intensified erythrocyte hemolysis. Hemolytic anemia might have been caused by congenital insufficiency of the following enzyme:

- A. Glucose 6-phosphate dehydrogenase
- B. Glucose 6-phosphatase
- C. Glycogen phosphorylase
- D. Glycerol phosphate dehydrogenase
- E. γ -glutamyltransferase

10. A child's blood presents high content of galactose, glucose concentration is low. There are such presentations as cataract, mental deficiency, adipose degeneration of liver. What disease is it?

- A. Galactosemia
- B. Diabetes mellitus
- C. Lactosemia
- D. Steroid diabetes
- E. Fructosemia

11. To prevent long-term effects of 4-day malaria a 42-year-old patient was prescribed primaquine. On the 3-rd day from the begin of treatment there appeared stomach and heart pains, dyspepsia, general cyanosis, hemoglobinuria. What caused side effects of the preparation?

- A. Genetic insufficiency of glucose-6-phosphate dehydrogenase
- B. Cumulation of the preparation
- C. Decreased activity of microsomal liver enzymes
- D. Delayed urinary excretion of the preparation
- E. Drug potentiation by other preparations

12. Pyruvate concentration in the patient's urine has increased 10 times from normal amount. What vitamin deficiency can be the reason of this change:

- A. Vitamin B₁

- B. Vitamin C
- C. Vitamin A
- D. Vitamin E
- E. Vitamin B₆

13. A child has got galactosemia. Concentration of glucose in blood has not considerably changed. Deficiency of what enzyme caused this illness?

- A. Galactose-1-phosphate uridylyltransferase
- B. Amylo-1,6-glucosidase
- C. Phosphoglucomutase
- D. Galactokinase
- E. Hexokinase

14. Purine ring biosynthesis occurs in ribose-5-phosphate through gradual accumulation of nitrogen and carbon atoms and closing of the rings. The source of ribose phosphate is the process of:

- A. Pentose phosphate cycle
- B. Glycolysis
- C. Glyconeogenesis
- D. Gluconeogenesis
- E. Glycogenolysis

15. Vitamin B₁ deficiency has a negative effect on a number of processes. This is caused by the dysfunction of the following enzyme:

- A. Pyruvate dehydrogenase complex
- B. Aminotransferase
- C. Succinate dehydrogenase
- D. Glutamate
- E. Lactate dehydrogenase

16. Oxidative decarboxylation of pyruvic acid is catalyzed by a multienzyme complex with several functionally linked coenzymes. Name this complex:

- A. Thymidine diphosphate (TDP), flavin adenine dinucleotide (FAD), coenzyme A (CoASH), nicotine amide adenine dinucleotide (NAD), lipoic acid
- B. Flavin adenine dinucleotide (FAD), tetrahydrofolic acid, pyridoxal-5-phosphate, thymidine diphosphate (TDP), choline
- C. Nicotine amide adenine dinucleotide (NAD), pyridoxal-5-phosphate, thymidine diphosphate (TDP), methylcobalamin, biotin
- D. Coenzyme A (CoASH), flavin adenine dinucleotide (FAD), pyridoxal-5-phosphate, tetrahydrofolic acid, carnitine
- E. Lipoic acid, tetrahydrofolic acid, pyridoxal-5-phosphate, methylcobalamin

17. Sulfanilamides are applied as antimicrobial agents in clinical practice. Sulfanilamide treatment, however, can result in hemolytic anemia development in patients that suffer from genetic defect of the following enzyme of pentose phosphate metabolism in erythrocytes:

- A. Glucose-6-phosphate dehydrogenase
- B. Hexokinase
- C. Transketolase
- D. Transaldolase
- E. Pyruvate kinase

18. Pyruvic acid as an intermediate metabolite of carbohydrate, lipid and amino acid metabolism can undergo oxidative decarboxylation. The cause of this process is the lack of the following nutrient in the diet:

- A. Thiamin
- B. Pyridoxine
- C. Ascorbic acid
- D. Citrine
- E. Pangamic acid

19. It is known that the pentose phosphate pathway occurring in the adipocytes of adipose tissue acts as a cycle. What is the main function of this cycle in the adipose tissue?

- A. NADPH₂ generation
- B. Ribose-phosphate production
- C. Xenobiotic detoxification
- D. Energy generation
- E. Glucose oxidation to end products

20. The following enzyme is required for the hexose monophosphate shunt pathway:

- A. Glucose-6-phosphate dehydrogenase
- B. Glucose-6-phosphatase
- C. Phosphorylase
- D. Phosphofructokinase
- E. Pyruvate dehydrogenase

21. Pyruvate dehydrogenase complex and α -ketoglutarate dehydrogenase complex require the following for their oxidative decarboxylation:

- A. TPP, Lipoamide, CoASH, FAD, NAD⁺
- B. CoASH and lipoic acid
- C. NAD⁺ and FAD
- D. CoASH and TPP
- E. TPP

22. Biosynthesis of the purine ring occurs owing to ribose-5-phosphate by gradual joining of nitrogen and carbon atoms inside the heterocycle structure and closing of the rings. The metabolic source of ribose-5-phosphate is:

- A. Pentose phosphate pathway
- B. Glycolysis
- C. Gluconeogenesis
- D. Glycogenesis
- E. Glycogenolysis

23. Ribulose 5 phosphate (RU5P) is converted to ribose 5 phosphate (R5P) by the enzyme?

- A. Ribose-5-phosphate isomerase
- B. Ribose 5 phosphate dehydrogenase
- C. Ribulose 5 phosphate dehydrogenase
- D. Ribulose-5-phosphate isomerase
- E. Aldolase

24. Galactose is phosphorylated by galactokinase to form:

- A. Galactose-1-phosphate

- B. Galactose-6-phosphate
- C. Galactose-1,6-diphosphate
- D. Glucose-6-phosphate
- E. All of these

25. Individuals who eat fresh fava beans are protected to a certain extent from malaria. Which enzyme deficiency takes place under these conditions?

- A. Glucose-6-phosphate dehydrogenase
- B. Transketoase
- C. Pyruvate dehydrogenase
- D. Ribulosephoshate isomerase
- E. Transaldolase

26. The pentose phosphate pathway sometimes referred to as:

- A. Hexose monophosphate shunt
- B. Hexose bisphosphate shunt
- C. Embden-Meyerhof-Parnas pathway
- D. Chargaff pathway
- E. Krebs-Henseleit pathway

27. Lipoic acid is a cofactor of the next enzyme complex:

- A. Pyruvate dehydrogenase
- B. Succinate dehydrogenase
- C. Lactate dehydrogenase
- D. Cytochrome oxidase
- E. Transketolase

28. Pyruvate decarboxylase (one of enzymes of pyruvate dehydrogenase complex) contains as coenzyme:

- A. Thiamine pyrophosphate
- B. Ascorbic acid
- C. Folic acid
- D. Pyridoxine
- E. Tocoferol

29. Two important products of pentose phosphate pathway are:

- A. NADPH and pentose sugars
- B. Glucose and NADH
- C. Pentose sugars and sedoheptulose
- D. Pentose sugars and 4 membered sugars
- E. NADH and pentose sugars

30. Transketolase (one of enzymes of pentose phosphate pathway) contains as coenzyme:

- A. TPP
- B. Tocoferol
- C. Pyridoxine
- D. NAD
- E. Folic acid

31. A 2-year-old boy has the increase of liver and spleen sizes detected and eye cataract present. The total sugar level in blood is increased, but glucose tolerance is

within the normal range. The inherited disturbance of the metabolism of what substance is the cause of the indicated state?

- A. Galactose
- B. Saccharose
- C. Maltose
- D. Fructose
- E. Glucose

32. Which of the following enzymes catalyze reaction: Fructose + ATP → Fructose-1-phosphate + ADP:

- A. Fructokinase
- B. Pyruvate kinase
- C. Galactokinase
- D. Hexokinase
- E. Glucokinase

33. Dehydrogenase enzymes of the hexose-monophosphate shunt are:

- A. NADP⁺ specific
- B. NAD⁺ specific
- C. Biotin specific
- D. FAD specific
- E. FMN specific

34. In a patient are manifested symptoms of intoxication with arsenic compounds. What metabolic process is damaged taking into account that arsenic containing substances inactivate lipoic acid?

- A. Oxidative decarboxylation of pyruvate
- B. Microsomal oxidation
- C. Coupling of oxidation and phosphorylation
- D. Neutralization of superoxide anions
- E. Fatty acids biosynthesis

35. Before pyruvic acid enters the TCA cycle it must be converted to:

- A. Acetyl CoA
- B. α-ketoglutarate
- C. Lactate
- D. Citrate
- E. Glucose

36. Which from listed below vitamins is involved in the oxidative decarboxylation pyruvate?

- A. Lipoic acid
- B. Tocoferol
- C. Ascorbic acid
- D. Pyridoxine
- E. Folic acid

37. The oxidative phase of pentose phosphate pathway is very active in cells such as red blood cells or hepatocytes. Which of the following products is the end product of this phase?

- A. Ribulose-5-phosphate
- B. 6-Phospho-gluconate

- C. Pyruvate
- D. Glyceraldehyde-3-phosphate
- E. Fructose-6-phosphate

38. Which from listed below pathways is responsible for the synthesis of ribose-5-phosphate, a component of nucleic acids:

- A. Pentose phosphate pathway
- B. Embden-Meyerhof-Parnas pathway
- C. Oxidative decarboxylation of pyruvate
- D. Glycolysis
- E. Krebs cycle

39. Which of the following substances inhibit pentose phosphate pathway:

- A. NADPH⁺
- B. Mg²⁺
- C. NAD⁺
- D. FAD
- E. ADP

40. NADPH serves to regenerate in red cells to prevent their lysis:

- A. Glutathione
- B. NADP
- C. Cysteine
- D. Carnitine
- E. Cholesterol

41. There are several pathways for glucose transformation and utilization, one of them is pentose phosphate pathway, which actively proceeds in liver, adrenal cortex, red blood cells. What is the main aim of this pathway?

- A. NADPH₂ generation and production of pentoses
- B. Acetyl-CoA production
- C. Synthesis of glycogen and fat
- D. FADH₂ generation
- E. NADH₂ and gluconic acid production

42. Our body can get pentoses from:

- A. HMP shunt
- B. Glycolytic pathway
- C. Uronic acid pathway
- D. TCA cycle
- E. Gluconeogenesis

43. Transketolase activity is affected in:

- A. Thiamine deficiency
- B. Pyridoxine deficiency
- C. Ascorbic acid deficiency
- D. Biotin deficiency
- E. PABA deficiency

44. Which of the following symptoms would be seen in a patient with a severe deficiency of thiamine?

- A. A decreased level of transketolase activity in red blood cells

- B. A decrease in blood level of lactate
- C. Xerophthalmia
- D. A low level of cell transaminase activity
- E. An increased clotting time of blood

45. Oxidative decarboxylation of pyruvate requires:

- A. CoASH
- B. Pyridoxal phosphate
- C. Biotin
- D. Cytochromes
- E. NADP⁺

46. The glucoso-6-phosphate dehydrogenase deficiency causes hemolytic anemia due to lack of:

- A. NADPH
- B. NADP
- C. Pentoses
- D. ATP
- E. Cholesterol

47. The total number of moles of ATP produced by the aerobic oxidation of 1 mol of glucose is:

- A. 38
- B. 58
- C. 2
- D. 12
- E. 52

48. How many molecules of ATP are produced in oxidative decarboxylation of pyruvate:

- A. 6
- B. 4
- C. 2
- D. 12
- E. 38

49. During aerobic oxidation of glucose, 6 molecules of ATP are produced by substrate level phosphorylation. Name the enzyme catalyze substrate level phosphorylation:

- A. Phosphoglycerate kinase, pyruvate kinase, succinate thiokinase
- B. Hexokinase, phosphofructokinase, citrate synthase
- C. Isocitrate dehydrogenase, aldolase, enolase
- D. Transketolase, glucokinase, galactokinase
- E. Transketolase, fumarase, malate dehydrogenase

50. A 30-years old woman is training for her first marathon, and her coach has her keeping a pace that allows her to stay below her anaerobic threshold. By avoiding anaerobic muscle glycolysis, the pyruvate produced in the muscle does not accumulate because it is converted to which one of the following?

- A. Acetyl CoA
- B. Alanine
- C. Ethanol
- D. Lactic acid
- E. Fructose

TOPIC № 9. BREAKDOWN AND BIOSYNTHESIS OF GLYCOGEN. REGULATION OF GLYCOGEN METABOLISM, BIOSYNTHESIS OF GLUCOSE – GLUCONEOGENESIS

1. During intensive muscle work there is a large amount of ammonia produced in the muscles. What amino acid plays the main role in the transportation of ammonia to the liver and participates in gluconeogenesis reactions?
 - A. Alanine
 - B. Arginine
 - C. Lysine
 - D. Ornithine
 - E. Aspartate
2. A 40-year-old woman suffers from Cushing's disease - steroid diabetes. On biochemical examination she has hyperglycemia and hypochloremia. What process activates in the first place in such patients?
 - A. Gluconeogenesis
 - B. Glycogenolysis
 - C. Glucose reabsorption
 - D. Glucose transport to the cells
 - E. Glycolysis
3. During intensive physical exertion, one of the energy sources for the working muscles is glucose produced as the result of gluconeogenesis. This process is the most intensive in the following organ:
 - A. Liver
 - B. Brain
 - C. Lungs
 - D. Muscles
 - E. Stomach
4. Congenital pyruvate carboxylase deficiency causes physical and mental retardation in children and leads to early death. It is characterized by lactic acidemia, lactaciduria, and a number of metabolic disorders. Among others, inhibition of the following occurs:
 - A. Citric acid cycle and gluconeogenesis
 - B. Glycolysis and glycogenolysis
 - C. Glycogenesis and glycogenolysis
 - D. Lipolysis and lipogenesis
 - E. Pentose-phosphate pathway and glycolysis
5. A child with point mutation presents with absence of glucose 6-phosphatase, hypoglycemia, and hepatomegaly. What pathology are these signs characteristic of?
 - A. Von Gierke's disease (Glycogen storage disease type I)
 - B. Cori's disease (Glycogen storage disease type III)
 - C. Addison's disease (Primary adrenal insufficiency)
 - D. Parkinson's disease
 - E. McArdle's disease (Glycogen storage disease type V)
6. Characteristic sign of glycogenosis is muscle pain during physical work. Blood examination usually reveals hypoglycemia. This pathology is caused by congenital deficiency of the following enzyme:
 - A. Glycogen phosphorylase

- B. Glucose 6-phosphate dehydrogenase
- C. α -amylase
- D. γ -amylase
- E. Lysosomal glycosidase

7. Pancreas is known as a mixed gland. Endocrine functions include production of insulin by beta cells. This hormone affects metabolism of carbohydrates. What is its effect on the activity of glycogen phosphorylase (GP) and glycogen synthase (GS)?

- A. It inhibits GP and activates GS
- B. It activates both GP and GS
- C. It inhibits both GP and GS
- D. It activates GP and inhibits GS
- E. It does not affect the activity of GP and GS

8. Prolonged fasting causes hypoglycemia which is amplified by alcohol consumption, as the following process is inhibited:

- A. Gluconeogenesis
- B. Glycolysis
- C. Glycogenolysis
- D. Lipolysis
- E. Proteolysis

9. A child has a history of hepatomegaly, hypoglycemia, seizures, especially on an empty stomach and in stressful situations. The child is diagnosed with Gierke disease. This disease is caused by the genetic defect of the following enzyme:

- A. Glucose-6-phosphatase
- B. Amyloid-1,6-glycosidase
- C. Phosphoglucomutase
- D. Glycogen phosphorylase
- E. Glucokinase

10. Glycogen polysaccharide is synthesized from the active form of glucose. The immediate donor of glucose residues during the glycogenesis:

- A. UDP-glucose
- B. Glucose-1-phosphate
- C. ADP-glucose
- D. Glucose-6-phosphate
- E. Glucose-3-phosphate

11. During starvation muscle proteins break up into free amino acids. These compounds will be the most probably involved into the following process:

- A. Gluconeogenesis in liver
- B. Gluconeogenesis in muscles
- C. Synthesis of higher fatty acids
- D. Glycogenolysis
- E. Decarboxylation

12. A patient ill with neurodermatitis has been taking prednisolone for a long time. Examination revealed high rate of sugar in his blood. This complication is caused by the drug influence upon the following link of carbohydrate metabolism:

- A. Gluconeogenesis activation
- B. Glycogenogenesis activation

- C. Intensification of glucose absorption in the bowels
- D. Inhibition of glycogen synthesis
- E. Activation of insulin decomposition

13. A child is languid, apathetic. Liver is enlarged and liver biopsy revealed a significant excess of glycogene. Glucose concentration in the bloodstream is below normal. What is the cause of low glucose concentration?

- A. Low (absent) activity of glycogene phosphorylase in liver
- B. Low (absent) activity of hexokinase
- C. High activity of glycogen synthetase
- D. Low (absent) activity of glucose 6-phosphatase
- E. Deficit of a gene that is responsible for synthesis of glucose 1-phosphaturidine transferase

14. The gluconeogenesis is activated in the liver after intensive physical trainings .What substance is utilized in gluconeogenesis first of all in this case:

- A. Lactate
- B. Pyruvate
- C. Glucose
- D. Glutamate
- E. Alanine

15. A patient with the symptoms of acute alcoholic poisoning was brought to the hospital. What carbohydrates metabolism changes are typical for this condition?

- A. The gluconeogenesis velocity in liver is decreased
- B. The gluconeogenesis is increased in liver
- C. The breakage of glycogen is increased in liver
- D. The anaerobic glucose metabolism predominates in muscles
- E. The anaerobic breakage of glucose is increased in muscles

16. Inherited diseases, such as mucopolysaccharidoses, are manifested in metabolic disorders of connective tissue, bone and joint pathologies. The sign of this disease is the excessive urinary excretion of the following substance:

- A. Glycosaminoglycans
- B. Amino acids
- C. Glucose
- D. Lipids
- E. Urea

17. Avidin - an egg white protein inhibits reception of biotin (carboxylase coenzyme) by the body. What reaction will be blocked by avidin administration?

- A. CO₂ attachment to pyruvate
- B. NH₃ attachment to glutamate
- C. NH₃ detachment from glutamine
- D. Detachment of phosphate residuals
- E. Beta-oxidation of fatty acids

18. Information transfer from peptide hormones to intracellular second messengers occurs involving adenylate cyclase. What reaction is catalyzed by adenylate cyclase?

- A. Cyclic adenosine monophosphate production
- B. ATP breakdown into ADP and inorganic phosphate
- C. ATP synthesis from adenosine monophosphate and pyrophosphate

- D. ADP breakdown with adenosine monophosphate and inorganic phosphate production
- E. ATP breakdown into adenosine monophosphate and pyrophosphate

19. Addison's (bronze) disease is treated with glucocorticoids. Their effect is provided by the potentiation of the following process:

- A. Gluconeogenesis
- B. Glycolysis
- C. Pentose phosphate cycle
- D. Glycogenolysis
- E. Ornithine cycle

20. Food rich in carbohydrates at first increases the blood sugar and then decreases its rate due to the insulin action. What process is activated by this hormone?

- A. Synthesis of glycogen
- B. Gluconeogenesis
- C. Breakdown of glycogen
- D. Breakdown of proteins
- E. Breakdown of lipids

21. Caffeine inhibits phosphodiesterase which converts cAMP to AMP. The most typical feature of caffeine intoxication is the reduced intensity of:

- A. Glycogen synthesis
- B. Protein phosphorylation
- C. Pentose phosphate pathway
- D. Glycolysis
- E. Lipolysis

22. Alpha-cells of pancreas stimulate synthesis of the glucagon hormone that is involved into the carbohydrate metabolism. It has the following effect on liver processes:

- A. Activates glycogenolysis
- B. Activates alcoholic fermentation
- C. Inhibits glycogenolysis
- D. Inhibits glycolysis
- E. Activates lipogenesis

23. A child has mental and physical retardation, grave damage of internal connective tissue. Urine analysis reveals keratan sulfates. What metabolic process is disturbed?

- A. Glycosaminoglycans
- B. Collagen
- C. Elastin
- D. Fibronectin
- E. Hyaluronic acid

24. One of the means of regulating enzyme activity in a human body is the covalent modification. Glycogen phosphorylase and glycogen synthetase activity is regulated by the following type of covalent modification:

- A. Phosphorylation-dephosphorylation
- B. ADP-ribosylation
- C. Methylation
- D. Hydrolysis
- E. Sulfonation

25. A patient with rheumatoid arthritis has been given hydrocortisone for a long time. He has developed hyperglycemia, polyuria, glycosuria, thirst. These complications of treatment result from the activation of the following process:

- A. Gluconeogenesis
- B. Glycogenolysis
- C. Glycogenesis
- D. Glycolysis
- E. Lipolysis

26. Degeneration of glycogen in liver is stimulated by glucagon. What secondary messenger (mediator) is thus formed in the cell?

- A. c-AMP
- B. c-GMP
- C. CO
- D. NO
- E. Triacylglycerol

27. It is known that many hormones act through the adenylate cyclase system causing the enzyme activation by phosphorylation. What enzyme is activated by hormonal signals and catalyzes glycogen breakdown?

- A. Phosphorylase
- B. Phosphotransferase
- C. Glucomutase
- D. Phosphatase
- E. Tyrosinase

28. It has been revealed that intense physical exercise causes activation of gluconeogenesis in liver of experimental rats. Which substance is glucose precursor in this case?

- A. Pyruvate
- B. Glycogen
- C. Palmitate
- D. Urea
- E. Stearate

29. A 34-year-old patient has low endurance of physical loads. At the same time skeletal muscles have increased concentration of glycogen. This is caused by the reduced activity of the following enzyme:

- A. Glycogen phosphorylase
- B. Glucose-6-phosphate dehydrogenase
- C. Phosphofructokinase
- D. Glycogen synthase
- E. Glucose-6-phosphatase

30. Chronic overdosage of glucocorticoids leads to the development of hyperglycemia. What process of carbohydrate metabolism is responsible for this effect?

- A. Gluconeogenesis
- B. Glycogenolysis
- C. Aerobic glycolysis
- D. Pentose-phosphate cycle
- E. Glycogenesis

31. The patient exhausted by starvation presents with intensification of the following process in the liver and kidneys:

- A. Gluconeogenesis
- B. Urea synthesis
- C. Bilirubin synthesis
- D. Hippuric acid synthesis
- E. Uric acid synthesis

32. Mucin aggregates retain water, which results in their viscosity and protective action. It is possible because mucin structure contains:

- A. Glycosaminoglycans
- B. Homopolysaccharides
- C. Disaccharides
- D. Oligosaccharides
- E. Glucose

33. After introduction of adrenaline the patient's blood glucose level increased. It is caused by intensified:

- A. Glycogenolysis in the liver
- B. Glycogenolysis in the muscles
- C. Glycolysis in the liver
- D. Glycolysis in the skeletal muscles
- E. Glycogen synthesis

34. Breakdown of cyclic adenosine monophosphate (cAMP) and cyclic guanosine monophosphate (cGMP) into simple, non-cyclic nucleoside monophosphates is catalyzed by the following enzyme:

- A. Phosphodiesterase
- B. Glycogen phosphorylase
- C. Glucose 6-phosphatase
- D. Protein kinase
- E. Adenylate cyclase

35. What types of linkages are present between the glucose units of glycogen?

- A. α -1-4 and α -1-6 linkages
- B. β -1-6 linkages only
- C. α -1-4 linkages only
- D. β -1-4 and β -1-6 linkages
- E. β -1-4 linkages only

36. The greatest quantity of the body glycogen can be found in which of the following human tissue?

- A. Liver
- B. Kidney
- C. Stomach
- D. Cardiac muscle
- E. Brain

37. The conversion of alanine to glucose is termed:

- A. Gluconeogenesis
- B. Oxidative decarboxylation

- C. Glycolysis
- D. Specific dynamic action
- E. Glycogenesis

38. Activity of enzymes of glycogen metabolism is regulated in the next way:

- A. Covalent modification by phosphorylation-dephosphorylation
- B. By dissociation into subunits
- C. By limited proteolysis
- D. By isomerization of reaction products
- E. By a noncompetitive inhibition

39. Phosphorolysis of carbohydrates plays a key role in a mobilization of polysaccharides. Under the action of phosphorylase from glycogen is produced the next substance:

- A. Glucose -1-phosphate
- B. Glucose
- C. Fructose 6-phosphate
- D. Glucose 6-phosphate
- E. Glucose 1,6-bis-phosphate

40. Which one of the following is a rate limiting enzyme of gluconeogenesis?

- A. Pyruvate carboxylase
- B. Phosphoglucomutase
- C. Pyruvate kinase
- D. Phosphofructokinase
- E. Hexokinase

41. Insulin exhibits the next effect on glycogen metabolism:

- A. Stimulation of glycogenesis by activation of glycogen synthase
- B. Stimulation of glycogen breakdown by activation of phosphorylase
- C. Stimulation of glycogen utilization in muscle cells
- D. Suppression of glycogen breakdown by inhibition of debranching enzyme
- E. Activation of glycogenolysis by activation of phosphorylase a

42. Glycogen synthesis takes place under the action of several enzymes. Indicate, what enzyme provides the formation of 1,6-glycosidic bonds in glycogen molecule?

- A. Glycosyl 4,6-transferase
- B. Glycogen synthase
- C. Hexokinase
- D. Glucokinase
- E. Glucose 1-phosphate uridil transferase

43. The carbohydrate reserved in human body is:

- A. Glycogen
- B. Lactose
- C. Inulin
- D. Glucose
- E. Starch

44. The active form of glycogen ____ is phosphorylated; the active form of glycogen ____ is dephosphorylated.

- A. Phosphorylase; synthase

- B. Synthase; phosphorylase
- C. Hydrolase; semisynthase
- D. Dehydrogenase; hydrolase
- E. Hydrolase; dehydrogenase

45. Which of the following is a precursor for glucose synthesis via gluconeogenesis?

- A. Glycerol
- B. Cortisone
- C. Glucagon
- D. Cholesterol
- E. Leucin

46. Lactate formed in muscles can be utilised through:

- A. Cori's cycle
- B. Rapoport-Luebeling cycle
- C. Citric acid cycle
- D. Glucose-alanine cycle
- E. Tricarboxylic acid cycle

47. Some hours after an intensive physical training a sportsman showed activated gluconeogenesis. Which of the following is the basic substrate of gluconeogenesis?

- A. Lactate
- B. Serine
- C. Aspartate
- D. Glutamate
- E. α -Ketoglutarate

48. The characteristic enzymes of gluconeogenesis are found in the cytosol, except for:

- A. Pyruvate carboxylase, which is in the mitochondria
- B. Glucose-6-phosphatase, which is in the mitochondria
- C. Fructose-1,6-bisphosphatase, which is in the mitochondria
- D. Fructose-1,6-bisphosphatase, which is in the glycogen granule
- E. Pyruvate carboxylase, which is in the glycogen granule

49. Which of the following supports gluconeogenesis?

- A. $\text{Pyruvate} + \text{ATP} + \text{HCO}_3^- = \text{oxaloacetate} + \text{ADP} + \text{P}_i + \text{H}^+$
- B. Lysine degradation
- C. Leucine degradation
- D. $\text{Acetyl CoA} + \text{oxaloacetate} + \text{H}_2\text{O} = \text{citrate} + \text{CoA}$
- E. $\alpha\text{-ketoglutarate} + \text{aspartate} = \text{glutamate} + \text{oxaloacetate}$

50. The branching enzyme acts on the glycogen when the glycogen chain has been lengthened to between glucose units:

- A. 1 and 6
- B. 2 and 7
- C. 3 and 9
- D. 6 and 11
- E. 5 and 10

TOPIC № 10. STUDIES OF MECHANISMS OF METABOLIC AND HORMONAL REGULATION OF CARBOHYDRATE METABOLISM. DIABETES MELLITUS

1. Condition of a patient with diabetes mellitus sharply deteriorated after a regular injection of insulin. The patient became anxious and broke out in cold sweat; tremor of the extremities, general weakness, and dizziness appeared. What medicine can remove these symptoms?

- A. Adrenaline
- B. Tolbutamide
- C. Caffeine
- D. Noradrenaline
- E. Glibutid (Buformin)

2. Ketosis develops in the patients with diabetes mellitus, as the result of activation of fatty acids oxidation processes. What acid-base imbalance can result from accumulation of excessive ketone bodies in the blood?

- A. Metabolic acidosis
- B. Metabolic alkalosis
- C. No imbalance occurs
- D. Respiratory acidosis
- E. Respiratory alkalosis

3. A 40-year-old woman suffers from Cushing's disease - steroid diabetes. On biochemical examination she has hyperglycemia and hypochloremia. What process activates in the first place in such patients?

- A. Gluconeogenesis
- B. Glycogenolysis
- C. Glucose reabsorption
- D. Glucose transport to the cells
- E. Glycolysis

4. An unconscious patient was brought into the hospital. The smell of acetone can be detected from the patient's mouth. Blood glucose - 25 mmol/L, ketone bodies 0.57 mmol/L. What hormone deficiency can result in the development of this condition?

- A. Insulin
- B. Thyroxin
- C. Glucocorticoids
- D. Aldosterone
- E. Somatotropin

5. Examination of a 56-year-old woman with a history of type 1 diabetes revealed a disorder of protein metabolism that is manifested by aminoacidemia in the laboratory blood test values, and clinically by the delayed wound healing and decreased synthesis of antibodies. Which of the following mechanisms causes the development of aminoacidemia?

- A. Increased proteolysis
- B. Albuminosis
- C. Decrease in concentration of blood amino acids
- D. Increase in plasma oncotic pressure
- E. Increase in low-density lipoproteins level

6. A 30-year-old man with diabetes mellitus type I was hospitalized. The patient is comatose. Laboratory tests revealed hyperglycemia and ketonemia. What metabolic disorder can be detected in this patient?

- A. Metabolic acidosis
- B. Metabolic alkalosis
- C. Respiratory acidosis
- D. Respiratory alkalosis
- E. Acid-base balance is normal

7. A patient with insulin-dependent diabetes mellitus has been administered insulin. After a certain period of time the patient developed fatigue, irritability, excessive sweating. What is the main mechanism of such presentations developing?

- A. Carbohydrate starvation of the brain
- B. Increased glycogenolysis
- C. Increased ketogenesis
- D. Increased lipogenesis
- E. Decreased glyconeogenesis

8. Pancreas is known as a mixed gland. Endocrine functions include production of insulin by beta cells. This hormone affects metabolism of carbohydrates. What is its effect on the activity of glycogen phosphorylase (GP) and glycogen synthase (GS)?

- A. It inhibits GP and activates GS
- B. It activates both GP and GS
- C. It inhibits both GP and GS
- D. It activates GP and inhibits GS
- E. It does not affect the activity of GP and GS

9. A patient with diabetes mellitus suffers from persistently nonhealing surgical wound, which is a sign of disrupted tissue trophism. What is the cause of such disorder?

- A. Disruption of protein metabolism regulation
- B. Hypoglycemia
- C. Ketonemia
- D. Increased lipid catabolism
- E. Anemia

10. Prior to glucose utilization in cells it is transported inside cells from extracellular space through plasmatic membrane. This process is stimulated by the following hormone:

- A. Insulin
- B. Glucagon
- C. Thyroxin
- D. Aldosterone
- E. Adrenalin

11. A 15-year-old patient has fasting plasma glucose level 4,8 mmol/l, one hour after glucose challenge it becomes 9,0 mmol/l, in 2 hours it is 7,0 mmol/l, in 3 hours it is 4,8 mmol/l. Such parameters are characteristic of:

- A. Subclinical diabetes mellitus
- B. Diabetes mellitus type 1
- C. Diabetes mellitus type 2
- D. Healthy person
- E. Cushing's disease

12. A 39-year-old female patient with a history of diabetes was hospitalized in a precomatose state for diabetic ketoacidosis. This condition had been caused by an increase in the following metabolite level:

- A. Acetoacetate
- B. Citrate
- C. Alpha-ketoglutarate
- D. Malonate
- E. Aspartate

13. A patient with diabetes developed a diabetic coma due to the acid-base imbalance. Specify the kind of this imbalance:

- A. Metabolic acidosis
- B. Metabolic alkalosis
- C. Respiratory acidosis
- D. Gaseous alkalosis
- E. Non-gaseous alkalosis

14. A patient ill with neurodermatitis has been taking prednisolone for a long time. Examination revealed high rate of sugar in his blood. This complication is caused by the drug in flurence upon the following link of carbohydrate metabolism:

- A. Gluconeogenesis activation
- B. Glycogenogenesis activation
- C. Intensification of glucose absorption in the bowels
- D. Inhibition of glycogen synthesis
- E. Activation of insulin decomposition

15. Patients who suffer from severe diabetes and don't receive insulin have metabolic acidosis. This is caused by increased concentration of the following metabolites:

- A. Ketone bodies
- B. Fatty acids
- C. Unsaturated fatty acids
- D. Triacylglycerols
- E. Cholesterol

16. A 62-year-old female patient has developed a cataract (lenticular opacity) secondary to the diabetes mellitus. What type of protein modification is observed in case of diabetic cataract?

- A. Glycosylation
- B. Phosphorylation
- C. ADP-ribosylation
- D. Methylation
- E. Limited proteolysis

17. A patient is ill with diabetes mellitus accompanied by hyperglycemia on an empty stomach (7,2 millimole/l). The hyperglycemia rate can be retrospectively estimated (over the last 4-8 weeks before the examination) on the ground of the rate of the following blood plasma protein:

- A. Glycated hemoglobin
- B. Albumin
- C. Fibrinogen
- D. C-reactive protein

E. Ceruloplasmin

18. A patient was delivered to the hospital by an emergency team. Objectively: grave condition, unconscious, adynamy. Cutaneous surfaces are dry, eyes are sunken, face is cyanotic. There is tachycardia and smell of acetone from the mouth. Analysis results: blood glucose 20,1 micromole/l (standard is 3,3-5,5 micromole/l), urine glucose - 3,5% (standard is - 0). What is the most probable diagnosis?

- A. Hyperglycemic coma
- B. Hypoglycemic coma
- C. Acute heart failure
- D. Acute alcoholic intoxication
- E. Anaphylactic shock

19. A patient with diabetes mellitus experienced loss of consciousness and convulsions after injection of insulin. What is the result of biochemical blood analysis for concentration of the sugar?

- A. 1,5 mmol/L
- B. 8,0 mmol/L
- C. 10,0 mmol/L
- D. 3,3 mmol/L
- E. 5,5 mmol/L

20. The B cells of endocrine portion of pancreas are selectively damaged by alloxan poisoning. How will it be reflected in blood plasma?

- A. The content of sugar increases
- B. The content of fibrinogen decrease
- C. The level of sugar decreases
- D. The content of globulins decreases
- E. The content of albumins decreases

21. When investigating human saliva it is necessary to assess its hydrolytic properties. What substance should be used as a substrate in the process?

- A. Starch
- B. Proteins
- C. Fats
- D. Fiber
- E. Amino acids

22. A 60 year old patient was found to have a dysfunction of main digestive enzyme of saliva. This causes the disturbance of primary hydrolysis of:

- A. Carbohydrates
- B. Fats
- C. Proteins
- D. Cellulose
- E. Lactose

23. The 49-year-old female patient suffering long-term from pancreatic diabetes has developed the following symptoms after administering insulin: weakness, facial pallor, palpitation, anxiety, double vision, numbness of lips and tongue apex. Glucose molar concentration in blood was 2,5 mmol/l. What complication has developed in the patient?

- A. Hypoglycemic coma
- B. Hyperosmolar coma

- C. Hyperglycemic coma
- D. Hyperketonemic coma
- E. Uremic coma

24. The 13-year-old female patient having suffered from measles complains of dry mouth, thirst, body weight loss, polyuria, her glucose concentration in blood is 16 mmol/l. What disease can be suspected?

- A. Type I pancreatic diabetes
- B. Type II pancreatic diabetes
- C. Diabetes insipidus
- D. Steroidogenic diabetes
- E. Glycogenosis

25. Addison's (bronze) disease is treated with glucocorticoids. Their effect is provided by the potentiation of the following process:

- A. Gluconeogenesis
- B. Glycolysis
- C. Pentose phosphate cycle
- D. Glycogenolysis
- E. Ornithine cycle

26. Food rich in carbohydrates at first increases the blood sugar and then decreases its rate due to the insulin action. What process is activated by this hormone?

- A. Synthesis of glycogen
- B. Gluconeogenesis
- C. Breakdown of glycogen
- D. Breakdown of proteins
- E. Breakdown of lipids

27. A patient was admitted to a hospital in a state of hypoglycemic coma. It occurs at the following level of blood glucose:

- A. 2,5 mmol/l or less
- B. 4,0 mmol/l
- C. 3,3 mmol/l
- D. 4,5 mmol/l
- E. 5,5 mmol/l

28. Diabetes and starvation cause the excess production of ketone bodies that are used as an energy source. They are produced from the following compound:

- A. Acetyl-CoA
- B. Isocitrate
- C. Lactate
- D. Malate
- E. Ketoglutarate

29. Alpha-cells of pancreas stimulate synthesis of the glucagon hormone that is involved into the carbohydrate metabolism. It has the following effect on liver processes:

- A. Activates glycogenolysis
- B. Activates alcoholic fermentation
- C. Inhibits glycogenolysis
- D. Inhibits glycolysis
- E. Activates lipogenesis

30. A nurse accidentally injected a nearly double dose of insulin to a patient with diabetes mellitus. The patient lapsed into a hypoglycemic coma. What drug should be injected in order to help him out of coma?

- A. Glucose
- B. Lidase
- C. Insulin
- D. Somatotropin
- E. Noradrenaline

31. A patient has been found to have sugar in the urine. Blood glucose is normal. Arterial pressure is normal. What is the mechanism of glycosuria development in this case?

- A. Disturbance of glucose reabsorption in the nephron tubules
- B. Insulin deficiency
- C. Hyperfunction of adrenal medulla
- D. Hyperfunction of thyroid gland
- E. Hyperfunction of adrenal cortex

32. After introduction of adrenaline the patient's blood glucose level increased. It is caused by intensified:

- A. Glycogenolysis in the liver
- B. Glycogenolysis in the muscles
- C. Glycolysis in the liver
- D. Glycolysis in the skeletal muscles
- E. Glycogen synthesis

33. The concentration of glucose in the blood plasma of a healthy man varies within the following limits:

- A. 3.3-5.5 mM/l
- B. 1.0-2.0 mM/l
- C. 6.0-9.5 mM/l
- D. 10.0-25.0 mM/l
- E. 2.0-4.0 mM/l

34. The patient with complaints of permanent thirst applied to the doctor. Hyperglycemia, polyuria and increased concentration of 17-ketosteroids in the urine were revealed. What disease is the most likely?

- A. Steroid diabetes
- B. Insulin-dependent diabetes mellitus
- C. Myxoedema
- D. Type I glycogenosis
- E. Addison's disease

35. In a 57 years old patient suffering from diabetes mellitus ketoacidosis has been developed. Biochemical background of this status is decrease in utilization of acetyl-CoA due to a deficiency of:

- A. Oxaloacetate
- B. Glutamate
- C. α -ketoglutarate
- D. Aspartate
- E. Succinate

36. In patient S. blood glucose level is over the renal threshold, polyuria is observed, as well as acidosis and ketonuria. What disease can be suggested?
- A. Diabetes mellitus
 - B. Hypercorticism
 - C. Starvation
 - D. Hyperthyreosis
 - E. Addison disease
37. Destruction of pancreatic islets of Langerhans results in the decrease of production of:
- A. Glucagon and insulin
 - B. Parathormone and cortisone
 - C. Thyroxine and calcitonin
 - D. Insulin and adrenaline
 - E. Callicrein and angiotensin
38. Insulin is a hormone with _____ concerning carbohydrates metabolism:
- A. Anabolic activity
 - B. Catabolic activity
 - C. Lypolytic activity
 - D. Glycogenolytic activity
 - E. Luteotropic activity
39. Blood glucose level is decreased by:
- A. Insulin
 - B. Glucagone
 - C. Epinephrine
 - D. Glucocorticoid hormones
 - E. Testosterone
40. Renal threshold, polyuria is observed, as well as acidosis and ketonuria. What disease can be suggested?
- A. Diabetes mellitus
 - B. Starvation
 - C. Hypercorticism
 - D. Addison disease
 - E. Hyperthyreosis
41. Glucagon is produced in the next endocrine gland:
- A. Langerhans islands, α cells
 - B. Thymus
 - C. Medullar part of adrenals
 - D. Parathyroid gland
 - E. Pitiutary gland
42. A 40-year-old woman diagnosed with diabetes mellitus is admitted to a department of endocrinology. The patient complains of thirst and increased hunger. What pathological components are exposed at laboratory research of the patient's urine?
- A. Glucose, ketone bodies
 - B. Protein, amino acid
 - C. Protein, creatine
 - D. Bilirubin, urobilin

E. Blood

43. A 45-year-old woman does not have any symptoms of insulin dependent diabetes mellitus but testing on an empty stomach showed the increase of the blood glucose level (7.5 mM/l). What additional laboratory test needs to be done to substantiate the diagnosis?

- A. Determination of tolerance to glucose
- B. Determination of tolerance to glucose on an empty stomach
- C. Determination of rest nitrogen level in the blood
- D. Determination of ketone bodies concentration in the urine
- E. Determination of glycosylated hemoglobin level

44. Glucose is completely reabsorbed in renal tubules up to the next value of blood glucose level:

- A. 10 mmoles/l
- B. 6,5 mmoles/l
- C. 5,5 mmoles/l
- D. 80 mmoles/l
- E. 150 mmoles/l

45. Amylolytic enzymes catalyze the hydrolysis of polysaccharides and oligosaccharides. They have an effect upon the following chemical bond:

- A. Glycosidic
- B. Hydrogen
- C. Peptide
- D. Amide
- E. Phosphodiester

46. The most severe and dangerous complication of diabetes mellitus is hypoglycemic coma that is characterized by loss of consciousness and is lethal, unless efficient emergency treatment is received by patient. What is the main pathogenetic component of hypoglycemic coma?

- A. Carbohydrate deficiency and low energy of cerebral neurons
- B. Carbohydrate deficiency and low energy of myocardium cells
- C. Blood hyperosmia
- D. Noncompensated ketoacidosis
- E. Respiratory alkalosis

47. Maltose is composed of which two sugars:

- A. Glucose and glucose
- B. Glucose and fructose
- C. Glucose and galactose
- D. Galactose and fructose
- E. Lactose and galactose

48. Which of the following hormones promotes hypoglycemia:

- A. Insulin
- B. Epinephrin
- C. Glucagon
- D. Aldosteron
- E. Cortisol

49. A patient has been receiving Theophylline (inhibitor of cyclic adenosine monophosphate phosphodiesterase) for a week. What hormone can increase its action due to such treatment and cause hyperglycemia?

- A. Glucagon
- B. Testosterone
- C. Aldosterone
- D. Insulin
- E. Estradiol

50. A patient has been found to have sugar in the urine. Blood glucose is normal. Arterial pressure is normal. What is the mechanism of glycosuria development in this case?

- A. Disturbance of glucose reabsorption in the nephron tubules
- B. Insulin deficiency
- C. Hyperfunction of adrenal medulla
- D. Hyperfunction of thyroid gland
- E. Hyperfunction of adrenal cortex

TOPIC №11. CATABOLISM AND BIOSYNTHESIS OF TRIACYLGLYCEROLS AND PHOSPHOLIPIDS. INTRACELLULAR LIPOLYSIS AND MOLECULAR MECHANISMS OF ITS REGULATION.

1. Stool test detects in the patients feces a large amount of undigested fats. This patient is the most likely to have disturbed secretion of the following enzymes:

- A. Pancreatic lipases
- B. Pancreatic amylase
- C. Pancreatic proteases
- D. Bile lipase
- E. Gastric protease

2. Obesity is a common disease. The aim of its treatment is to lower content of neutral fats in the body. What hormone-sensitive enzyme is the most important for intracellular lipolysis?

- A. Triacylglycerol lipase
- B. Protein kinase
- C. Adenylate kinase
- D. Diacylglycerol lipase
- E. Pancreatic lipase

3. Blood of the patients with diabetes mellitus shows increased content of free fatty acids. Name the most likely cause of this:

- A. Increased activity of adipose triglyceride lipase
- B. Accumulation of palmitoyl-CoA in cytosol
- C. Activation of ketone bodies utilization
- D. Activation of apo-A1, apo-A2, and apo-A4 apolipoprotein synthesis
- E. Decreased activity of plasma phosphatidylcholine-cholesterolacyltransferase

4. Emotional stress causes activation of hormone-sensitive triglyceride lipase in the adipocytes. What secondary mediator takes part in this process?

- A. Cyclic adenosine monophosphate
- B. Cyclic guanosine monophosphate
- C. Adenosine monophosphate
- D. Diacylglycerol
- E. Ions of Ca^{2+}

5. A 2-year-old child presents with acute psychomotor retardation, vision and hearing impairment, sharp enlargement of the liver and spleen. The child is diagnosed with hereditary Niemann-Pick disease. What genetic defect is the cause of this disease?

- A. Sphingomyelinase deficiency
- B. Glucose-6-phosphatase deficiency
- C. Amylo-1,6-glucosidase deficiency
- D. Acid lipase deficiency
- E. Xanthine oxidase deficiency

6. A 3-year-old girl with mental retardation has been diagnosed with sphingomyelin lipidosis (Niemann-Pick disease). In this condition synthesis of the following substance is disrupted:

- A. Sphingomyelinase
- B. Glycosyltransferase

- C. Sphingosine
- D. Ceramides
- E. Gangliosides

7. A patient is diagnosed with glucocerebroside lipidosi (Gaucher's disease) that manifests as splenomegaly, liver enlargement, affected bone tissue, and neuropathies. What enzyme of complex lipid catabolism is deficient, thus causing this disease?

- A. Glucocerebrosidase
- B. Hexosaminidase
- C. Sphingomyelinase
- D. β -Galactosidase
- E. Hyaluronidase

8. A diet must include fats. Fats perform plastic function in an organism due to their inclusion in:

- A. Cell membranes
- B. Cell ion channel
- C. Cell ion pumps
- D. Cell end-organs
- E. Glycocalyx

9. A patient with atherosclerosis has been prescribed Linaetholum containing essential fatty acids. Which of the following acids is an essential part of the preparation?

- A. Linolenic
- B. Palmitic
- C. Crotonic
- D. Stearic
- E. Oleic

10. For cardiovascular disease prevention the patient was recommended to take vitamin F. What is the chemical nature of this vitamin?

- A. Complex of polyunsaturated fatty acids
- B. Cholesterol derivative
- C. Polysaccharide complex
- D. Amino acids complex
- E. Carotin derivative

11. Roentgenologically confirmed obstruction of common bile duct resulted in preventing bile from inflowing to the duodenum. What process is likely to be disturbed?

- A. Fat emulgation
- B. Protein absorption
- C. Carbohydrate hydrolysis
- D. Hydrochloric acid secretion in stomach
- E. Salivation inhibition

12. A patient has a gallstone lodged in the common bile duct, which blocks bile supply to the intestine. What digestive process will be disturbed in this case?

- A. Fat digestion
- B. Protein absorption
- C. Carbohydrate digestion
- D. Carbohydrate absorption
- E. Protein digestion

13. Inhibition of the synthesis of bile acids from cholesterol in liver of an experimental animals has caused maldigestion of lipids. What is the role of these acids in the enteral lipidic metabolism?

- A. They emulsify dietary lipids
- B. They keep balance of alkaline environment in the intestines
- C. They participate in the synthesis of lipids
- D. They are part of LDL
- E. They activate the formation of chylomicrons

14. In snake venom there is a substance that causes erythrocyte hemolysis, when it is introduced into a human organism. Blood test revealed a large amount of lysolecithin (lysophosphatidylcholine). What enzyme leads to accumulation of lysolecithin in blood?

- A. Phospholipase A₂
- B. Phospholipase A₁
- C. Phospholipase C
- D. Phospholipase D
- E. Neuraminidase

15. After the consumption of animal food rich in fats, a patient feels discomfort, and droplets of fats are found during laboratory investigation of his feces. Bile acids are revealed in the urine. The cause of such state is the deficiency of ____ in the digestive tract.

- A. Bile acids
- B. Fatty acids
- C. Chylomicrons
- D. Triacylglycerols
- E. Phospholipids

16. Fabry's disease (one of sphingolipidoses) is an autosomal recessive disease. Major symptoms of this disease: skin rash, kidney failure, pain in lower extremities. It is caused by a deficiency of:

- A. α -Galactosidase A
- B. Hexosaminidase A and B
- C. Gm1 gangliosidase
- D. Galactocerebrosidase
- E. Ceraminase

17. A 35-year-old man with pheochromocytoma has high levels of epinephrine and norepinephrine registered in the blood. The concentration of free fatty acids is increased by a factor of eleven. Which of the following enzymes accelerates the lipolysis under the action of epinephrine?

- A. Triacylglycerol lipase
- B. Lipoprotein lipase
- C. Phospholipase A
- D. Phospholipase C
- E. Cholesterol esterase

18. Essential fatty acids cant by synthesized because mammals do not possess the enzymes for their biosynthesis. Which of the following is an essential fatty acid?

- A. Linoleic acid
- B. Palmitic acid

- C. Oleic acid
- D. Stearic
- E. Butyric

19. The insufficient secretion of what enzyme is the cause of incomplete fats degradation in the digestive tract and appearance of great quantity of neutral fats in feces?

- A. Pancreatic lipase
- B. Phospholipase
- C. Enterokinase
- D. Amylase
- E. Pepsin

20. A 44-year-old woman complains of common weakness, heart pain, considerable increase of body weight. Objectively: moon-like face, hirsutism, AP - 165/100 mm Hg, height - 164 cm, weight - 103 kg; fat is mostly accumulated in the region of neck, upper shoulder girdle, stomach. What is the main pathogenetic mechanism of obesity?

- A. Increased production of glucocorticoids
- B. Decreased production of thyroidal hormones
- C. Increased production of insulin
- D. Decreased production of glucagon
- E. Increased production of mineralocorticoids

21. What compound of lipid nature may contain a carbohydrate moiety and is presented in most cell membranes?

- A. Ganglioside GM2
- B. Sphingomyelin
- C. Phosphatidylserine
- D. Cholesterol
- E. Leukotrienes

22. The form in which most dietary lipids are packaged and exported from the intestinal mucosa cells is as follows:

- A. Chylomicrons
- B. Mixed micelles
- C. Free triacylglycerol
- D. 2-Monoacylglycerol
- E. Free fatty acids

23. The essence of lipolysis, that is the mobilization of fatty acids from neutral fats depots, is an enzymatic process of hydrolysis of triacylglycerols to fatty acids and glycerol. Fatty acids that release during this process enter blood circulation and are transported by:

- A. Serum albumins
- B. Globulins
- C. HDL
- D. LDL
- E. Chylomicrons

24. Choose from listed below a hormone, which stimulates the formation of glycogen and triacylglycerols:

- A. Insulin

- B. Norepinephrine
- C. Glucagon
- D. Epinephrine
- E. Thyroxine

25. In digestion of dietary lipids there is a need of one of the digestive secretions. What secretion listed below takes part in lipids emulsification?

- A. Bile
- B. Intestinal juice
- C. Pancreatic juice
- D. Saliva
- E. Gastric juice

26. Bile acids are necessary for fat digestion. They are produced in the liver from the next precursor:

- A. Cholesterol
- B. Protoporphyrin IX
- C. Corticosterol
- D. Lecithin
- E. Arachidonic acid

27. Which one of the following enzymes is NOT involved in the degradation of dietary lipids during digestion?

- A. Lipoprotein lipase
- B. Pancreatic lipase
- C. Gastric lipase
- D. Phospholipase A₂
- E. Cholesterol ester hydrolase

28. Which one of the following substances is an intermediate in the synthesis of both glycerol-containing phospholipids and triacylglycerol?

- A. Phosphatidic acid
- B. Choline
- C. Acetoacetyl CoA
- D. CDP-Ethanolamine
- E. 3-Hydroxybutyrate

29. In adipose tissue, glycerol-3-phosphate required for the synthesis of triglycerides comes mainly from:

- A. Dihydroxyacetone phosphate formed in glycolysis
- B. Hydrolysis of pre-existing triglycerides
- C. Free glycerol
- D. Hydrolysis of phospholipids
- E. –

30. In patients suffering from diabetes mellitus an increase in a content of non esterified fatty acids in blood is observed. It may be caused by:

- A. Increase in activity of triacylglycerol lipase
- B. Stimulation of ketone bodies utilization
- C. Activation of synthesis of apolipoproteins A₁ , A₂ , A₃

- D. Decrease in activity of phosphatidylcholine-cholesterol-acyltransferase in blood plasma
- E. Accumulation in cytosol of palmitoyl-CoA

31. Which one of the following statements about the absorption of lipids from the intestine is correct?

- A. Dietary triacylglycerol is partially hydrolyzed and absorbed as free fatty acids and monoacyl glycerol
- B. Release of fatty acids from triacylglycerol in the intestine is inhibited by bile salts
- C. Dietary triacylglycerol must be completely hydrolyzed to free fatty acids and glycerol before absorption
- D. Fatty acids that contain ten carbons or less are absorbed and enter the circulation primarily via the lymphatic system
- E. Formation of chylomicrons does not require protein synthesis in the intestinal mucosa

32. After consumption of lipids in the body then begins their digestion and absorption in intestines. What products of lipid hydrolysis are absorbed in the intestine?

- A. Monoacylglycerol, fatty acids
- B. Amino acids
- C. Polypeptides
- D. Monosaccharides
- E. Lipoproteins

33. Lipids have a lot of important functions. What definition will the best describe triacylglycerols?

- A. In the average individual, represent sufficient energy to sustain life for several weeks
- B. Would be expected to be good emulsifying agents
- C. Yield about the same amount of ATP on complete oxidation as would an equivalent weight of glycogen
- D. Are stored as hydrated molecules
- E. Are generally negatively charged molecules at physiological pH

34. Phospholipids are representatives of lipids. All of the following statements describe phosphoglycerides EXCEPT:

- A. They are a major store of metabolic energy
- B. They are both amphipathic and amphoteric
- C. They arise from glycerol-3-phosphate
- D. They are found in cell membranes
- E. They contain two fatty acid moieties

35. Cell membrane is built of lipids, proteins and glycosides. Phospholipids are important cell membrane components because:

- A. They have both polar and non polar portions
- B. They have glycerol
- C. They can form bilayers in water
- D. They combine covalently with proteins
- E. They consist of fatty acids

36. Fatty acids, waxes, sterols, fat-soluble vitamins, glycerids and phospholipids are classified as lipids. They have the following properties:

- A. All of these
- B. Insoluble in water and soluble in fat solvent

- C. High energy content
- D. Structural component of cell membrane
- E. Precursors in biosynthesis of prostaglandins

37. Reserve fat is accumulated in adipose tissue. Indicate which from listed below disorders of lipid metabolism occur in fat tissue:

- A. Obesity
- B. Steatorrhea
- C. Ketosis
- D. Retention hyperlipemia
- E. Fatty infiltration of liver

38. Some hormones regulate lipid metabolism. Hepatic lipogenesis is stimulated by:

- A. Insulin
- B. cAMP
- C. Glucagon
- D. Epinephrine
- E. Cortisol

39. Lipids are digested in duodenum by pancreatic juice and bile. Pancreatic lipase converts triacylglycerols into:

- A. 2-Monoacylglycerol
- B. 2,3-Diacylglycerol
- C. 1-Monoacylglycerol
- D. 3-Monoacylglycerol
- E. 1,3-Diacylglycerol

40. Human body accumulates fat in adipose tissue and liver. Lipids are stored mainly in the form of:

- A. Triglycerides
- B. Glycolipids
- C. Phospholipids
- D. Fatty acids
- E. Steroids

41. Fatty acids, waxes, sterols, fat-soluble vitamins, glycerids and phospholipids are classified as lipids. Waxes contain higher alcohols named as:

- A. Cetyl
- B. Methyl
- C. Ethyl
- D. Phytol
- E. Propionyl

42. Synthesis and catabolism of lipids actively take place in adipose tissue, which lacks:

- A. Glycerol kinase
- B. Hormone-sensitive lipase
- C. cAMP-dependent protein kinase
- D. Glycerol-3-phosphate dehydrogenase
- E. –

43. Lipids in adipose tissue are broken down to fatty acids and glycerol. Free fatty acids are transported in the blood:

- A. Combined with albumin
- B. Combined with fatty acid binding protein
- C. Combined with β -lipoprotein
- D. In unbound free salts
- E. Combined with globulin

44. Lecithin has amphiphilic properties, which means both hydrophilic and lipophilic. The nitrogenous base in lecithin is:

- A. Choline
- B. Ethanolamine
- C. Serine
- D. Betaine
- E. Alanine

45. Human body accumulates fat as a source of energy and thermoinsulative substance. Lipid stores are mainly present in:

- A. Adipose tissue
- B. Liver
- C. Brain
- D. Muscles
- E. Kidneys

46. Lipids are digested in duodenum by pancreatic juice and bile. Co-lipase is also necessary and is a:

- A. Protein
- B. Vitamin
- C. Bile salt
- D. Phospholipid
- E. Amino acid

47. Hexosaminidase A is an enzyme involved in the hydrolysis of terminal N-acetyl-D-hexosamine residues in N-acetyl- β -D-hexosaminides and is deficient in:

- A. Tay-Sachs disease
- B. Gaucher's disease
- C. Niemann-Pick disease
- D. Fabry's disease
- E. Gierke disease

48. Glycerol released from adipose tissue by hydrolysis of triglycerides is mainly:

- A. Taken up by liver
- B. Taken up by extrahepatic tissues
- C. Reutilised in adipose tissue
- D. Excreted from the body
- E. -

49. Sphingolipidoses are a class of lipid storage disorders relating to sphingolipid metabolism. Mental retardation occurs in:

- A. All of these
- B. Tay-Sachs disease
- C. Gaucher's disease
- D. Niemann-Pick disease
- E. None of these

50. Free glycerol cannot be used for triglyceride synthesis, because it has to be phosphorylated first by glycerol kinase, which is absent in:

- A. Adipose tissue
- B. Liver
- C. Kidney
- D. Intestine

51. Physical examination of a 16-year-old boy, who came to the clinic for a routine visit, reveals small reddish-black papules on the abdomen and scrotum, intermittent paresthesias in the digits bilaterally and heat intolerance. These findings indicate Fabry disease – X-linked recessive lysosomal storage disease, caused by deficiency of α -galactosidase A. Which of the following substances is most likely to be elevated in this patient's vascular endothelium?

- A. Ceramide trihexoside
- B. Galactocerebroside
- C. Glucocerebroside
- D. Lactosyl cerebroside
- E. Sphingomyelin

52. A 2-year-old girl brought to the clinic because she has recently developed muscle weakness and is having difficulty walking. A peripheral nerve biopsy reveals histologic evidence of demyelination and macrophages with prominent reddish-pink vacuoles in the cytoplasm after staining with toluidine blue (metachromasia). Metachromasia is caused by accumulation of sulfatides, mainly cerebroside sulfate. This patient has a deficiency of which of the following enzymes?

- A. Arylsulfatase A
- B. α -Galactosidase A
- C. β -Hexosaminidase A
- D. Galactocerebrosidease
- E. Glucocerebrosidease
- F. Iduronate sulfatase
- G. Sphingomyelinase

TOPIC №12. β -OXIDATION AND BIOSYNTHESIS OF FATTY ACIDS. STUDIES ON METABOLISM OF FATTY ACIDS AND KETONE BODIES.

1. One of the factors that cause obesity is the inhibition of fatty acids oxidation due to:
 - A. Low carnitine content
 - B. Impaired phospholipid synthesis
 - C. Excessive consumption of fatty foods
 - D. Choline deficiency
 - E. Lack of carbohydrates in the diet
2. The key reaction of fatty acid synthesis is production of malonyl-CoA. What metabolite is the source of malonyl-CoA synthesis?
 - A. Acetyl-CoA
 - B. Succinyl-CoA
 - C. Acyl-CoA
 - D. Malonate
 - E. Citrate
3. A patient during fasting developed ketoacidosis as a result of increased fatty acids decomposition. This decomposition can be inhibited with:
 - A. Insulin
 - B. Glucagon
 - C. Adrenaline
 - D. Thyroxin
 - E. Cortisol
4. A patient with diabetes mellitus has been delivered to a hospital unconscious. BP is low, Kussmaul's respiration is observed, the smell of acetone can be detected from the patient's mouth. What mechanism is leading in the coma development in this case?
 - A. Accumulation of ketone bodies in blood
 - B. Accumulation of potassium ions
 - C. Accumulation of sodium ions
 - D. Accumulation of chlorine ions
 - E. Accumulation of urea
5. Fatty acids arrive into mitochondria, and there their oxidation occurs. Name the vitamin-like substance that takes part in transportation of fatty acids through mitochondrial membrane:
 - A. Carnitine
 - B. Choline
 - C. Biotin
 - D. Pantothenic acid
 - E. Folic acid
6. Hydrolysis reaction will NOT occur with:
 - A. Glycerol
 - B. Starch
 - C. Cellulose
 - D. Fat
 - E. Protein

7. Intracellular metabolism of glycerol starts with its activation. What compound is formed in the first reaction of its conversion?

- A. α -Glycerolphosphate
- B. Pyruvate
- C. Lactate
- D. Choline
- E. Acetyl coenzyme A

8. Fatty acids synthesis occurs in human body. What compound is initial in this process?

- A. Acetyl coenzyme A
- B. Vitamin C
- C. Glycine
- D. Succinate
- E. Cholesterol

9. Lipids are obvious energetic material for the body. What is the main pathway of fatty acids metabolism in mitochondria?

- A. β -Oxidation
- B. Decarboxylation
- C. Reduction
- D. α -Oxidation
- E. γ -Oxidation

10. Appearance of sugar and ketone bodies is revealed in the patient's urine. Blood glucose concentration is 10,1 mM/l. What is a presumptive diagnosis of the patient?

- A. Diabetes mellitus
- B. Atherosclerosis
- C. Toxic hepatitis
- D. Pancreatitis
- E. Myocardial infarction

11. A 46-year-old woman complains of dryness in the oral cavity, thirst, frequent urination, general weakness. Biochemical research of the patient's blood showed hyperglycemia and hyperketonemia. Sugar and ketone bodies are revealed in the urine. Diffuse changes in myocardium are marked on the electrocardiogram. Make an assumptive diagnosis of the illness.

- A. Diabetes mellitus
- B. Alimentary hyperglycemia
- C. Acute pancreatitis
- D. Diabetes insipidus
- E. Ischemic cardiomyopathy

12. In a 57-year-old patient, suffering from diabetes mellitus, ketoacidosis has been developed. Biochemical background of this status is decrease in utilization of acetyl-CoA due to a deficiency of:

- A. Oxaloacetate
- B. 2-Oxoglutarate
- C. Glutamate
- D. Aspartate
- E. Succinate

13. A condition called «diabetic ketoacidosis» is caused by a lack of insulin leading to a build-up of ketoacids. Excessive ketone bodies are formed by the biochemical imbalance in uncontrolled or poorly managed diabetes. Which compounds are called ketone bodies?

- A. Acetoacetate, β -hydroxybutyrate, and acetone
- B. Aspartate, pyruvate
- C. α -Ketoglutarate, malate, succinate
- D. Acyl-CoA, malonyl-CoA
- E. Cholic and deoxycholic acid

14. A 40-year-old woman diagnosed with diabetes mellitus is admitted to a department of endocrinology. The patient complains of thirst and increased hunger. What pathological components are exposed at laboratory research of the patient's urine?

- A. Glucose, ketone bodies
- B. Protein, amino acid
- C. Protein, creatine
- D. Bilirubin, urobilin
- E. Sodium, potassium

15. Under diabetes mellitus, the level of ketone bodies in blood dramatically rises, which results in the development of metabolic acidosis. What substance is the precursor of the ketone bodies synthesis?

- A. Acetyl-CoA
- B. Succinyl-CoA
- C. Propionyl-CoA
- D. Malonyl-CoA
- E. Methylmalonyl-CoA

16. A patient manifests ketonuria. What disease is recognized by the augmented concentration of ketone bodies in his urine?

- A. Diabetes mellitus
- B. Acute glomerular inflammation
- C. Urolithiasis
- D. Tuberculosis of the kidney
- E. Myocardial infarction

17. Aerobic oxidation of substrates is typical of a cardiac muscle. Which of the following is the major oxidation substrate of a cardiac muscle?

- A. Fatty acids
- B. Triacylglycerols
- C. Glycerol
- D. Glucose
- E. Amino acids

18. Carnitine is recommended to a sportsman as a preparation that increases physical activity and improves achievements. What biochemical process is mostly activated under the action of carnitine?

- A. Transport of fatty acids into mitochondria
- B. Ketone bodies synthesis
- C. Lipids synthesis
- D. Tissue respiration
- E. Steroid hormones synthesis

19. Lipids are the most valuable energetic material for an organism. What is the main pathway of fatty acids metabolism in cell mitochondria?

- A. β -oxidation
- B. Decarboxylation
- C. Reduction
- D. α -oxidation
- E. γ -oxidation

20. The intermediates in fatty acid synthesis are linked to acyl carrier protein (ACP), a component of fatty acid synthase. The prosthetic group of ACP is:

- A. Phosphopantetheine
- B. Methionine
- C. Thiamine
- D. Biotin
- E. Cobalamin

21. A 1-year-old child was brought to a clinic with signs of muscle weakness. Through the inspection, the deficiency of carnitine in the muscles was determined. The biochemical mechanism of the development of this pathology consists in the disorder of the process of:

- A. Transport of fatty acids into mitochondria
- B. Regulation of the level of Ca^{2+} in mitochondria
- C. Substrate level of phosphorylation
- D. Utilization of lactate
- E. Synthesis of actin and myosin

22. A patient with high rate of obesity was advised to use carnitine as a food additive in order to enhance "fat burning". What is the role of carnitine in the process of fat oxidation?

- A. Transport of FFA (free fatty acids) from cytosol to the mitochondria
- B. Transport of FFA from fat depots to the tissues
- C. It takes part in one of reactions of FFA beta-oxidation
- D. FFA activation
- E. Activation of intracellular lipolysis

23. Patients who suffer from severe diabetes and don't receive insulin have metabolic acidosis. This is caused by increased concentration of the following metabolites:

- A. Ketone bodies
- B. Fatty acids
- C. Unsaturated fatty acids
- D. Triacylglycerols
- E. Cholesterol

24. One functional subunit of multi-enzyme complex for de novo synthesis of fatty acids contains:

- A. Two -SH groups
- B. One -SH group
- C. Three -SH groups
- D. Four -SH groups
- E. Five -SH groups

25. The enzyme acyl-CoA synthase catalyses the conversion of a fatty acid of an active fatty acid in the presence of:

- A. ATP
- B. ADP
- C. AMP
- D. GTP
- E. UDP

26. Patients who suffer from severe diabetes and don't receive insulin have metabolic acidosis. This is caused by increased concentration of the following metabolites:

- A. Ketone bodies
- B. Fatty acids
- C. Unsaturated fatty acids
- D. Triacylglycerols
- E. Cholesterol

27. In diabetes mellitus and starvation there is an increase of ketone bodies content in blood, which are utilized as energetic material by tissues. Note the substance which is used in ketone bodies synthesis.

- A. Acetyl-CoA
- B. Citrate
- C. Succinyl-CoA
- D. α -Ketoglutarate
- E. Malate

28. In a patient suffering from diabetes mellitus in blood was detected acetone. Note the process of its production in the body:

- A. By condensation of two molecules of acetyl-CoA
- B. In course of α -oxidation of fatty acids
- C. In course of β -oxidation of fatty acids
- D. In course of γ -oxidation of fatty acids
- E. In tricarboxylic acid cycle.

29. During the prolonged starvation in blood of a person an increase in ketone bodies content occurs. It is caused by the next factors:

- A. Production of acetyl-CoA
- B. Decrease of free fatty acid level in blood plasma
- C. Mobilization of high density lipoproteins
- D. Enhancement of fatty acids biosynthesis in liver
- E. Decrease of triacylglycerols in adipose tissue

30. What process of lipid metabolism requires a protein with covalently bound prosthetic group derived from pantothenic acid?

- A. Fatty acid biosynthesis
- B. β -Oxidation of fatty acids
- C. Utilization of ketone bodies
- D. Bile acid synthesis from cholesterol
- E. Utilization of LDL

31. The removal of two-carbon units from a fatty acyl coenzyme A (fatty acyl-CoA) involves four sequential reactions. Which of the following best describes the reaction sequence?

- A. Dehydrogenation, hydratation, dehydrogenation, cleavage
- B. Oxidation, dehydration, oxidation, cleavage
- C. Reduction, dehydration, reduction, cleavage
- D. Hydrogenation, dehydration, hydrogenation, cleavage
- E. Reduction, hydration, dehydrogenation, cleavage

32. Acetyl-CoA carboxylase regulates fatty acid synthesis by which of the following mechanism?

- A. All of these
- B. Covalent modification
- C. Induction and repression
- D. Allosteric regulation
- E. None of these

33. Propionyl CoA formed from the oxidation of fatty acids having an odd number of carbon atoms is converted into:

- A. *D*-Methylmalonyl CoA
- B. Acetoacetyl CoA
- C. Acetyl CoA
- D. Butyryl CoA
- E. Acetyl CoA

34. What process of lipid metabolism requires a protein with covalently bound prosthetic group derived from pantothenic acid?

- A. Fatty acid biosynthesis
- B. β -Oxidation of fatty acids
- C. Utilization of ketone bodies
- D. Bile acid synthesis from cholesterol
- E. Utilization of LDL

35. An experimental animal has been given excessive amount of carbon-labeled glucose for a week. What compound can the label be found in?

- A. Palmitic acid
- B. Methionine
- C. Vitamin A
- D. Choline
- E. Arachidonic acid

36. Essential fatty acids can't be synthesized because mammals do not possess the enzymes for their biosynthesis. Which of the following is an essential fatty acid:

- A. Linoleic acid
- B. Palmitic acid
- C. Oleic acid
- D. Stearic
- E. Butyric

37. Which of the following is required as a reductant in fatty acid synthesis?

- A. NADPH₂
- B. NADH₂
- C. FADH₂
- D. FMNH₂

E. FAD

38. Carnitine is a vitaminoid, which takes part in lipids metabolism. It is required for the transport of:

- A. Long chain fatty acids into mitochondria
- B. Triglycerides into mitochondria
- C. Short chain fatty acids into mitochondria
- D. Triglycerides out of liver
- E. Glycerol into cytosol

39. β -Oxidation of fatty acids provides organism with energy. The enzymes of β -oxidation are found in:

- A. Mitochondria
- B. Cytosol
- C. Golgi apparatus
- D. Nucleus
- E. Microsomes

40. β -Oxidation of fatty acids is a cyclic process. During each cycle of β -oxidation:

- A. Two carbon atoms are removed from the carboxyl end of the fatty acid
- B. One carbon atom is removed from the methyl end of the fatty acid
- C. One carbon atom is removed from the carboxyl end of the fatty acid
- D. Two carbon atoms are removed from the methyl end of the fatty acid
- E. Three carbon atom is removed from the methyl end of the fatty acid

41. NADPH_2 is required for fatty acid synthesis and can come from:

- A. Hexose monophosphate shunt
- B. Oxidative decarboxylation of malate
- C. Extramitochondrial oxidation of isocitrate
- D. Citric acid cycle
- E. All of these

42. Citrate stimulates fatty acid synthesis by all of the following EXCEPT:

- A. Participating in the production of ATP
- B. Allosterically activating acetyl-CoA carboxylase
- C. Providing a mechanism to transport acetyl CoA from the mitochondria to the cytosol
- D. Participating in a pathway that ultimately produces CO_2 and NADPH in the cytosol
- E. -

43. *De novo* synthesis and oxidation of fatty acids differ in the following respect:

- A. Synthesis occurs in cytosol and oxidation in mitochondria
- B. Synthesis is decreased and oxidation increased by insulin
- C. NADH is required in synthesis and FAD in oxidation
- D. Malonyl CoA is formed during oxidation but not during synthesis
- E. -

44. *De novo* synthesis of fatty acids requires all of the following substances EXCEPT:

- A. NADH
- B. NADPH
- C. Panthothenic acid
- D. ATP
- E. Biotin

45. Carnitine is a vitaminoid, which transports fatty acids into mitochondria and is synthesized from:

- A. Lysine and methionine
- B. Glycine and arginine
- C. Aspartate and glutamate
- D. Proline and hydroxyproline
- E. Lysine and arginine

46. β -Oxidation of fatty acids provides organism with ATP and requires all the following coenzymes EXCEPT:

- A. NADP
- B. FAD
- C. NAD
- D. CoA
- E. -

47. Carboxylation of acetyl-CoA to malonyl-CoA takes place in the presence of a special coenzyme of carboxylases, which is:

- A. Biotin
- B. FAD
- C. NAD⁺
- D. NADP⁺
- E. GTP

48. Malonyl-CoA provides 2-carbon units to fatty acids and reacts with the next group of acyl carrier protein:

- A. -SH group
- B. -NH₂ group
- C. -COOH group
- D. -CH₂OH group
- E. -OH group

49. Propionyl CoA consists of 3 carbon atoms and is formed on oxidation of:

- A. Fatty acids with odd number of carbon atoms
- B. Polyunsaturated fatty acids
- C. Monounsaturated fatty acids
- D. Fatty acids with even number of carbon atoms
- E. None of these

50. Carnitine takes part in lipids metabolism. What process cannot occur in the absence of carnitine?

- A. β -Oxidation of fatty acids
- B. Cleavage of triacylglycerol
- C. Utilization of ketone bodies
- D. Fatty acid biosynthesis
- E. Biosynthesis of prostaglandins

51. A 4-year-old child is brought to the physician because of delayed growth. The mother also states that the child is unsteady on his feet and cannot properly use eating utensils. Physical exam reveals the boy demonstrates signs of muscle hypotonia. The

physician diagnoses a deficiency in acetyl-CoA carboxylase. Which of the following is likely to be deficient in this patient?

- A. Malonyl-coenzyme A
- B. Glycerol-3-phosphate
- C. Ketone bodies
- D. NADPH₂
- E. S-adenosylmethionine

52. A 10-year-old boy presents with progressive neurologic and dermatologic symptoms. His mother says he has a progressively worsening staggering gait, he has thick, dry and scaly skin. The patient also reports that he has been having difficulty with his sense of smell. During a thorough physical examination, visual acuity testing reveals bilateral deficits; a sensorineural hearing loss is also identified. A nerve conduction study shows delayed action potential propagation. Diagnostic testing reveals an accumulation of phytanic acid within multiple tissues, including the epidermal layer of skin. These findings suggest Refsum disease – disease caused by deficiency of special enzymes, which are shortening very-long-chain fatty acids into long-chain fatty acids, which will be metabolized via β -oxidation later. A disorder in which of the following organelles is most likely causing this patient's symptoms?

- A. Peroxisomes
- B. Endoplasmic reticulum
- C. Endosomes
- D. Mitochondria
- E. Cytoskeleton
- F. Ribosomes

TOPIC № 13. BIOSYNTHESIS AND BIOTRANSFORMATION OF CHOLESTEROL. PATHOLOGY OF LIPID METABOLISM: STEATORRHEA, ATHEROSCLEROSIS, OBESITY. TRANSPORT FORMS OF LIPIDS: LIPOPROTEINS OF BLOOD PLASMA.

1. Increased HDL levels decrease the risk of atherosclerosis. What is the mechanism of HDL anti-atherogenic action?
 - A. They remove cholesterol from tissues
 - B. They supply tissues with cholesterol
 - C. They are involved in the breakdown of cholesterol
 - D. They activate the conversion of cholesterol to bile acids
 - E. They promote absorption of cholesterol in the intestine
2. During examination of a teenager with xanthomatosis the family history of hypercholesterolemia is revealed. What transportable lipids are increased in concentration in case of such a disease?
 - A. Low-density lipoproteins
 - B. Chylomicrons
 - C. Very low-density lipoproteins
 - D. High-density lipoproteins
 - E. Intermediate-density lipoproteins
3. Cholesterol content in blood serum of a 12-year-old boy is 25 mmol/l. Anamnesis states hereditary familial hypercholesterolemia caused by synthesis disruption of receptor-related proteins for:
 - A. Low-density lipoproteins
 - B. High-density lipoproteins
 - C. Chylomicrons
 - D. Very low-density lipoproteins
 - E. Middle-density lipoproteins
4. A 67-year-old man consumes eggs, pork fat, butter, milk and meat. Blood test results: cholesterol - 12,3 mmol/l, total lipids - 8,2 g/l, increased low-density lipoprotein fraction (LDL). What type of hyperlipoproteinemia is observed in the patient?
 - A. Hyperlipoproteinemia type IIa
 - B. Hyperlipoproteinemia type I
 - C. Hyperlipoproteinemia type IIb
 - D. Hyperlipoproteinemia type IV
 - E. Cholesterol, hyperlipoproteinemia
5. A dry-cleaner's worker has been found to have hepatic steatosis. This pathology can be caused by disruption of synthesis of the following substance:
 - A. Phosphatidylcholine
 - B. Tristearin
 - C. Urea
 - D. Phosphatidic acid
 - E. Cholic acid
6. Synthesis of phospholipids is disordered under the liver fat infiltration. Indicate which of the following substances can enhance the process of methylation during phospholipids synthesis?
 - A. Methionine
 - B. Ascorbic acid

- C. Glucose
- D. Glycerol
- E. Citrate

7. Obesity is a common disease. The aim of its treatment is to lower content of neutral fats in the body. What hormone-sensitive enzyme is the most important for intracellular lipolysis?

- A. Triacylglycerol lipase
- B. Protein kinase
- C. Adenylate kinase
- D. Diacylglycerol lipase
- E. Monoacylglycerol lipase

8. During metabolic process active forms of the oxygen including superoxide anion radical are formed in the human body. With help of what enzyme is this anion activated?

- A. Superoxide dismutase
- B. Catalase
- C. Peroxidase
- D. Glutathione peroxidase
- E. Glutathione reductase

9. A 67-year-old patient has atherosclerosis of cardiac and cerebral vessels. Examination revealed hyperlipidemia. What class of blood plasma lipoproteids is most important in atherosclerosis pathogenesis?

- A. Low-density lipoproteids
- B. Chylomicrons
- C. α -lipoproteids
- D. High-density lipoproteids
- E. –

10. Blood serum of the patient has milky appearance. Biochemical analysis revealed high content of triacylglycerols and chylomicrons. This condition is caused by hereditary defect of the following enzyme:

- A. Lipoprotein lipase
- B. Phospholipase
- C. Pancreatic lipase
- D. Adipose tissue hormone-sensitive lipase
- E. Phosphodiesterase

11. Preventative examination of a 55-year-old patient revealed type II diabetes mellitus. An endocrinologist detected an increase in body weight and liver enlargement. The man is a non-smoker and does not abuse alcohol but likes to have a "hearty meal". Histological examination by means of diagnostic liver puncture revealed that the hepatocytes were enlarged mostly on the lobule periphery, their cytoplasm had transparent vacuoles that reacted positively with sudan III. What liver pathology was revealed?

- A. Fatty hepatitis
- B. Acute viral hepatitis
- C. Chronic viral hepatitis
- D. Alcohol hepatitis
- E. Portal liver cirrhosis

12. The patient, who for a long time has been keeping to an unbalanced lowprotein diet, developed fatty liver infiltration. Name the substance, absence of which in the diet can lead to this condition:

- A. Methionine
- B. Alanine
- C. Cholesterol
- D. Arachidonic acid
- E. Biotin

13. In the process of metabolism human body produces active oxygen forms, including superoxide anion radical O_2^- . This anion is inactivated by the following enzyme:

- A. Superoxide dismutase
- B. Catalase
- C. Peroxidase
- D. Glutathione peroxidase
- E. Glutathione reductase

14. Periodontitis induces development of lipid peroxidation in the periodontal tissues, as well as increase in malondialdehyde and hydrogen peroxide concentration in the oral cavity. Which of the following enzymes provides antioxidant protection?

- A. Catalase
- B. Amylase
- C. Maltase
- D. Lactase
- E. Invertase

15. A woman, who had undergone mastectomy due to breast cancer, was prescribed a course of radiation therapy. What vitamin preparation has marked antiradiation effect due to its antioxidant activity?

- A. Tocopherol acetate
- B. Ergocalciferol
- C. Riboflavin
- D. Cyanocobalamin
- E. Folic acid

16. There are various diseases that cause sharp increase of active oxygen, thus leading to cell membranes destruction. Antioxidants are used to prevent it from happening. The most potent natural antioxidant is:

- A. α -tocopherol
- B. Glucose
- C. Vitamin D
- D. Fatty acids
- E. Glycerol

17. Hyperlipemia can be observed in 2-3 hours after eating fatty food. 9 hours later lipid content normalizes again. How can this condition be characterized?

- A. Alimentary hyperlipemia
- B. Transport hyperlipemia
- C. Hyperplastic obesity
- D. Retention hyperlipemia
- E. Hypertrophic obesity

18. A 70-year-old patient presents with cardiac and cerebral atherosclerosis. Examination revealed changes of blood lipid spectre. Increase of the following lipoproteins plays a significant role in atherosclerosis pathogenesis:

- A. Low-density lipoproteins
- B. Very low-density lipoproteins
- C. Intermediate density lipoproteins
- D. High-density lipoproteins
- E. Chylomicrons

19. A patient demonstrates milkywhite color of blood plasma due to high content of chylomicrons. Disintegration of triacylglycerol is disrupted. Deficiency of the following enzyme activity is observed:

- A. Lipoprotein lipase
- B. Amylase
- C. Tripsin
- D. Cholesterol esterase
- E. Lactase

20. Natural peptides can carry out various functions. What bioactive peptide is a major antioxidant and functions as a coenzyme?

- A. Glutathione
- B. Bradykinin
- C. Oxytocin
- D. Liberin
- E. Anserine

21. Increased concentration of active oxygen forms is a mechanism of pathogenesis in a number of diseases. To prevent this process, antioxidants are prescribed. Select an antioxidant from the list below:

- A. α -Tocopherol
- B. Glucose
- C. Calciferol
- D. Cobalamine
- E. Glycerol

22. A man 67 years old suffers from brain vessels atherosclerosis. After investigation hyperlipidemia was detected. What class of lipoproteins in blood plasma will be increased the most of all in biochemical investigation?

- A. LDL
- B. HDL
- C. Non esterified fatty acids in complex with albumin
- D. Chylomicrons
- E. VLDL

23. In a human body the adipose tissue is the basic location of triacylglycerols (TAG) deposit. At the same time their synthesis takes place in hepatocytes. In the form of what molecular complex are TAG transported from the liver into the adipose tissue?

- A. VLDL
- B. Chylomicrons
- C. LDL
- D. HDL
- E. Complexes with albumin

24. After the consumption of a diet rich in fats, a patient complains of languor and nausea. Later signs of steatorrea appear. The level of blood cholesterol makes 9,2 mM/l. The shortage of what substances causes this state of the patient?

- A. Bile acids
- B. Triacylglycerols
- C. Fatty acids
- D. Phospholipids
- E. Chylomicrons

25. What products are produced from superoxide anion under the action of superoxide dismutase?

- A. Free oxygen
- B. Hydroxyl radical
- C. Protons
- D. NAD
- E. FMN reduced

26. What enzyme can decompose hydrogen peroxide without involvement of organic compounds as donors of hydrogen?

- A. Catalase
- B. Peroxidase
- C. Monooxygenase
- D. Cytochrome P₄₅₀
- E. Lipoxygenase

27. A patient suffers from arterial hypertension due to atherosclerotic injury of blood vessels. The consumption of what dietary lipid needs to be limited?

- A. Cholesterol
- B. Oleic acid
- C. Lecithine
- D. Monooleateglycerol
- E. Phosphatidylserine

28. Profuse foam appeared when dentist put hydrogen peroxide on the mucous of the oral cavity. What enzyme caused such activity?

- A. Catalase
- B. Cholinesterase
- C. Acetyltransferase
- D. Glucose-6-phosphate-dehydrogenase
- E. Methemoglobinreductase

29. Hydrogen peroxide is harmful and extremely toxic to living cells. Chose an enzyme which is used by cells for neutralization of hydrogen peroxide:

- A. Glutathion peroxidase
- B. Cytochrome oxidase
- C. NADPH₂-oxidase
- D. Cyclooxygenase
- E. Monoamine oxidase

30. In diseases which are accompanied by hypoxia an incomplete reduction of oxygen molecule in respiratory chain and accumulation of hydrogen peroxide occurs. Note an enzyme which provides neutralization of hydrogen peroxide:

- A. Glutathion peroxidase
- B. Cytochrome oxidase
- C. Succinate dehydrogenase
- D. Glutathion reductase
- E. Oxidase of reduced NADP

31. Fats of phospholipids is disordered due to fat infiltration of the liver. Indicate which of the presented substances can enhance the process of methylation during phospholipids synthesis?

- A. Methionine
- B. Ascorbic acid
- C. Glucose
- D. Glycerin
- E. Citrate

32. Bile acids are necessary for fat digestion. They are produced in the liver from the next precursor:

- A. Cholesterol
- B. Protoporphyrin IX
- C. Corticosterol
- D. Lecithin
- E. Arachidonic acid

33. In a patient after investigation it was detected an increased content of low density lipoproteins in blood serum. What disease can be expected in this patient?

- A. Atherosclerosis
- B. Pneumonia
- C. Gastritis
- D. Acute pancreatitis
- E. Kidney disease

34. In cases of complete or partial restriction of lipotropic factors in humans develops a fat degeneration of liver. What substances can be considered as lipotropic?

- A. Choline
- B. Pyridoxine
- C. Fatty acids
- D. Cholesterol
- E. Triacylglycerols

35. Obesity generally reflects excess intake of energy and is often associated with the development of:

- A. Non-insulin dependent diabetes mellitus
- B. Nervousness
- C. Hepatitis
- D. Colon cancer
- E. –

36. The complaints and objective data permit to suppose an inflammatory process in gall bladder, disorder of colloidal properties of bile, probability of bile stones formation. What compound can cause their formation?

- A. Cholesterol
- B. Oxalates
- C. Chlorides
- D. Phosphates
- E. Urates

37. In a worker of chemical cleaning the fatty liver dystrophy was recognized. What substance biosynthesis disorder can lead to this pathology?

- A. Phosphatidyl choline
- B. Tristearylglycerol
- C. Phosphatidic acid
- D. Urea
- E. Folic acid

38. A patient with high blood cholesterol levels was treated with lovastatin. This drug lowers blood cholesterol levels because it inhibits:

- A. HMG CoA reductase in liver and peripheral tissues
- B. Lipoprotein lipase in adipose tissue
- C. Citrate lyase in liver
- D. VLDL excretion by the liver
- E. Absorption of dietary cholesterol

39. Chose from listed below compounds the final product of cholesterol metabolism in human body:

- A. Chenodeoxycholic acid
- B. Cortisol
- C. Prostaglandine E₂
- D. Cholecalciferol
- E. Ergosterol

40. Laboratory investigation of the patient's blood plasma, which was performed 4 hours after a consumption of a fat diet, displayed a marked increase of plasma turbidity. The most credible cause of this phenomenon is the increase of:

- A. Chylomicrons
- B. HDL
- C. LDL
- D. Cholesterol
- E. Phospholipids

41. Laboratory investigation of a patient revealed a high level of plasma LDL. What disease can be diagnosed?

- A. Atherosclerosis
- B. Nephropathy
- C. Acute pancreatitis
- D. Pneumonia
- E. Gastritis

42. In cases of complete or partial restriction of lipotropic factors provided in humans develops a fat degeneration of liver. What substances can be considered as lipotropic?

- A. Choline
- B. Fatty acids
- C. Triacylglycerols
- D. Cholesterol
- E. Pyridoxine

43. An experimental animal that was kept on protein-free diet developed fatty liver infiltration, in particular as a result of deficiency of methylating agents. This is caused by disturbed generation of the following metabolite:

- A. Choline
- B. DOPA
- C. Cholesterol
- D. Acetoacetate
- E. Linoleic acid

44. Note an intermediate metabolite which is on the cholesterol synthesis pathway and is of multifunctional significance:

- A. β -Hydroxy β -methyl glutaryl-CoA (HMG-CoA)
- B. Succinyl-CoA
- C. Acetoacetate
- D. Palmitoyl-CoA
- E. 2-Oxoglutaryl-CoA

45. A person with a low-density lipoprotein (LDL) receptor deficiency was treated with lovastatin. As a consequence of the action of this drug, the person should have:

- A. Lower blood cholesterol levels
- B. Increased de novo cholesterol synthesis
- C. Increased ACAT activity
- D. Fewer LDL receptors in cell membranes
- E. Higher blood triacylglycerol levels

46. In metabolic transformations in human body appear active oxygen intermediates, including hydrogen peroxide. This substance is reduced by substrates as donor of hydrogen with the aid of the next enzyme:

- A. Catalase
- B. Cytochrome P-450
- C. Glutathion peroxidase
- D. Glutathion reductase
- E. Superoxide dismutase

47. In a patient after the action of ionizing radiation an increased level of malonic dialdehyde was detected in blood, indicating the activation of peroxide oxidation of lipids. This may lead to injury of biological membranes due to:

- A. Degradation of phospholipids
- B. Oxidation of cholesterol
- C. Changes in structure of transfer proteins
- D. Breakdown of carbohydrate constituents
- E. Activation of Na, K-ATPase

48. All the following correctly describe the intermediate 3-OH-3-methyl glutaryl CoA except:

- A. It is generated enzymatically in the mitochondrial matrix
- B. It is formed in the cytoplasm
- C. It is involved in the synthesis of cholesterol
- D. It inhibits the first step in cholesterol synthesis
- E. It is involved in the synthesis of ketone bodies

49. A man 67 years old suffers from brain vessels atherosclerosis. After investigation hyperlipidemia was detected. What class of lipoproteins in blood plasma will be increased most of all in biochemical investigation?

- A. LDL
- B. HDL
- C. Non esterified fatty acids in complex with albumin
- D. Chylomicrons
- E. VLDL

50. Chylomicron, intermediate density lipoproteins (IDL), low density lipoproteins (LDL) and very low density lipoproteins (VLDL) all are serum lipoproteins. What is the correct ordering of these particles from the lowest to the greatest density?

- A. Chylomicron, VLDL, IDL, LDL
- B. LDL, IDL, VLDL, Chylomicron
- C. VLDL, IDL, LDL, Chylomicron
- D. Chylomicron, IDL, VLDL, LDL
- E. IDL, VLDL, LDL, Chylomicron

51. A 25-year-old woman presents to her family physician for a routine check-up. Physical examination reveals mildly overweight woman with a smooth, firm but mobile, skin-colored nodule over the Achilles tendon. A fasting lipid panel shows markedly elevated total cholesterol, LDL cholesterol and triglyceride levels and decreased HDL cholesterol levels. The physician starts her on a medication to manage her condition and counsels her on lifestyle modifications. Which of the following describes the mechanism of action of the medication this patient takes to treat her hypercholesterolemia?

- A. Inhibition of 3-hydroxy-3-methylglutaryl coenzyme A reductase
- B. Activates peroxisome proliferator-activated receptor α
- C. Inhibition of bile acid reuptake in the intestine
- D. Inhibition of cholesterol uptake by the intestinal brush border
- E. Reduced transfer of cholesteryl ester from HDL to LDL and delayed HDL clearance

52. A 30-year-old man comes for evaluation because of acute epigastric pain that radiates to his back and worsens after meals. Serum lipase concentration is increased, blood is drawn in the clinic and plasma is found to be milky-white in color. The preliminary diagnosis is type I dyslipidemia (familial hyperchylomicronemia). Which of the following most likely explains the pathophysiology of this patient's underlying condition?

- A. Lipoprotein lipase deficiency
- B. Defect in processing LDL receptors
- C. Increase in apolipoprotein CII levels
- D. Mutation in apolipoprotein E

E. VLDL cholesterol clearance deficiency

53. A 25-year-old man comes to his primary care physician for a physical examination before starting a new job. His family history is significant for a father and grandmother with “cholesterol issues”. Physical examination reveals a well-developed, well-nourished adult man with well-demarcated white plaques on his upper eyelids. Laboratory studies show: total cholesterol level – 300 mg/dL, LDL level – 200 mg/dL, triglyceride level – 130 m/dL, HDL level – 60 mg/dL. The preliminary diagnosis is familial hypercholesterolemia. A mutation in which of the following proteins is most likely responsible for this patient’s condition?

- A. Apolipoprotein B-100
- B. Apolipoprotein A-II
- C. Apolipoprotein C-II
- D. Apolipoprotein E
- E. Lipoprotein lipase deficiency

54. A 22-year-old man visits his primary care physician after recently being discharged from the hospital. Before hospitalization, the patient presented with 1 day of nausea, vomiting and abdominal pain radiating to his back. Relevant labs from the hospital: triglycerides - >1000 mg/dL, lipase – 714 U/L. Repeated labs today: LDL – 124 mg/dL, HDL – 48 mg/dL, triglycerides – 644 mg/dL. What is the mechanism of action of the first-line pharmaceutical intervention indicated for this patient?

- A. Increases activity of lipoprotein lipase
- B. Inhibition of 3-hydroxy-3-methylglutaryl coenzyme A reductase
- C. Inhibits intestinal absorption of cholesterol
- D. Inhibits lipolysis by hormone-sensitive lipase
- E. Sequestration of charged bile acids

55. A 3-day-old infant remains in the neonatal intensive care after being born at 27 weeks` gestation. Although the pregnancy was uncomplicated, the infant developed significant respiratory distress after delivery due to surfactant deficiency. Which of the following amino acids is essential for *de novo* synthesis surfactant, taking into account that its main component is phosphatidylcholine?

- A. Methionine
- B. Glycine
- C. Serine
- D. Threonine
- E. Valine

TOPIC №14. STUDIES ON METABOLISM OF AMINO ACIDS (DEAMINATION, TRANSAMINATION, DECARBOXYLATION). BIOSYNTHESIS OF GLUTATHION AND CREATINE.

1. A 15-year-old boy has been diagnosed with acute viral hepatitis. What blood value should be determined to confirm acute affection of hepatic cells?
 - A. Aminotransferase activity (AST, ALT)
 - B. Unconjugated and conjugated bilirubin content
 - C. Erythrocytes sedimentation rate (ESR)
 - D. Cholesterol content
 - E. Protein fraction content

2. A 50-year-old woman diagnosed with cardiac infarction has been delivered into an intensive care ward. What enzyme will be the most active during the first two days?
 - A. Aspartate aminotransferase
 - B. Alanine aminotransferase
 - C. Alanine aminopeptidase
 - D. LDH₄
 - E. LDH₅

3. Depression and emotional disturbances result from the lack of noradrenaline, serotonin, and other biogenic amines in the brain. Their content in the synapses can be increased through administration of antidepressants that inhibit the following enzyme:
 - A. Monoamine oxidase
 - B. Diamine oxidase
 - C. *L*-amino acids oxidase
 - D. *D*-amino acid oxidase
 - E. Phenylalanine-4-monooxygenase

4. Monoamine oxidase inhibitors are widely used as psychopharmacological drugs. They change the level of nearly all neurotransmitters in synapses, with the following neurotransmitter being the exception:
 - A. Acetylcholine
 - B. Noradrenaline
 - C. Adrenaline
 - D. Dopamine
 - E. Serotonin

5. It is known that in catecholamine metabolism a special role belongs to monoamine oxidase (MAO). This enzyme inactivates mediators (noradrenaline, adrenaline, dopamine) by:
 - A. Oxidative deamination
 - B. Adjoining amino groups
 - C. Removing methyl groups
 - D. Carboxylation
 - E. Hydrolysis

6. Prescription of penicillin G sodium salt has caused development of neurotoxic effects (hallucinations, convulsions). Such reaction is the result of antagonism with the following neurotransmitter:
 - A. GABA
 - B. Dopamine

- C. Serotonin
- D. Adenosine
- E. Acetylcholine

7. A 7-year-old child was admitted to an emergency clinic in the state of allergic shock provoked by a wasp sting. High concentration of histamine was determined in the patient's blood. Which biochemical reaction leads to the production of this amine?

- A. Decarboxylation
- B. Hydroxylation
- C. Dehydration
- D. Deamination
- E. Reduction

8. During hypersensitivity skin test a patient received an allergen subcutaneously, after which the patient developed skin redness, edema, and pain due to histamine action. This biogenic amine is produced as the result of the following transformation of histidine amino acid:

- A. Decarboxylation
- B. Methylation
- C. Phosphorilation
- D. Isomerization
- E. Deamination

9. A woman resting in the countryside has been stung by a bee. Immediately after she developed pain in the stung area. In a few minutes there developed a vesicle, erythema and intense itch; later – urticaria and expiratory dyspnea. What factors resulted in the patient developing expiratory dyspnea?

- A. Histamine
- B. Hageman's factor
- C. Lysosomal enzymes
- D. Noradrenaline
- E. Adrenaline

10. A 46-year-old female has been suffering from progressive myodystrophy (Duchenne's disease) for a long time, the change of catalytic activity of what flood enzyme proves to be a diagnostic test for the disease?

- A. Creatine kinase
- B. Lactate dehydrogenase
- C. Pyruvate dehydrogenase
- D. Glutamate dehydrogenase
- E. Adenylate kinase

11. A patient is diagnosed with cardiac infarction. Blood test for cardiospecific enzymes activity was performed. Which of the enzymes has three isoforms?

- A. Creatine kinase
- B. Lactate dehydrogenase
- C. Aspartate transaminase
- D. Alanine transaminase
- E. Pyruvate kinase

12. A patient has been prescribed pyridoxal phosphate. What processes are corrected with this drug?

- A. Transamination and decarboxylation of amino acids
- B. Oxidative decarboxylation of keto acids
- C. Deamination of amino acids
- D. Synthesis of purine and pyrimidine bases
- E. Protein synthesis

13. There is increased activity of AST, LDH₁, LDH₂, and CPK in the patient's blood. Pathological process most likely occurs in the:

- A. Heart
- B. Skeletal muscles
- C. Kidneys
- D. Liver
- E. Adrenal glands

14. A 60-year-old man consulted a doctor about an onset of chest pain. In blood serum analysis showed a significant increase in the activity of the following enzymes: creatine kinase and its MB isoform, aspartate aminotransferase. These changes indicate the development of the pathological process in the following tissues:

- A. Cardiac muscle
- B. Lungs
- C. Skeletal muscles
- D. Liver
- E. Smooth muscles

15. Significant amount of biogenic amines in body tissues can be subject to oxidative deamination due to the action of the following enzyme:

- A. Monoamine oxidase
- B. Transaminase
- C. *D*-amino acid oxidase
- D. Isomerase
- E. *L*-amino acid dehydrogenase

16. Biogenic amines, such as histamine, serotonin, dopamine and others, are highly active substances affecting various physiological functions. What transformation process of amino acids results in biogenic amines being produced in somatic tissues?

- A. Decarboxylation
- B. Deamination
- C. Transamination
- D. Oxidation
- E. Reductive amination

17. A patient presents with dysfunction of the cerebral cortex accompanied by epileptic seizures. He has been administered a biogenic amine synthesized from glutamate and responsible for central inhibition. What substance is it?

- A. γ -Aminobutyric acid
- B. Serotonin
- C. Dopamine
- D. Acetylcholine
- E. Histamine

18. A 24-year-old patient has been administered glutamic acid to treat epilepsy. Medicinal effect in this case occurs not due to glutamate itself, but due to the product of its decarboxylation:

- A. γ -Aminobutyric acid
- B. Histamine 4-monooxygenase
- C. Serotonin
- D. Dopamine
- E. Taurine

19. A 9-month-old infant is on bottle feeding. Formula used in feeding has insufficient content of vitamin B₆. The infant has seizures possibly caused by disruption in production of the following substance in the body:

- A. γ -Aminobutyric acid (GABA)
- B. Serotonin
- C. Histamine
- D. Dopamine
- E. β -Alanine

20. 30 minutes after dental treatment the patient developed red itching spots on the face and oral mucosa. The patient was diagnosed with urticaria. What bioactive substance with vasodilating and pruriginous effect is produced during this type of allergic reaction?

- A. Histamine
- B. Prostaglandin E₂
- C. Leukotriene B₄
- D. Interleukin-1
- E. Bradykinin

21. A woman has scalded her hand with boiling water. The affected area of her skin became red, swollen and painful. This effect is caused by accumulation of the following substance:

- A. Histamine
- B. Lysine
- C. Thiamine
- D. Glutamine
- E. Asparagine

22. What factor results in maximal dilation of the gemomicrocirculatory pahtway vessels and their increased permeability?

- A. Histamine
- B. Endothelin
- C. Vasopressin
- D. Noradrenaline
- E. Serotonin

23. Dopamine precursor - dioxyphenylalanine (DOPA) - is used in treatment of Parkinson's disease. This active substance is produced from the following amino acid:

- A. Tyrosine
- B. Alanine
- C. Cysteine
- D. Histidine
- E. Tryptophan

24. An 84-year-old patient suffers from parkinsonism. One of the pathogenetic development elements of this disease is deficiency of a certain mediator in some of the brain structures. Name this mediator:

- A. Dopamine
- B. Adrenaline
- C. Noradrenaline
- D. Histamine
- E. Acetylcholine

25. For biochemical diagnostics of cardiac infarction it is necessary to determine activity of a number of enzymes and their isoenzymes in the blood. What enzyme assay is considered to be optimal for confirming or ruling out cardiac infarction at the early stage, after the patient develops thoracic pain?

- A. Creatine kinase MB isoenzyme
- B. Creatine kinase MM isoenzyme
- C. LDH₁ isoenzyme
- D. LDH₅ isoenzyme
- E. Cytoplasmic isoenzyme of aspartate aminotransferase

26. A patient has myocardial infarction. The first several hours of such medical condition will be characterized by significant increase of activity of the following enzyme in his blood serum:

- A. Creatine phosphokinase
- B. Lactate dehydrogenase 4
- C. Aspartate aminotransferase
- D. Lactate dehydrogenase 5
- E. Alanine-aminotransferase

27. Protein structure includes proteinogenic amino acids. What is the position of the amino group in the structure of these amino acids?

- A. α -position
- B. β -position
- C. γ -position
- D. δ -position
- E. ε -position

28. A patient has a mental disorder due to the insufficient synthesis of gammaaminobutyric acid in the brain. Such pathological changes might be caused by the deficiency of the following vitamin:

- A. Pyridoxine
- B. Tocopherol
- C. Cyanocobalamin
- D. Folic acid
- E. Riboflavin

29. A 46-year-old patient presents with hyperactivity of creatine kinase in his blood serum. What pathology can be suspected?

- A. Myocardial infarction
- B. Acute pancreatitis
- C. Chronic hepatitis
- D. Hemolytic anemia

E. Renal failure

30. In response to the administration of protein drugs, a patient developed an allergic reaction. The development of the allergic reaction is caused by the increased synthesis of the following compound:

- A. Histamine
- B. Choline
- C. Adrenaline
- D. Histidine
- E. Serotonin

31. Patients with severe depression demonstrate decreased serotonin levels in brain and cerebrospinal fluid. What amino acid is a serotonin precursor?

- A. Tryptophan
- B. Threonine
- C. Tyrosine
- D. Glutamic acid
- E. Aspartic acid

32. Natural peptides can carry out various functions. What bioactive peptide is a major antioxidant and functions as a coenzyme?

- A. Glutathione
- B. Bradykinin
- C. Oxytocin
- D. Liberin
- E. Anserine

33. An important reaction for the synthesis of amino acid from carbohydrate intermediates is transamination, which requires the cofactor:

- A. Pyridoxal phosphate
- B. Riboflavin
- C. Niacin
- D. Thiamin
- E. Folic acid

34. Which of the following enzymes catalyses reactions in the biosynthesis of both catecholamines and indoleamines (serotonin)?

- A. Aromatic amino acid decarboxylase
- B. Dopamine β -hydroxylase
- C. Phenylethanolamine N-methyltransferase
- D. Tryptophan hydroxylase
- E. Tyrosine hydroxylase

35. In recognition of hepatitis the determination of the following enzymes activity in blood has diagnostic significance:

- A. Aminotransferases
- B. Amylase
- C. Lactate dehydrogenase
- D. Aldolase
- E. Creatin kinase

36. An unusually active amine, a mediator of inflammation and allergy, appears via decarboxylation of histidine. Which of the following is it?

- A. Histamine
- B. Serotonin
- C. Dopamine
- D. γ -Aminobutyrate
- E. Tryptamine

37. Examination of a patient suffering from cancer of urinary bladder revealed high rate of serotonin and hydroxyanthranilic acid. It is caused by excess of the following amino acid in the organism:

- A. Tryptophan
- B. Alanine
- C. Histidine
- D. Methionine
- E. Tyrosine

38. Glutamate decarboxylation results in formation of inhibitory transmitter in CNS. Name it:

- A. GABA
- B. Glutathione
- C. Histamine
- D. Serotonin
- E. Asparagine

39. Biochemical function of glutathion in an organism is connected with reduction and detoxification of organic peroxides. During an interaction of glutathion with hydroperoxides harmless organic alcohols are formed with subsequent further oxidation. Indicate an amino acid composing glutathion:

- A. Glutamate
- B. Valine
- C. Lysine
- D. Isoleucine
- E. Tryptophan

40. A child manifests epileptic seizures caused by vitamin B₆ deficiency. This is conditioned by the decrease of the γ -aminobutyrate level in the nervous tissue which acts as an inhibiting neurotransmitter. The activity of which enzyme is decreased in this case?

- A. Glutamate decarboxylase
- B. Pyridoxal kinase
- C. Glutamate dehydrogenase
- D. Alanine aminotransferase
- E. Glutamate synthetase

41. 12 hours after an acute attack of retrosternal pain a patient presented an increase of aspartate aminotransferase activity in blood serum. What pathology is this deviation typical for?

- A. Myocardium infarction
- B. Viral hepatitis
- C. Collagenosis
- D. Diabetes mellitus

E. Diabetes insipidus

42. In diagnostics of an acute viral hepatitis estimation of the next enzymatic activity in blood serum is the most valuable:

- A. Alanine aminotransferase
- B. Glutathion peroxidase
- C. Creatine kinase
- D. Amylase
- E. Alkaline phosphatase

43. A patient diagnosed with carcinoid of bowels was admitted to the hospital. Analysis revealed high production of serotonin. It is known that this substance is formed of tryptophan amino acid. What biochemical mechanism underlies this process?

- A. Decarboxylation
- B. Desamination
- C. Microsomal oxydation
- D. Transamination
- E. Formation of paired compounds

44. A patient with a cranial trauma manifests repeated epileptoid seizures. The biosynthesis of what biogenic amine is disturbed in this clinical situation?

- A. GABA
- B. Histamine
- C. Adrenaline
- C. Serotonin
- E. Dopamine

45. In psychiatric practice, biogenic amines and their derivatives are used for the treatment of certain diseases of the central nervous system. Name the substance of the mentioned below biochemical class which acts as an inhibitory mediator:

- A. GABA
- B. Histamine
- C. Serotonin
- D. Dopamine
- E. Taurine

46. In course of histidine catabolism a biogenic amine is formed that has powerful vasodilating effect. Name it:

- A. Histamine
- B. Serotonin
- C. Dioxyphenylalanine
- D. Noradrenalin
- E. Dopamine

47. Production of some toxic substances in large intestines occurs due to decarboxylation of some amino acids. Indicate, what substance is produced from ornithine?

- A. Putrescine
- B. Skatole
- C. Indole
- D. Cadaverine
- E. Phenol

48. In case of skin combustion the injured area of skin gets red and painful, the swelling of tissue also develops. What substance is responsible for these effects?

- A. Histamine
- B. Glutamine
- C. Lysine
- D. Thiamine
- E. Asparaginate

49. For diagnostics of certain illnesses the determination of blood transaminases activity is required. Which vitamin is a component of the cofactors of the enzymes?

- A. B₆
- B. B₁₂
- C. B₃
- D. B₈
- E. B₅

50. According to the clinical signs, pyridoxal phosphate was prescribed to a patient. For the correction of what biochemical processes is this drug recommended?

- A. Transamination and decarboxylation of amino acids
- B. Oxidative decarboxylation of ketoacids
- C. Deamination of amino acids
- D. Synthesis of purines and pyrimidines
- E. Protein synthesis

TOPIC №15. DETOXIFICATION OF AMMONIA AND UREA BIOSYNTHESIS.

1. Patient presents all signs of the hepatic coma: loss of consciousness, absence of reflexes, cramps, convulsions, disorder of heart activity, recurrent (periodical) respiration. What is the cerebrotoxic substance which accumulates in blood under hepatic insufficiency?

- A. Ammonia
- B. Interleukin-1
- C. Autoantibody
- D. Necrogenic substances
- E. Ketone bodies

2. An unconscious patient was taken by ambulance to the hospital. On objective examination the patient was found to have no reflexes, periodical convulsions, irregular breathing. After laboratory examination the patient was diagnosed with hepatic coma. Disorders of the central nervous system develop due to the accumulation of the following metabolite:

- A. Ammonia
- B. Urea
- C. Glutamine
- D. Bilirubin
- E. Histamine

3. During intensive muscle work there is a large amount of ammonia produced in the muscles. What amino acid plays the main role in the transportation of ammonia to the liver and participates in gluconeogenesis reactions?

- A. Alanine
- B. Arginine
- C. Lysine
- D. Ornithine
- E. Aspartate

4. After a serious viral infection a 3-year-old child has repeated vomiting, loss of consciousness, convulsions. Examination revealed hyperammonemia. What may have caused changes of biochemical blood indices of this child?

- A. Disorder of ammonia neutralization in ornithine cycle
- B. Activated processes of amino acids decarboxylation
- C. Disorder of biogenic amines neutralization
- D. Increased putrefaction of proteins in intestines
- E. Inhibited activity of transamination enzymes

5. A newborn child was found to have reduced intensity of sucking, frequent vomiting, hypotonia. Urine and blood exhibit increased concentration of citrulline. What metabolic process is disturbed?

- A. Ornithine cycle
- B. Tricarboxylic acid cycle
- C. Glycolysis
- D. Gluconeogenesis
- E. Cori cycle

6. Nitrogen is being excreted from the body mainly as urea. When activity of a certain enzyme in the liver is low, it results in inhibition of urea synthesis and nitrogen accumulation in blood and tissues. Name this enzyme:

- A. Carbamoyl phosphate synthetase
- B. Aspartate aminotransferase
- C. Urease
- D. Amylase
- E. Pepsin

7. The greater amount of nitrogen is excreted from the organism in form of urea. Inhibition of urea synthesis and accumulation of ammonia in blood and tissues are induced by the decreased activity of the following liver enzyme:

- A. Carbamoyl phosphate synthetase
- B. Aspartate aminotransferase
- C. Urease
- D. Amylase
- E. Pepsin

8. A patient with hereditary hyperammonemia due to a disorder of ornithine cycle has developed secondary orotaciduria. The increased synthesis of orotic acid is caused by an increase in the following metabolite of ornithine cycle:

- A. Carbamoyl phosphate
- B. Citrulline
- C. Ornithine
- D. Urea
- E. Argininosuccinate

9. A 2-year-old child with mental and physical retardation has been delivered to a hospital. He presents with frequent vomiting after having meals. There is phenylpyruvic acid in urine. Which metabolism abnormality is the reason for this pathology?

- A. Amino acid metabolism
- B. Lipidic metabolism
- C. Carbohydrate metabolism
- D. Water-salt metabolism
- E. Phosphoric calcium metabolism

10. 1,5-year-old child presents with both mental and physical lag, decolorizing of skin and hair, decrease in catecholamine concentration in blood. When a few drops of 5% solution of trichloroacetic iron had been added to the child's urine it turned olive green. Such alteration are typical for the following pathology of the amino acid metabolism:

- A. Phenylketonuria
- B. Alkaptonuria
- C. Tyrosinosis
- D. Albinism
- E. Xanthinuria

11. A sick child presents with high content of phenyl pyruvate in urine (normally it is practically absent). Blood phenylalanine level is 350 mg/L (norm - 15 mg/L). What disease are these symptoms characteristic of?

- A. Phenylketonuria
- B. Albinism
- C. Tyrosinosis

- D. Alkaptonuria
- E. Gout

12. Nappies of a newborn have dark spots being the evidence of homogentisic acid formation. This is caused by the metabolic disorder of the following substance:

- A. Tyrosine
- B. Galactose
- C. Methionine
- D. Cholesterol
- E. Tryptophan

13. In case of alkaptonuria, homogentisic acid is excreted in urine in large amounts. The development of this disease is associated with a disorder of metabolism of the following amino acid:

- A. Tyrosine
- B. Phenylalanine
- C. Alanine
- D. Methionine
- E. Asparagine

14. A patient has been diagnosed with alkaptonuria. Choose an enzyme that can cause this pathology when deficient:

- A. Homogentisic acid oxidase
- B. Phenylalanine hydroxylase
- C. Glutamate dehydrogenase
- D. Pyruvate dehydrogenase
- E. Dioxyphenylalanine decarboxylase

15. A patient with homogentisuria has signs of arthritis, ochronosis. In this case, the pain in the joints is associated with the deposition of:

- A. Homogentisates
- B. Urates
- C. Phosphates
- D. Oxalates
- E. Carbonates

16. Albinos can't stand sun impact – they don't acquire sun-tan but get sunburns. Disturbed metabolism of what amino acid underlies this phenomenon?

- A. Phenylalanine
- B. Methionine
- C. Tryptophan
- D. Glutamic acid
- E. Histidine

17. A newborn child rejects breast feeding, he is restless, his breathing is unrhythmical, and the urine has a specific smell of beer ferment or maple syrup. The innate defect of what enzyme causes this pathology?

- A. Dehydrogenase of branched-chain α -amino acids
- B. Glucose-6-phosphate dehydrogenase
- C. Glycerol kinase
- D. Aspartate aminotransferase
- E. UDP-glucuronyltransferase

18. Laboratory examination of a child revealed increased concentration of leucine, valine, isoleucine and their ketoderivatives in blood and urine. Urine smells of maple syrup. This disease is characterized by the deficit of the following enzyme:

- A. Dehydrogenase of branched amino acids
- B. Aminotransferase
- C. Glucose-6-phosphatase
- D. Phosphofructokinase
- E. Phosphofructomutase

19. A 50-year-old man, who has been suffering for a long time from viral hepatitis, developed mental impairments, impairments of consciousness, and motor disturbances (tremor, ataxia, etc.). What is the mechanism of such condition?

- A. Decreased detoxification function of the liver
- B. Insufficient phagocytic function of stellate macrophages
- C. Decreased synthesis of albumins and globulins in the liver
- D. Disturbed lipid exchange in the liver
- E. Alterations in the lipid composition of blood

20. A 2-year-old child presents with mental development retardation, intolerance of proteins, severe hyperammonemia against the background of low blood urea content. This condition is caused by the congenital deficiency of the following mitochondrial enzyme:

- A. Carbamoyl phosphate synthetase
- B. Citrate synthase
- C. Succinate dehydrogenase
- D. Malate dehydrogenase
- E. Monoamine oxidase

21. An oncological patient had been administered methotrexate. With time target cells of the tumour lost sensitivity to this drug. At the same time the change in gene expression of the following enzyme is observed:

- A. Dihydrofolate reductase
- B. Thiaminase
- C. Deaminase
- D. Folate oxidase
- E. Folate decarboxylase

22. Continuous treatment of cancer patients with methotrexate over time reduces the target cell's sensitivity to the drug. In this case gene amplification of the following enzyme is observed:

- A. Dihydrofolate reductase
- B. Thiaminase
- C. Deaminase
- D. Thioredoxin reductase
- E. –

23. Dopamine precursor - dioxyphenylalanine (DOPA) - is used in treatment of Parkinson's disease. This active substance is produced from the following amino acid:

- A. Tyrosine
- B. Alanine
- C. Cysteine

- D. Histidine
- E. Tryptophan

24. Mother had noticed her 5-year-old child's urine to become dark in colour. Bile pigments in urine were not detected. The diagnosis of alkaptonuria was made. What pigment is deficient?

- A. Homogentisic acid oxidase
- B. Phenylalanine hydroxylase
- C. Tyrosinase
- D. Oxyphenylpyruvate oxidase
- E. Phenylpyruvate decarboxylase

25. A 20-year-old woman came to the doctor with complaints of general weight loss, loss of appetite, weakness, skin discoloration resembling bronze tan. In addition to hyperpigmentation, examination in the hospital revealed bilateral adrenal tuberculosis. What substance leads to skin hyperpigmentation, when accumulated excessively?

- A. Melanin
- B. Bilirubin
- C. Hemozoin
- D. Lipofuscin
- E. Adrenochrome

26. Many organic compounds break up in the cell into simple products. What compounds break up into ammonia, carbon dioxide, and water in the human body?

- A. Amino acids
- B. Monosaccharides
- C. Monohydric alcohols
- D. Fatty acids
- E. Keto acids

27. Disintegration of adenosine nucleotides results in release of ammonia. What enzyme plays the key role in ammonia synthesis from these compounds?

- A. Adenosine deaminase
- B. Alcohol dehydrogenase
- C. Lactate dehydrogenase
- D. Alanine transaminase
- E. Amylase

28. Main process of ammonia neutralization occurs in the liver. Arginine decomposition reaction that produces urea as a result is catalyzed with arginase. What group of enzymes does arginase belong to?

- A. Hydrolases
- B. Synthetases
- C. Oxidoreductases
- D. Transferases
- E. Isomerases

29. A man presents with signs of albinism: blonde hair, extreme photosensitivity, impaired vision. What amino acid metabolism is disrupted in the patient?

- A. Tyrosine
- B. Methionine
- C. Proline

- D. Histidine
- E. Valine

30. Albinos become tanned poorly, instead they get sunburns. The disorder of what amino acid metabolism causes this phenomenon?

- A. Tyrosine
- B. Methionine
- C. Tryptophan
- D. Glutamine
- E. Histidine

31. In a child in urine were detected phenylpyruvate and phenylacetate. What enzyme insufficiency causes this phenomenon?

- A. Phenylalanine-4-monooxygenase
- B. Thyrosine-3-monooxygenase
- C. Fumarylacetoacetate hydrolase
- D. Cystathionyl- β -synthase
- E. DOPA-decarboxylase

32. The principal end product of protein metabolism, which is excreted in the greatest quantity in human urine, is:

- A. Urea
- B. Glutamine
- C. Ammonium and its salts
- D. Uric acid
- E. Allantoin

33. What chemical component in urine indicates on a hereditary metabolic disease – alkaptonuria?

- A. Homogentisic acid
- B. Phenylalanine
- C. Phenylpyruvic acid
- D. Pyruvic acid
- E. Tyrosine

34. An inborn error – maple syrup urine disease – is due to the deficiency of the enzyme:

- A. Isovaleryl-CoA-hydrogenase
- B. Phenylalanine hydroxylase
- C. Adenosyl transferase
- D. α -Ketoacid decarboxylase
- E. -

35. In albinism there is negative reaction to direct insolation, as a result solar burns may appear. Metabolic disorders of what amino acid cause these effects?

- A. Tyrosine
- B. Tryptophan
- C. Methionine
- D. Glutamic acid
- E. Histidine

36. Transfer of the carbamoyl moiety of carbamoyl phosphate to ornithine is catalysed by a liver mitochondrial enzyme:

- A. Ornithine transcarbamoylase
- B. Carbamoyl phosphate synthetase I
- C. N-acetyl glutamate synthetase
- D. N-acetyl glutamate hydrolase
- E. Carbamoyl phosphate synthetase II

37. In human body is degraded approximately 70 g of amino acids daily. The main end product of nitrogen metabolism in human is:

- A. Urea
- B. Ammonia
- C. Uric acid
- D. Glutamine
- E. Creatinine

38. What is the principal final nitrogen containing product of protein catabolism in human body?

- A. Urea
- B. Glutamine
- B. Ammonia and ammonium ion
- C. Creatinin
- E. Uric acid

39. Indicate amino acid, which is a precursor of the thyroid hormones thyroxine and triiodothyronine:

- A. Tyrosine
- B. Histidine
- C. Tryptophan
- D. Glycine
- E. Glutamate

40. In human body are synthesized 10 amino acids only from 20 ones needed for protein biosynthesis. What amino acid from listed below is produced in human body?

- A. Tyrosine
- B. Histidine
- C. Lysine
- D. Methionine
- E. Phenylalanine

41. Under alcaptonuria, the excessive quantity of homogentisate was found in the patient's urine (the urine darkens in the air). The innate defect of what enzyme is apparent?

- A. Homogentisate oxidase
- B. Alanine aminotransferase
- C. Tyrosinase
- D. Phenylalanine-4-monooxygenase
- E. Tyrosine aminotransferase

42. 13 years old patient complains of general weakness, dizziness, fatigue. Besides this mental underdevelopment is observed. Laboratory investigations revealed high content of valine, isoleucine and leucine in urine, which has a characteristic odor. What is the most probable cause of this condition?

- A. Maple syrup syndrome

- B. Cystinosis
- C. Phenylketonuria
- D. Porphyria
- E. Hyperuricemia (gout)

43. In a young child besides other clinical symptoms the sharp darkening of urine after standing in open air was revealed. Blood and urine examination detected the presence of homogentisic acid. What is the most probable cause of disease?

- A. Alkaptonuria
- B. Porphyria
- C. Albinism
- D. Cystinuria
- E. Hemolytic anemia

44. An infant shows the darkening of scleras, mucous membranes. The excreted urine darkens in tin air, homogentisic acid is determined both in the blood and urine. What is the diagnosis?

- A. Alkaptonuria
- B. Albinism
- C. Cystinuria
- D. Porphyria
- E. Hemolytic anemia

45. In two years old boy suffering from alkaptonuria urine became black after standing. This disease is hereditary disorder of:

- A. Tyrosine metabolism
- B. Alanine metabolism
- C. Urea synthesis
- D. Uric acid synthesis
- E. Cysteine metabolism

46. Laboratory analysis of the urine of a 6-day infant displayed excessive concentration of phenylpyruvate and phenylacetate. Metabolism of what amino acid is disturbed in the body of this child?

- A. Phenylalanine
- B. Tryptophan
- C. Methionine
- D. Histidine
- E. Arginine

47. A 9-year-old boy was brought to a hospital with signs of mental and physical retardation. A biochemical blood test revealed the increased level of phenylalanine. The blockage of what, enzyme can result in such state of the patient?

- A. Phenylalanine-4-monooxygenase
- B. Homogentisate oxidase
- C. Glutamine transaminase
- D. Aspartate aminotransferase
- E. Glutamate decarboxylase

48. In a patient suffering from liver cirrhosis a decrease in urea concentration in blood serum was detected. This may be caused by:

- A. Disorder of urea synthesis in liver

- B. Absence of alanine aminotransferase activity in hepatocytes
- C. Deficiency of ammonia for urea synthesis
- D. Deficiency of CO₂ for urea synthesis
- E. Excess of ammonia blocking enzymes of urea synthesis

49. Ammonia is a very poisonous chemical, especially for the nervous system. What substance takes a particularly active part in the detoxification of ammonia in the brain tissue?

- A. Glutamic acid
- B. Lysine
- C. Proline
- D. Histidine
- E. Alanine

50. Under the repeated action of ultraviolet rays, skin darkens because of the synthesis of melanin which protects cells from damage. The principal mechanism of this defence reaction is:

- A. Activation of tyrosinase
- B. Inhibition of tyrosinase
- C. Activation of homogentisate oxidase
- D. Inhibition of homogentisate oxidase
- E. Inhibition of phenylalanine hydroxylase

51. A 2-week-old infant is brought to his pediatrician for a check-up. His mother is concerned because he has not been feeding well and appears to have lost weight. His blood is found to contain excess of leucine, isoleucine and valine. This infant is most likely to exhibit which of the following additional symptoms?

- A. Dystonia
- B. Fair skin
- C. Hyperglycemia
- D. Recurrent urinary tract infection
- E. Red urine with no measurable RBCs
- F. Renal stones

TOPIC №16. METABOLISM OF INDIVIDUAL AMINO ACIDS. BIOSYNTHESIS OF PORPHYRINS. PORPHYRIAS.

1. Synthesis of phospholipids is disordered under the liver fat infiltration. Indicate which of the following substances can enhance the process of methylation during phospholipids synthesis?

- A. Methionine
- B. Ascorbic acid
- C. Glucose
- D. Glycerol
- E. Citrate

2. Urine analysis of a 12-year-old boy reveals high concentration of all aliphatic amino acids with the highest excretion of cystine and cysteine. US of kidneys revealed kidney concrements. What is the most likely pathology?

- A. Cystinuria
- B. Alkaptonuria
- C. Cystitis
- D. Phenylketonuria
- E. Hartnup disease

3. A hereditary disease - homocystinuria - is caused by disturbed transformation of homocysteine into methionine. Accumulated homocysteine forms its dimer (homocystine) that can be found in urine. What vitamin preparation can decrease homocysteine production?

- A. Vitamin B₁₂
- B. Vitamin C
- C. Vitamin B₁
- D. Vitamin B₂
- E. Vitamin PP

4. Vascular endothelium is characterized by high metabolic activity and synthesizes vasoactive substances. Among these substances there is a potent vasodilator synthesized from *L*-arginine. Name this vasodilator:

- A. Nitrogen oxide
- B. Histamine
- C. Bradykinin
- D. Acetylcholine
- E. Adrenaline

5. Examination of a patient suffering from cancer of urinary bladder revealed high rate of serotonin and hydroxyanthranilic acid. It is caused by excess of the following amino acid in the organism:

- A. Tryptophan
- B. Alanine
- C. Histidine
- D. Methionine
- E. Tyrosine

6. A male patient has been diagnosed with acute radiation disease. Laboratory examination revealed a considerable reduction of platelet serotonin level. The likely

cause of platelet serotonin reduction is the disturbed metabolism of the following substance:

- A. 5-Oxytryptophan
- B. Tyrosine
- C. Histidine
- D. Phenylalanine
- E. Serine

7. A mother consulted a doctor about her 5-year-old child who develops erythemas, vesicular rash and skin itch under the influence of sun. Laboratory studies revealed decreased iron concentration in the blood serum, increased uroporphyrinogen I excretion with the urine. What is the most likely inherited pathology in this child?

- A. Erythropoietic porphyria
- B. Methemoglobinemia
- C. Hepatic porphyria
- D. Coproporphyria
- E. Intermittent porphyria

8. Patients with erythropoietic porphyria (Gunther's disease) have teeth that fluoresce with bright red color when subjected to ultraviolet radiation; their skin is light-sensitive, urine is red-colored. What enzyme can cause this disease, when it is deficient?

- A. Uroporphyrinogen III cosynthase
- B. Uroporphyrinogen I synthase
- C. δ -Aminolevulinate synthase
- D. Uroporphyrinogen decarboxylase
- E. Ferrochelatase

9. A patient, who suffers from congenital erythropoietic porphyria, has skin photosensitivity. The accumulation of what compound in the skin can cause it?

- A. Uroporphyrinogen I
- B. Protoporphyrin
- C. Uroporphyrinogen II
- D. Coproporphyrinogen III
- E. Heme

10. The patient, who for a long time has been keeping to an unbalanced lowprotein diet, developed fatty liver infiltration. Name the substance, absence of which in the diet can lead to this condition: A. Methionine

- B. Alanine
- C. Cholesterol
- D. Arachidonic acid
- E. Biotin

11. Patients with severe depression demonstrate decreased serotonin levels in brain and cerebrospinal fluid. What aminoacid is a serotonin precursor?

- A. Tryptophan
- B. Threonine
- C. Tyrosine
- D. Glutamic acid
- E. Aspartic acid

12. Pharmaceuticals, containing mercury, arsen or other heavy metals, are inhibiting enzymes, possessing sulfhydryl groups. What amino acid is used for reactivation of these enzymes?

- A. Cysteine
- B. Histidine
- C. Isoleucine
- D. Aspartic acid
- E. Glycine

13. Fat of phospholipids is disordered due to fat infiltration of the liver. Indicate which of the presented substances can enhance the process of methylation during phospholipids synthesis?

- A. Methionine
- B. Ascorbic acid
- C. Glucose
- D. Glycerin
- E. Citrate

14. A polypeptide is shown to have a high pI value (approx. at pH 8,9). What from listed below amino acids is responsible for this property?

- A. Arginine
- B. Valine
- C. Serine
- D. Tyrosine
- E. Cysteine

15. Glutathion is a tripeptide possessing reducing properties. What amino acid residue is responsible for reductive properties of glutathion?

- A. Cysteine
- B. Glutamic acid
- C. Glycine
- D. Valine
- E. Aspartic acid

16. As a result of tryptophan hydroxylation in presence of tryptophan-5-monoxygenase is produced:

- A. Serotonin
- B. Histamine
- C. Dopamine
- D. Melanin
- E. Adrenaline

17. Examination of a patient suffering from cancer of urinary bladder revealed high rate of serotonin and hydroxyanthranilic acid. It is caused by excess of the following amino acid in the organism:

- A. Tryptophan
- B. Alanine
- C. Histidine
- D. Methionine
- E. Tyrosine

18. High levels of serotonin and 3-oxianthranilate are revealed in the blood of a patient suffering from urinary bladder cancer. By the disturbance of the metabolism of what amino acid is it caused?

- A. Tryptophan
- B. Alanine
- C. Histidine
- D. Methionine
- E. Tyrosine

19. In experimental animals held prolonged time on protein free diet, a fat degeneration of liver has been developed. The possible cause may be insufficiency of methylating agents. Indicate an amino acid, donor of methyl groups:

- A. Methionine
- B. Phenylalanine
- C. Lysine
- D. Cysteine
- E. Arginine

20. The product of oxidase reactions is hydrogen peroxide, a very toxic substance for cells. An important role in its reduction plays glutathion. Indicate an amino acid present in glutathion structure:

- A. Cysteine
- B. Serine
- C. Alanine
- D. Aspartate
- E. Thyrosine

21. A patient diagnosed with carcinoid of bowels was admitted to the hospital. Analysis revealed high production of serotonin. It is known that this substance is formed of tryptophan amino acid. What biochemical mechanism underlies this process?

- A. Decarboxylation
- B. Desamination
- C. Microsomal oxydation
- D. Transamination
- E. Formation of paired compounds

22. Biosynthesis of creatine, synthesis of choline from ethanolamine, adrenaline from noradrenaline, are taking part in a presense of:

- A. S-Adenosylmethionine
- B. NADH_2
- C. ATP
- D. NADPH_2
- E. THFA

23. High levels of serotonin and 3-oxianthranilate are revealed in the blood of a patient suffering from urinary bladder cancer. By the disturbance of the metabolism of what amino acid is it caused?

- A. Tryptophan
- B. Alanine
- C. Histidine
- D. Methionine
- E. Tyrosine

24. Methylene blue promotes oxidation of hemoglobin. Give the name of the obtained compound:

- A. Methemoglobin
- B. Hematin
- C. Hemine
- D. Carboxyhemoglobin
- E. Carbhemoglobin

25. As a complex protein, hemoglobin consists of protein and non-protein moieties. Indicate the components of hemoglobin.

- A. 4 Heme groups, 2 α - and 2 β -polypeptide chains
- B. Heme, 1 α - and 3 β -polypeptide chains
- C. 4 Heme groups and 4 β -polypeptide chains
- D. 4 Heme groups and 4 α -polypeptide chains
- E. Heme, 2 α - and 2 β -polypeptide chains

26. The content of vitamin PP is very low in milk and eggs, never the less these products have antipellagric action. It is caused by high content of precursor of this vitamin in mentioned products, namely:

- A. Tryptophan
- B. Riboflavin
- C. Thiamine
- D. Adenine
- E. GDP

27. During the patronage a doctor revealed that a child had symmetric roughness of skin on his cheeks, diarrhea, disturbance of nervous activity. The deficiency of what food factors caused the appearance of such symptoms?

- A. Nicotinic acid, tryptophan
- B. Lysine, ascorbic acid
- C. Threonine, panthothenic acid
- D. Methionine, lipoic acid
- E. Phenylalanine, pangamic acid

28. To obese patient with risk of liver fat degeneration is recommended diet enriched with lipotropic factors. What nutritional component is the most important in diet?

- A. Methionine
- B. Cholesterol
- C. Vitamin C
- D. Glycine
- E. Glucose

29. Reactions of methylation take place in biosynthesis of catecholamines, creatine, lecithin, as well as in detoxification of some xenobiotics. As donor of methyl groups serves the next substance:

- A. Methionine
- B. Leucine
- C. Glutathion
- D. Choline
- E. Adenosine

30. Which of the following enzymes catalyses reactions in the biosynthesis of both catecholamines and indoleamines (serotonin)?

- A. Aromatic amino acid decarboxylase
- B. Dopamine β -hydroxylase
- C. Phenylethanolamine N-methyltransferase
- D. Tryptophan hydroxylase
- E. Tyrosine hydroxylase

31. A patient, 64 years old, worked as pilot in past, has been working with ethanol gas in recent years. From that time, he began to notice pigmentation of hands and scars. Periodically, bubbles appear on the open parts of the body and extremities. The liver is enlarged by 10 cm. The violation of the liver's protein-synthetic function has been detected. Total protein of blood - 100 g/l, albumin - 40 g/l, globulin - 60 g/l. The content of iron in the blood is reduced by 50%. Urine of pink color, with increased content of coproporphyrins in it. What is the possible reason?

- A. Porphyria
- B. Hemolytic jaundice
- C. Albinism
- D. Gout
- E. Phenylketonuria

32. A patient, 51 years old, complains of constant dull pain in the epigastric region, weakness, weight loss, poor sleep, rashes on the surface of the skin of the face, neck, hands in the form of bubbles. In the history - alcohol abuse. For the first time noticed such a rash a year ago. Aggravation arose in the spring and summer. During examination on the skin of the hands, neck, face, old scars, pigmented spots, and liver enlarged by 5 cm were found. Glucose, bilirubin, and cholesterol are normal. What is the possible reason for this condition?

- A. Porphyrinuria
- B. Gierke disease
- C. Cystic fibrosis
- D. Pellagra
- E. They-Saks disease

33. A woman 43 years old, a worker of paint and varnish enterprise, complains of general weakness, weight loss, apathy, drowsiness. Chronic lead intoxication is laboratory confirmed: hypochromic anemia has been detected. In blood, elevated levels of protoporphyrin and reduced levels of δ -aminolevulinic acid, indicating a violation of the synthesis:

- A. Heme
- B. Protein
- C. RNA
- D. Mevalonic acid
- E. DNA

34. During examination it was found bubble rash and increased pigmentation of skin under the influence of ultraviolet radiation. Patient's urine is red coloured. Identification of which component in urine will give the possibility to verify Gunter's disease?

- A. Uroporphyrinogen I
- B. Acetone
- C. Hemoglobin
- D. Creatine

E. Bilirubin

35. There are 20 L-amino acids, which can be used for protein synthesis. The sulphur containing amino acid is:

- A. Methionine
- B. Serine
- C. Homoserine
- D. Valine
- E. Tyrosine

36. Disulphide bridges are providing secondary and tertiary structures of protein molecules. They are formed between the next amino acids:

- A. Cysteine-cysteine
- B. Lysine-aspartic acid
- C. Tyrosine-histidine
- D. Proline-tryptophan
- E. Histidine-arginine

37. Disulphide bridges are providing secondary and tertiary structures of protein molecules and can be formed between:

- A. Two cysteine residues
- B. Two methionine residues
- C. A methionine and a cysteine residue
- D. Two serine residues
- E. Two valine residues

38. Creatine is a precursor of creatine phosphate – a macroergic compound. The amino acids involved in the synthesis of creatine are:

- A. Arginine, glycine, active methionine
- B. Arginine, alanine, glycine
- C. Glycine, lysine, methionine
- D. Arginine, lysine, methionine
- E. Glycine, lysine, alanine

39. Creatine is a precursor of creatine phosphate – a macroergic compound. Note amino acids, which are participants of creatine biosynthesis:

- A. Arginine
- B. Lysine
- C. Methionine
- D. Tryptophan
- E. Phenylalanine

40. Lipotropic factors are used to prevent fatty liver disease. Which amino acid is a lipotropic factor?

- A. Methionine
- B. Lecuine
- C. Tryptophan
- D. Lysine
- E. Tyrosine

41. Biogenic amine serotonin is an important neurotransmitter and produced by decarboxylation of the next amino acid:

- A. Tryptophan
- B. Lysine
- C. Histidine
- D. Arginine
- E. Tyrosine

42. Heme is an iron-containing component of hemoglobin, which provides gas transport function of blood. What amino acid from listed below participates in biosynthesis of heme?

- A. Glycine
- B. Aspartic acid
- C. Methionine
- D. Histidine
- E. Phenylalanine

43. Which of denoted symptoms are characteristic to cystinosis?

- A. The increase of excretion of all amino acids except cyclic; the most prominent is excretion of cystine and cysteine
- B. Normal blood cystine level
- C. Absence of cystine stones in kidneys
- D. Hypoaminoaciduria
- E. Presence of phenylpyruvic acid in blood

44. Amino acids metabolism can be disturbed in patients with some hereditary diseases. Increased urinary indole acetic acid is diagnostic of:

- A. Hartnup disease
- B. Maple syrup urine disease
- C. Homocystinuria
- D. Phenylketonuria
- E. Alcaptonuria

45. Tryptophan is an essential amino acid and could be considered as a precursor of:

- A. Melatonin
- B. Thyroid hormones
- C. Melanin
- D. Epinephrine
- E. Insuline

46. Cystinuria is characterized by cystine stones in kidneys and results from inability to:

- A. Reabsorb cystine in renal tubules
- B. Convert cystine into cysteine
- C. Incorporate cysteine into proteins
- D. Metabolise cysteine
- E. Convert cysteine into methionine

47. Hemoglobin is an oxygen and carbon dioxide transporting molecule, present in erythrocytes and belongs to:

- A. Chromoproteins
- B. Nukleoproteins
- C. Phosphoproteins
- D. Lipoprotein
- E. Glycoproteins

48. Hemoglobin is an oxygen and carbon dioxide transporting molecule, present in erythrocytes. The structure of heme in hemoglobin is:

- A. Protoporphyrin IX, attached to the Fe^{2+}
- B. Four pyrrol rings, attached to Fe^{3+}
- C. Four pyrrol rings, attached to Fe^{2+}
- D. Porphyrin coupled with Fe
- E. Protoporphyrin X, attached to and Fe^{3+}

49. Protoporphyrin IX contains the porphine core – a tetrapyrrole macrocycle and belongs to one of the following:

- A. Hemoglobins
- B. Transferrins
- C. Ceruloplasmins
- D. Properdins
- E. Cryoglobulines

50. Niacin is a water-soluble vitamin and is synthesized in the body from:

- A. Tryptophan
- B. Tyrosine
- C. Glutamate
- D. Aspartate
- E. Valine

51. A 7-year-old boy is brought to the emergency department by his parents because of severe right-sided lower back and pelvic pain. His creatine level is 1,7 mg/dL and a urine analysis is positive for blood. The pain eventually ceases and the patient is advised to urinate into a strainer. A stone is retrieved and analyzed microscopically. The pathologist states the microscopic crystals appear hexagonal in shape. A defect in which process is likely to be the cause of this patient's recurrent symptoms?

- A. Amino acid reabsorption in the proximal tubule
- B. Calcium sensor in the parathyroid glands
- C. Parathyroid hormone receptor
- D. Vitamin D receptor
- E. Xanthine oxidase

II SEMESTER

TOPIC 1. BIOCHEMICAL FUNCTION OF NUCLEOTIDES AND NUCLEIC ACIDS.

1. Among organic substances of a cell there is a polymer composed of dozens, hundreds, and thousands of monomers. This molecule is capable of self-reproduction and can be an information carrier. X-ray structure analysis shows this molecule to consist of two complementary spiral threads. Name this compound:

- A. DNA
- B. RNA
- C. Cellulose
- D. Carbohydrate
- E. Hormone

2. Nucleolar organizers of the 13-15, 21, 22 human chromosomes contain about 200 cluster genes that synthesize RNA. These regions of chromosomes bear the information on the following type of RNA:

- A. rRNA
- B. tRNA
- C. mRNA
- D. snRNA
- E. tRNA + rRNA

3. Life cycle of a cell includes a process of DNA autoreduplication. As a result of this process monochromatid chromosomes become bichromatid. This phenomenon is observed within the following period of the cell cycle:

- A. S
- B. G₀
- C. G₁
- D. G₂
- E. M

4. Nowadays about 50 minor bases have been found in the t-RNA structure besides the main four nitrogenous bases. Choose the minor nitrogenous base:

- A. Dihydrouracil
- B. Uracil
- C. Cysteine
- D. Adenine
- E. Cytosine

5. A ribonucleoprotein (RNP) is a complex of ribonucleic acid and RNA-binding protein. These complexes play an integral part in a number of important biological functions that include DNA replication, regulating gene expression and regulating the metabolism of RNA. Indicate nitrogenous base which is a specific component of ribonucleoproteins

- A. Uracil
- B. Adenine
- C. Guanine
- D. Thymine
- E. Cytosine

6. Nucleoproteins tend to be positively charged, facilitating interaction with the negatively charged nucleic acid chains. Which of the following proteins are obvious constituents of nucleoproteins?

- A. Histones and protamins
- B. Albumin and globulins
- C. Cytochromes b₅ and c
- D. Dynein and kinesin
- E. Prolamin and glutelin

7. Nucleic acids, and DNA in particular, are key macromolecules for the continuity of life. How is called elementary monomer of polymer chain of nucleic acids?

- A. Mononucleotide
- B. Nucleoside
- C. Amino acid
- D. Ribosyl-3-phosphate
- E. Nitrogenous base

8. Which of the following if a complementary to cytosine nitrogenous base in DNA double helix according to Watson and Crick model

- A. Guanine
- B. Adenine
- C. Uracil
- D. Thymine
- E. Xanthine

9. Three major forms of DNA are double stranded and connected by interactions between complementary base pairs. These are terms A-form, B-form, and Z-form DNA. One step of DNA double helix in B-form contains the next number of base pairs:

- A. 10
- B. 7
- C. 15
- D. 13
- E. 20

10. Both DNA and RNA are polymers. The chemical structure of the simple monomer units making up these 2 molecules is very similar. The monomers of these polymers are called nucleotides or mononucleotides. What type of chemical bonds join together mononucleotides in DNA or RNA chain?

- A. Phosphodiester bonds
- B. Hydrogen
- C. Ionic
- D. Coordinative
- E. Hydrophobic interactions

11. The base sequence of a segment of DNA is pCpApGpTpTpApGpC. Which of the following sequences are complementary?

- A. pGpTpCpApApTpCpG
- B. pGpCpTpApApCpTpG
- C. CpGpApTpTpGpApC
- D. pTpApGpCpCpApGpT
- E. pCpApGpTpTpApGpC

12. Chargaff Rules of base equivalence was established by Erwin Chargaff. In accordance to these rules if the cytosine content of double-helical DNA is 20 mole% of the total bases, the adenine content would be:

- A. 30 mole%
- B. 10 mole%
- C. 20 mole%
- D. 40 mole%
- E. 50 mole%

13. If a sample of DNA is found to have the base composition in mole ratio of adenine 40, thymine 22, guanine 19, cytosine 19, what conclusion can be drawn?

- A. The DNA is single-stranded
- B. The DNA has a high melting point
- C. The DNA is a circular duplex
- D. The DNA is a linear duplex
- E. The DNA has highly repetitive sequences

14. Which scientists first gave experimental evidence that DNA is the genetic material?

- A. Avery, MacLeod, and McCarty who repeated the transformation experiments of Griffith, and chemically characterized the transforming principle.
- B. Garrod, who postulated that Alcaptonuria, or black urine disease, was due to a defective enzyme.
- C. Beadle and Tatum, who used a mutational and biochemical analysis of the bread mold *Neurospora* to establish a direct link between genes and enzymes.
- D. Watson and Crick who gave a model for the structure of DNA
- E. Meselson and Stahl who showed that DNA is replicated semiconservatively.

15. The secondary structure of a typical tRNA consists of hydrogen bonded stems and associated loops, which often contain nucleotides with modified bases. In tRNA molecule D arm is named for the presence of the base:

- A. Dihydrouridine
- B. Uridine
- C. Pseudouridine
- D. Thymidine
- E. Adenine

16. Transfer RNA (tRNA) serves as the nucleic acid decoding device that reads the triplet genetic code of messenger RNA (mRNA) and causes the insertion of codon-specific amino acids in a growing protein chain during the process of translation in the ribosome. The structure of tRNA appears like a:

- A. Clover leaf
- B. Helix
- C. Hair pin
- D. Coil
- E. Supercoil

17. Three major forms of DNA are double stranded and connected by interactions between complementary base pairs. These are terms A-form, B-form, and Z-form DNA. The distance spanned by one turn of B form DNA is:

- A. 3.4 nm
- B. 1.0 nm
- C. 2.9 nm
- D. 5.5 nm
- E. 8.8 nm

18. For the DNA strand 5'-TACGATCATAT-3' the correct complementary DNA strand is:
- A. 3'-ATGCTAGTATA-5'
 - B. 3'-TACGATCATAT-5'
 - C. 3'-AUGCUAGUAUA-5'
 - D. 3'-GCATATACGCG-5'
 - E. 3'-TATACTAGCAT-5'
19. In eukaryotic cells, most DNA is located in the cell nucleus though some DNA is also contained in other organelles. Which of the following organelles contains DNA?
- A. Mitochondria
 - B. Golgi apparatus
 - C. Lysosomes
 - D. Smooth endoplasmic reticulum
 - E. Rough endoplasmic reticulum
20. According to Chargaff's rule of base pairing In a double stranded molecule of DNA, the ratio of purines: pyrimidines is:
- A. Always 1:1
 - B. Variable
 - C. Determined by the base sequence in RNA
 - D. Determined by the number of purines in the sense strand of the DNA
 - E. Genetically determined
21. Different types of RNA play important roles in both normal cellular processes and diseases. On which of the following molecules would you find an anticodon?
- A. Transfer RNA
 - B. Messenger RNA
 - C. Ribosomal RNA
 - D. Small nuclear RNA
 - E. Heterogenous RNA
22. The samples of blood of a child and of a supposed father were directed for affiliation to medical forensic examination. Which chemical components need to be identified in the explored samples of blood?
- A. DNA
 - B. tRNA
 - C. rRNA
 - D. mRNA
 - E. mnRNA
23. The complementary base pairs of guanine with cytosine and adenine with thymine connect to one another using hydrogen bonds. How many hydrogen bonds support a complementary base pair G-C?
- A. 3
 - B. 1
 - C. 2
 - D. 5
 - E. 7
24. Nucleic acids absorb ultraviolet light in 250-270 nm region. This property is determined by the following chemical structures:

- A. Nitrogenous bases
- B. Hydrogen bonds
- C. Phosphodiester bonds
- D. Phosphoric acid
- E. Ribose

25. RNA is a complex compound of high molecular weight that functions in cellular protein synthesis and replaces DNA as a carrier of genetic codes in some viruses. RNA consists of ribose nucleotides (nitrogenous bases appended to a ribose sugar) attached by phosphodiester bonds, forming strands of varying lengths. Which of the following nucleotide bases is not found in RNA?

- A. Thymine
- B. Adenine
- C. Uracil
- D. Guanine
- E. Cytosine

26. DNA is an organic chemical of complex molecular structure that is found in all prokaryotic and eukaryotic cells and in many viruses. Which of the following molecules does not form part of DNA?

- A. Amino acid
- B. Purine
- C. Deoxyribose
- D. Pyrimidine
- E. Phosphate

27. The base composition of samples of genomic DNA from several different animals are given below. For one sample, you determine the composition of G to be 29.5 %, which of the samples is likely to come from the same species?

- A. 20.5 % A
- B. 26.7 % C
- C. 22.5 % A
- D. 29.5 % T
- E. 24.5 % C

28. Nucleotides also play a central role in metabolism at a fundamental, cellular level. The most abundant free nucleotide in mammalian cells is:

- A. ATP
- B. CTP
- C. FAD
- D. GTP
- E. NAD

29. "Cap" is a guanosine residue methylated on the N-7 position. In RNA molecule 'Caps':

- A. Are unique to eukaryotic mRNA
- B. Occur at the 3' end of tRNA
- C. Are unique to prokaryotic tRNA
- D. Allow correct translation of prokaryotic mRNA
- E. Allow tRNA to be processed

30. In RNA molecule guanine content does not necessarily equal its cytosine content nor does its adenine content necessarily equal its uracil content since it is a:
- A. Single stranded molecule
 - B. Double stranded molecule
 - C. Double stranded helical molecule
 - D. Polymer of purine and pyrimidine ribonucleotides
 - E. Polymer of aminoacids
31. In the chemical sciences, methylation denotes the addition of a methyl group on a substrate, or the substitution of an atom (or group) by a methyl group. Methylation is a form of alkylation, with a methyl group, rather than a larger carbon chain, replacing a hydrogen atom. Methylated purines and pyrimidines are characteristically present in:
- A. tRNA
 - B. mRNA
 - C. hnRNA
 - D. rRNA
 - E. DNA
32. A nucleosome is a basic unit of DNA packaging in eukaryotes, consisting of a segment of DNA wound in sequence around histone protein cores. The core of nucleosome is composed from the following types of histones:
- A. H2a, H2b, H3, H4
 - B. H1, H2a, H2b, H3
 - C. H1, H3, H4
 - D. H2a, H2b, H2c, H2d
 - E. H1, H2, H3, H4
33. From nitrates, nitrites and nitrosamines in organism is formed nitrous acid which causes oxidative deamination of nitrogenous bases of nucleotides. This induce a point mutation by replacement of cytosine to...
- A. Uracil
 - B. Adenine
 - C. Thymine
 - D. Guanine
 - E. Inosine
34. A sample of some substance was submitted to hydrolysis, in hydrolysate were detected organic bases of purine and pyrimidine classes, ribose and phosphates, amino acids. What substance was the most probably taken for investigation?
- A. Ribonucleoprotein
 - B. Glycoprotein
 - C. Chromoprotein
 - D. Phosphoprotein
 - E. Deoxyribonucleoprotein
35. Heat denaturation of DNA, also called melting, causes the double helix structure to unwind to form single stranded DNA. The hyperchromic effect refers to:
- A. An increase in the absorbance of light at 260 nm in course of DNA denaturation
 - B. The increase in the melting temperature (T_m) of DNA with increasing of cytosine-guanine content
 - C. An increase of the absorbance of light at 260 nm when DNA-RNA hybrids are annealed

- D. None of the above
- E. A maximum rate of denaturation versus temperature for double-helical DNA

36. Radiolabelled H³-thymidine was introduced to cell culture medium. In what cell organelles will be detected H³-label thereafter?

- A. Nucleus
- B. Lysosomes
- C. Ribosomes
- D. Golgi apparatus
- E. Endoplasmic reticulum

37. Nitrosamines belong to deaminating mutagens. From what nitrogenous base does uracil appear as a result of their action?

- A. Cytosine
- B. Adenine
- C. Guanine
- D. Thymine
- E. Methyluracil

38. Hereditary information is saved in DNA, unless the last does not participate directly in protein biosynthesis in the cell. What process provides realization of information upon amino acid sequence in proteins?

- A. Translation
- B. Transcription
- C. Translocation
- D. Replication
- E. Transversion

39. Nucleosome core in eukaryotes is a bead-like particle which contains the next number of histone molecules.:

- A. 8
- B. 4
- C. 6
- D. 7
- E. 10

40. The fact that DNA bears the genetic information of an organism implies that:

- A. DNA from different tissues in the same organism should usually have the same base composition
- B. Base composition should be identical from species to species
- C. DNA base composition should change with age
- D. DNA base composition is altered with nutritional state of an organism

41. Nucleic acids are the biopolymers, or small biomolecules, essential to all known forms of life. Which of the following are the same in RNA and DNA molecules?

- A. The purines
- B. The pyrimidines
- C. Both the purines and pyrimidines
- D. Neither the purines and pyrimidines
- E. Pentose

42. A sequence of DNA reads "A-T-T-G-C-A: 'How many hydrogen bonds would you expect to see holding this sequence to its complementary strand?'

- A. 14
- B. 12
- C. 16
- D. 10
- E. 18

43. Analysis of a sample of DNA found that 20% of the bases were adenine. What percentage of the bases would be pyrimidines?

- A. 60
- B. 30
- C. 20
- D. 50
- E. 80

44. Analysis of a molecule of DNA found it to contain 200 adenine bases, 20% of the total number of bases in the strand. How many phosphate groups did it contain?

- A. 1000
- B. 200
- C. 400
- D. 800
- E. 2000

45. The research of Erwin Chargaff was essential in the discovery of the structure of DNA by Crick and Watson. Chargaff analyzed the base composition of DNA from a wide range of organisms. Which of these relationships did he find within the genome of each organism?

- A. $A+G = T+C$
- B. $A = C$ $G = T$
- C. $A = G$ $C = T$
- D. $A+T = C+G$

46. Foot and mouth disease virus (FMDV) is the pathogen that causes foot and mouth disease in livestock. An analysis of the genetic material of the 'O' strain of FMDV showed that it contains 1996 adenine bases, 2131 guanine bases, 1642 uracil bases and 2365 cytosine bases. Which one of the following describes the genetic material of the virus?

- A. Single-stranded RNA
- B. Single-stranded DNA
- C. Double-stranded RNA
- D. Double-stranded dNA

TOPIC 2. CATABOLISM OF PURINE NUCLEOTIDES, DETERMINATION OF END PRODUCTS OF THEIR METABOLISM.

1. A patient suffering from gout was prescribed allopurinol. What pharmacological property of allopurinol provides therapeutic effect in this case?
 - A. Competitive inhibition of xanthine oxidase
 - B. Acceleration of nitrogen-containing substances excretion
 - C. Acceleration of pyrimidine nucleotides catabolism
 - D. Deceleration of pyrimidine nucleotides salvage
 - E. Acceleration of nucleic acids synthesis
2. A physician has an appointment with a 40-year-old patient complaining of recurrent pain attacks in his hallux joints and their swelling. Urine analysis revealed its marked acidity and pink color. What substances can cause such changes in urine?
 - A. Uric acid salt
 - B. Chlorides
 - C. Ammonium salts
 - D. Calcium phosphate
 - E. Magnesium sulfate
3. A 65-year-old man suffering from gout complains of pain in his kidneys. Ultrasonic examination revealed kidney stones. A certain substance in increased concentration can cause kidney stones formation. Name this substance:
 - A. Uric acid
 - B. Cholesterol
 - C. Bilirubin
 - D. Urea
 - E. Cystine
4. A 49-year-old man complains of pain in his metatarsophalangeal joints and joint deformation. In blood hyperuricemia can be observed. X-ray has revealed metatarsophalangeal joint space narrowing, erosion, periarticular calcification of the both joints, osteoporosis. Microscopy has revealed inflammatory granulomatous reaction surrounding necrotizing masses in the area of the first metatarsophalangeal joint. Choose the most likely diagnosis:
 - A. Gout
 - B. Pyrophosphate arthropathy
 - C. Rheumatoid arthritis
 - D. Hyperparathyroidism
 - E. Urolithiasis
5. A 46-year-old female patient consulted a doctor about pain in the small joints of the upper and lower limbs. The joints are enlarged and shaped like thickened nodes. Serum test revealed an increase in urate concentration. This might be caused by a disorder in metabolism of:
 - A. Purines
 - B. Carbohydrates
 - C. Lipids
 - D. Pyrimidines
 - E. Amino acids

6. In cancer patients who have been continuously receiving methotrexate, the target cells of tumor with time become insensitive to this drug. In this case, gene amplification of the following enzyme is observed:

- A. Dihydrofolate reductase
- B. Thiaminase
- C. Deaminase
- D. Thioredoxin reductase
- E. –

7. Pterin derivatives (aminopterin and methotrexate) are the inhibitors of dihydrofolate reductase, so that they inhibit the regeneration of tetrahydrofolic acid from dihydrofolate. These drugs inhibit the intermolecular transfer of monocarbon groups, thus suppressing the synthesis of the following polymer:

- A. DNA
- B. Protein
- C. Homopolysaccharides
- D. Gangliosides
- E. Glycosaminoglycans

8. A 42-year-old male patient with gout has an increased blood uric acid concentration. In order to reduce the level of uric acid the doctor administered him allopurinol. Allopurinol is the competitive inhibitor of the following enzyme:

- A. Xanthine oxidase
- B. Adenosine deaminase
- C. Adenine phosphoribosyl transferase
- D. Hypoxanthine guanine phosphoribosyl transferase
- E. Guanine deaminase

9. Children with Lesch-Nyhan syndrome have a severe form of hyperuricemia accompanied by the formation of tophi, urate calculi in the urinary tracts, as well as serious neuro-psychiatric disorders. The cause of this disease is the reduced activity of the following enzyme:

- A. Hypoxanthine guanine phosphoribosyl transferase
- B. Xanthine oxidase
- C. Dihydrofolate reductase
- D. Thymidylate synthase
- E. Carbamoyl phosphate synthetase

10. A 46-year-old patient consulted a doctor complaining about joint pain that becomes stronger the day before the weather changes. Blood examination revealed an increased concentration of uric acid. The most probable cause of the disease is the intensified disintegration of the following substance:

- A. Adenosine monophosphate
- B. Cytidine monophosphate
- C. Uridine triphosphate
- D. Uridine monophosphate
- E. Thymidine monophosphate

11. In a child a physical and mental underdevelopment is observed. In urine is excreted large quantity of orotic acid. This hereditary disease is a result of the next metabolic disorder:

- A. Pyrimidine nucleotides synthesis

- B. Pyrimidine nucleotides breakdown
- C. Purine nucleotides synthesis
- D. Purine nucleotides breakdown
- E. Ornithine cycle of urea production

12. A 48-year-old patient complained about intense pain, slight swelling and reddening of skin over the joints, temperature rise up to 38°C. Blood analysis revealed high concentration of urates. This condition might be caused by disturbed metabolism of:

- A. Purines
- B. Collagen
- C. Cholesterol
- D. Pyrimidines
- E. Carbohydrates

13. An oncological patient was administered methotrexate. With the lapse of time the target cells of the tumor lost sensitivity to this preparation. We can observe changes in the gene expression of the following enzyme:

- A. Dihydrofolate reductase
- B. Thiminase
- C. Desaminase
- D. Folate oxidase
- E. Folate decarboxylase

14. A 65 year old man suffering from gout complains of kidney pain. Ultrasound examination revealed renal calculi. The most probable cause of calculi formation is the strengthened concentration of the following substance:

- A. Uric acid
- B. Cholesterol
- C. Bilirubin
- D. Urea
- E. Cystine

15. A doctor administered Allopurinol to a 26-year-old young man with the symptoms of gout. What pharmacological action of Allopurinol ensures therapeutic effect?

- A. By inhibiting uric acid synthesis
- B. By increasing uric acid excretion
- C. By inhibiting leucocyte migration into the joint
- D. By general anti-inflammatory effect
- E. By general analgetic effect

16. In one-month-old child an enhanced content of orotic acid in urine is detected, a child has diminished weight gain. What treatment must be undertaken in order to correct metabolic disorders?

- A. Injections of uridine
- B. Injections of adenosine
- C. Injections of guanosine
- D. Injections of thymidine
- E. Injections of histidine

17. An oncological patient had been administered methotrexate. With time target cells of the tumor lost sensitivity to this drug. At the same time the change in gene expression of the following enzyme is observed:

- A. Dehydropholate reductase
- B. Thiaminase
- C. Deaminase
- D. Pholateoxidase
- E. Pholate decarboxylase

18. A 1,7-year-old child with a developmental delay and manifestations of self-agression has the concentration of uric acid in blood at the rate of 1,96 millimole/l. What metabolic disorder is this typical for?

- A. Lesch-Nyhan syndrome
- B. Gout
- C. Acquired immunodeficiency syndrome
- D. Gierke's disease
- E. Cushing's basophilism

19. A patient has increased content of uric acid in his blood that is clinically presented by pain syndrome as a result of urate deposition in the joints. What process does this acid result from?

- A. Breakdown of purine nucleotides
- B. Lysis of pyrimidine nucleotides
- C. Heme catabolism
- D. Proteolysis
- E. Reutilization of purine bases

20. A 52-year-old man presents with fever and pain in the joints. Both of his first metatarsophalangeal articulations are deformed, swollen, and reddened. Blood urea is high. The patient is diagnosed with gout. What is the main developmental factor in the pathogenesis of this disease?

- A. Hyperuricemia
- B. Argininosuccinic aciduria
- C. Hyperazotemia
- D. Hyperaminoacidemia
- E. Citrullinuria

21. Purine ring biosynthesis occurs in ribose-5-phosphate through gradual accumulation of nitrogen and carbon atoms and closing of the rings. The source of ribose phosphate is the process of:

- A. Pentose phosphate cycle
- B. Glycolysis
- C. Glyconeogenesis
- D. Gluconeogenesis
- E. Glycogenolysis

22. An oncological patient was prescribed fluorouracil that is a competitive inhibitor of thymidine synthase. It inhibits the process of:

- A. Pyrimidine nucleotides synthesis
- B. Carbohydrate disintegration
- C. Purine nucleotides synthesis
- D. Purine nucleotides disintegration
- E. Lipids synthesis

23. Gout develops when purine nucleotide metabolism is disturbed. A doctor prescribed the patient allopurinol that is a competitive inhibitor of:

- A. Xanthine oxidase
- B. Succinate dehydrogenase
- C. Alcohol dehydrogenase
- D. Lactate dehydrogenase
- E. Hexokinase

24. A 72-year-old woman complains on pains in joints, restriction of movement in joints. The joints are swollen, looking as an enlarged knots. In blood and urine an increased concentration of uric acid is detected. What disease is characterized by these symptoms?

- A. Gout
- B. Alkaptonuria
- C. Pellagra
- D. Hepatitis
- E. Liver cirrhosis

25. A physician prescribed allopurinol to a patient suffering from gout. What pharmacological property of allopurinol provide a therapeutic effect in this case?

- A. Competitive inhibition of xanthine oxydase
- B. Acceleration of pyrimidine nucleotides catabolism.
- C. Increase of nitrogen-containing substances excretion.
- D. Decrease of pyrimidine nucleotides reutilization.
- E. Acceleration of nucleic acids biosynthesis

26. The decrease of uric acid concentration and the accumulation of xanthine and hypoxanthine were found in the blood of a 12-year-old boy. The genetic defect of the synthesis of what enzyme does it testifies to?

- A. Xanthine oxydase
- B. Arginase
- C. Ornithine carbamoyl transferase
- D. Urease
- E. Glycerol kinase

27. A 50-year-old patient is diagnosed with gout and there is hyperuricemia in his blood. The metabolism of what substances is disturbed?

- A. Purines
- B. Fats
- C. Amino acids
- D. Carbohydrates
- E. Pyrimidines

28. An 8-year-old boy suffers from Lesch-Nyhan's disease. The increased concentration of uric acid was determined in this blood. Which biochemical process disorder is the cause of this inherited disease?

- A. Salvage of purine nucleotides
- B. Synthesis of deoxyribonucleotides
- C. Synthesis of purine nucleotides
- D. Synthesis of pyrimidine nucleotides
- E. Degradation of pyrimidine nucleotides

29. Hereditary Lesch-Nyhan syndrome is characterized by combination of symptoms of gout and mental underdevelopment. This disease is caused by hereditary defect in the next metabolic pathway:

- A. Hypoxanthine and guanine reutilisation
- B. Urea cycle
- C. Pyrimidine nucleotides synthesis
- D. Pyrimidine nucleotides breakdown
- E. Purine nucleotides synthesis de novo

30. In a child a physical and mental underdevelopment is observed. In urine is excreted large quantity of orotic acid. This hereditary disease is a result of the next metabolic disorder:

- A. Pyrimidine nucleotides synthesis
- B. Purine nucleotides breakdown
- C. Ornithine cycle of urea production
- D. Purine nucleotides synthesis
- E. Pyrimidine nucleotides breakdown

31. A patient with a suspicion of gout was brought to a clinic. What biochemical analysis is it necessary to perform to confirm the diagnosis?

- A. Determination of uric acid level in the blood and urine.
- B. Determination of concentration of urea in the blood and urine.
- C. Determination of amino acids level in the blood.
- D. Determination of creatine level in the blood.
- E. Measurement of urease activity in the blood.

32. A patient complains of pain in the small joints. High concentration of uric acid is detected in his blood plasma. What pathology causes such changes?

- A. Gout
- B. Diabetes mellitus
- C. Phenylketonuria
- D. Lesch-Nyhan syndrome
- E. Diabetes insipidus

33. A 46-year-old patient consulted a doctor with complaints of soreness in the joints which increased when the weather changed. The increase of uric acid concentration was determined in his blood. The augmented degradation of which substance is the most credible cause of this state?

- A. AMP
- B. UTP
- C. CMP
- D. UMP
- E. TMP

34. A 65-year-old man, suffering from gout, complains of pains in the area of kidneys. Ultrasonic inspection revealed the presence of stones inside the kidneys. The raised concentration of which substance is the most credible cause of kidney stones formation in this case?

- A. Uric acid
- B. Cholesterol
- C. Bilirubin
- D. Urea

E. Cystine

35. A 58-year-old man was operated on prostate cancer. Three months later he underwent a course of radiotherapy and chemotherapy. The complex of medicinal preparations prescribed to the patient included 5-fluoro-deoxyuridine, which is a thymidylate synthase inhibitor. The synthesis of what biomolecule is blocked under the action of this medicine in the first place?

- A. DNA
- B. Protein
- C. mRNA
- D. rRNA
- E. tRNA

36. A 40-year-old woman consulted a doctor complaining of pain in the small joints of hands and feet. The joints are enlarged; they have the appearance of thickened knots. The increased level of urates is determined in the blood plasma. The cause of pathology is the disorder of metabolism of:

- A. Purines
- B. Ammo acids
- C. Carbohydrates
- D. Lipids
- E. Pyrimidines

37. In a 60-year-old man a surgical treatment of prostate cancer was performed, after which a course of chemotherapy with 5-fluorouracil was conducted. Biosynthesis of what vital important substances is blocked with this drug?

- A. DNA
- B. mRNA
- C. rRNA
- D. tRNA
- E. Protein

38. A 46-year-old man consulted a physician because of pains in small joints. The pains were intensified after the consumption of meat food. The patient was diagnosed with urolithiasis accompanied by uric acid accumulation. The treatment with allopurinol was prescribed. What enzyme is allopurinol competitive inhibitor of?

- A. Xanthine oxidase
- B. Urease
- C. Arginase
- D. Dihydrouracyl dehydrogenase
- E. Carbamoyl synthase

39. A physician evaluates a 42-year-old patient for fatigue. The patient is found to have an elevated white blood cell count and an enlarged spleen. A referral to an oncologist results in a diagnosis of chronic myelogenous leukemia. Treatment with hydroxyurea, a ribonucleotide reductase inhibitor, is begun. The normal function of ribonucleotide reductase is to catalyse which one of the following reactions?

- A. Convert ADP to dADP
- B. Form PRPP from adenosine diphosphate (ADP) and ribose
- C. Convert xanthine to uric acid
- D. Form carbamoylphosphate from glutamine, CO_2 , and two ATP molecules
- E. Convert guanosine to guanine and ribose 1-phosphate

40. Formation of thymidine nucleotides, which are used for the biosynthesis of DNA, begins from dUDP, which on the first stage is hydrolysed to dUMP, and thereafter methylated. What compound serves as the donor of methyl groups?

- A. Methylene tetrahydrofolate
- B. Lecithin
- C. Choline
- D. Methionine
- E. Carnitine

41. In reaction of transformation of ribose to deoxyribose in course of deoxyribonucleotide production for DNA biosynthesis participates a low molecular weight protein thioredoxine. It contains two SH groups, which in course of reaction are oxidized. What coenzyme is used in restoration of reduced form of thioredoxine?

- A. NADP H₂
- B. Coenzyme Q
- C. Glutathion
- D. NAD H₂
- E. AMP

42. A 7-year-old boy suffers from mental retardation and self-mutilation (e.g., biting through lip) and has an increased susceptibility to gout. These symptoms are characteristic of Lesch-Nyhan syndrome, which is due to a mutation in which of the following pathways?

- A. Salvage pathway for purines
- B. Salvage pathway for pyrimidines
- C. Pathway of uric acid synthesis
- D. De novo biosynthesis of purines
- E. De novo biosynthesis of pyrimidines

43. A 58-year-old man is awakened by a throbbing ache in his great toe. He has suffered these symptoms before, usually after indulging in a rich meal. On examination, he is noted to have a greatly inflamed great toe; also of note are several small nodules on the antihelix of his ear. Inhibition of which of the following proteins might prevent further occurrences of this man's ailments?

- A. Xanthine oxidase
- B. Carbamoyl phosphate synthetase
- C. HGPRT
- D. Orotate phosphoribosyl transferase
- E. PRPP synthetase

44. Nitrosamines are considered as deaminating mutagenic agents. What nitrogenous base is transformed to uracil after deamination with these mutagens?

- A. Cytosine
- B. Adenine
- C. Guanine
- D. Thymine
- E. Methyluracil

45. A 56-year-old diabetic patient with end-stage renal disease receives a kidney transplant from his son. His nephrologist is concerned about the possibility of transplant

rejection and puts the patient on mycophenolic acid, which inhibits which important enzyme in the synthesis of nucleotides?

- A. IMP dehydrogenase
- B. PRPP synthetase
- C. Adenylosuccinate synthetase
- D. Ribonucleotide reductase
- E. Adenylosuccinate lyase

46. Xanthine oxidase is a metalloenzyme and contains the following metal ion as cofactor:

- A. Molybdenum
- B. Copper
- C. Iron
- D. Zinc
- E. Mangan

47. In urine of monthly child was detected the enchanced quantity of orotic acid. A child gains body mass badly. What substances should be used for correction of metabolism?

- A. Uridine
- B. Adenosine
- C. Guanosine
- D. Thymine
- E. Histidine

48. The products of xanthine oxidase reaction include one of the following compound:

- A. Hydrogen peroxide
- B. Urea
- C. Allantoin
- D. CO₂
- E. Superoxide anion

49. A 13-year-old boy with intellectual disability is brought to the doctor because of strong pain in joints. During the examination, his doctor notices that the boy makes uncontrollable self-injury. His blood analysis reveals increased concentration of uric acid. Which of the following is the most likely cause of these findings?

- A. Absence of hypoxantine guanine phosphoribosyl transferase
- B. Deficiency of xanthine oxidase
- C. Absence of dihydrofolate reductase
- D. Increased activity of thymidylate synthase
- E. Absence of carbamoyl phosphates

TOPIC 3 REPLICATION OF DNA AND TRANSCRIPTION OF RNA. ANALYSIS OF MUTATIONS AND MECHANISMS OF DNA REPARATIONS

1. T-lymphocytes are determined to be affected with HIV. In this case viral enzyme reverse transcriptase (RNA-dependent DNA-polymerase) catalyzes the synthesis of:
 - A. DNA based on the viral RNA matrix
 - B. Viral RNA based on the DNA matrix
 - C. Viral protein based on the viral RNA matrix
 - D. Viral DNA based on the DNA matrix
 - E. Informational RNA based on the viral protein matrix
2. Parents of a sick 5-year-old girl visited a genetic consultation. Karyotype investigation revealed 46 chromosomes. One chromosome of the 15th pair was abnormally long, having a part of the chromosome belonging to the 21st pair attached to it. What mutation occurred in this girl?
 - A. Translocation
 - B. Deletion
 - C. Inversion
 - D. Deficiency
 - E. Duplication
3. Cells of a person working in the Chernobyl Exclusion Zone have undergone a mutation in DNA molecule. However, with time the damaged interval of DNA molecule has been restored to its initial structure with a specific enzyme. In this case the following occurred:
 - A. Repair
 - B. Replication
 - C. Transcription
 - D. Reverse transcription
 - E. Translation
4. During cell division DNA replication occurs after a signal is received from the cytoplasm, then a certain portion of the DNA helix unwinds and splits into two individual strands. What enzyme facilitates this process?
 - A. Helicase
 - B. RNA polymerase
 - C. Ligase
 - D. Restrictase
 - E. DNA polymerase
5. An experiment proved that UV irradiated skin cells of patients with xeroderma pigmentosum restore the native structure of DNA slower than the cells of healthy people due to the defect in repair enzyme. What enzyme takes part in this process?
 - A. Endonuclease
 - B. RNA ligase
 - C. Primase
 - D. DNA polymerase
 - E. DNA gyrase
6. It was found out that some compounds, for instance fungi toxins and some antibiotics can inhibit activity of RNA-polymerase. What process will be disturbed in a cell in case of inhibition of this enzyme?
 - A. Transcription

- B. Processing
- C. Replication
- D. Translation
- E. Reparation

7. You are studying functioning of a bacteria operon. The operator gene has been released from the repressor gene. Immediately after this the following process will start in the cell:

- A. Transcription
- B. Translation
- C. Replication
- D. Processing
- E. Repression

8. It was proved that a molecule of immature mRNA (precursor mRNA) contained more triplets than amino acids found in the synthesized protein. The reason for that is that translation is normally preceded by:

- A. Processing
- B. Initiation
- C. Reparation
- D. Mutation
- E. Replication

9. It was revealed that T-lymphocytes were affected by HIV. Virus enzyme reverse transcriptase (RNA-dependent DNA polymerase) - catalyzes the synthesis of:

- A. DNA on the matrix of virus mRNA
- B. Virus informational RNA on the matrix of DNA
- C. DNA on virus ribosomal RNA
- D. Viral DNA on DNA matrix
- E. mRNA on the matrix of virus protein

10. RNA-polymerase B(II) is blocked due to amanitine poisoning (poison of deathcup). It disturbs:

- A. Synthesis of m-RNA
- B. Synthesis of t-RNA
- C. Reversetranscription
- D. Primerssynthesis
- E. Maturation of m-RNA

11. Into human body were incorporated mercury ions. This led to the increase in rate of transcription of the gene, responsible for detoxification of heavy metals. What protein gene amplification is in the background of this process?

- A. Metallothioneine
- B. Ceruloplasmin
- C. Interferone
- D. Transferrin
- E. Ferritin

12. In the course of evolution there developed molecular mechanisms for correction of damaged DNA molecules. This process is called:

- A. Reparation
- B. Transcription

- C. Translation
- D. Replication
- E. Processing

13. Under the influence of physical factors there can develop defects in a DNA molecule. Ultraviolet irradiation, for instance, can cause development of dimers. Dimers are two adjacent pyrimidine bases joined together. Name these bases:

- A. Thymine and cytosine
- B. Adenine and thymine
- C. Guanine and cytosine
- D. Adenine and guanine
- E. Guanine and thymine

14. Patients suffering from xeroderma pigmentosum have extremely photosensitive skin due to disrupted excision repair. Specify the process that is affected in such patients:

- A. Repair of DNA molecule
- B. Synthesis of rRNA
- C. Maturation of rRNA
- D. Synthesis of protein primary structure
- E. Intron extraction and exon connection

15. As a result of treatment of viral RNA with nitrous acid, UCA triplet mutated to UGA triplet. What kind of mutation occurred?

- A. Transition
- B. Nucleotide deletion
- C. Missense
- D. Nucleotide insertion
- E. Inversion

16. Prokaryotic cell division is different from that of eukaryotic, but there is one molecular process that is the basis of both types of division. Name this process.

- A. DNA replication
- B. Transcription
- C. Reparation
- D. Translation
- E. Gene amplification

17. In some areas of South Africa many people have sickle cell disease characterized by red blood cells that assume an abnormal sickle shape due to the substitution of glutamic acid for valine in the hemoglobin molecule. What is the cause of this disease?

- A. Gene mutation
- B. Disturbances of the mechanisms of genetic information transmission
- C. Crossing-over
- D. Genomic mutation
- E. Transduction

18. During reproduction of some RNA-containing viruses that cause tumors in animals, genetic information can be transmitted in the opposite direction from the RNA to the DNA via a specific enzyme. The enzyme of reverse transcription is called:

- A. Reverse transcriptase
- B. DNA polymerase
- C. Ligase

- D. Primase
- E. Topoisomerase

19. DNA replication occurs during the cell division when a signal is received from the cytoplasm, and a certain portion of the DNA helix is unwound and divided into two chains. The helix is unwound by the following enzyme:

- A. Helicase
- B. Restrictase
- C. DNA polymerase
- D. RNA polymerase
- E. Ligase

20. Skin of patients with pigment xeroderma is very sensitive to the sun radiation, there is a risk of skin cancer development. The reason for this is hereditary deficiency of UV endonuclease. As a result of this defect the following process is disturbed:

- A. DNA reparation
- B. Transcription
- C. DNA replication
- D. Translation
- E. Initiation

21. Inside a human cell the informational RNA containing both exons and introns was delivered to the granular endoplasmic reticulum to the ribosomes. What process does NOT take place?

- A. Processing
- B. Replication
- C. Transcription
- D. Translation
- E. Prolongation

22. Blood of a child and putative father was referred to forensic medical examination for affiliation. What chemical components should be identified in the blood under study?

- A. DNA
- B. Transfer RNA
- C. Ribosomal RNA
- D. MessengerRNA
- E. SnRNA

23. A group of researchers set an experiment and obtained a nucleate mutant cells. In the first place they will have disturbed synthesis of the following compounds:

- A. Ribosomal RNA
- B. Transfer RNA
- C. Lipids
- D. Monosaccharides
- E. Polysaccharides

24. In a genetical laboratory in course of work with DNA molecules of white rats of Wistar's line a nucleotide was substituted for another one. At that only one amino acid was substituted in the peptide. This result is caused by the following mutation:

- A. Transversion
- B. Deletion
- C. Duplication

- D. Displacement of reading frame
- E. Translocation

25. General structure of eukaryotic genes is as follows: exon-intron-exon. Such functional structure of a gene leads to certain specifics of the transcription process. What sequence will correspond with precursor mRNA (immature)?

- A. Exon-intron-exon
- B. Exon-exon-intron
- C. Exon-exon
- D. Intron-exon
- E. Exon-intron

26. A mutation has occurred in a cell in the first exon of the structural gene. The number of nucleotide pairs changed from 290 to 250. Name this type of mutation:

- A. Deletion
- B. Inversion
- C. Duplication
- D. Translocation
- E. Nullisomy

27. A man is a carrier of HIV that is an RNA virus. The cells of this patient synthesize viral DNA. This process is based on:

- A. Reverse transcription
- B. Replication
- C. Transcription
- D. Repair
- E. Translation

28. RNA of AIDS virus invaded leukocyte and caused production of viral DNA in a cell with the aid of the enzyme revertase. This is based on the next process:

- A. Reversed transcription
- B. Operone activation
- C. Operone repression
- D. Convariant replication
- E. Reversed translation

29. In oncology patients prolong application of antitumor drugs induce appearance of resistance of target cells to this drugs. What process is responsible for this effect?

- A. Gene amplification
- B. Gene recombination
- C. Gene modification
- D. Gene expression
- E. Gene mutation

30. Oncology patient was administered an antitumor drug – methotrexate. After some period tumor cells lost sensitivity to this drug. What gene amplification caused this effect?

- A. Dihydrofolate reductase
- B. Glutathion reductase
- C. Thioredoxine reductase
- D. Ribonucleotide reductase
- E. Methemoglobin reductase

31. Molecular analysis of patient's hemoglobin suffering from anemia revealed change of amino acid Glu 6 for Val-6 in B-chain. What is the molecular mechanism of this pathology?

- A. Gene mutation
- B. Gene transduction
- C. Chromosomal mutation
- D. Genome mutation
- E. Gene amplification

32. For the treatment of urogenital infections are used quinolons – inhibitors of the enzyme DNA-gyrase. What process is damaged under the influence of quinolons first of all?

- A. Replication
- B. Gene amplification
- C. Reversed transcription
- D. Reparation
- E. Gene recombination

33. In a patient a disease “xeroderma pigmentosum” was recognized. His skin is extremely sensitive to direct sunlight. Hereditary disorder in biosynthesis of what specific enzyme causes this disease?

- A. Endonuclease
- B. Exonuclease
- C. RNA Polymerase I
- D. Glycosidase
- E. DNA-ligase

34. Ability to divide is characteristic of procariotic and eukaryotic cells. Procariotic cell division is different from that of eukaryotic, but there is one molecular process that is the basis of both types of division. Name this process.

- A. DNA replication
- B. Transcription
- C. Reparation
- D. Translation
- E. Gene amplification

35. A 23-year-old man presents to his family physician with a painless swelling of his testicles. An ultrasound is suspicious for a neoplasm, and a biopsy confirms the presence of cancer. He is referred to an oncologist, who begins treatment with the topoisomerase inhibitor etoposide. The normal function of this enzyme is to do which of the following?

- A. Break and rejoin the DNA helix during replication
- B. Synthesize RNA primers for DNA polymerase
- C. Prevent the single strands of DNA from reannealing during replication
- D. Repair nuclear DNA in the event of DNA damage
- E. Unwind the DNA helix during replication

36. A 37-year-old immigrant from Thailand develops fevers, night sweats, weight loss, and a blood-tinged cough. He present to the emergency room, where an infectious disease doctor is consulted and immediately prescribes a multidrug regimen that includes rifampin. Rifampin inhibits which one of the following types of enzymes?

- A. DNA-dependent RNA polymerase
- B. DNA-dependent DNA polymerase
- C. RNA-dependent DNA polymerase
- D. RNA-dependent RNA polymerase
- E. Reverse transcriptase

37. Two couples present to the emergency room with severe nausea, vomiting, and diarrhea. One of the patients admits that she had a dinner party and served a salad containing mushrooms she had picked during haikai the forest earlier that day. Inhibition of which enzyme or process explains the clinical manifestations of a-amanitin poisoning seen in these patients

- A. RNA polymerase II
- B. RNA splicing
- C. RNA polymerase I
- D. RNA polyadenylation
- E. RNA polymerase III

38. A 4-year-old child, on a well-child check-up, is found to have a large flank mass. Computed tomography demonstrates a large mass arising from the kidney, and a subsequent biopsy reveals a diagnosis of Wilms tumor. A pediatric oncologist starts chemotherapy including the transcription inhibitor actinomycin D. Which of the following statements is correct regarding transcription regulation in bacteria?

- A. The TATA box contains a consensus sequence for the binding of RNA polymerase.
- B. All mRNAs are monocistronic
- C. The RNA chain grows in the 3' to 5' direction
- D. RNA polymerase requires a primer
- E. Rho factor is critical for initiation of RNA synthesis

39. A 20-year-old anemic man is found to have an abnormal form of β -globin (Hemoglobin Constant Spring) that is 172 amino acids long, rather than the 141 found in the normal protein. Which of the following point mutations is consistent with this abnormality?

- A. UAA \rightarrow CAA
- B. UAA \rightarrow UAG
- C. CGA \rightarrow UGA
- D. GAU \rightarrow GAC
- E. GCA \rightarrow GAA.

40. Scientists were running the gene experiments on *Escherichia coli*. For the of these experiments, they inserted a segment of human DNA into the circular genome of bacteria. To accomplish this, they used a restriction enzyme, which is known for its ability to cut DNA at palindromic sequences. Which of the following is a palindromic sequence of DNA?

- A. GTGTACAC
- B. CGCAGAGC
- C. CGTCGC
- D. ATTAGGAT
- E. TATAAG

42. A 34-year-old woman found mushrooms in the forest near her home. A few hours after eating cooked mushrooms, she experienced colicky abdominal pain, vomiting,

diarrhea, and nausea. She has driven herself to the emergency department with these mushrooms. The mushrooms were identified as *Amanita phalloides*. Which of the following enzymes did the toxin present in these mushrooms inhibit?

- A. RNA polymerase II
- B. Helicases
- C. RNA polymerase I
- D. Topoisomerase
- E. RNA primase

43. Scientists are investigating the antineoplastic properties of an existing medication. In an in vitro experiment, cancer cells are exposed to this drug and observed over time. Cells exposed to the drug are found to be uniformly arrested in metaphase with intact mitotic spindles. Which of the following drugs most likely was used in this experiment?

- A. Paclitaxel
- B. 5-Fluorouracil
- C. Vincristine
- D. Bleomycin
- E. Cyclophosphamide

44. Scientists are investigating the genetic causes of β -thalassemia in 50 patients. In one of these patients, molecular tests showed a single nucleotide substitution in a large noncoding intervening sequence. This patient's β -globin gene was cloned and further purified by electrophoresis, which shows a significantly shortened β -globin protein. The mutation responsible for this patient's β -thalassemia most likely leads to a defect during which of the following processes?

- A. Posttranscriptional modification
- B. Transcription
- C. Meiosis
- D. Posttranslational modification
- E. Replication

TOPIC № 4. BIOSYNTHESIS OF PROTEINS ON RIBOSOMES, INITIATION, ELONGATION AND TERMINATION IN SYNTHESIS OF POLYPEPTIDE CHAIN.

1. Infectious diseases are treated with antibiotics (streptomycin, erythromycin, chloramphenicol). They inhibit the following stage of protein synthesis:
 - A. Translation
 - B. Transcription
 - C. Replication
 - D. Processing
 - E. Splicing
2. At the stage of translation in the rough endoplasmic reticulum, the ribosome moves along the mRNA. Amino acids are joined together by peptide bonds in a specific sequence, and thus polypeptide synthesis takes place. The sequence of amino acids in a polypeptide corresponds to the sequence of:
 - A. mRNA codons
 - B. tRNA nucleotides
 - C. tRNA anticodons
 - D. rRNA anticodons
 - E. rRNA nucleotides
3. A patient's organism has decreased concentration of magnesium ions that are necessary for attachment of ribosomes to the granular endoplasmic reticulum. It is known that this causes protein biosynthesis disturbance. What stage of protein biosynthesis will be disturbed?
 - A. Translation
 - B. Transcription
 - C. Amino acid activation
 - D. Replication
 - E. Termination
4. In diphtheria infection an inhibition of translation process in ribosomes is observed due to inactivation of eEF-2 and blocking the translocation of polypeptide from A site to P-site of ribosome. What enzyme cause inactivation of eEF-2?
 - A. ADP-ribosyl transferase
 - B. EEF-2 –protein kinase
 - C. Peptidyl transferase
 - D. Peptidyl translocase
 - E. Hypoxanthine, guanin-phosphoribosyl transferase
5. What enzyme is used for synthesis of genes from template RNA or DNA in gene engineering? (This enzyme was discovered in some RNA containing viruses).
 - A. Revertase
 - B. Exonuclease
 - C. Endonuclease
 - D. Topoisomerase I
 - E. Helicase
6. In a patient was recognized endemic goiter. What type of post-translational modification of thyroglobuline is damaged in a patient?
 - A. Iodination
 - B. Phosphorylation

- C. Methylation
- D. Acetylation
- E. Glycosylation

7. Genetic information is stored in DNA, which does not participate directly in protein synthesis in the cell. What process provides the transformation of genetic information into amino acid sequence of polypeptide chain?

- A. Translation
- B. Translocation
- C. Transcription
- D. Replication
- E. Splicing

8. The inherited information is saved in DNA, though directly in the synthesis of protein in a cell it does not participate. What process provides the realization of the inherited information in a polypeptide chain?

- A. Translation
- B. Transcription
- C. Translocation
- D. Replication
- E. Transformation

9. Redundancy (degeneracy) of the genetic code means that:

- A. A given base triplet can code for more than one amino acid
- B. There is no punctuation in the code sequences
- C. The third base in codon is not important in coding
- D. A given amino acid can be coded for by more than one base triplet
- E. Codons are not ambiguous

10. A human genome contains about 30000 genes, and the amount of variants of antibodies reaches millions. What mechanism is used for the formation of new genes that are responsible for the synthesis of such amount of antibodies?

- A. Recombination of genes
- B. Amplification of genes
- C. Replication of DNA
- D. Reparation of DNA
- E. Formation of Okazaki fragments

11. During cell analysis, their cytoplasm was determined to have high content of aminoacyl tRNA synthetase. This enzyme ensures the following process:

- A. Amino acid activation
- B. Repair
- C. Elongation
- D. Transcription
- E. Replication

12. One of the protein synthesis stages is recognition. The first iRNA triplet starts with UAU triplet. What complementary triplet is found in tRNA?

- A. AUA
- B. AAA
- C. GUG
- D. UGU

E. CUC

13. A patient has decreased concentration of magnesium ions that are required for ribosomes connection to granular endoplasmic reticulum. This condition is known to disturb the process of protein biosynthesis. Disturbance occurs at the following stage:

- A. Translation
- B. Transcription
- C. Replication
- D. Amino acids activation
- E. Processing

14. Streptomycin and other aminoglycosides prevent the joining of formylmethionyl-tRNA by bonding with the 30S ribosomal subunit. This effect leads to disruption of the following process:

- A. Translation initiation in procaryotes
- B. Translation initiation in eucaryotes
- C. Transcription initiation in procaryotes
- D. Transcription initiation in eucaryotes
- E. Replication initiation in procaryotes

15. A young family came for a genetic counseling to identify the father of their child. The husband insists that the child does not resemble him at all and cannot possibly be his. Polymerase chain reaction method for person identification is based on the following:

- A. Gene amplification
- B. Nucleotide deletion
- C. Genetic recombination
- D. Missense mutation
- E. Transduction

16. Amino acids join to each other in ribosomes of granular endoplasmic reticulum. Knowing the sequence of amino acids and applying genetic code, it is possible to determine the sequence of nucleoids in:

- A. mRNA
- B. Introns
- C. Proteins
- D. Carbohydrates
- E. rRNA

17. Genetic information is stored in DNA but does not participate directly in protein synthesis within DNA cells. What process ensures transfer of genetic information into polypeptide chain?

- A. Translation
- B. Formation of rRNA
- C. Formation of tRNA
- D. Formation of iRNA
- E. Replication

18. A cell of granular endoplasmic reticulum is at the stage of translation, when mRNA advances to the ribosomes. Amino acids get bound by peptide bonds in a certain sequence thus causing polypeptide biosynthesis. The sequence of amino acids in a polypeptide corresponds with the sequence of:

- A. mRNA codons

- B. tRNA nucleotides
- C. tRNA anticodons
- D. rRNA nucleotides
- E. rRNA anticodons

19. It is known that information about sequence of amino acids in a protein molecule is encoded as a sequence of four types of nucleotides in a DNA molecule, and different amino acids are encoded by different number of triplets - from one to six. Such peculiarity of the genetic code is called:

- A. Degeneracy
- B. Universality
- C. Nonoverlapping
- D. Tripletty
- E. Specificity

20. A 27-year-old man is seen by his physician for a week-long cough, sore throat, and difficulty swallowing. He is diagnosed with diphtheria, which has reactivated because of waning immunity. One way in which diphtheria toxin leads to cell death is through the inhibition of eEF-2. Which statement best explains the function of eEF-2?

- A. It is required for the translocation of peptidyl-tRNA during translation
- B. It is required for the initiation of protein synthesis
- C. It is the agent that binds to, and is inactivated by, chloramphenicol
- D. It functions as a peptidyl transferase
- E. It is analogous to the prokaryotic factor eIF-1

21. A PCR assay needs to be developed to determine the HIV status of a newborn in the pediatric intensive care unit whose mother is HIV positive. Which set of primers should be used for the assay?

- A. The primers should be designed with identical sequences to those in the HIV genome and must bind to DNA in a complementary, antiparallel manner
- B. The primers should consist of antiparallel complements of two parts of a noninfected human genome
- C. The primers should be synthesized so that, after annealing with potential infective DNA, the 5' end of both primers "face" each other.
- D. The primers should be designed to be synthesized with dideoxynucleotides to allow sequencing of the mutation.
- E. The primers should be designed so that, after annealing with potential infective DNA, the 5' end of primer 1 would "face" the 3' end of primer 2.

22. An 8-year old boy is treated with Ciprofloxacin for some respiratory infection. Which of the following enzyme activity is most directly affected by this drug?

- A. Topoisomerase
- B. DNA polymerase
- C. Reverse transcriptase
- D. RNA polymerase
- E. DNA-ligase

23. In order to study or detect individual genes or specific DNA regions or mutations of interest, it is often necessary to obtain a large quantity of nucleic acid for study. Which of the following techniques is primarily undertaken to amplify DNA?

- A. PCR
- B. Northern Blotting

- C. Western Blotting
- D. Southern Blotting
- E. ELISA

24. The same codons are used to code for the same amino acids in all the living organisms. This feature of genetic code is known as:

- A. Universality
- B. Specificity
- C. Non-overlapping
- D. Degenerate
- E. Commaless

25. The genetic code is the set of rules by which information encoded in genetic material is translated into proteins by living cells. A particular codon always codes for the same amino acid. This feature of genetic code is known as:

- A. Specificity
- B. Universality
- C. Non-overlapping
- D. Degenerate
- E. Polarity

26. Translation is a complex process and it has become a favorite target for inhibition by antibiotics. Majority of the antibiotics interfere with the bacterial protein synthesis and are harmless to higher organisms. Explain the mechanism of action of tetracycline.

- A. It inhibits the binding of aminoacyl tRNA to the ribosomal complex
- B. It causes misreading of mRNA and interferes with the normal pairing between codons and anticodons.
- C. It enters the A site of ribosome and gets incorporated into the growing peptide chain and causes its release
- D. It acts as a competitive inhibitor of the enzyme peptidyl transferase
- E. It inhibits translocation by binding with 50S subunit of bacterial ribosome

27. Post-translational modification refers to the covalent and generally enzymatic modification of proteins following protein biosynthesis. In post-translation modification of nascent protein chain are involved the following proteins:

- A. Chaperons 60 K
- B. Cathepsins
- C. Caspases
- D. Cytochrome c
- E. Ubiquitin

28. Genetic code refers to the relationship between the sequence of nitrogenous bases (UCAG) in mRNA and the sequence of amino acids in a polypeptide chain. What amino acid is coded by the triplet of bases AUG?

- A. Methionine
- B. Serine
- C. Tyrosine
- D. Cysteine
- E. Valine

29. Which of the following toxins inhibits eukaryotic protein synthesis through the inactivation elongation factor eEF₂?

- A. Diphtheria toxin
- B. Ricin
- C. Sarcin
- D. Puromycin
- E. Cycloheximide

30. O-linked glycosylation is one of the types of post-translational modification of proteins. It is the attachment of a sugar molecule to the oxygen atom of serine (Ser) or threonine (Thr) amino acids in a protein destined for secretion from the cell. Glycosylation proceeds in which of the following cell compartment:

- A. Golgi vesicles
- B. Mitochondria
- C. Lysosomes
- D. Proteasomes
- E. Ribosomes

31. Restrictases are enzymes of bacterial origin, which are used in recombinant DNA technology. They belong to the next class of enzymes:

- A. Hydrolases
- B. Oxido-reductases
- C. Transferases
- D. Liases
- E. Isomerases

32. Gene amplification is an increase in the number of copies of a gene without a proportional increase in other genes. This can result from duplication of a region of DNA that contains a gene through errors in DNA replication and repair machinery as well as through fortuitous capture by selfish genetic elements. Which of the following techniques is used for the amplification of genes?

- A. Polymerase chain reaction (PCR)
- B. DNA fingerprint analysis
- C. Southern blot analysis
- D. Northern blot analysis
- E. Restriction fragment length polymorphism (RFLP) analysis

33. A pharmaceutical company is studying a new antibiotic that inhibits bacterial protein synthesis. When this antibiotic is added to an in vitro protein synthesis system that is translating the mRNA sequence AUGUUUUUUUAG, the only product formed is the dipeptide fMet-Phe. What step in protein synthesis is most likely inhibited by the antibiotic?

- A. Ribosomal translocation
- B. Initiation
- C. Binding of charged tRNA to the ribosomal A site
- D. Peptidyltransferase activity
- E. Termination.

34. Degeneration of the genetic code is the ability of more than one triplet to encode a single amino acid. Which amino acid is encoded by only one triplet?

- A. Methionine.
- B. Serine.
- C. Alanine.
- D. Leucine.

E. Lysine.

35. A tRNA molecule that is supposed to carry cysteine (tRNA^{cys}) is mischarged, so that it actually carries alanine (ala-tRNA^{cys}). Assuming no correction occurs, what will be the fate of this alanine residue during protein synthesis?

- A. It will be incorporated into a protein in response to a cysteine codon
- B. It will be incorporated into a protein in response to an alanine codon
- C. It will remain attached to the tRNA, as it cannot be used for protein synthesis
- D. It will be incorporated randomly at any codon
- E. It will be chemically converted to cysteine by cellular enzymes.

36. Translation is a complex process and it has become a favorite target for inhibition by antibiotics. Majority of the antibiotics interfere with the bacterial protein synthesis and are harmless to higher organisms. Explain the mechanism of action of puromycin.

- A. It enters the A site of ribosome and gets incorporated into the growing peptide chain and causes its release
- B. It causes misreading of mRNA and interferes with the normal pairing between codons and anticodons.
- C. It inhibits the binding of aminoacyl tRNA to the ribosomal complex
- D. It acts as a competitive inhibitor of the enzyme peptidyl transferase
- E. It inhibits translocation by binding with 50S subunit of bacterial ribosome

37. Protein synthesis rates in procaryotes are limited by the rate of mRNA synthesis. If RNA synthesis occurs at the rate of 50 nucleotides/sec, then rate of protein occurs at:

- A. 17 amino acids/sec
- B. 10 amino acids/sec
- C. 25 amino acids/sec
- D. 50 amino acids/sec
- E. 100 amino acids/sec

38. What enzyme allows for synthesis of various genes from template-RNA to DNA in genetic engineering (this enzyme catalyzes the process discovered in RNA-viruses)?

- A. Reverse transcriptase
- B. Exonuclease
- C. DNA-ligase
- D. Helicase
- E. Endonuclease

39. Interferon was named for its ability to interfere with viral proliferation. The various forms of interferon are the body's most rapidly produced and important defense against viruses. Interferons can also combat bacterial and parasitic infections, inhibit cell division, and promote or impede the differentiation of cells. What is the mechanism of interferon action?

- A. Protein synthesis depression
- B. Protein synthesis increase
- C. Replication activation
- D. Transcription activation
- E. Repair activation

40. In a patient with cystic fibrosis caused by the $\Delta F508$ mutation, the mutant cystic fibrosis transmembrane conductance regulator (CFTR) protein folds incorrectly. The patient's cells modify this abnormal protein by attaching ubiquitin molecules to it. What

is the fate of this modified CFTR protein?

- A. It is degraded by the proteasome
- B. It performs its normal function, as the ubiquitin largely corrects for the effect of the mutation
- C. It is secreted from the cell
- D. It is placed into storage vesicles
- E. It is repaired by cellular enzymes

41. A 21-years-old man presents to the hospital with a 1-week history of headaches, fever, chills, and nonproductive cough. Vital signs are: temperature 38.2°C, blood pressure 102/76 mm Hg, heart rate 96, respiratory rate 20, and oxygen saturation 92% on room air. Rales and diffuse wheezes are auscultated bilaterally on lung examination. A chest x-ray reveals a fluffy bilateral infiltrates. An antibiotic is prescribed. Which of the following is the mechanism of action of the antibiotic used to treat this patient's infection?

- A. Inhibiting protein synthesis by blocking the translocation of the peptide chain
- B. Forming free radical toxic metabolites that damage bacterial cell DNA
- C. Blocking the transpeptidase cross-linkage of cell walls
- D. Inhibiting mycolic acid synthesis
- E. Inhibiting DNA-dependent RNA polymerase

TOPIC 5. MOLECULAR AND CELLULAR MECHANISMS OF ACTION OF PROTEIN AND PEPTIDE HORMONES ON TARGET CELLS. MECHANISM OF HORMONAL ACTION OF AMINO ACID DERIVATIVES AND BIOGENIC AMINES. HORMONAL REGULATION OF CALCIUM HOMEOSTASIS.

1. After a case of sepsis a 27-year-old woman developed "bronzed" skin discoloration characteristic of Addison's disease. Hyperpigmentation mechanism in this case is based on increased secretion of:

- A. Melanocyte-stimulating hormone
- B. Somatotropin
- C. Gonadotropin
- D. β -lipotropin
- E. Thyroid-stimulating hormone

2. During removal of the hyperplastic thyroid gland of a 47-year-old woman, the parathyroid gland was damaged. One month after the surgery the patient developed signs of hypoparathyroidism: frequent convulsions, hyperreflexia, laryngospasm. What is the most likely cause of the patient's condition?

- A. Hypocalcemia
- B. Hyponatremia
- C. Hyperchlorhydria
- D. Hypophosphatemia
- E. Hyperkalemia

3. Atria of a test animal were superdistended with blood, which resulted in decreased reabsorption of Na and water in renal tubules. This can be explained by the effect of the following factor on the kidneys:

- A. Natriuretic hormone
- B. Aldosterone
- C. Renin
- D. Angiotensin
- E. Vasopressin

4. To stimulate the labor activity a parturient woman was prescribed a drug - a posterior pituitary hormone that does not affect the blood pressure. As the pregnancy progresses, the sensitivity to this hormone increases. Name the prescribed drug:

- A. Oxytocin
- B. Dinoprostone
- C. Dinoprost
- D. Pituitrin
- E. Ergotal

5. A 30-year-old woman complains of intense thirst and dryness of the mouth that developed after a severe emotional shock. Laboratory analysis revealed increase of the patient's blood sugar level up to 10 mmol/L. What endocrine gland is affected in the patient?

- A. Pancreas
- B. Thyroid gland
- C. Gonads
- D. Adrenal glands
- E. Pineal gland

6. Corticosteroid hormones regulate the adaptation processes of the body as a whole to environmental changes and ensure the maintenance of internal homeostasis. What hormone activates the hypothalamo-pituitary-adrenal axis?

- A. Corticoliberin
- B. Somatoliberin
- C. Somatostatin
- D. Corticostatin
- E. Thyroliberin

7. A 41-year-old man has a history of recurrent attacks of heartbeats (paroxysms), profuse sweating, headaches. Examination revealed hypertension, hyperglycemia, increased basal metabolic rate, and tachycardia. These clinical presentations are typical of the following adrenal pathology:

- A. Hyperfunction of the medulla
- B. Hypofunction of the medulla
- C. Hyperfunction of the adrenal cortex
- D. Hypofunction of the adrenal cortex
- E. Primary aldosteronism

8. A comatose patient was taken to the hospital. He has a history of diabetes mellitus. Objectively: Kussmaul breathing, low blood pressure, acetone odor of breath. After the emergency treatment the patient's condition improved. What drug had been administered?

- A. Insulin
- B. Adrenaline
- C. Isadrinum
- D. Glibenclamide
- E. Furosemide

9. A patient with signs of osteoporosis and urolithiasis has been admitted to the endocrinology department. Blood test revealed hypercalcemia and hypophosphatemia. These changes are associated with abnormal synthesis of the following hormone:

- A. Parathyroid hormone
- B. Calcitonin
- C. Cortisol
- D. Aldosterone
- E. Calcitriol

10. As a result of a home injury, a patient suffered a significant blood loss, which led to a fall in blood pressure. Rapid blood pressure recovery after the blood loss is provided by the following hormones:

- A. Adrenaline, vasopressin
- B. Cortisol
- C. Sex hormones
- D. Oxytocin
- E. Aldosterone

11. A child has abnormal formation of tooth enamel and dentin as a result of low concentration of calcium ions in blood. Such abnormalities might be caused by deficiency of the following hormone:

- A. Parathormone
- B. Thyrocalcitonin
- C. Thyroxin
- D. Somatotropic hormone
- E. Triiodothyronine

12. A man has a considerable decrease in diuresis as a result of 1.5 l blood loss. The primary cause of such diuresis disorder is the hypersecretion of the following hormone:

- A. Vasopressin
- B. Corticotropin
- C. Natriuretic
- D. Cortisol
- E. Parathormone

13. Before the cells can utilize the glucose, it is first transported from the extracellular space through the plasmatic membrane inside them. This process is stimulated by the following hormone:

- A. Insulin
- B. Glucagon
- C. Thyroxin
- D. Aldosterone
- E. Adrenalin

14. Parodontitis is treated with calcium preparations and a hormone that stimulates tooth mineralization and inhibits tissue resorption. What hormone is it?

- A. Parotin
- B. Parathormone
- C. Adrenalin
- D. Aldosterone
- E. Thyroxine

15. A 20 year old patient complains of morbid thirst and hyperdiuresis (up to 10 l daily). Glucose concentration in blood is normal but it is absent in urine. The patient has been diagnosed with diabetes insipidus. What hormonal drug is the most appropriate for management of this disorder?

- A. Vasopressin
- B. Cortisol
- C. Thyroxin
- D. Oxytocin
- E. Insulin

16. A student, who did not go to the university, by chance met a dean in the street and got very nervous. Emotional stress causes activation of hormone-sensitive triglyceride lipase in the adipocytes. What secondary mediator takes part in this process?

- A. Cyclic adenosine monophosphate
- B. Cyclic guanosine monophosphate
- C. Adenosine monophosphate
- D. Diacylglycerol
- E. Ions of Ca²⁺

17. A 5-month-old boy was hospitalized for tonic convulsions. He has a life-time history of this disease. Examination revealed coarse hair, thinned and fragile nails, pale and dry skin. In blood: calcium – 1.5 millimol/l, phosphorri – 1.9 millimol/l. These changes are associated with:

- A. Hypoparathyroidism
- B. Hyperparathyroidism
- C. Hyperaldosteronism
- D. Hypoaldosteronism
- E. Hypothyroidism

18. The minute blood volume in a patient with transplanted heart has increased as a result of physical activity. What regulative mechanism is responsible for these changes?

- A. Catecholamines
- B. Sympathetic unconditioned reflexes
- C. Parasympathetic unconditioned reflexes
- D. Sympathetic conditioned reflexes
- E. Parasympathetic conditioned reflexes

19. The secretion of which hypophysial hormones will be inhibited after taking the oral contraceptives containing sex hormones?

- A. Gonadotropic hormone
- B. Vasopressin
- C. Thyrotrophic hormone
- D. Somatotrophic hormone
- E. Oxytocin

20. A 32-year-old patient consulted a doctor about the absence of lactation after parturition. Such disorder might be explained by the deficit of the following hormone:

- A. Prolactin
- B. Somatotropin
- C. Vasopressin
- D. Thyrocalcitonin
- E. Glucagon

21. A 46-year-old patient suffering from the diffuse toxic goiter underwent resection of the thyroid gland. After the surgery the patient presents with appetite loss, dyspepsia, increased neuromuscular excitement. The body weight remained unchanged. Body temperature is normal. Which of the following has caused such a condition in this patient?

- A. Reduced production of parathormone
- B. Increased production of thyroxin
- C. Increased production of calcitonin
- D. Increased production of thyroliberin
- E. Reduced production of thyroxin

22. Products of some proteins hydrolysis and modification are the biologically active substances called hormones. Lipotropin, corticotropin, melanotropin and endorphins are synthesized in the hypophysis of the following protein:

- A. Proopiomelanocortin (POMC)
- B. Neuroalbumin
- C. Neurostromin

- D. Neuroglobulin
- E. Thyreoglobulin

23. A patient has osmotic pressure of blood plasma at the rate of 350 mOsmol/l (norm is 300 mOsmol/l). This will cause hypersecretion of the following hormone:

- A. Vasopressin
- B. Aldosterone
- C. Cortisol
- D. Adrenocorticotropin
- E. Natriuretic

24. A 32-year-old patient consulted a doctor about the absence of lactation after parturition. Such disorder might be explained by the deficit of the following hormone:

- A. Prolactin
- B. Somatotropin
- C. Vasopressin
- D. Thyrocalcitonin
- E. Glucagon

25. A 40-year-old patient complains of intensive heartbeats, sweating, nausea, visual impairment, arm tremor, hypertension. From his anamnesis: 2 years ago he was diagnosed with pheochromocytoma. Hyperproduction of what hormones causes the given pathology?

- A. Catecholamines
- B. Aldosterone
- C. Glucocorticoids
- D. ACTH
- E. Thyroidal hormones

26. Kidneys of a man under examination show increased reabsorption of calcium ions and decreased resorption of phosphate ions. What hormone causes this phenomenon?

- A. Parathormone
- B. Thyrocalcitonin
- C. Hormonal form D₃
- D. Aldosterone
- E. Vasopressin

27. A 2-year-old child experienced convulsions because of lowering calcium ions concentration in the blood plasma. Function of what structure is decreased?

- A. Parathyroid glands
- B. Hypophysis
- C. Adrenal cortex
- D. Pineal gland
- E. Thymus

28. There is only one hormone among the neurohormones which refers to the derivatives of amino acids according to classification. Point it out:

- A. Melatonin
- B. Thyroliberin
- C. Vasopressin
- D. Oxytocin

E. Somatotropin

29. A man after 1.5 litre blood loss has suddenly reduced diuresis. The increased secretion of what hormone caused such diuresis alteration?

- A. Vasopressin
- B. Corticotropin
- C. Natriuretic
- D. Cortisol
- E. Parathormone

30. A 30-year-old woman complains of intense thirst and dryness of the mouth that developed after a severe emotional shock. Laboratory analysis revealed increase of the patient's blood sugar level up to 10 mmol/L. What endocrine gland is affected in the patient?

- A. Pancreas
- B. Thyroid gland
- C. Gonads
- D. Adrenal glands
- E. Pineal gland

31. A patient with diabetes mellitus was injected a drug to manage hypoglycemia but probably was overdosed it and now he is in the state of hypoglycemic coma. What hormone can cause this condition if overdosed?

- A. Insulin
- B. Progesterone
- C. Cortisol
- D. Somatotropin
- E. Corticotropin

32. Due to morbid affection of the supraoptic and paraventricular nuclei of the hypothalamus a 40-year-old patient has developed polyuria (10-12 liters per day) and polydipsia. The following hormone is deficient, thus leading to this disturbance:

- A. Vasopressin
- B. Oxytocin
- C. Corticotropin
- D. Somatotropin
- E. Thyrotropin

33. A patient during fasting developed ketoacidosis as a result of increased fatty acids decomposition. This decomposition can be inhibited with:

- A. Insulin
- B. Glucagon
- C. Adrenaline
- D. Thyroxin
- E. Cortisol

34. A 49-year-old patient was found to have a disproportionate enlargement of hands, feet, nose, ears, superciliary arches and cheek bones. Blood test revealed hyperglycemia, impaired glucose tolerance. What is the most likely cause of this pathology development?

- A. Hypersecretion of growth hormone
- B. Posterior pituitary hypersecretion

- C. Insulin hyposecretion
- D. Vasopressin hyposecretion
- E. Glucocorticoid hypersecretion

35. A 40-year-old patient was revealed to have blood clotting time of 2 minutes under a stressful condition. It is primarily caused by the following hormone affecting hemocoagulation:

- A. Catecholamine
- B. Cortisol
- C. Aldosterone
- D. Somatotropin
- E. Vasopressin

36. A patient with pituitary tumor complains of increased daily diuresis (polyuria). Glucose concentration in blood plasma equals 4.8 mmol/l. What hormone can be the cause of this if its secretion is disturbed?

- A. Vasopressin
- B. Aldosterone
- C. Natriuretic hormone
- D. Insulin
- E. Angiotensin I

37. Physical activity caused an increase in the cardiac output in a patient with a transplanted heart. What regulative mechanism is responsible for these changes?

- A. Catecholamines
- B. Sympathetic unconditioned reflexes
- C. Parasympathetic unconditioned reflexes
- D. Sympathetic conditioned reflexes
- E. Parasympathetic conditioned reflexes

38. Anterior pituitary produces hormones, regulating the function of peripheral endocrine glands. The interaction between the anterior pituitary and target glands is functioning according to feedback mechanism. Choose from the mentioned below a hormone secreted from anterior pituitary:

- A. Growth hormone
- B. Vasopressin
- C. Oxytocin
- D. Epinephrine
- E. Norepinephrine

39. Secondary messengers diacylglycerol and inositol triphosphate are produced from subsequent phospholipid of plasma membrane due to the activity of the following enzyme:

- A. Phospholipase C
- B. Phospholipase A₁
- C. Phospholipase A₂
- D. Phospholipase D
- E. Phosphodiesterase

40. Utilization of glucose occurs by means of sugar transport from the extracellular matrix through the plasma membrane membrane into the cell. What hormone stimulates this process?

- A. Insulin
- B. Glucagon
- C. Thyroxine
- D. Aldosterone
- E. Adrenaline

41. In patient S. blood glucose level is 10 mmol/l, polyuria, glucosuria and ketonuria are observed. What pathological state can be suggested?

- A. Diabetes mellitus
- B. Starvation
- C. Hypercorticism
- D. Addison disease
- E. Hyperthyreosis

42. Due to morbid affection of the supraoptic and paraventricular nuclei of the hypothalamus a 40-year-old patient has developed polyuria (10-12 liters per day) and polydipsia. The following hormone is deficient, thus leading to this disturbance:

- A. Vasopressin
- B. Oxytocin
- C. Corticotropin
- D. Somatotropin
- E. Thyrotropin

43. A 49-year-old patient was found to have a disproportionate enlargement of hands, feet, nose, ears, superciliary arches and cheek bones. Blood test revealed hyperglycemia, impaired glucose tolerance. What is the most likely cause of this pathology development?

- A. Hypersecretion of growth hormone
- B. Posterior pituitary hypersecretion
- C. Insulin hyposecretion
- D. Vasopressin hyposecretion
- E. Glucocorticoid hypersecretion

44. A severe injury in a 36-year-old patient resulted in a significant blood loss which was accompanied by a blood pressure drop. What hormones provide rapid recovery of blood pressure after the blood loss?

- A. Adrenalin, vasopressin
- B. Cortisol
- C. Sex hormone
- D. Oxytocin
- E. Aldosterone

45. After a person had drunk 1,5 liters of water, the amount of urine increased significantly, and its relative density decreased to 1,001. These changes are a result of decreased water reabsorption in the distal nephron portion due to reduced secretion of:

- A. Vasopressin
- B. Aldosterone
- C. Angiotensin II
- D. Renin
- E. Prostaglandins

46. A 45 years old man visited a doctor because of persistent headache, shaking of hands, increased heart rate, increased arterial pressure, that is not decreased by the antihypertensive drugs he was prescribed several months ago. Blood glucose in fasting condition is 7.0 mmol/l. The ultrasonographical examination of the adrenal glands did not reveal any solids. What is the most probable diagnosis in this patient?

- A. Pheochromocytoma, located in the pancreatic gland
- B. Diabetes melitus
- C. Impaired tolerance to glucose
- D. Cushing disease
- E. Migraine

47. A 50 years old woman was hospitalised in the cardiologic department because of arterial hypertension, hypertonic crises, pain in chest, increased heart rate. Blood glucose level is 6.7 mmol/l. The ultrasonographical examination of the abdominal cavity revealed a tumor of the medullar part of the adrenal glands. Which hormone caused the mentioned above syndromes?

- A. Epinephrine
- B. Glucagon
- C. Cortisol
- D. Thyroxin
- E. Growth hormone

48. A 48 year old patient, who 2 months ago was in the traffic accident and stayed in hospital for 6 weeks because of cranial trauma presents with fatigue and astenia. Arterial pressure 90/60 (he used to have it on the level of 130/80), Pulse – 60/min, blood glucose level is 3.4 mmol/l. His skin looks suntanned but he was not in the sun. He also reports erectile dysfunction. What is the most probable cause of the patient's condition?

- A. Panhypopituitarism
- B. Adrenal glands insufficiency
- C. Endemic goiter
- D. Diabetes insipus
- E. Bronze disease

49. A 30 year old woman visited a doctor because of severe fatigue, dizziness, episodes of consciousness. The arterial pressure is 110/80, pulse 80/min. Blood glucose is 2.5 mmol/l. USG revealed a tumor in the pancreatic gland. Overproduction of which hormone caused the patient's disorder?

- A. Insulin
- B. TSH
- C. Glucagon
- D. Growth hormone
- E. Adrenaline

50. A 25 year old woman has been taking oral contraceptives to prevent unwilling pregnancy. The decrease of the production of which hormone may be detected in this patient?

- A. FSH
- B. LH
- C. Insulin
- D. ADH

E. Melanocyte-stimulating hormone

TOPIC №6. INVESTIGATION OF MOLECULAR AND CELLULAR MECHANISMS OF ACTION OF STEROID AND THYROID HORMONES UPON TARGET CELLS

1. A 40-year-old woman on examination presents with intensified basal metabolic rate. What hormone present in excess leads to such condition?
 - A. Triiodothyronine
 - B. Thyrocalcitonin
 - C. Glucagon
 - D. Aldosterone
 - E. Somatostatin
2. A 16-year-old girl presents with no hair on the pubis and in the armpits, her mammary glands are underdeveloped, no menstruations. What hormone imbalance can it be indicative of?
 - A. Ovarian failure
 - B. Hyperthyroidism
 - C. Hypothyroidism
 - D. Pancreatic islet failure
 - E. Adrenal medulla hyperfunction
3. On examination the patient presents with hirsutism, moon-shaped face, stretch marks on the abdomen. BP is 190/100 mm Hg, blood glucose is 17.6 mmol/L. What pathology is such clinical presentation characteristic of?
 - A. Adrenocortical hyperfunction
 - B. Hyperthyroidism
 - C. Hypothyroidism
 - D. Gonadal hypofunction
 - E. Hyperfunction of the insular apparatus
4. A 19-year-old young man was examined in the nephrology clinic. High potassium was detected in his secondary urine. What hormone is likely to cause such change, if it is produced in excess?
 - A. Aldosterone
 - B. Oxytocin
 - C. Adrenaline
 - D. Glucagon
 - E. Testosterone
5. A 43-year-old female complains of weight loss, hyperhidrosis, low-grade fever, increased irritability. She has been found to have hyperfunction of the sympathetic adrenal system and basal metabolism. These disorders can be caused by hypersecretion of the following hormone:
 - A. Thyroxine
 - B. Somatotropin
 - C. Corticotropin
 - D. Insulin
 - E. Aldosterone
6. After a severe stress the patient presents with eosinopenia in the blood test. In this case the decreased number of eosinophils can explain changes in the level of the following hormones:

- A. Glucocorticoids
- B. Adrenaline
- C. Insulin
- D. Mineralocorticoids
- E. Vasopressin

7. A 35-year-old man with peptic ulcer disease has undergone antrectomy. After the surgery secretion of the following gastrointestinal hormone will be disrupted the most:

- A. Gastrin
- B. Histamine
- C. Secretin
- D. Cholecystokinin
- E. Neurotensin

8. For people adapted to high external temperatures profuse sweating is not accompanied by loss of large volumes of sodium chloride. This is caused by the effect the following hormone has on perspiratory glands:

- A. Aldosterone
- B. Vasopressin
- C. Cortisol
- D. Thyroxin
- E. Natriuretic

9. Autopsy of a 40-year-old woman, who died of cerebral hemorrhage during hypertensive crisis, revealed: upper- body obesity, hypertrichosis, hirsutism, stretchmarks on the skin of thighs and abdomen. Pituitary basophil adenoma is detected in the anterior lobe. What diagnosis is the most likely?

- A. Cushing's disease
- B. Essential hypertension
- C. Alimentary obesity
- D. Simmonds' disease
- E. Hypothalamic obesity

10. A 12-year-old child is of short stature, has disproportionate body structure and mental retardation. These characteristics might be caused by the hyposalivation of the following hormone:

- A. Thyroxine
- B. Insulin
- C. Cortisol
- D. Somatotropin
- E. Glucagon

11. A patient who had been taking diclofenac sodium for arthritis of mandibular joint developed an acute condition of gastric ulcer. Such side effect of this medicine is caused by inhibition of the following enzyme:

- A. Cyclooxygenase-1 (COX-1)
- B. Cyclooxygenase-2 (COX-2)
- C. Lipoxygenase
- D. Phosphodiesterase
- E. Monoamine oxidase

12. A 60-year-old patient with a long history of stenocardia takes coronarodilator agents. He has also been administered acetylsalicylic acid to reduce platelet aggregation. What is the mechanism of antiplatelet action of acetylsalicylic acid?

- A. It reduces the activity of cyclooxygenase
- B. It reduces the activity of phosphodi- esterase
- C. It enhances the activity of platelet adenylate cyclase
- D. It enhances the synthesis of prostacyclin
- E. It has membrane stabilizing effect

13. A 19-year-old male was found to have an elevated level of potassium in the secondary urine. These changes might have been caused by the increase in the following hormone level:

- A. Aldosterone
- B. Oxytocin
- C. Adrenaline
- D. Glucagon
- E. Testosterone

13. Deficiency of linoleic and linolenic acids in the body leads to the skin damage, hair loss, delayed wound healing, thrombocytopenia, low resistance to infections. These changes are most likely to be caused by the impaired synthesis of the following substances:

- A. Eicosanoids
- B. Interleukins
- C. Interferons
- D. Catecholamines
- E. Corticosteroids

14. A 30-year-old female exhibits signs of virilism (growth of body hair, balding temples, menstrual disorders). This condition can be caused by the overproduction of the following hormone:

- A) Testosterone
- B. Oestriol
- C. Relaxin
- D. Oxytocin
- E. Prolactin

15. A 30 year old woman has subnormal concentration of enzymes in the pancreatic juice. This might be caused by the hyosecretion of the following gastrointestinal hormone:

- A. Cholecystokinin-pancreozymin
- B. Somatostatin
- C. Secretin
- D. Gastro-inhibiting peptide
- E. Vaso-intestinal peptide

16. Examination of a 42 year old patient revealed a tumour of adenohipophysis. Objectively: the patient's weight is 117 kg, he has moon-like hyperemic face, red- blue striae of skin distension on his belly. Osteoporosis and muscle dystrophy are present. AP is 210/140 mm Hg. What is the most probable diagnosis?

- A. Cushing's disease
- B. Cushing's syndrome

- C. Conn's disease
- D. Diabetes mellitus
- E. Essential hypertension

17. A concentrated solution of sodium chloride was intravenously injected to an animal. This caused decreased reabsorption of sodium ions in the renal tubules. It is the result of the following changes of hormonal secretion:

- A. Aldosterone reduction
- B. Aldosterone increase
- C. Vasopressin reduction
- D. Vasopressin increase
- E. Reduction of atrial natriuretic factor

18. The patient with complaints of permanent thirst applied to the doctor. Hyperglycemia, polyuria and increased concentration of 17-ketosteroids in the urine were revealed. What disease is the most likely?

- A. Steroid diabetes
- B. Insulin-dependent diabetes mellitus
- C. Myxoedema
- D. Type I glycogenosis
- E. Addison's disease

19. A female patient presents with endocrine dysfunction of follicular cells of the ovarian follicles resulting from an inflammation. The synthesis of the following hormone will be inhibited:

- A. Estrogen
- B. Progesterone
- C. Lutropin
- D. Follicle stimulating hormone
- E. Follistatine

20. To prevent the transplant rejection after organ transplantation it is required to administer hormone therapy for the purpose of immunosuppression. What hormones are used for this purpose?

- A. Glucocorticoids
- B. Mineralocorticoids
- C. Sexual hormones
- D. Catecholamines
- E. Thyroid

21. A concentrated solution of sodium chloride was intravenously injected to an animal. This caused decreased reabsorption of sodium ions in the renal tubules. It is the result of the following changes of hormonal secretion:

- A. Aldosterone reduction
- B. Aldosterone increase
- C. Vasopressin reduction
- D. Vasopressin increase
- E. Reduction of atrial natriuretic factor

22. A patient with hypoparathyreosis has multiple carious lesions of teeth. This pathology is caused by insufficiency of the following hormone:

- A. Calcitonin
- B. Thyroxin
- C. Triiodothyronine
- D. Thyroid-stimulating hormone
- E. Somatotropin

23. A 44 year old woman complains of general weakness, heart pain, significant increase of body weight. Objectively: moon face, hirsutism, AP is 165/100 mm Hg, height - 164 cm, weight - 103 kg; the fat is mostly accumulated on her neck, thoracic girdle, belly. What is the main pathogenetic mechanism of obesity?

- A. Increased production of glucocorticoids
- B. Reduced production of thyroid hormones
- C. Increased insulin production
- D. Reduced glucagon production
- E. Increased mineralocorticoid production

24. Parents of a 10 year old boy consulted a doctor about extension of hair-covering, growth of beard and moustache, low voice. Intensified secretion of which hormone must be assumed?

- A. testosterone
- B. somatotropin
- C. oestrogen
- D. progesterone
- E. cortisol

25. A girl is diagnosed with adrenogenital syndrome (pseudohermaphroditism). This pathology was caused by hypersecretion of the following adrenal hormone:

- A. Androgen
- B. Estrogen
- C. Aldosterone
- D. Cortisol
- E. Adrenalin

26. Following thyroid surgery, a 47-year- old female patient had fibrillary twitching of muscles in the arms, legs and face. These disorders can be treated by the introduction of the following hormone:

- A. Parathyroid hormone
- B. Triiodothyronine
- C. Thyrotropin
- D. Thyroxine
- E. Thyroid-stimulating hormone

27. Examination of a patient revealed hyperkalemia and hyponatremia. Low secretion of which hormone may cause such changes?

- A. Aldosteron
- B. Vasopressin
- C. Cortisol
- D. Parathormone
- E. Natriuretic

28. Under some diseases it is observed aldosteronism accompanied by hypertension and edema due to sodium retention in the organism. What organ of the internal secretion is affected under aldosteronism?

- A. Adrenal glands
- B. Testicle
- C. Ovaries
- D. Pancreas
- E. Hypophysis

29. A person addressed to a doctor because of increased arterial pressure, reduced diuresis, hypernatremia, hypokalemia. Hypersecretion of what hormone can cause such changes?

- A. Aldosterone
- B. Vasopressin
- C. Auricular sodiumuretic factor
- D. Adrenalin
- E. Parathormone

30. Thyrotoxicosis leads to increased production of thyroidal hormones T_3 and T_4 , weight loss, tachycardia, psychic excitement and so on. How do thyroidal hormones effect energy metabolism in the mitochondrion of cells?

- A. Disconnect oxidation and oxidative phosphorylation
- B. Activate substrate phosphorylation
- C. Stop substrate phosphorylation
- D. Stop respiratory chain
- E. Activate oxidative phosphorylation

31. A 19-year-old female suffers from tachycardia in rest condition, weight loss, excessive sweating, exophthalmos and irritability. What hormone would you expect to find elevated in her serum?

- A. Thyroxine
- B. Cortisol
- C. Mineralocorticoids
- D. ACTH
- E. Insulin

32. An 18-year-old student presents with enlarged thyroid gland accompanied by accelerated metabolism and increased heart rate. These signs can be observed during hypersecretion of thyroxin. What organelles of thyroid cells are primarily responsible for hormone production and secretion?

- A. Golgi apparatus
- B. Mitochondria
- C. Ribosomes
- D. Centrosomes
- E. Lysosomes

33. Endemic goiter is known to be widespread in certain geochemical areas. This is an important medica and social problem, significantly affecting general health and development of growing organism. The deficiency of what chemical element causes this disease?

- A. Iodine
- B. Iron

- C. Zinc
- D. Copper
- E. Cobalt

34. A patient appealed to the doctor with complaints about tremor and hypokinesia. The biochemical analysis of blood showed the reduced amount of dopamine. Name its methabolite-precursor.

- A. Tyrosine
- B. Dioxyphenylalanine
- C. Tyramine
- D. Phenylalanine
- E. Phenylpyruvate

35. The activity of cyclooxygenase can be suppressed by some medical preparations. What preparation exhibits irreversible inhibitory action upon this enzyme?

- A. Acetylsalicylic acid
- B. Insulin
- C. Allopurinol
- D. Oligomycine
- E. Aminationone

36. Cushing's disease, which is characterized by obesity, hypertension and elevated blood glucose level, is caused by disorder in production and secretion of the next hormones:

- A. ACTH and glucocorticoids overproduction
- B. Insulin insufficiency
- C. ACTH and glucocorticoids insufficiency
- D. Thyroxine insufficiency
- E. Estriol overproduction

37. Addison's disease or so called bronze disease is a severe disorder of sodium-potassium turnover due to failure in production of the following hormone:

- A. Aldosterone
- B. Thyroxine
- C. Triiodothyronine
- D. Testosterone
- E. Progesterone

38. Some hormone induce uncoupling of respiration and oxidative phosphorylation in mitochondria and lower the efficiency of ATP production. What is this hormone?

- A. Thyroxine
- B. Adrenalin
- C. ACTH
- D. Oxytocine
- E. Testosterone

39. Due to trauma the patient's parathyroid glands have been removed, which resulted in inertness, thirst, sharp increase of neuromuscular excitability. Metabolism of the following substance is disturbed:

- A. Calcium
- B. Manganese
- C. Chlorine

- D. Molybdenum
- E. Zinc

40. After a traffic accident a man presents with severe blood loss, consciousness disturbance, low blood pressure, as well as compensatory activation of the renin-angiotensin system, which results in:

- A. Hyperproduction of aldosterone
- B. Increased blood coagulation
- C. Intensification of erythropoiesis
- D. Hyperproduction of vasopressin
- E. Intensification of heart contractions

41. A doctor has established significant growth retardation, disproportional body build, and mental deficiency of a child. What is the most likely cause of this pathology?

- A. Hypothyroidism
- B. Insufficient nutrition
- C. Hyperthyroidism
- D. Genetic defects
- E. Hypopituitarism

42. A patient with rheumatoid arthritis has been given hydrocortisone for a long time. He has developed hyperglycemia, polyuria, glycosuria, thirst. These complications of treatment result from the activation of the following process:

- A. Gluconeogenesis
- B. Glycogenolysis
- C. Glycogenesis
- D. Glycolysis
- E. Lipolysis

43. A 62-year-old woman complains with burning pain in epigastrium. The intragastric pH-metry revealed that stomach pH was 1.3 (normal is 1.5-3.5). Which hormone can reverse the hyperacidity noted in this patient?

- A. Secretin
- B. Gastrin
- C. Growth hormone
- D. Cholecystokinin
- E. Pepsin

44. An 11 week pregnant patient visited her obstetrician, complaining of severe nausea, usually in the morning. Due to physical examination the size of uterus was bigger than expected for her period of pregnancy. The level of human chorionic gonadotropine- β makes 17 mMO/l. The heart action of the foetus was not detected and USG picture gives evidence of chorionepithelioma. Which endocrine disorder may be detected in this patient?

- A. Increased function of the thyroid gland
- B. Impaired tolerance to glucose
- C. Diabetes insipidus
- D. Diabetes mellitus
- E. Hypofunction of the thyroid gland

45. A 40 year old woman came to a surgeon because of pain in her right leg. The right calf is swalled, hot and thicker than the left one. The onset of this condition was about a week ago after she came back from her journey to Canada. Body temperature is 36.7 C, she has an increased heart rate, increased arterial pressure and increased

rate of breaths per minute. Which changes in the system of eicosanoids mediate this patient's condition?

- A. Increased thromboxane A₂
- B. Decreased thromboxane A₂
- C. Increased leukotriene B₄
- D. Increased PGE₂
- E. Increased PGE₂ and leukotriene B₄

46. The patient was prescribed paracetamol because of fever due to influenza. The production of which arachidonic acid derivative will be increased by the effect of this drug?

- A. Leukotriene B₄
- B. Prostaglandin E₂
- C. Thromboxane A₂
- D. thromboxane I₂
- E. Leukotriene B₃

47. The patient underwent several courses of radiation therapy because of brain cancer. After some time she noted that her skin looks suntanned. The family doctor revealed arterial hypotension, decreased heart rate. The failure of which endocrine gland the most evidently developed in this patient?

- A. Adrenal cortex
- B. Adrenal medullar
- C. Pancreas
- D. Hypothalamus
- E. Anterior pituitary

48. The patient after the removal of a big part of thyroid gland because of multiple nodes was prescribed a lifelong therapy with a drug, that should prevent the manifestations of thyroid gland insufficiency. This drug is based on the hormone:

- A. Tyroxine
- B. Parathormone
- C. TSH
- D. Cortisol
- E. Aldosteron

49. A 45 year old female patient with a severe form of lupus erythematosus was treated with prednisolone (a synthetic form of cortisol) for several months. Because of clinical improvement the doctor recommended a step decrease of the dose of drug but the patient ceased therapy because she was gaining weight under the effect of steroid. Next day the patient was brought to hospital by ambulance because of the hypotonic crisis, loss of consciousness, decreased heart rate. What caused the patient's condition?

- A. Acute insufficiency of adrenal glands
- B. Hyperfunction of adrenal glands
- C. Decreased production of adrenaline
- D. Increased production of adrenaline
- E. Steroid diabetes

50. A 42 year old man developed the manifestations of graft-versus-host disease after he was transplanted an allogenic bone marrow from the unrelated donor for the treatment of blood malignancy. Which drug should be prescribed to inhibit immunoaggression in this patient?

- A. Cortisol
- B. Aldosteron
- C. ACTH
- D. Testosteron
- E. Insulin

TOPIC 7. INVESTIGATION OF NERVE TISSUE. PATHOCHEMISTRY OF PSYCHOTIC DISORDERS

1. A patient complained about dizziness, memory impairment, periodical convulsions. It was revealed that these changes were caused by a product of decarboxylation of glutamic acid. Name this product:

- A. GABA
- B. Pyridoxal phosphate
- C. TDP
- D. ATP
- E. THFA

2. A patient with encephalopathy was admitted to the neurological in-patient department. There was revealed a correlation between increasing of encephalopathy and substances absorbed by the bloodstream from the intestines. What substances that are formed in the intestines can cause endotoxemia?

- A. Indole
- B. Butyrate
- C. Acetacetate
- D. Biotin
- E. Ornithine

3. Tetanus toxin induces tonic straining of skeletal and vessel muscles due to inhibition of secretion by nerve endings such neurotransmitter as:

- A. Glycine
- B. GABA
- C. Norepinephrine
- D. Acetylcholine
- E. Glutamate

4. Pharmacological effects of antidepressants are connected with inhibition of an enzyme catalyzing biogenic amines noradrenaline and serotonin in the mitochondrions of cerebral neurons. What enzyme participates in this process?

- A. Monoamine oxidase
- B. Transaminase
- C. Decarboxylase
- D. Peptidase
- E. Lyase

5. A cerebral trauma caused increased ammonia generation. What amino acid participates in the excretion of ammonia from the cerebral tissue?

- A. Glutamic
- B. Tyrosine
- C. Valine
- D. Tryptophan
- E. Lysine

6. A newborn child has convulsions that have been observed after prescription of vitamin B₆. This most probable cause of this effect is that vitamin B₆ is a component of the following enzyme:

- A. Glutamate decarboxylase

- B. Pyruvate dehydrogenase
- C. Nitroglutarate dehydrogenase
- D. Aminolevulinic synthase
- E. Glycogen phosphorylase

7. It is known that the monoamine oxidase (MAO) enzyme plays an important part in the metabolism of catecholamine neurotransmitters. In what way does the enzyme inactivate these neurotransmitters (norepinephrine, epinephrine, dopamine)?

- A. Oxidative deamination
- B. Addition of an amino group
- C. Removal of a methyl group
- D. Carboxylation
- E. Hydrolysis

8. An unconscious patient was taken by ambulance to the hospital. On objective examination the patient was found to have no reflexes, periodical convulsions, irregular breathing. After laboratory examination the patient was diagnosed with hepatic coma. Disorders of the central nervous system develop due to the accumulation of the following metabolite:

- A. Ammonia
- B. Urea
- C. Glutamine
- D. Bilirubin
- E. Histamine

9. A patient with signs of emotional lability that result in troubled sleep has been prescribed nitrazepam. Specify the sleep-inducing mechanism of this drug:

- A. GABA-ergic system activation
- B. Blockade of opiate receptors
- C. Inhibition of stimulating amino acids
- D. H1-histamine receptors stimulation
- E. Suppression of serotonergic neurotransmission 2014

10. Decarboxylation of glutamate induces production of gamma-aminobutyric acid (GABA) neurotransmitter. After breakdown, GABA is converted into a metabolite of the citric acid cycle, that is:

- A. Succinate
- B. Citric acid
- C. Malate
- D. Fumarate
- E. Oxaloacetate

11. Monoamine oxidase inhibitors are widely used as psychopharmacological drugs. They change the level of nearly all neurotransmitters in synapses, with the following neurotransmitter being the exception:

- A. Acetylcholine
- B. Noradrenaline
- C. Adrenaline
- D. Dopamine
- E. Serotonin

12. Emotional stress causes activation of hormon-sensitive triglyceride lipase in the adipocytes. What secondary mediator takes part in this process?

- A. Cyclic adenosine monophosphate
- B. Cyclic guanosine monophosphate
- C. Adenosine monophosphate
- D. Diacylglycerol
- E. Ions of Ca^{2+}

13. Prescription of penicillin G sodium salt has caused development of neurotoxic effects (hallucinations, convulsions). Such reaction is the result of antagonism with the following neurotransmitter:

- A. GABA
- B. Dopamine
- C. Serotonin
- D. Adenosine
- E. Acetylcholine

14. A 3-year-old girl with mental retardation has been diagnosed with sphingomyelin lipidosis (Niemann-Pick disease). In this condition synthesis of the following substance is disrupted:

- A. Sphingomyelinase
- B. Glycosyltransferase
- C. Sphingosine
- D. Ceramides
- E. Gangliosides

15. A patient with insulin-dependent diabetes mellitus has been administered insulin. After a certain period of time the patient developed fatigue, irritability, excessive sweating. What is the main mechanism of such presentations developing?

- A. Carbohydrate starvation of the brain
- B. Increased glycogenolysis
- C. Increased ketogenesis
- D. Increased lipogenesis
- E. Decreased glyconeogenesis

16. A 2-year-old child presents with acute psychomotor retardation, vision and hearing impairment, sharp enlargement of the liver and spleen. The child is diagnosed with hereditary Niemann-Pick disease. What genetic defect is the cause of this disease?

- A. Sphingomyelinase deficiency
- B. Glucose 6-phosphatase deficiency
- C. Amylo-1,6-glucosidase deficiency
- D. Acid lipase deficiency
- E. Xanthine oxidase deficiency

17. For the compensatory treatment of nervous system alterations (dementia) with simultaneous involvement of skin (dermatitis) and gastrointestinal tract (diarrhea) an antipellagric vitamin was administered to the patient:

- A. PP
- B. C
- C. A
- D. B_6
- E. K

18. The peculiarity of the amino acid constituents of the brain is the large amount of monoaminodicarboxylic acids, including:

- A. Glutamate, aspartate
- B. Arginin, lysine
- C. Glutamine, asparagine
- D. Serine, histidine
- E. Valine, tyrosine

19. The main representatives of opioid neuropeptides are met-enkephaline and leu-enkephaline which chemical structure is typical for:

- A. Pentapeptides
- B. Tetrapeptides
- C. Hexapeptides
- D. Octapeptides
- E. Decapeptides

20. Which monooxidase inhibitors are commonly used in clinical practice as psychopharmacologic drugs, f.i. in treatment of the depressive conditions, schizofrenia:

- A. Iprinosil, pirasidol
- B. Methionine, cysteine
- C. Heparin, carnosine
- D. Riboflavin, retinol
- E. Epinephrine, serotonin

21. GABA is a depressing mediator in CNS. The inhibition of GABA-involved nervous impulse transfer between the neuronal cells is caused by the increased permeability of biomembrane for the ions of:

- A. Cl^-
- B. K^+
- C. Ca^{++}
- D. Mg^{++}
- E. Na^+

22. Neuronal cells were established to have significant requirements in glucose. What compound may be used by the CNS cells after extensive physical exercises and prolonged starvation?

- A. Acetoacetate
- B. Glycerol
- C. Amino acids
- D. Glutathione
- E. Purins

23. Which neurotransmitter of CNS is synthesized from alpha-ketoglutarate in the course of reaction of the following sequence – transamination and decarboxylation

- A. GABA
- B. Histamine
- C. Tryptophan
- D. Dophamine
- E. Serotonine

24. A well known neurotransmitters epinephrine and norepinephrine, belonging to the group of catecholamines, are playing a number of pivotal roles in our body. They are produced from the following precursor amino acid:

- A. Phenylalanine
- B. Histidine
- C. Lysine
- D. Glutamate
- E. Tryptophane

25. Multiple sclerosis is a progressive neurologic disorder, often causing disability of the patients because of loss of myelin sheets by neurons in the course of autoimmunoaggression. Myelin sheets of nerve fibers are composed from the sphingomyelin, which contains the next substance as a constituent:

- A. Glycerol
- B. Phosphocholine
- C. Galactose
- D. Neuraminic acid
- E. Glucuronic acid

26. Certain genetically mediated disorders of central nervous system are caused by impaired gangliosides turnover. Gangliosides are important components of neuronal plasma membrane. They contain the following constituents EXCEPT:

- A. Acetylneuraminic acid
- B. Ceramide
- C. Phosphoric acid
- D. Lignoceric acid
- E. Galactose

27. Schizophrenia is a disease with the established changes in the system of biogenic amines in brain. In a brain of patients with schizophrenia the increased number of the following neurotransmitter receptors is registered:

- A. Dopamine specific
- B. Serotonin specific
- C. Adrenoreceptors
- D. Cholinoreceptors
- E. GABA-receptors

28. Disorders in myelinization of nerve fibers leads to severe neurologic disorders and mental retardation. Such disorders are typical for inborn errors in metabolism of:

- A. Neutral lipids
- B. Cholesterol
- C. Sphingolipids
- D. Glycerophosphatides
- E. Lipoproteins

29. Fabry's disease (one of sphingolipidoses) is an autosomal recessive disease. Major symptoms of this disease: skin rash, kidney failure, pain in lower extremities. It is caused by a deficiency of:

- A. Hexosaminidase A and B
- B. G_{m1} Gangliosidase
- C. Galactocerebrosidase
- D. α -Galactosidase A

E. Ceraminase

30. Parkinson's disease significantly affects neuromotor functions of patients. This disease is caused by a dysfunction in the following neurotransmitter system:

- A. Cholinergic
- B. Catecholaminergic
- C. Dopaminergic
- D. Serotonergic
- E. Met-enkephalinergic

31. Disorders in myelination of nerve fibers leads to severe neurologic disorders and mental underdevelopment. Such disorders are typical for inborn errors in metabolism of:

- A. Sphingolipids
- B. Neutral lipids
- C. Cholesterol
- D. Glycerophosphatides
- E. Lipoproteins

32. Dopamine precursor – dioxyphenaline (DOPA) – is used in treatment of Parkinson's disease. This active substance is produced from the following amino acid:

- A. Tyrosine
- B. Histidine
- C. Cysteine
- D. Alanine
- E. Tryptophan

33. An 84 year old patient suffers from parkinsonism. One of the pathogenetic development elements of this disease is deficiency of a certain mediator in some of the brain structures. Name this mediator:

- A. Dopamine
- B. Noradrenaline
- C. Adrenaline
- D. Acetylcholine
- E. Histamine

34. A patient applied to a doctor complaining about dizziness, memory impairment, periodical convulsions. It was found out that such changes were caused by a product of glutamic acid decarboxylation. What product is meant?

- A. GABA
- B. Pyridoxalphosphate
- C. Thymidine diphosphate
- D. ATP
- E. Tetrahydrofolate

35. A 50-year-old man sustained a great stress. This caused a dramatic increase in adrenaline and noradrenaline concentration. What enzymes catalyze the inactivation of the latter?

- A. Monoamine oxidases
- B. Glycosidases
- C. Peptidases
- D. Carboxylase

E. Tyrosinase

36. Depressions and emotional disorders result from noradrenaline, serotonin and other biogenic amines deficiency in brain. Concentration of these compounds in synapses can be increased by means of antidepressants that inhibit the activity of the following enzyme:

- A. Monoamine oxidase
- B. Diamine oxidase
- C. L-amino acid oxidase
- D. D-amino acid oxidase
- E. Phenylalanine-4-monooxygenase

37. A patient presents with dysfunction of cerebral cortex accompanied by epileptic seizures. He has been administered a biogenic amine synthesized from glutamate and responsible for central inhibition. What substance is it?

- A. Gamma-amino butyric acid
- B. Serotonin
- C. Dopamine
- D. Acetylcholine
- E. Histamine

38. Inhibitory effect of GABA is due to the increased permeability of the postsynaptic membrane for chloride ions. This mediator is produced as a result of decarboxylation of the following amino acid:

- A. Glutamate
- B. Aspartate
- C. Glutamine
- D. Asparagine
- E. Arginine

39. Wilson's disease is a disorder of copper transport which leads to the accumulation of this metal in brain and liver cells. It is associated with a disturbance in the synthesis of the following protein:

- A. Ceruloplasmin
- B. Metallothionein
- C. Transcobalamin
- D. Haptoglobin
- E. Siderophilin

40. A 9-month-old infant is on bottle feeding. Formula used in feeding has insufficient content of vitamin B₆. The infant has seizures possibly caused by disruption in production of the following substance in the body:

- A. Gamma aminobutyric acid (GABA)
- B. Serotonin
- C. Histamine
- D. Dopamine
- E. β -alanine

41. A 50-year-old man addressed a hospital with complaints of memory disorders, painful sensations along the nerve trunks, decreased mental ability, circulatory disorders and dyspepsia. Anamnesis states excessive alcohol consumption. What vitamin deficiency can result in such signs?

- A. Thiamine
- B. Niacin
- C. Retinol
- D. Calciferol
- E. Riboflavin

42. Several neurological and psychic disorders are caused by the alteration in the system of biogenic amines in brain. Significant amount of biogenic amines in body tissues can be subject to oxidative deamination due to the action of the following enzyme:

- A. Monoamine oxidase
- B. Transaminase
- C. D-amino acid oxidase
- D. Isomerase
- E. L-amino acid dehydrogenase

43. A 24-year-old patient has been administered glutamic acid to treat epilepsy. Medicinal effect in this case occurs not due to glutamate itself, but due to the product of its decarboxylation:

- A. γ -aminobutyric acid
- B. Histamine 4-monooxygenase
- C. Serotonin
- D. Dopamine
- E. Taurine

44. The pediatrician during regular check-up states that a 3 year old child has delay in physical and mental development. The child has enlarged spleen and liver. Ophthalmoscopic examination revealed red spot on the macula. In bone marrow bioplate macrophages with foamy appearance were found. What is the function of the enzyme deficient in this patient?

- A. Conversion of sphingomyelin to ceramide
- B. Conversion of ceramide to ganglioside
- C. Conversion of different forms of gangliosides
- D. Conversion of glucocerebroside to sphingomyelin
- E. Conversion of different forms of ceramides

45. A 2 year old girl has delay in motor and mental development and her condition is constantly worsening. Her disease is mediated by the inborn deficiency of arylsulphatase. Which compound is increased in brain in this disease?

- A. Cerebroside sulphate
- B. Sphingomyelin
- C. Gangliosides
- D. Glycolipids
- E. Lactate

46. It is known that in metabolism of catecholamine mediators a special role belongs to monoamine oxidase (MAO). How does this enzyme deactivate these mediators (noradrenaline, adrenaline, dopamine)?

- A. Oxidative deamination
- B. Carboxylation
- C. Hydrolysis
- D. Amino group attachment

E. Methyl group removal

47. The scientists report the higher incidence of depressive disorders in the countries with decreased number of sunny days per year. This fact is mediated by the decreased production of which substance?

- A. Serotonin
- B. Melatonin
- C. Acetylcholine
- D. GABA
- E. Adrenaline

48. The woman has just delivered a baby. The concentration of what biologically active substances may be expected to be increased in her brain?

- A. Opioid peptides
- B. Melatonin
- C. Acetylcholine
- D. Growth hormone
- E. GABA

49. Different stages of sleep are characterized by different rate of metabolism. How is oxygen consumption affected during rapid eye movement phase of sleep?

- A. Increased compared to slow wave stage of sleep
- B. Increased compared to slow wave stage of sleep
- C. Does not change between stages of sleep
- D. Does not change compared to wakefulness
- E. Increased compared to wakefulness

50. Metabolism in brain is affected by numerous factors. What biochemical changes may be observed in brain during physiologic sleep?

- A. Increased content of lactate, oxidation of ketone bodies, increased biosynthesis of acetylcholine
- B. Decreased content of lactate, decrease of utilization of ketone bodies, decreased biosynthesis of acetylcholine
- C. Decreased content of lactate, increase of utilization of ketone bodies, decreased biosynthesis of acetylcholine
- D. No specific changes
- E. Increased production of serotonin

TOPIC № 8. DIGESTION OF PROTEINS, CARBOHYDRATES AND LIPIDS IN DIGESTIVE TRACT

1. A woman has been limiting the amount of products in her diet to lose some weight. 3 months later she developed edemas and her diuresis increased. What dietary component deficiency is the cause of this?

- A. Proteins
- B. Fats
- C. Carbohydrates
- D. Vitamins
- E. Minerals

2. Stool test detects in the patients feces a large amount of undigested fats. This patient is the most likely to have disturbed secretion of the following enzymes:

- A. Pancreatic lipases
- B. Pancreatic amylase
- C. Pancreatic proteases
- D. Bile lipase
- E. Gastric protease

3. One of the causes of pernicious anemia is disturbed synthesis of transcobalamin Castle's intrinsic factor-by the parietal cells of the stomach. What substance is called Castle's extrinsic factor?

- A. Cobalamin
- B. Folic acid
- C. Pyridoxine
- D. Riboflavin
- E. Biotin

4. A patient has developed systemic (megaloblastic) anemia despite eating a balanced diet. The day before he underwent a gastric surgical resection. The anemia in this patient is caused by the deficiency of:

- A. Castle factor
- B. Vitamin C
- C. Vitamin PP
- D. Protein
- E. Folic acid

5. When investigating human saliva it is necessary to assess its hydrolytic properties. What substance should be used as a substrate in the process?

- A. Starch
- B. Proteins
- C. Fats
- D. Fiber
- E. Amino acids

6. A 35-year-old man with peptic ulcer disease has undergone antrectomy. After the surgery secretion of the following gastrointestinal hormone will be disrupted the most:

- A. Gastrin
- B. Histamine
- C. Secretin
- D. Cholecystokinin

E. Neurotensin

7. Name the drug that inhibits excretory function of pancreas during treatment of acute pancreatitis:

- A. Contrykal (Aprotinin)
- B. Allochol
- C. Panzynom
- D. Pancreatin (Mezym forte)
- E. Festal

8. Feces of a patient contain high amount of undissociated fats and have grayish-white color. Specify the cause of this phenomenon:

- A. Obturation of bile duct
- B. Hypoactivation of pepsin by hydrochloric acid
- C. Hypovitaminosis
- D. Enteritis
- E. Irritation of intestinal epithelium

9. A patient has a critical impairment of protein, fat and hydrocarbon digestion. Most likely it has been caused by low secretion of the following digestive juice:

- A. Pancreatic juice
- B. Saliva
- C. Gastric juice
- D. Bile
- E. Intestinal juice

10. A 49-year-old male patient with acute pancreatitis was likely to develop pancreatic necrosis, while active pancreatic proteases were absorbed into the bloodstream and tissue proteins broke up. What protective factors of the body can inhibit these processes?

- A. α 2-macroglobulin, α 1-antitrypsin
- B. Immunoglobulin
- C. Cryoglobulin, interferon
- D. Ceruloplasmin, transferrin
- E. Hemopexin, haptoglobin

11. A patient has normally coloured stool including a large amount of free fatty acids. The reason for this is a disturbance of the following process:

- A. Fat absorption
- B. Fat hydrolysis
- C. Biliary excretion
- D. Choleresis
- E. Lipase secretion

12. To prevent attacks of acute pancreatitis a doctor prescribed the patient trasyolol (contrycal, gordox), which is an inhibitor of:

- A. Trypsin
- B. Elastase
- C. Carboxypeptidase
- D. Chymotrypsin
- E. Gastricsin

13. Due to the blockage of the common bile duct (which was radiographically confirmed), the biliary flow to the duodenum was stopped. We should expect the impairment of:

- A. Fat emulsification
- B. Protein absorption
- C. Carbohydrate hydrolysis
- D. Secretion of hydrochloric acid
- E. Salivation inhibition

14. A 30 year old woman has subnormal concentration of enzymes in the pancreatic juice. This might be caused by the hyposecretion of the following gastrointestinal hormone:

- A. Cholecystokinin-pancreozymin
- B. Somatostatin
- C. Secretin
- D. Gastro-inhibiting peptide
- E. Vaso-intestinal peptide

15. A 60 year old patient was found to have a dysfunction of main digestive enzyme of saliva. This causes the disturbance of primary hydrolysis of:

- A. Carbohydrates
- B. Fats
- C. Proteins
- D. Cellulose
- E. Lactose

16. A 30-year-old male patient with acute pancreatitis has been found to have a disorder of cavitory protein digestion. The reason for such condition can be the hyposynthesis and hyposecretion of the following enzyme:

- A. Trypsin
- B. Pepsin
- C. Lipase
- D. Dipeptidase
- E. Amylase

17. A coprological survey revealed lightcolored feces containing drops of neutral fat. The most likely reason for this condition is the disorder of:

- A. Bile inflow into the bowel
- B. Gastric juice acidity
- C. Pancreatic juice secretion
- D. Intestinal juice secretion
- E. Intestinal absorption

18. A newborn develops dyspepsia after the milk feeding. When the milk is substituted by the glucose solution the dyspepsia symptoms disappear. The newborn has the subnormal activity of the following enzyme:

- A. Lactase
- B. Invertase
- C. Maltase
- D. Amylase
- E. Isomaltase

19. A patient complains of frequent diarrheas, especially after consumption of rich food, weight loss. Laboratory examination revealed steatorrhea; his feces were hypocholic. What might have caused such condition?

- A. Obturation of biliary tracts
- B. Inflammation of mucous membrane of small intestine
- C. Lack of pancreatic lipase
- D. Lack of pancreatic phospholipase
- E. Unbalanced diet

20. A newborn child suffers from milk curdling in stomach, this means that soluble milk proteins (caseins) transform to insoluble proteins (paracaseins) by means of calcium ions and a certain enzyme. What enzyme takes part in this process?

- A. Renin
- B. Pepsin
- C. Gastrin
- D. Secretin
- E. Lipase

21. A patient consumed a lot of reach in proteins food that caused increase of rate of proteolytic enzymes of pancreatic juice. It is also accompanied by increase of rate of the following enzyme:

- A. Tripsin
- B. Pepsin
- C. Enterokinase
- D. Gastricsin
- E. Renin

22. Examination of a patient suffering from chronic hepatitis revealed a significant decrease in the synthesis and secretion of bile acids. What process will be mainly disturbed in the patient's bowels?

- A. Fat emulsification
- B. Protein digestion
- C. Carbohydrate digestion
- D. Glycerin absorption
- E. Amino acid absorption

23. After consumption of rich food a patient has nausea and heartburn, steatorrhea. This condition might be caused by:

- A. Bile acid deficiency
- B. Increased lipase secretion
- C. Disturbed tripsin synthesis
- D. Amylase deficiency
- E. Disturbed phospholipase synthesis

24. Surgical removal of a part of stomach resulted in disturbed absorption of vitamin B₁₂, it is excreted with feces. The patient was diagnosed with anemia. What factor is necessary for absorption of this vitamin?

- A. Gastromucoprotein
- B. Gastrin
- C. Hydrochloric acid
- D. Pepsin
- E. Folic acid

25. Examination of a 35 year old patient revealed high acidity of gastric juice. What receptors should be blocked in order to reduce it?

- A. Histamine
- B. α 1-adrenoreceptors
- C. α 2-adrenoreceptors
- D. β 1-adrenoreceptors
- E. β 2-adrenoreceptors

26. After intake of rich food a patient feels nausea and sluggishness; with time there appeared signs of steatorrhea. Blood cholesterine concentration is 9,2 micromole/l. This condition was caused by lack of:

- A. Bile acids
- B. Triglycerides
- C. Fatty acids
- D. Phospholipids
- E. Chylomicrons

27. A patient has a disturbed absorption of fat hydrolysates. It might have been caused by a deficit in the small intestine cavity:

- A. Of bile acids
- B. Of bile pigments
- C. Of lipolytic enzymes
- D. Of sodium ions
- E. Of liposoluble vitamins

28. Secretion of what gastrointestinal hormones will be primarily decreased as a result of duodenum removal?

- A. Cholecystokinin and secretin
- B. Gastrin
- C. Histamine
- D. Gastrin and histamine
- E. Neurotensin

29. A patient with encephalopathy was admitted to the neurological inpatient department. There was revealed a correlation between increasing of encephalopathy and substances absorbed by the bloodstream from the intestines. What substances that are formed in the intestines can cause endotoxemia?

- A. Indole
- B. Butyrate
- C. Acetacetate
- D. Biotin
- E. Ornithine

30. A 30-year-old woman was diagnosed with insufficiency of exocrinous function of pancreas. Hydrolysis of what nutrients will be disturbed?

- A. Proteins, fats, carbohydrates
- B. Proteins, fats
- C. Proteins, carbohydrates
- D. Fats, carbohydrates
- E. Proteins

31. A patient with hypersecretion of the gastric juices was recommended to exclude concentrated bouillons and vegetable decoctions from the diet because of their stimulation of gastric secretion. What is the dominating mechanism of stimulation of secretion in this case?

- A. Stimulation of gastrin production by G-cells
- B. Irritation of taste receptor
- C. Irritation of mechanoreceptors of the oral cavity
- D. Irritation of mechanoreceptors of the stomach
- E. Stimulation of excretion of secretin in the duodenum

32. Indican excretion is a diagnostic criterion of intensified protein putrefaction in the intestine. Name the end product of tryptophan "decay" occurring in the large intestine:

- A. Indole
- B. Hydrogen sulfide
- C. Putrescine
- D. Benzoic acid
- E. Mercaptan

33. A 5-year-old child presents with abdominal distension, abdominal cramps, and diarrhea occurring 1-4 hours after drinking milk. Described symptoms are caused by the lack of enzymes that break up:

- A. Lactose
- B. Fructose
- C. Glucose
- D. Maltose
- E. Saccharose

34. The end product of starch hydrolysis is:

- A. D-glucose
- B. D-fructose
- C. Saccharose
- D. Maltose
- E. D-galactose

35. Contrykal is used to prevent pancreatic autolysis. This drug is the inhibitor of the following enzymes:

- A. Proteases
- B. Lipases
- C. Glycosidases
- D. Nucleases
- E. Synthetases

36. After drinking milk a 1-year-old child developed diarrhea, flatulence. The baby is likely to have deficiency of the following enzyme:

- A. Lactase
- B. Maltase
- C. Aldolase
- D. Hexokinase
- E. Glycosidase

37. Inhibition of the synthesis of bile acids from cholesterol in liver of an experimental animals has caused maldigestion of lipids. What is the role of these acids in the enteral lipidic metabolism?

- A. They emulsify dietary lipids
- B. They keep balance of alkaline environment in the intestines
- C. They participate in the synthesis of lipids
- D. They are part of LDL
- E. They activate the formation of chylomicrons

38. During calculous cholecystitis attack the patient has developed the following symptoms: saponated feces and steatorrhea. What stage of fats metabolism is disrupted according to those symptoms?

- A. Fat digestion, absorption and secretion
- B. Fat absorption
- C. Intermediary metabolism of fats
- D. Fats metabolism in adipose tissue
- E. Depositing disruption

39. During gastric secretory function research decrease of hydrochloric acid concentration in gastric juice was detected. What enzyme will be less active in such a condition?

- A. Pepsin
- B. Amylase
- C. Lipase
- D. Dipeptidase
- E. Hexokinase

40. The 55-year-old female patient has developed a case of acute pancreatitis caused by greasy food. What is the main pathogenesis step of this disorder?

- A. Premature activation of enzymes in gland ducts and cells
- B. Pancreatic juice deficiency
- C. Low bile production in liver
- D. Fats digestion disruption
- E. Acute bowel obstruction

41. A 42-year-old woman, who has been keeping to a vegetarian diet for a long period of time, consulted a doctor. Examination revealed negative nitrogen balance in the patient. What factor is the most likely cause of such a condition?

- A. Insufficient amount of proteins in the diet
- B. Insufficient amount of dietary fiber
- C. Excessive amount of fats in the diet
- D. Insufficient amount of fats in the diet
- E. Decreased rate of metabolic processes

42. Protein digestion in the stomach is carried out by pepsin secreted in form of an inactive pepsinogen. Pepsinogen is converted to pepsin by the removal of the N-terminal peptide that is provoked by:

- A. Perchloric acid
- B. Sulfuric acid
- C. Acetic acid
- D. Bile acids
- E. Amino acids

43. Digestion of proteins in the digestive tract is a complex process of their hydrolysis till peptides and free amino acids. What enzymes decompose proteins in the duodenum?

- A. Trypsin, chemotrypsin
- B. Enterokinase, lipase
- C. Amylase, maltase
- D. Pepsin, gastricsin
- E. Lipase, phospholipase

44. A patient has undergone surgical removal of the pylorus. Decreased secretion of the following hormone can be expected:

- A. Gastrin
- B. Histamine
- C. Secretin
- D. Cholecystokinin
- E. Gastric inhibitory polypeptide

45. An experimental animal, a dog, received a weak solution of hydrochloric acid through a tube inserted into the duodenum. Primarily it will result in increased secretion of the following hormone:

- A. Secretin
- B. Gastrin
- C. Histamine
- D. Cholecystokinin
- E. Neurotensin

46. During experiment the processes of food and water hydrolysis products absorption were studied. It was determined that these processes mainly occur in the following gastrointestinal segment:

- A. Small intestine
- B. Stomach
- C. Large intestine
- D. Rectum
- E. Oral cavity

47. Laboratory investigation of the patient's blood plasma, which was performed 4 hours after a consumption of a fat diet, displayed a marked increase of plasma turbidity. The most credible cause of this phenomenon is the increase of in the plasma.

- A. Chylomicrons
- B. LDL
- C. HDL
- D. Cholesterol
- E. Phospholipids

48. Note substance, which activates pepsinogen to pepsin:

- A. Hydrochloric acid
- B. Enterokinase
- C. Trypsin
- D. Bile acids
- E. Adenosine triphosphate

49. Chose the enzyme which plays an important role in production of hydrochloric acid by parietal cells of gastric mucosa glands:

- A. Carbonic anhydrase
- B. Catalase
- C. Pyruvate dehydrogenase
- D. Cytochrome oxidase
- E. Peroxidase

50. Zymogens of proteolytic enzymes are activated by the next process:

- A. Limited proteolysis
- B. Hydroxylation of lysine
- C. Carboxylation of glutamic acid
- D. Decarboxylation of aspartic acid side chain
- E. Phosphorylation of serine residues in protein molecule

TOPIC 9. FUNCTIONAL ROLE OF WATER AND FAT SOLUBLE VITAMINS IN METABOLISM

1. A 36-year-old female patient has a history of B₂-hypovitaminosis. The most likely cause of specific symptoms (epithelial, mucosal, cutaneous, corneal lesions) is the deficiency of:

- A. Flavin coenzymes
- B. Cytochrome A1
- C. Cytochrome oxidase
- D. Cytochrome B
- E. Cytochrome C

2. In case of enterobiasis acridine - the structural analogue of vitamin B₂ - is administered. The synthesis disorder of which enzymes does this medicine cause in microorganisms?

- A. FAD-dependent dehydrogenases
- B. Cytochrome oxidases
- C. Peptidases
- D. NAD-dependent dehydrogenases
- E. Aminotransferases

3. A patient complains of photoreception disorder and frequent acute viral diseases. He has been prescribed a vitamin that affects photoreception processes by producing rhodopsin, the photosensitive pigment. What vitamin is it?

- A. Retinol acetate
- B. Tocopherol acetate
- C. Pyridoxine hydrochloride
- D. Cyanocobalamin
- E. Thiamine

4. Examination of a patient with frequent haemorrhages from the internal organs and mucous membranes revealed proline and lysine within the collagen fibers. Disorder of their hydroxylation is caused by lack of the following vitamin:

- A. Vitamin C
- B. Vitamin K
- C. Vitamin A
- D. Vitamin B₁
- E. Vitamin E

5. Symptoms of pellagra (vitamin PP deficiency) is particularly pronounced in patients with low protein diet, because nicotinamide precursor in humans is one of the essential amino acids, namely:

- A. Tryptophan
- B. Threonine
- C. Arginine
- D. Histidine
- E. Lysine

6. A 4-year-old child with hereditary renal lesion has signs of rickets; vitamin D concentration in blood is normal. What is the most probable cause of rickets development?

- A. Impaired synthesis of calcitriol
- B. Increased excretion of calcium
- C. Hyperfunction of parathyroid glands
- D. Hypofunction of parathyroid glands
- E. Lack of calcium in food

7. Coenzym A participates in numerous important metabolic reactions. It is a derivative of the following vitamin:

- A. Pantothenic acid
- B. Thiamine
- C. Niacin
- D. Calciferol
- E. Ubiquinone

8. A 3 year old child with symptoms of stomatitis, gingivitis and dermatitis of open skin areas was delivered to a hospital. Examination revealed inherited disturbance of neutral amino acid transporting in the bowels. These symptoms were caused by the deficiency of the following vitamin:

- A. Niacin
- B. Pantothenic acid
- C. Vitamin A
- D. Cobalamin
- E. Biotin

9. A doctor examined a child and revealed symptoms of rickets. Development of this disease was caused by deficiency of the following compound:

- A. 1,25 [OH]-dichydroxycholecalciferol
- B. Biotin
- C. Tocopherol
- D. Naphtaquinone
- E. Retinol

10. A patient, who has been suffering for a long time from intestine disbacteriosis, has increased hemorrhaging caused by disruption of posttranslational modification of blood-coagulation factors II, VII, IX, and X in the liver. What vitamin deficiency is the cause of this condition?

- A. K
- B. B₁₂
- C. B₉
- D. C
- E. P

11. A doctor recommends a patient with duodenal ulcer to drink cabbage and potato juice after the therapy course. Which substances contained in these vegetables help to heal and prevent the ulcers?

- A. Vitamin U
- B. Pantothenic acid

- C. Vitamin C
- D. Vitamin B₁
- E. Vitamin K

12. A 64 year old woman has impairment of twilight vision (hemeralopy). What vitamin should be recommended in the first place?

- A. A
- B. B₂
- C. E
- D. C
- E. B₆

13. Vitamin A together with specific cytochrome receptors penetrates through the nuclear membranes, induces transcription processes that stimulate growth and differentiation of cells. This biological function is realized by the following form of vitamin A:

- A. Trans-retinoic acid
- B. Trans-retinal
- C. Cis-retinal
- D. Retinol
- E. Carotin

14. Increased fragility of vessels, enamel and dentine destruction resulting from scurvy are caused by disorder of collagen maturation. What stage of procollagen modification is disturbed under this avitaminosis?

- A. Hydroxylation of proline
- B. Formation of polypeptide chains
- C. Glycosylation of hydroxylysine residues
- D. Removal of C-ended peptide from procollagen
- E. Detaching of N-ended peptide

15. Blood test of a patient suffering from atrophic gastritis gave the following results:

RBCs - $2,0 \cdot 10^{12}/l$, Hb- 87 g/l, colour index - 1,3, WBCs - $4,0 \cdot 10^9/l$, thrombocytes - $180 \cdot 10^9/l$. Anaemia might have been caused by the following substance deficiency:

- A. Vitamin B₁₂
- B. Vitamin A
- C. Vitamin K
- D. Iron
- E. Zinc

16. It has been found out that one of a pesticide components is sodium arsenate that blocks lipoic acid. Which enzyme activity is impaired by this pesticide?

- A. Pyruvate dehydrogenase complex
- B. Microsomal oxidation
- C. Methemoglobin reductase
- D. Glutathione peroxidase
- E. Glutathione reductase

17. A patient presents with dry peeling skin, frequent cases of acute respiratory diseases, xerophthalmia. What vitamin preparation should be prescribed in this case?

- Retinol acetate
- B. Thiamine
- C. Cyanocobalamin
- D. Menadione (Vikasolum)
- E. Ergocalciferol

18. A 6-year-old child suffers from delayed growth, disrupted ossification processes, decalcification of the teeth. What can be the cause?

- A. Vitamin D deficiency
- B. Decreased glucagon production
- C. Insulin deficiency
- D. Hyperthyroidism
- E. Vitamin C deficiency

19. As a result of posttranslative modifications some proteins taking part in blood coagulation, particularly prothrombin, become capable of calcium binding. The following vitamin takes part in this process:

- A. K
- B. C
- C. A
- D. B₁
- E. B₂

20. A patient diagnosed with focal tuberculosis of the upper lobe of the right lung had been taking isoniazid as a part of combination therapy. After some time, the patient reported of muscle weakness, decreased skin sensitivity, blurred vision, impaired motor coordination. Which vitamin preparation should be used to address these phenomena?

- A. Vitamin B₆
- B. B. Vitamin A
- C. Vitamin D
- D. Vitamin B₁₂
- E. Vitamin C

21. Examination of a child who hasn't got fresh fruit and vegetables during winter revealed numerous subcutaneous hemorrhages, gingivitis, carious cavities in teeth. What vitamin combination should be prescribed in this case?

- A. Ascorbic acid and rutin
- B. Thiamine and pyridoxine
- C. Folic acid and cobalamin
- D. Riboflavin and nicotinamide
- E. Calciferol and ascorbic acid

22. A 10-year-old girl has a history of repeated acute respiratory viral infection. After recovering she presents with multiple petechial hemorrhages on the sites of friction from clothing rubbing the skin. What kind of hypovitaminosis has this girl?

- A. C
- B. B₆
- C. B₁
- D. A

E. B₂

23. During examination of an 11-month-old infant a pediatrician revealed osteoectasia of the lower extremities and delayed mineralization of cranial bones. Such pathology is usually provoked by the deficit of the following vitamin:

- A. Cholecalciferol
- B. Thiamin
- C. Pantothenic acid
- D. Bioflavonoids
- E. Riboflavin

24. In clinical practice tuberculosis is treated with izoniazid preparation - that is an antivitamin able to penetrate into the tuberculosis bacillus. Tuberculostatic effect is induced by the interference with replication processes and oxidation-reduction reactions due to the buildup of pseudo-coenzyme:

- A. NAD
- B. FAD
- C. FMN
- D. TDP
- E. CoQ

25. A pregnant woman with several miscarriages in anamnesis is prescribed a therapy that includes vitamin preparations. What vitamin facilitates carrying of a pregnancy?

- A. Alpha-tocopherol
- B. Folic acid
- C. Cyanocobalamin
- D. Pyridoxal phosphate
- E. Rutin

26. A patient suffers from vision impairment - hemeralopy (night blindness). What vitamin preparation should be administered the patient in order to restore his vision?

- A. Retinol acetate
- B. Vicasol
- C. Pyridoxine
- D. Thiamine chloride
- E. Tocopherol acetate

27. After an extended treatment with sulfanamides a patient has developed macrocytic anemia. Production of active forms of the following vitamin is disrupted in such a condition:

- A. Folic acid
- B. Thiamine
- C. Riboflavin
- D. Pyridoxine
- E. Cyanocobalamin

28. A 56 year old patient came to a hospital with complaints about general weakness, tongue pain and burning, sensation of limb numbness. In the past he underwent resection of forestomach. In blood: Hb- 80 g/l; erythrocytes - $2,0 \cdot 10^{12}$ /l; colour index - 1,2, leukocytes - $3,5 \cdot 10^9$ /l. What anemia type is it?

- A. B₁₂-folate deficient
- B. Hemolytic
- C. Posthemorrhagic
- D. Aplastic
- E. Iron-deficient

29. A 9 m.o. child has delayed dentition, it is also out of order. Upper jaw configuration is horizontal ("high"palate); microscopically - irregular mineralization of tooth enamel, wrinkled enamel prisms, some of them are vacuolized. Predentin zone is extended; there are solitary denticles. What disease is it?

- A. Early rickets
- B. Late rickets
- C. Osteomalacia
- D. Gout
- E. Hypervitaminosis D

30. A 6-year-old child suffers from delayed growth, disrupted ossification processes, decalcification of the teeth. What can be the cause?

- A. Vitamin D deficiency
- B. Decreased glucagon production
- C. Insulin deficiency
- D. Hyperthyroidism
- E. Vitamin C deficiency

31. A patient is diagnosed with chronic atrophic gastritis attended by deficiency of Castle's intrinsic factor. What type of anemia does the patient have?

- A. B₁₂ -deficiency anemia
- B. Iron refractory anemia
- C. Hemolytic anemia
- D. Iron-deficiency anemia
- E. Protein-deficiency anemia

32. A number of diseases, in particular myocardial infarction and liver cirrhosis, can be diagnosed by evaluating activity of blood transaminases. What vitamin is one of cofactors of these enzymes?

- A. B₆
- B. B₂
- C. B₁
- D. B₈
- E. B₅

33. Pyruvate concentration in the patient's urine has increased 10 times from normal amount. What vitamin deficiency can be the reason of this change:

- A. Vitamin B₁
- B. Vitamin C
- C. Vitamin A
- D. Vitamin E
- E. Vitamin B₆

34. Hydroxylation of substrates plays important role in the processes of detoxification of xenobiotics. But the reactions of of detoxification of xenobiotics requires a donor of protons. Which of the following vitamins can play this role?

- A. Vitamin C
- B. Vitamin P
- C. Vitamin B₆
- D. Vitamin E
- E. Vitamin A

35. A patient underwent radiation therapy because of Hodgkin's lymphoma. One of the side effects of radiation therapy was ulceration of oral cavity. In order to accelerate healing of a radiation ulcer a vitamin drug was administered. What drug is it?

- A. Retinol acetate
- B. Retabolil
- C. Prednisolone
- D. Levamisole
- E. Methyluracil

36. Surgical removal of a part of stomach resulted in disturbed absorption of vitamin B₁₂, it is excreted with feces. The patient was diagnosed with anemia. What factor is necessary for absorption of this vitamin?

- A. Gastromucoprotein
- B. Gastrin
- C. Hydrochloric acid
- D. Pepsin
- E. Folic acid

37. According to clinical indications a patient was administered pyridoxal phosphate. What processes is this medication intended to correct?

- A. Transamination and decarboxylation of aminoacids
- B. Oxidative decarboxylation of ketonic acids
- C. Desamination of purine nucleotide
- D. Synthesis of purine and pyrimidine bases
- E. Protein synthesis

38. A 64 year old homeless malnourished woman has impairment of twilight vision (hemeralopy). What vitamin should be recommended for the correction of this condition?

- A. Vitamin A
- B. Vitamin B₂
- C. Vitamin E
- D. Vitamin C
- E. Vitamin B₆

39. Vitamin B₁ deficiency causes disturbance of oxidative decarboxylation of α -ketoglutaric acid. This leads to the impaired synthesis of the following coenzyme:

- A. Thiamine pyrophosphate
- B. Nicotinamide adenine dinucleotide

- C. Flavine adenine dinucleotide
- D. Lipoic acid
- E. Coenzyme A

40. In patients with the biliary tract obstruction the blood coagulation is inhibited; the patients have frequent haemorrhages caused by the subnormal assimilation of the following vitamin:

- A. K
- B. A
- C. D
- D. E
- E. C

41. A 20-year-old male patient complains of general weakness, rapid fatigability, irritability, decreased performance, bleeding gums, petechiae on the skin. What vitamin deficiency may be a cause of these changes?

- A. Ascorbic acid
- B. Riboflavin
- C. Thiamine
- D. Retinol
- E. Folic acid

42. A patient who was only on a plant diet for a long time and avoided oils and fats developed the signs of the skin damage, hair loss, delayed wound healing, thrombocytopenia, low resistance to infections because of the deficiency of vitamin F (linoleic and linolenic acids in the body). These changes are most likely to be caused by the impaired synthesis of the following substances:

- A. Eicosanoids
- B. Interleukins
- C. Interferons
- D. Catecholamines
- E. Corticosteroids

43. It has been found out that one of the components of insecticides, used in protection of agrocultures from insects, include sodium arsenate that blocks lipoic acid. Which enzyme activity is impaired by this pesticide?

- A. Pyruvate dehydrogenase complex
- B. Microsomal oxidation
- C. Methemoglobin reductase
- D. Glutathione peroxidase
- E. Glutathione reductase

44. A patient has pellagra. Interrogation revealed that he had lived mostly on maize for a long time and eaten little meat. This disease had been caused by the deficit of the following substance in the maize:

- A. Tryptophan
- B. Tyrosine
- C. Proline
- D. Alanine
- E. Histidine

45. During regular check-up a child is detected with interrupted mineralization of the bones, caries, curvature of limbs, deformation of chest. What vitamin deficiency can be the cause?

- A. Calciferol
- B. Riboflavin
- C. Tocopherol
- D. Folic acid
- E. Cobalamin

46. A woman who has been keeping to a clean-rice diet for a long time was diagnosed with polyneuritis (beriberi). What vitamin deficit results in development of this disease?

- A. Thiamine
- B. Ascorbic acid
- C. Pyridoxine
- D. Folic acid
- E. Riboflavin

47. Removal of gall bladder of a patient has disturbed processes of Ca absorption through the intestinal wall. What vitamin will stimulate this process?

- A. D₃
- B. P P
- C. C
- D. B₁₂
- E. K

48. An infant, who was on synthetic formula feeding, developed signs of vitamin B₁ deficiency. What reactions does this vitamin take part in?

- A. Keto acids oxidative decarboxylation
- B. Amino acids transamination
- C. Amino acids decarboxylation
- D. Proline hydroxylation
- E. Redox reactions

49. A patient underwent an operation on account of gall bladder excision that resulted in obstruction of Ca absorption through the bowels wall. What vitamin will stimulate this process?

- A. D₃
- B. P P
- C. C
- D. B₁₂
- E. K

50. Examination of a man who hadn't been consuming fats but had been getting enough carbohydrates and proteins for a long time revealed dermatitis, poor wound healing, vision impairment. What is the probable cause of metabolic disorder?

- A. Lack of linoleic acid, vitamins A, D, E, K
- B. Lack of palmitic acid
- C. Lack of vitamins P P , H
- D. Low caloric value of diet

E. Lack of oleic acid

51. Most participants of Magellan expedition to America died from avitaminosis. This disease declared itself by general weakness, subcutaneous hemorrhages, falling of teeth, gingival hemorrhages. What is the name of this avitaminosis?

- A. Scurvy
- B. Pellagra
- C. Rachitis
- D. Polyneuritis (beriberi)
- E. Biermer's anemia

52. A patient who was previously ill with mastectomy as a result of breast cancer was prescribed radiation therapy. What vitamin preparation has marked radioprotective action caused by antioxidant activity?

- A. Tocopherol acetate
- B. Ergocalciferol
- C. Thiamine chloride
- D. Riboflavin
- E. Folic acid

53. A clinic observes a 49 year old patient with significant prolongation of coagulation time, gastrointestinal haemorrhages, subcutaneous hematomas. These symptoms might be explained by the deficiency of the following vitamin:

- A. K
- B. B₁
- C. B₆
- D. H
- E. E

54. A consciousnessless patient, found in the street, was brought to hospital to the emergency department. When he came to consciousness he said that he was homeless. The man looks like alcoholic and does not deny alcohol consumption. His body mass index is decreased and he does not care what he eats. Bruises and small petechiae are revealed on his body as well as bleeding of gums. This disorder is caused by:

- A. Impaired hydroxylation of proline and lysine in endoplasmic reticulum
- B. Impaired glycosylation of proline and lysine in nucleus
- C. Impaired glycosylation of proline and isoleucine in Golgi apparatus
- D. Impaired glycosylation of proline and isoleucine in ribosomes
- E. Impaired hydroxylation of proline and lysine in cytoplasm

55. A 60 year old man is in psychiatric clinic undergoing therapy for alcoholism. The vitamin deficient in this patient is the cofactor for the following enzyme:

- A. Alfacetoglutarate dehydrogenase
- B. Delta-aminolevulinic synthase
- C. Dopamine hydroxylase
- D. Homocysteinmethyltransferase
- E. Pyruvate carboxylase

TOPIC 10. ACID-BASE BALANCE AND RESPIRATORY FUNCTION OF RED BLOOD CELLS. PATHOLOGICAL FORMS OF HEMOGLOBIN.

1. A patient with respiratory failure has blood pH of 7.35. $p\text{CO}_2$ test revealed hypercapnia. Urine pH test revealed an increase in the urine acidity. What form of acid-base imbalance is the case?
 - A. Compensated respiratory acidosis
 - B. Compensated metabolic acidosis
 - C. Decompensated metabolic acidosis
 - D. Compensated respiratory alkalosis
 - E. Decompensated respiratory alkalosis
2. A patient is ill with diabetes mellitus accompanied by hyperglycemia on an empty stomach (7,2 millimole/l). The hyperglycemia rate can be retrospectively estimated (over the last 4-8 weeks before the examination) on the ground of the rate of the following blood plasma protein:
 - A. Glycated hemoglobin
 - B. Albumin
 - C. Fibrinogen
 - D. C-reactive protein
 - E. Ceruloplasmin
3. From the group of children who were eating sweet sappy watermelon two kids developed the signs of poisoning: rapid weakness, dizziness, headache, vomiting, edema, tachycardia, cyanosis of mouth, ears, tips of the fingers cyanosis. High concentration of nitrates was detected. What is the leading mechanism of the pathogenesis of the poisoning in the two children?
 - A. Insufficiency of met-Hb-reductase
 - B. Insufficiency of superoxiddismutase
 - C. Block cytochrome oxidase
 - D. Insufficiency glutathione pyroxidase
 - E. Insufficiency of catalase
4. A 39-year-old female patient with a history of diabetes was hospitalized in a precomatose state for diabetic ketoacidosis. This condition had been caused by an increase in the following metabolite level:
 - A. Acetoacetate
 - B. Citrate
 - C. Alpha-ketoglutarate
 - D. Malonate
 - E. Aspartate
5. Human red blood cells do not contain mitochondria. What is the main pathway for ATP production in these cells?
 - A. Anaerobic glycolysis
 - B. Aerobic glycolysis
 - C. Oxidative phosphorylation
 - D. Creatine kinase reaction
 - E. Cyclase reaction
6. Diseases of respiratory system and circulatory disorders impair the transport of oxygen, thus causing hypoxia. Under these conditions the energy metabolism is

carried out by anaerobic glycolysis. As a result, the following substance is generated and accumulated in blood:

- A. Lactic acid
- B. Pyruvic acid
- C. Glutamic acid
- D. Citric acid
- E. Fumaric acid

7. A public utility specialist went down into a sewer well without protection and after a while lost consciousness. Ambulance doctors diagnosed him with hydrogen sulfide intoxication. What type of hypoxia developed?

- A. Hemic
- B. Overload
- C. Tissue
- D. Circulatory
- E. Respiratory

8. When ascending to the top of Elbrus, a mountain climber experiences oxygen starvation, dyspnea, palpitations, and numbness of the extremities. What kind of hypoxia has developed in the mountain climber?

- A. Hypoxic
- B. Circulatory
- C. Hemic
- D. Tissue
- E. Cardiac

9. A 25 year old Palestinian woman complains of weakness, dizziness, dyspnea. In anamnesis: periodically exacerbating anemia. In blood: Hb - 60 g/l, erythrocytes – 2.5×10^{12} /l, reticulocytes - 35% , anisocytosis and poikilocytosis of erythrocytes, a lot of target cells and polychromatophils. What type of anemia is it?

- A. Thalassemia
- B. Sickle-cell anemia
- C. Minkowsky-Shauffard disease
- D. Addison-Biermer disease
- E. Glucose 6-phosphate dehydrogenase- deficient anemia

10. Diabetes mellitus causes ketosis as a result of activated oxidation of fatty acids. What disorders of acid-base equilibrium may be caused by excessive accumulation of ketone bodies in blood?

- A. Metabolic acidosis
- B. Metabolic alkalosis
- C. Any changes won't happen
- D. Respiratory acidosis
- E. Respiratory alkalosis

11. A pregnant woman had been having toxicosis with severe repeated vomiting for 24 hours. In the end of the day there appeared tetanic convulsions and fluid loss. What shift of acid-base state caused these changes?

- A. Excretory alkalosis
- B. Gaseous alkalosis
- C. Gaseous acidosis

- D. Metabolic acidosis
- E. Excretory acidosis

12. A patient with hypochromic anemia has splitting hair and loss of hair, increased nail brittling and taste alteration. What is the mechanism of the development of these symptoms?

- A. Deficiency of iron-containing enzymes
- B. Deficiency of vitamin B₁₂
- C. Decreased production of parathyrin
- D. Deficiency of vitamin A
- E. Decreased production of thyroid hormones

13. A 30-year-old man with diabetes mellitus type I was hospitalized. The patient is comatose. Laboratory tests revealed hyperglycemia and ketonemia. What metabolic disorder can be detected in this patient?

- A. Metabolic acidosis
- B. Metabolic alkalosis
- C. Respiratory acidosis
- D. Respiratory alkalosis
- E. Acid-base balance is normal

14. During ascent into mountains a person develops increased respiration rate and rapid heart rate. What is the cause of these changes?

- A. Decrease of O₂ partial pressure
- B. Increase of C O₂ partial pressure
- C. Increase of blood pH
- D. Increase of nitrogen content in air
- E. Increase of air humidity

15. A patient suffers from disrupted patency of the airways at the level of small and medium-sized bronchial tubes. What changes of acid-base balance can occur in the patient?

- A. Respiratory acidosis
- B. Respiratory alkalosis
- C. Metabolic acidosis
- D. Metabolic alkalosis
- E. Acid-base balance remains unchanged

16. After taking poor-quality food a patient developed repeated episodes of diarrhea. On the next day he presented with decreased arterial pressure, tachycardia, extrasystole. Blood pH is 7,18. These abnormalities were caused by the development of:

- A. Nongaseous acidosis
- B. Gaseous acidosis
- C. Nongaseous alkalosis
- D. Gaseous alkalosis
- E. Metabolic alkalosis

17. Buffer capacity of a worker's blood was decreased due to exhausting muscular work. By coming of what acid substance in the blood can this state be explained?

- A. Lactate
- B. Pyruvate
- C. 1,3-bisphosphoglycerate
- D. α -ketoglutarate
- E. 3-phosphoglycerate

18. Examination of initial molecular structure revealed substitution of the glutamic acid by valine. What inherited pathology is it typical for?

- A. Sickle-cell anemia
- B. Thalassemia
- C. Minkowsky-Shauffard disease
- D. Favism
- E. Hemoglobinosis

19. Along with normal hemoglobin types there can be pathological ones in the organism of an adult. Name one of them:

- A. HbS
- B. HbF
- C. HbA₁
- D. HbA₂
- E. HbO₂

20. A 19-year-old female patient has had low haemoglobin rate of 90-95 g/l since childhood. Blood count results obtained after hospitalisation are as follows:

erythrocytes - $3,2 \cdot 10^{12}$ /l, Hb- 85 g/l, colour index - 0,78; leukocytes - $5,6 \cdot 10^9$ /l, platelets - $210 \cdot 10^9$ /l. Smear examination revealed anisocytosis, poikilocytosis and target cells. Reticulocyte rate is 6%. Iron therapy was ineffective. What blood pathology corresponds with the described clinical presentations?

- A. Thalassemia
- B. Enzymopathy
- C. Membranopathy
- D. Sickle-cell anemia
- E. Favism

21. A hypertensive patient had been keeping to a salt-free diet and taking antihypertensive drugs together with hydrochlorothiazide for a long time. This resulted in electrolyte imbalance. What disorder of the internal environment occurred in the patient?

- A. Hypochloremic alkalosis
- B. Metabolic acidosis
- C. Hyperkalemia
- D. Hypermagnesemia
- E. Increase in circulating blood volume

22. An infant has pylorospasm, weakness, hypodynamia, convulsions as a result of frequent vomiting. What kind of acid-base disbalance is it?

- A. Excretory alkalosis
- B. Excretory acidosis
- C. Metabolic acidosis
- D. Exogenous nongaseous acidosis

E. Gaseous alkalosis

23. A 3 year old child with fever was given aspirin. It resulted in intensified erythrocyte haemolysis. Hemolytic anemia might have been caused by congenital insufficiency of the following enzyme:

- A. Glucose 6-phosphate dehydrogenase
- B. Glucose 6-phosphatase
- C. Glycogen phosphorylase
- D. Glycerol phosphate dehydrogenase
- E. γ -glutamyltransferase

24. An infant has apparent diarrhea resulting from improper feeding. One of the main diarrhea effects is plentiful excretion of sodium bicarbonate. What form of acid-base balance disorder is the case?

- A. Metabolic acidosis
- B. Metabolic alkalosis
- C. Respiratory acidosis
- D. Respiratory alkalosis
- E. No disorders of acid-base balance will be observed

25. A patient with diabetes developed a diabetic coma due to the acid-base imbalance. Specify the kind of this imbalance:

- A. Metabolic acidosis
- B. Metabolic alkalosis
- C. Respiratory acidosis
- D. Gaseous alkalosis
- E. Non-gaseous alkalosis

26. A 56 y.o. patient has been suffering from thyreotoxicosis for a long time. What type of hypoxia can be developed?

- A. Tissue
- B. Hemic
- C. Circulatory
- D. Respiratory
- E. Mixed

27. The resuscitation unit has admitted a patient in grave condition. It is known that he had mistakenly taken sodium fluoride which blocks cytochrome oxidase. What type of hypoxia developed in the patient?

- A. Tissue
- B. Hemic
- C. Cardiovascular
- D. Hypoxic
- E. Respiratory

28. Hemoglobin catabolism results in release of iron which is transported to the bone marrow by a certain transfer protein and used again for the synthesis of hemoglobin. Specify this transfer protein:

- A. Transferrin (siderophilin)
- B. Transcobalamin
- C. Haptoglobin
- D. Ceruloplasmin

E. Albumin 2013

29. A 20 year old patient complains of general weakness, dizziness, quick fatigability. Blood analysis results: Hb- 80 g/l. Microscopical examination results: erythrocytes are of modified form. This condition might be caused by:

- A. Sickle-cell anemia
- B. Hepatocellular jaundice
- C. Acute intermittent porphyria
- D. Obturative jaundice
- E. Addison's disease

30. A patient presents with disturbed patency of the airways at the level of small and medium bronchial tubes. What acid-base imbalance can the patient develop?

- A. Respiratory acidosis
- B. Metabolic acidosis
- C. Respiratory alkalosis
- D. Acid-base balance remains unchanged
- E. Metabolic acidosis

31. A man is in the state of rest. He has been forcing himself to breath deeply and frequently for 3-4 minutes. What effect will it have upon acid-bace balance of the organism?

- A. Respiratory alkalosis
- B. Respiratory acidosis
- C. Metabolic alkalosis
- D. Metabolic acidosis
- E. There will be no change in acid-base balance

32. A female patient with toxemia of pregnancy has hypersalivation resulting in a daily loss of 3-4 liters of saliva. What disorder of water-salt metabolism occurs in such cases?

- A. Hyperosmolar hypohydration
- B. Hypoosmolar hypohydration
- C. Isoosmolar hypohydration
- D. Hypokalemia
- E. -

33. A woman with intractable vomiti-ng was admitted to the infectious di sease ward. What changes of water-salt metabolism are likely to be observed?

- A. Hypoosmolar dehydration
- B. Isoosmolar dehydration
- C. Hyperosmolar dehydration
- D. Hypoosmolar hyperdehydration
- E. Hyperosmolar hyperdehydration

34. Ketoacidosis that develops due to accumulation of ketone bodies in blood serum is a primary complication of diabetes mellitus. What acid-base disbalance develops during this condition?

- A. Metabolic acidosis
- B. Metabolic alkalosis
- C. Respiratory acidosis
- D. Respiratory alkalosis

E. -

35. During auscultation a 26-year-old patient was asked to breathe deep. After 10 breaths the patient lost consciousness, which is associated with the development of the following condition:

- Respiratory alkalosis
- B. Carbon dioxide acidosis
- C. Erythropenia
- D. Polycythemia
- E. Reduced oxygen capacity of blood

36. It is known that people who permanently live in highland have an increased concentration of erythrocytes per each blood volume unit. Owing to this fact blood can optimally fulfil the following function:

- A. Gas transport
- B. Amino acid transport
- C. Haemostasis participation
- D. Maintenance of acid-base balance
- E. Maintenance of ionic equilibrium

37. A 20-year-old young man, who started to train systematically in athletics, has the following resting-state blood values: erythrocytes - $5,5 \cdot 10^{12}$ /l, reticulocytes - 12%, hemoglobin - 160 g/l, color index - 1,03. Such blood values indicate erythropoiesis stimulation due to the following occurring in the process of his training:

- A. Hypoxemia
- B. Hypercapnia
- C. Physical activity
- D. Hyperventilation
- E. Hyperglycemia

38. In some areas of South Africa many people have sickle cell disease characterized by red blood cells that assume an abnormal sickle shape due to the substitution of glutamic acid for valine in the hemoglobin molecule. What is the cause of this disease?

- A. Gene mutation
- B. Disturbances of the mechanisms of genetic information transmission
- C. Crossing-over
- D. Genomic mutation
- E. Transduction

39. A patient with enteritis accompanied with intense diarrhea has reduced quantity of water in the extracellular space and increased quantity of water inside the cells as well as low blood osmolarity. Name this disorder of water-electrolytic metabolism:

- A. Hyposmolar hypohydration
- B. Hyperosmolar hypohydration
- C. Osmolar hypohydration
- D. Hyposmolar hyperhydration
- E. Hyperosmolar hyperhydration

40. A patient complains about attacks of laboured breathing, dizziness. He works at a chemical plant producing hydrocyanic acid. The described symptoms might be associated with dysfunction of the following enzyme:

- A. Cytochrome oxidase
- B. Lactate dehydrogenase
- C. Succinate dehydrogenase
- D. Catalase
- E. Pyruvate dehydrogenase

41. Thalassemia is a genetic disorder of synthesis of one of the chains of hemoglobin. Inhibition of β - chain synthesis leads to formation of β -thalassemia. Which of the following will be the best feature of the disease?

- A. Increased concentration of hemoglobin F
- B. Decreased concentration of hemoglobin F
- C. Hemolytic anemia.
- D. Sickle erythrocyte shape
- E. Reduction of hemoglobin A₂

42. In complex proteins their prosthetic group is associated with protein moiety. Choose from the list one amino acid responsible for the formation of bonds between these two parts:

- A. Histidine
- B. Serine
- C. Alanine
- D. Tyrosine
- E. Lysine

43. In erythrocytes carbonic acid is formed from CO₂ and H₂O. What enzyme provides a synthesis of carbonic acid in erythrocytes and its degradation in the capillaries?

- A. Anhydrase
- B. Amylase
- C. Elastase
- D. Alkaline phosphatase
- E. Lipase

44. As a complex protein, hemoglobin consists of protein and non-protein moieties. Indicate the components of hemoglobin.

- A. 4 Hem groups, 2 α - and 2 β - polypeptide chains
- B. Hem, 1 α - and 3 β - polypeptide chains
- C. 4 Hem groups and 4 β - polypeptide chains
- D. 4 Hem groups and 4 α -polypeptide chains
- E. Hem, 2 α - and 2 β - polypeptide chains

45. A 45 year old patient was brought to a clinic after being evacuated from his apartment during fire. The physician revealed poisoning with cyanides, that were present in the furniture and evaporated during fire. Blood pH is 7.25. What compound will be revealed in the blood of this patient?

- A. Lactic acid
- B. Pyruvate
- C. Carboxyhemoglobin
- D. Methemoglobin
- E. NO

46. A 70 year old man visited his family doctor because of shortness of breath and chronic cough during the last 12 years. The patient smokes about 120 packages of

cigarettes per year. Physical examination revealed emphysema. Blood analysis: pH – 7.40. Which enzyme the most probably got accumulated in lungs of this patient and resulted in the described condition?

- A. Carboanhydrase
- B. Alkaline phosphatase
- C. Cytochrome oxidase
- D. Pyruvate dehydrogenase
- E. Glucokinase

47. An 18 year old man came to a clinic with complains for severe pain in his bones, especially in the lower extremities. He notes that before he emigrated from Africa he had several similar episodes that passed without medical interventions. He also remembers that his brother had similar symptoms and died from respiratory problems. Physical examination revealed icterity of skin and mucous membranes, pain in bones, increased of the content of white blood cells. Hb is 6.9 g/dl, hematocrit – 29%. Which inborn disease is associated with this condition?

- A. Point mutation of gene of β -chains of hemoglobin
- B. Decreased synthesis of β -chains of hemoglobin
- C. Deficiency of carbonic anhydrase
- D. Deficiency of pyruvate dehydrogenase
- E. Point mutation of gene of α -chains of hemoglobin

TOPIC 11. PROTEINS OF BLOOD PLASMA: PROTEINS OF ACUTE PHASE, GENUINE AND INDICATORY ENZYMES. NONPROTEIN NITROGEN-CONTAINING AND NITROGEN-FREE COMPONENTS OF BLOOD

1. Hemoglobin catabolism results in release of iron which is transported to the bone marrow by a certain transfer protein and used again for the synthesis of hemoglobin.

Specify this transfer protein:

- A. Transferrin (siderophilin)
- B. Transcobalamin
- C. Haptoglobin
- D. Ceruloplasmin
- E. Albumin

2. Blood plasma of a healthy man contains several dozens of proteins. During an illness new proteins can originate, namely the protein of "acute phase". Select such protein from the listed below:

- A. C-reactive protein
- B. Prothrombin
- C. Fibrinogen
- D. G immunoglobulin
- E. A immunoglobulin

3. A patient being treated for viral hepatitis type B got symptoms of hepatic insufficiency. What blood changes indicative of protein metabolism disorder will be observed in this case?

- A. Absolute hypoalbuminemia
- B. Absolute hyperalbuminemia
- C. Absolute hyperfibrinogenemia
- D. Proteinic blood composition is unchanged
- E. Absolute hyperglobulinemia

4. A patient consulted a doctor with complaints of dyspnea occurring after physical exertion. Physical examination revealed anemia, paraprotein was detected among gamma globulins. What value should be determined in the patient's urine to confirm the diagnosis of myeloma?

- A. Bence Jones protein
- B. Bilirubin
- C. Hemoglobin
- D. Ceruloplasmin
- E. Antitrypsin

5. 6 hours after the myocardial infarction a patient was found to have elevated level of lactate dehydrogenase in blood. What isoenzyme should be expected in this case?

- A. LDH₁
- B. LDH₂
- C. LDH₃
- D. LDH₄
- E. LDH₅ 2013

6. A 28-year-old patient undergoing treatment in the pulmonological department has been diagnosed with pulmonary emphysema caused by splitting of alveolar septum by tissular tripsin. The disease is caused by the congenital deficiency of the following protein:

- A. α_1 -proteinase inhibitor
- B. α_2 -macroglobulin
- C. Cryoglobulin
- D. Haptoglobin
- E. Transferrin

7. The concentration of albumins in human blood sample is lower than normal. This leads to edema of tissues. What blood function is damaged?

- A. Maintaining the oncotic blood pressure
- B. Maintaining the Ph level
- C. Maintaining the body temperature
- D. Maintaining the blood sedimentation system
- E. All answers are correct

8. A 46-year-old female patient has a continuous history of progressive muscular (Duchenne's) dystrophy. Which blood enzyme changes will be of diagnostic value in this case?

- A. Creatine phosphokinase
- B. Lactate dehydrogenase
- C. Pyruvate dehydrogenase
- D. Glutamate dehydrogenase
- E. Adenylate cyclase

9. A considerable increase of activity of MB-forms of CPK (creatinephosphokinase) and LDH-1 was revealed on the examination of patient's blood. What is the most likely pathology?

- A. Myocardial infarction
- B. Hepatitis
- C. Rheumatism
- D. Pancreatitis
- E. Cholecystitis

10. Marked increase of activity of MB- forms of CPK (creatinephosphokinase) and LDH-1 was revealed by examination of the patient's blood. What is the most probable pathology?

- A. Myocardial infarction
- B. Hepatitis
- C. Rheumatism
- D. Pancreatitis
- E. Cholecystitis

11. A number of diseases, for instance myocardial infarction or liver cirrhosis, accompanied by the impairment of the integrity of cell membrane, can be diagnosed by evaluating activity of blood transaminases. What vitamin is one of cofactors of these enzymes?

- A. B₆
- B. B₂

- C. B₁
- D. B₈
- E. B₅

12. A 50-year-old woman diagnosed with cardiac infarction has been delivered into an intensive care ward. What enzyme will be the most active during the first two days?

- A. Aspartate aminotransferase
- B. Alanine aminotransferase
- C. Alanine aminopeptidase
- D. LDH₄
- E. LDH₅

13. A patient had hemorrhagic stroke. Blood examination revealed strengthened kinin concentration. The patient was prescribed contrical. It was administered in order to inhibit the following proteinase:

- A. Kallikrein
- B. Pepsin
- C. Trypsin
- D. Chemotrypsin
- E. Collagenase

14. Upon toxic damage of hepatic cells resulting in disruption of liver function the patient developed edemas. What changes of blood plasma are the main cause of edema development?

- A. Decrease of albumin content
- B. Increase of globulin content
- C. Decrease of fibrinogen content
- D. Increase of albumin content
- E. Decrease of globulin content

15. To lose some weight a woman has been limiting the amount of products in her diet. 3 months later she developed edemas and her diuresis increased. What dietary component deficiency is the cause of this?

- A. Proteins
- B. Fats
- C. Carbohydrates
- D. Vitamins
- E. Minerals

16. A patient has been admitted to the contagious isolation ward with signs of jaundice caused by hepatitis virus. Which of the symptoms given below is strictly specific for hepatocellular jaundice?

- A. Increase of ALT, AST level
- B. Hyperbilirubinemia
- C. Bilirubinuria
- D. Cholemia
- E. Urobilinuria

17. The high level of Dehydrogenase (LDH) concentration showed the increase of LDH-1 and LDH-2 in a patient's blood plasma. Point out the most probable diagnosis:

- A. Myocardial infarction
- B. Skeletal muscle dystrophy
- C. Diabetes mellitus
- D. Viral hepatitis
- E. Acute pancreatitis

18. A 62 year old woman complains of frequent pain attacks in the area of her chest and backbone, rib fractures. Her doctor suspected myeloma (plasmocytoma). What of the following laboratory characteristics will be of the greatest diagnostic importance?

- A. Paraproteinemia
- B. Hyperalbuminemia
- C. Proteinuria
- D. Hypoglobulinemia
- E. Hypoproteinemia

19. Nitrogen is being excreted from the body mainly as urea. When activity of a certain enzyme in the liver is low, it results in inhibition of urea synthesis and nitrogen accumulation in blood and tissues. Name this enzyme:

- A. Carbamoyl phosphate synthetase
- B. Aspartate aminotransferase
- C. Urease
- D. Amylase
- E. Pepsin

20. 12 hours after an acute attack of retrosternal pain a patient presented a jump of aspartate aminotransferase activity in blood serum. What pathology is this deviation typical for?

- A. Myocardium infarction
- B. Viral hepatitis
- C. Collagenosis
- D. Diabetes mellitus
- E. Diabetes insipidus

21. A patient who had been working hard under conditions of elevated temperature of the environment, has now a changed quantity of blood plasma proteins. What phenomenon is the case?

- A. Relative hyperproteinemia
- B. Absolute hyperproteinemia
- C. Absolute hypoproteinemia
- D. Disproteinemia
- E. Paraproteinemia

22. A 15-year-old boy has been diagnosed with acute viral hepatitis. What blood value should be determined to confirm acute affection of hepatic cells?

- A. Aminotransferase activity (AST, ALT)
- B. Unconjugated and conjugated bilirubin content
- C. Erythrocytes sedimentation rate (ESR)
- D. Cholesterol content
- E. Protein fraction content

23. Examination of a 56-year-old woman with a history of type 1 diabetes mellitus revealed a disorder of protein metabolism that is manifested by aminoacidemia in the laboratory blood test values, and clinically by the delayed wound healing and decreased synthesis of antibodies. Which of the following mechanisms causes the development of aminoacidemia?

- A. Increased proteolysis
- B. Albuminosis
- C. Decrease in the concentration of amino acids in blood
- D. Increase in the oncotic pressure in the blood plasma
- E. Increase in low-density lipoprotein level

24. Blood test of the patient revealed albumine content of 20 g/l and increased activity of lactate dehydrogenase isoenzyme 5 (LDH₅). These results indicate disorder of the following organ:

- A. Liver
- B. Kidneys
- C. Heart
- D. Lungs
- E. Spleen

25. A traumatology unit received a patient with crushed muscular tissue. What biochemical indicator of urine will be raised in this case?

- A. Creatinine
- B. Total lipids
- C. Glucose
- D. Mineral salts
- E. Uric acid

26. Examination of a 56-year-old woman with a history of type 1 diabetes revealed a disorder of protein metabolism that is manifested by aminoacidemia in the laboratory blood test values, and clinically by the delayed wound healing and decreased synthesis of antibodies. Which of the following mechanisms causes the development of aminoacidemia?

- A. Increased proteolysis
- B. Albuminosis
- C. Decrease in concentration of blood amino acids
- D. Increase in plasma oncotic pressure
- E. Increase in low-density lipoproteins level

27. In investigation of serum proteins various physical and physicochemical methods can be used. In particular, serum albumins and globulins can be separated by the method of:

- A. Electrophoresis
- B. Polarography
- C. Dialysis
- D. Spectrography
- E. Refractometry

28. 12 hours after an acute attack of retrosternal pain a patient presented a jump of aspartate aminotransferase activity in blood serum. What pathology is this deviation typical for?

- A. Myocardium infarction

- B. Viral hepatitis
- C. Collagenosis
- D. Diabetes mellitus
- E. Diabetes insipidus

29. A patient presents high activity of LDH-1,-2, aspartate aminotransferase, creatine phosphokinase. In what organ (organs) is the development of a pathological process the most probable?

- A. In the heart muscle (initial stage of myocardium infarction)
- B. In skeletal muscles (dystrophy, atrophy)
- C. In kidneys and adrenals
- D. In connective tissue
- E. In liver and kidneys

30. For biochemical diagnostics of myocardial infarction it is necessary to measure activity of a number of enzymes and their isoenzymes. What enzymatic test is considered to be the best to prove or disprove the diagnosis of infarction in the early period after the chest pain is detected?

- A. Creatine kinase isoenzyme CK-MB
- B. Creatine kinase isoenzyme CK-MM
- C. LDH1 isoenzyme
- D. LDH2 isoenzyme
- E. Aspartate cytoplasmic isoenzyme

31. A 46 year old female patient has a continuous history of progressive muscular (Duchenne's) dystrophy. Which blood enzyme changes will be of diagnostic value in this case?

- A. Creatine phosphokinase
- B. Lactate dehydrogenase
- C. Pyruvate dehydrogenase
- D. Glutamate dehydrogenase
- E. Adenylate cyclase

32. Examination of a 27-year-old patient revealed pathological changes in liver and brain. Blood plasma analysis revealed an abrupt decrease in the copper concentration, urine analysis revealed an increased copper concentration. The patient was diagnosed with Wilson's degeneration. To confirm the diagnosis it is necessary to study the activity of the following enzyme in blood serum:

- A. Ceruloplasmin
- B. Carbonic anhydrase
- C. Xanthine oxidase
- D. Leucine aminopeptidase
- E. Alcohol dehydrogenase

33. A patient complains about dyspnea provoked by the physical activity. Clinical examination revealed anaemia and presence of the paraprotein in the zone of gamma-globulins. To confirm the myeloma diagnosis it is necessary to determine the following index in the patient's urine:

- A. Bence Jones protein
- B. Bilirubin
- C. Haemoglobin
- D. Ceruloplasmin

E. Antitrypsin

34. Electrophoretic study of a blood serum sample, taken from the patient with pneumonia, revealed an increase in one of the protein fractions. Specify this fraction:

- A. γ -globulins
- B. Albumins
- C. α_1 -globulins
- D. α_2 -globulins
- E. β -globulins

35. Analysis of blood serum of a patient revealed increase of alanine aminotransferase and aspartate aminotransferase level. What cytological changes can cause such a situation?

- A. Cellular breakdown
- B. Disturbed function of energy supply of cells
- C. Disorder of enzyme systems of cells
- D. Disturbance of genetic apparatus of cells
- E. Disturbance of cellular interrelations

36. A 49-year-old male patient with acute pancreatitis was likely to develop pancreatic necrosis, while active pancreatic proteases were absorbed into the blood stream and tissue proteins broke up. What protective factors of the body can inhibit these processes?

- A. α_2 -macroglobulin, α_1 -antitrypsin
- B. Immunoglobulin
- C. Cryoglobulin, interferon
- D. Ceruloplasmin, transferrin
- E. Hemopexin, haptoglobin

37. The main classes of blood plasma proteins are fibrinogen, albumins and globulins. What is normal quantitative proportion of albumin to globulins (albumin/globulin coefficient)?

- A. 1.5:2
- B. 2:1
- C. 5:1
- D. 1:1
- E. 1:5

38. Examination of a patient with chronic renal insufficiency revealed an increase in residual nitrogen concentration in blood up to 35 millimole/l, more than half of which is urea. What type of hyperazotemia is it?

- A. Retentional
- B. Hepatic
- C. Productional
- D. Residual
- E. Combined

39. Wilson's disease is a disorder of copper transport which leads to the accumulation of this metal in brain and liver cells. It is associated with a disturbance in the synthesis of the following protein:

- A. Ceruloplasmin
- B. Metallothionein

- C. Transcobalamin
- D. Haptoglobin
- E. Siderophilin

40. A 50-year-old woman with myocardial infarction has been delivered to the intensive care unit. Which enzyme's activity will be most increased during the first two days?

- A. Aspartate aminotransferase
- B. Alanine aminotransferase
- C. Alanine aminopeptidase
- D. LDH₄
- E. LDH₅

41. Examination of a patient with hepatolenticular degeneration revealed that synthesis of ceruloplasmin protein has a defect. What organelles is this defect connected with?

- A. Granular endoplasmic reticulum
- B. Agranular endoplasmic reticulum
- C. Mitochondrions
- D. Golgi complex
- E. Lysosomes

42. Blood pressure is regulated by a number of biologically active compounds. What peptides that enter the bloodstream can affect the vascular tone?

- A. Kinins
- B. Leukotrienes
- C. Enkephalins
- D. Iodothyronines
- E. Endorphins

43. A patient was found to have an increased blood serum LDH-1 activity. In which organ is the pathological process localized?

- A. Heart
- B. Liver
- C. Kidneys
- D. Stomach
- E. Muscles

44. Examination of a patient revealed toxic hepatitis developed on the background of the use of medicines. This diagnosis can be confirmed by the activity of the following enzyme of blood serum:

- A. Alanine amino transferase
- B. Creatine phosphokinase
- C. Pyruvate dehydrogenase
- D. Maltase
- E. Malate dehydrogenase

45. Blood analysis of a patient revealed high content of the following enzymes: creatine kinase (MB-isoform), aspartate aminotransferase and LDH 1,2. What pathology should be suspected in this case?

- A. Myocardium infarction
- B. Muscular dystrophy
- C. Liver cirrhosis

- D. CNS affection
- E. Pancreatitis

46. A 38 year old patient suffers from shortness of breath. These symptoms have been progressing during recent months. From childhood he has episodes of bronchoobstruction. Physical and X-ray examination revealed emphysema. What is the molecular background for patient's condition?

- A. Genetic mutation, manifested by an inadequate activity of the inhibitor of proteases
- B. Genetic mutation, characterized by decreased surfactant production
- C. Bronchial asthma
- D. Mucoviscidosis
- E. Coeliac disease

TOPIC 12. BLOOD COAGULATION, ANTICOAGULANT AND FIBRINOLYTIC SYSTEMS OF BLOOD. BIOCHEMISTRY OF IMMUNE REACTIONS. IMMUNODEFFICIENCIES.

1. A 30-year-old patient with a past history of virus B hepatitis complains of prolonged nose bleeds. What drug will be most efficient in remedying this condition?
 - A. Vicasolum
 - B. Fraxiparine
 - C. Folic acid
 - D. Dipyridamol
 - E. Asparcam
2. A patient is diagnosed with hereditary coagulopathy that is characterised by factor VIII deficiency. Specify the phase of blood clotting during which coagulation will be disrupted in the given case:
 - A. Thromboplastin formation
 - B. Thrombin formation
 - C. Fibrin formation
 - D. Clot retraction
 - E. -
3. After implantation of a cardiac valve a young man systematically takes indirect anticoagulants. His state was complicated by hemorrhage. What substance content has decreased in blood?
 - A. Prothrombin
 - B. Haptoglobin
 - C. Heparin
 - D. Creatin
 - E. Ceruloplasmin
4. A 60-year-old man suffering from chronic hepatitis frequently observes nasal and gingival hemorrhages, spontaneous hemorrhagic rashes on the skin and mucosa. Such presentations result from:
 - A. Decreased synthesis of prothrombin and fibrinogen
 - B. Increased blood content of ami- notransferases
 - C. Decreased synthesis of serum albumins
 - D. Increased blood content of macroglobulins and cryoglobulins
 - E. Decreased blood content of cholinesterase
5. Preoperative examination revealed prothrombin deficiency in the blood of the patient. What drug should be preliminarily prescribed to mitigate blood loss in the patient during the surgery?
 - A. Vicasol (Menadione)
 - B. Thrombin
 - C. Aminocapronic acid
 - D. Phenylin (Phenindione)
 - E. Contrykal (Aprotinin)
6. To prevent postoperative bleeding a 6-year-old child was administered vicasol that is a synthetic analogue of vitamin K. Name post-translational changes of blood coagulation factors that will be activated by vicasol:
 - A. Carboxylation of glutamin acid

- B. Phosphorylation of serine radicals
- C. Partial proteolysis
- D. Polymerization
- E. Glycosylation

7. After pancreatic surgery the patient developed hemorrhagic syndrome with disturbed 3rd stage of blood clotting. What will be the most likely mechanism of the hemostatic disorder?

- A. Fibrinolysis activation
- B. Decrease of prothrombin synthesis
- C. Decrease of fibrinogen synthesis
- D. Qualitative abnormalities of fibrinogenesis
- E. Fibrin-stabilizing factor deficiency

8. Parents of a 5-year-old boy report him to have frequent colds that develop into pneumonias, presence of purulent rashes on the skin. Laboratory tests have revealed the following: absence of immunoglobulins of any type, and naked cells are absent from the lymph nodes punctate. What kind of immune disorder is it?

- A. X-linked hypogammaglobulinemia (Bruton type agammaglobulinemia)
- B. Autosomal recessive agammaglobulinaemia (Swiss type)
- C. Hypoplastic anemia
- D. Agranulocytosis
- E. Louis-Barr syndrome

9. A 3-year-old boy with pronounced hemorrhagic syndrome has no antihemophilic globulin A (factor VIII) in the blood plasma. Hemostasis has been impaired at the following stage:

- A. Internal mechanism of prothrombinase activation
- B. External mechanism of prothrombinase activation
- C. Conversion of prothrombin to thrombin
- D. Conversion of fibrinogen to fibrin
- E. Blood clot retraction

10. A 5-year-old child is diagnosed with Bruton syndrome (X-linked agammaglobulinemia) that manifests itself in severe clinical course of bacterial infections and absence of B lymphocytes and plasma cells. What changes of immunoglobulin content can be observed in blood serum of the child with immunodeficiency?

- A. Decreased IgA, IgM
- B. Increased IgA, IgM
- C. Decreased IgD, IgE
- D. Increased IgD, IgE
- E. No changes

11. A patient visited a dentist to extract a tooth. After the tooth had been extracted, bleeding from the tooth socket continued for 15 minutes. Anamnesis states that the patient suffers from active chronic hepatitis. What phenomenon can extend the time of hemorrhage?

- A. Decrease of fibrinogen content in blood
- B. Thrombocytopenia
- C. Hypocalcemia
- D. Increased activity of anticoagulation system

E. Decrease of albumine content in blood

12. A newborn baby has numerous hemorrhages. Blood coagulation tests reveal increased prothrombin time. The child is most likely to have a disorder of the following biochemical process:

- A. Production of gamma-carboxyglutamate
- B. Conversion of homocysteine to methionine
- C. Conversion of methylmalonyl CoA to succinyl CoA
- D. Degradation of glutathione
- E. Hydroxylation of proline

13. A patient with tissue trauma was taken a blood sample for the determination of blood clotting parameters. Specify the right sequence of extrinsic pathway activation:

- A. III - VIIa - Xa
- B. III - IV - Xa
- C. IV - VIII: TF - Xa
- D. IV - VIIa - Xa
- E. III - VIII: TF - Xa

14. To stop the bleeding the patient was prescribed a direct coagulant. During introduction of the solution the patient was complaining of pain along the vein, hot sensation, and palpitations. Name the drug that causes such symptoms:

- A. Calcium chloride
- B. Hirudine
- C. Ergocalciferol
- D. Pentoxyl
- E. Streptokinase

15. Activation of a number of hemostatic factors occurs through their joining with calcium ions. What structural component allows for adjoining of calcium ions?

- A. Gamma-carboxyglutamic acid
- B. Gamma-aminobutyric acid
- C. Gamma-oxybutyric acid
- D. Hydroxyproline
- E. Monoamine-dicarboxylic acids 2016

16. After a disease a 16-year-old boy is presenting with decreased function of protein synthesis in the liver as a result of vitamin K deficiency. This may cause disorder of:

- A. Blood coagulation
- B. Erythrocyte sedimentation rate
- C. Anticoagulant production
- D. Erythropoietin production
- E. Osmotic blood pressure

17. A patient suffers from the haemorrhagic syndrome that shows itself in frequent nasal bleedings, posttraumatic and spontaneous intracutaneous and intra-articular haemorrhages. After a laboratory study a patient was diagnosed with the type B haemophilia. This disease is provoked by the deficit of the following factor of blood coagulation:

- A. IX
- B. VIII
- C. XI

- D. V
- E. VII

18. To prevent postoperative bleeding a 6 y.o. child was administered vicasol that is a synthetic analogue of vitamin K. Name post-translational changes of blood coagulation factors that will be activated by vicasol:

- A. Carboxylation of glutamin acid
- B. Phosphorylation of serine radicals
- C. Partial proteolysis
- D. Polymerization
- E. Glycosylation

19. A 13-year-old boy presents with eczematous rashes on his shins and torso. Anamnesis states cases of otitis, pneumonia, and furuncles in the patient. Blood test:

platelets - $70 \cdot 10^9 / l$, low activity of T helper and T suppressor cells, low IgM, with normal IgA and IgG. What immunodeficient disease does this boy have?

- A. Wiskott-Aldrich syndrome
- B. Louis-Bar syndrome (Ataxia- telangiectasia)
- C. Severe combined immunodeficiency (Swiss type)
- D. DiGeorge syndrome
- E. Chediak-Higashi syndrome

20. Parents of a 5-year-old child report him to have frequent colds that develop into pneumonias, presence of purulent rashes on the skin. Laboratory tests have revealed the following: absence of immunoglobulins of any type; naked cells are absent from the lymph nodes punctate. What kind of immune disorder is it?

- A. X-linked hypogammaglobulinemia (Bruton type agammaglobulinemia)
- B. Autosomal recessive agammaglobulinaemia (Swiss type)
- C. Hypoplastic anemia
- D. Agranulocytosis
- E. Louis-Barr syndrome

21. A patient complains about dyspnea provoked by the physical activity. Clinical examination revealed anaemia and presence of the paraprotein in the zone of gamma-globulins. To confirm the myeloma diagnosis it is necessary to determine the following index in the patient's urine:

- A. Bence Jones protein
- B. Bilirubin
- C. Haemoglobin
- D. Ceruloplasmin
- E. Antitrypsin

22. A tooth extraction in a patient with chronic persistent hepatitis was complicated with prolonged hemorrhage. What is the reason for the haemorrhagic syndrome?

- A. Decrease in thrombin production
- B. Increase in thromboplastin production
- C. Decrease in fibrin production
- D. Increase in fibrinogen synthesis
- E. Fibrinolysis intensification

23. A 12-year-old patient has been admitted to a hospital for hemarthrosis of the knee joint. From early childhood he suffers from frequent bleedings. Diagnose the boy's disease:

- A. Hemophilia
- B. Hemorrhagic vasculitis
- C. Hemolytic anemia
- D. B₁₂ (folic acid)-deficiency anemia
- E. Thrombocytopenic purpura

24. A female patient has been diagnosed with cervical erosion, which is a precancerous pathology. What defense mechanism can prevent the development of a tumor?

- A. Increase in natural killer level (NK-cells)
- B. High-dose immunological tolerance
- C. Increase in the activity of lysosomal enzymes
- D. Simplification of the antigenic structure of tissues
- E. Low-dose immunological tolerance

25. A patient is diagnosed with hereditary coagulopathy that is characterised by factor VIII deficiency. Specify the phase of blood clotting during which coagulation will be disrupted in the given case:

- A. Thromboplastin formation
- B. Thrombin formation
- C. Fibrin formation
- D. Clot retraction
- E. -

26. Lymphocytes and other cells of our body synthesize universal antiviral agents as a response to viral invasion. Name these protein factors:

- A. Interferon
- B. Interleukin – 2
- C. Cytokines
- D. Interleukin – 4
- E. Tumor necrosis factor

27. In order to speed up healing of a wound of oral mucosa a patient was prescribed a drug that is a thermostable protein occurring in tears, saliva, mother's milk as well as in a new-laid hen's egg. It is known that this protein is a factor of natural resistance of an organism. What is it called?

- A. Lysozyme
- B. Complement
- C. Interferon
- D. Interleukin
- E. Imanine

28. A 46-year-old female is scheduled for a maxillofacial surgery. It is known that the patient is prone to high blood coagulation. What natural anticoagulant can be used to prevent blood clotting?

- A. Heparin
- B. Hirudin
- C. Sodium citrate
- D. Fibrinolysin

E. None of the above-listed substance

29. A patient ill with essential hypertension was recommended a drug that prevents thrombosis. It is to be taken parenterally. What drug is it?

- A. Heparin
- B. Amben
- C. Protamine sulfate
- D. Neodicumarin
- E. Syncumar

30. In our country, routine preventive vaccinations against poliomyelitis involve using live vaccine that is administered orally. What immunoglobulins are responsible for the development of local post-vaccination immunity in this case?

- A. Secretory IgA
- B. IgM
- C. IgG
- D. Serum IgA
- E. IgE

31. A patient who suffers from pneumonia has high body temperature. What biologically active substance plays the leading part in origin of this phenomenon?

- A. Interleukin-I
- B. Histamine
- C. Bradykinin
- D. Serotonin
- E. Leukotrienes

32. A 27 y.o. patient put eye drops that contain penicillin. After a few minutes she felt itching and burning of her body, there appeared lip and eye-lid edemata; arterial pressure began to drop. What immunoglobulins took part in the development of this allergic reaction?

- A. IgE and IgG
- B. IgM and IgG
- C. IgA and IgM
- D. Ig M and IgD
- E. IgG and IgD

33. A 2-year-old child has got intestinal dysbacteriosis, which results in hemorrhagic syndrome. What is the most likely cause of hemorrhage of the child?

- A. Vitamin K insufficiency
- B. Activation of tissue thromboplastin
- C. PP hypovitaminosis
- D. Fibrinogen deficiency
- E. Hypocalcemia

34. A patient with tissue trauma was taken a blood sample for the determination of blood clotting parameters. Specify the right sequence of extrinsic pathway activation.

- A. III – VIIa – Xa
- B. III – IV – Xa
- C. IV – VIII: TF – Xa
- D. IV – VIIa – Xa
- E. III – VIII: TF – Xa

35. In some countries it is regulated by law to administer vitamin K to newborns. Why are newborns at risk to develop vitamin K deficiency?

- A. Their intestine is sterile
- B. They have increased need for vitamin K
- C. They do not have expression of genes responsible for vitamin K synthesis
- D. In infancy more blood clotting factors require vitamin K
- E. They are at increased risk of bleeding

36. A patient has myocardial infarction with thrombosis of the left coronary artery. What pharmacological preparation group should be used to reestablish blood flow?

- A. Fibrinolysis activators
- B. Narcotic analgesics
- C. β -adrenergic blockers
- D. Angiotensin-converting enzyme inhibitors
- E. Glucocorticoids

37. A patient was ill with burn disease that was complicated by DIC syndrome. What stage of DIC syndrome can be suspected if it is known that the patient's blood coagulates in less than 3 minutes?

- A. Hypercoagulation
- B. Transition phase
- C. Hypocoagulation
- D. Fibrinolysis
- E. Terminal

38. A 16 year old boy after an illness has diminished function of protein synthesis in liver as a result of vitamin K deficiency. It will cause disturbance of:

- A. Blood coagulation
- B. Erythrocyte sedimentation rate
- C. Anticoagulant generation
- D. Erythropoietin secretion
- E. Osmotic blood pressure

39. A patient underwent a surgery for excision of a cyst on pancreas. After this he developed haemorrhagic syndrome with apparent disorder of blood coagulation. Development of this complication can be explained by:

- A. Activation of fibrinolytic system
- B. Insufficient fibrin production
- C. Reduced number of thrombocytes
- D. Activation of anticoagulation system
- E. Activation of Christmas factor

40. After transfusion of 200 ml of blood a patient presented with body temperature rise up to $37,9^{\circ}\text{C}$. Which of the following substances is the most likely cause of temperature rise?

- A. Interleukin-1
- B. Interleukin-2
- C. Tumour necrosis factor
- D. Interleukin-3
- E. Interleukin-4

41. Which from listed below immunoglobulins is secretory, belongs to the nonspecific immunity and inhibits adsorption and growth of bacteria on mucosa surfaces?

- A. IgA
- B. IgM
- C. IgD
- D. IgE
- E. IgG

42. Hemophilia B is a genetically mediated X-linked disorder of blood clotting. This disease is caused by deficiency of the next blood coagulation factor:

- A. Christmas factor (factor IX)
- B. Proaccelerin
- C. Antihemophilic globulin A
- D. Tissue thromboplastin
- E. Proconvertin

43. A patient exhibits small (petechial) hemorrhages under the skin and mucous membranes, bleeding gums, tooth decay, general weakness, edemata of the lower extremities. What vitamin deficiency can be suspected?

- A. C
- B. K
- C. B1
- D. B12
- E. A

44. What disease of blood coagulation system is based upon abrupt deceleration of blood coagulation due to disturbed formation of plasma thromboplastin (VIII factor deficit)?

- A. Hemophilia
- B. Thrombocytopenia
- C. Trombophylia
- D. Hemorrhagic vasculitis
- E. Hemorrhagic purpura

TOPIC 13. END PRODUCTS OF HEME CATABOLISM. PATHOBIOCHEMISTRY OF JAUNDICES.

1. After consumption of rich food a patient has nausea and heartburn, steatorrhea. This condition might be caused by:
 - A. Bile acid deficiency
 - B. Increased lipase secretion
 - C. Disturbed trypsin synthesis
 - D. Amylase deficiency
 - E. Disturbed phospholipase synthesis
2. A 43-year-old patient suffers from acute pancreatitis with disrupted common bile duct patency. What condition can develop in this case?
 - A. Mechanical jaundice
 - B. Hemolytic jaundice
 - C. Hepatocellular jaundice
 - D. Hepatic coma
 - E. Portal hypertension
3. Hepatitis has led to the development of hepatic failure. Mechanism of edemata formation is activated by the impairment of the following liver function:
 - A. Protein-synthetic
 - B. Barrier
 - C. Chologenetic
 - D. Antitoxic
 - E. Glycogen-synthetic
4. Cells of healthy liver actively synthesize glycogen and proteins. What organelles are the most developed in them?
 - A. Granular and agranular endoplasmic reticulum
 - B. Cell center
 - C. Lysosomes
 - D. Mitochondria
 - E. Peroxisomes
5. A patient presents with icteritiousness of skin, scleras and mucous membranes. Blood plasma the total bilirubin is increased, stercobilin is increased in feces, urobilin is increased in urine. What type of jaundice is it?
 - A. Haemolytic
 - B. Gilbert's disease
 - C. Parenchymatous
 - D. Obturational
 - E. Cholestatic
6. A dry-cleaner's worker has been found to have hepatic steatosis. This pathology can be caused by disruption of synthesis of the following substance:
 - A. Phosphatidylcholine
 - B. Tristearin
 - C. Urea
 - D. Phosphatidic acid
 - E. Cholic acid

7. A 46-year-old woman suffering from cholelithiasis developed jaundice. Her urine became dark yellow, while feces are light-colored. What substance will be the most increased in concentration in the blood serum in this case?

- A. Conjugated bilirubin
- B. Unconjugated bilirubin
- C. Biliverdine
- D. Mesobilirubin
- E. Urobilinogen

8. An unconscious patient was taken by ambulance to the hospital. On objective examination the patient was found to have no reflexes, periodical convulsions, irregular breathing. After laboratory examination the patient was diagnosed with hepatic coma. Disorders of the central nervous system develop due to the accumulation of the following metabolite:

- A. Ammonia
- B. Urea
- C. Glutamine
- D. Bilirubin
- E. Histamine

9. A patient has a disturbed absorption of fat hydrolysates. It might have been caused by a deficit in the small intestine cavity:

- A. Of bile acids
- B. Of bile pigments
- C. Of lipolytic enzymes
- D. Of sodium ions
- E. Of liposoluble vitamins

10. A patient complains of frequent diarrheas, especially after consumption of fattening food, and of body weight loss. Laboratory examination revealed steatorrhea; hypocholic feces. What can be the cause of this condition?

- A. Obturation of biliary tracts
- B. Mucous membrane inflammation of small intestine
- C. Lack of pancreatic lipase
- D. Lack of pancreatic phospholipase
- E. Unbalanced diet

11. After intake of rich food a patient feels nausea and sluggishness; with time there appeared signs of steatorrhea. Blood cholesterol concentration is 9,2 micromole/l. This condition was caused by lack of:

- A. Bile acids
- B. Triglycerides
- C. Fatty acids
- D. Phospholipids
- E. Chylomicrons

12. A patient with jaundice has high total bilirubin that is mainly indirect (unconjugated), high concentration of stercobilin in the feces and urine. The level of direct (conjugated) bilirubin in the blood plasma is normal. What type of jaundice can be suspected?

- A. Hemolytic
- B. Parenchymal (hepatic)

- C. Mechanical
- D. Neonatal
- E. Gilbert's disease

13. A coprological survey revealed light-colored feces containing drops of neutral fat. The most likely reason for this condition is the disorder of:

- A. Bile inflow into the bowel
- B. Gastric juice acidity
- C. Pancreatic juice secretion
- D. Intestinal juice secretion
- E. Intestinal absorption

14. An experimental animal that was kept on protein-free diet developed fatty liver infiltration, in particular as a result of deficiency of methylating agents. This is caused by disturbed generation of the following metabolite:

- A. Choline
- B. DOPA
- C. Cholesterol
- D. Acetoacetate
- E. Linoleic acid

15. A 46 year old woman suffering from cholelithiasis developed jaundice. Her urine became dark-yellow and feces became colourless. Blood serum will have the highest concentration of the following substance:

- A. Conjugated bilirubin
- B. Unconjugated bilirubin
- C. Biliverdin
- D. Mesobilirubin
- E. Urobilinogen

16. A patient suffers from hepatic cirrhosis. Examination of which of the following substances excreted by urine can characterize the state of antitoxic function of liver?

- A. Hippuric acid
- B. Ammonium salts
- C. Kreatinine
- D. Uric acid
- E. Aminoacids

17. A full-term newborn child has yellowish skin and mucous membranes. This might be probably caused by temporary deficiency of the following enzyme:

- A. UDP-glucuronyltransferase
- B. Uridine transferase
- C. Heme synthetase
- D. Heme oxygenase
- E. Biliverdin reductase

18. A 48-year-old patient was admitted to the hospital with complaints about weakness, irritability, sleep disturbance. Objectively: skin and scleras are of yellow colour. In blood: increased concentration of total bilirubin with prevailing direct bilirubin. The feces are acholic. The urine is dark (contains bile pigments). What type of jaundice is it?

- A. Mechanic
- B. Haemolytic
- C. Parenchymatous
- D. Gilbert's syndrome
- E. Crigler-Najjar syndrome

19. A patient with jaundice has high total bilirubin that is mainly indirect (unconjugated), high concentration of stercobilin in the stool and urine. The level of direct (conjugated) bilirubin in the blood plasma is normal. What kind of jaundice can you think of?

- A. Hemolytic
- B. Parenchymal (hepatic)
- C. Mechanical
- D. Neonatal jaundice
- E. Gilbert's disease

20. Low level of albumins and fibrinogen was detected in the patient's blood. Decreased activity of what organelle of the liver hepatocytes can most probably cause it?

- A. Granular endoplasmatic reticulum
- B. Agranular endoplasmatic reticulum
- C. Mitochondrions
- D. Golgi complex
- E. Lysosomes

21. A patient presents with steatorrhea. This disorder can be linked to disturbed supply of the intestine with the following substances:

- A. Bile acids
- B. Carbohydrates
- C. Tripsin
- D. Chymotrypsin
- E. Amylase

22. A patient has been admitted to the contagious isolation ward with signs of jaundice caused by hepatitis virus. Which of the symptoms given below is strictly specific for hepatocellular jaundice?

- A. Increase of ALT, AST level
- B. Hyperbilirubinemia
- C. Bilirubinuria
- D. Cholemia
- E. Urobilinuria

23. A patient has yellow skin colour, dark urine, dark-yellow feces. What substance will have strengthened concentration in the blood serum?

- A. Unconjugated bilirubin
- B. Conjugated bilirubin
- C. Mesobilirubin
- D. Verdoglobin
- E. Biliverdin

24. A patient complains of frequent diarrheas, especially after consumption of rich food, weight loss. Laboratory examination revealed steatorrhea; his feces were hypocholic. What might have caused such condition?

- A. Obturation of biliary tracts
- B. Inflammation of mucous membrane of small intestine
- C. Lack of pancreatic lipase
- D. Lack of pancreatic phospholipase
- E. Unbalanced diet

25. A patient presents with icteritiousness of skin, scleras and mucous membranes. Blood plasma the total bilirubin is increased, stercobilin is increased in feces, urobilin is increased in urine. What type of jaundice is it?

- A. Haemolytic
- B. Gilbert's disease
- C. Parenchymatous
- D. Obturational
- E. Cholestatic

26. Enzymatic jaundices are accompanied by abnormal activity of UDP-glucuronyl transferase. What compound is accumulated in blood serum in case of these pathologies?

- A. Unconjugated bilirubin
- B. Conjugated bilirubin
- C. Dehydrobilirubin
- D. Hydrobilirubin
- E. Choleglobin

27. M-r S presents all signs of the hepatic coma: loss of consciousness, absence of reflexes, cramps, convulsion, disorder of heart activity, recurrent (periodical) respiration. What are cerebrotoxic substances which accumulate in blood under hepar insufficiency?

- A. Ammonia
- B. IL-1
- C. Autoantibody
- D. Necrosogenic substances
- E. Ketonic body

28. Ultramicroscopical examination of "dark" hepatocyte population in the cell cytoplasm detected a developed granular endoplasmic reticulum. What function has this organella in these cells?

- A. Synthesis of blood plasma proteins
- B. Carbohydrate synthesis
- C. Deintoxicative function
- D. Bile production
- E. Calcium ion depositing

29. Blood analysis of a patient with jaundice reveals conjugated bilirubinemia, increased concentration of bile acids. There is no stercobilinogen in urine. What type of jaundice is it?

- A. Obstructive jaundice
- B. Hepatocellular jaundice
- C. Parenchymatous jaundice

- D. Hemolytic jaundice
- E. Cythemolytic jaundice

30. Jaundice treatment involves administration of barbiturates inducing the synthesis of UDP-glucuronyl transferase. A medicinal effect is caused by the production of:

- A. Direct reacting (conjugated) bilirubin
- B. Indirect reacting (unconjugated) bilirubin
- C. Biliverdin
- D. Protoporphyrin
- E. Heme

31. After a serious viral infection a 3-year-old child has repeated vomiting, loss of consciousness, convulsions. Examination revealed hyperammonemia. What may have caused changes of biochemical blood indices of this child?

- A. Disorder of ammonia neutralization in ornithinic cycle
- B. Activated processes of aminoacids decarboxylation
- C. Disorder of biogenic amines neutralization
- D. Increased putrefaction of proteins in intestines
- E. Inhibited activity of transamination enzymes

32. Blood analysis of a patient with jaundice reveals conjugated bilirubinemia, increased concentration of bile acids. There is no stercobilinogen in urine. What type of jaundice is it?

- A. Obstructive jaundice
- B. Hepatocellular jaundice
- C. Parenchymatous jaundice
- D. Hemolytic jaundice
- E. Cythemolytic jaundice

33. An infant born prematurely 2 days ago presents with yellow coloring of skin and mucosa. Such a condition in the infant is caused by temporary deficiency of the following enzyme:

- A. UDP-glucuronyl transferase
- B. Aminolevulinatase synthase
- C. Heme oxygenase
- D. Heme synthetase
- E. Biliverdine reductase

34. A patient is ill with hepatocirrhosis. State of antitoxic liver function can be characterized by examination of the following substance excreted by urine:

- A. Hippuric acid
- B. Ammonium salts
- C. Creatinine
- D. Uric acid
- E. Amino acids

35. Hemoglobin catabolism results in release of iron which is transported to the bone marrow by a certain transfer protein and used again for the synthesis of hemoglobin. Specify this transfer protein:

- A. Transferrin (siderophilin)

- B. Transcobalamin
- C. Haptoglobin
- D. Ceruloplasmin
- E. Albumin

36. A 16-year-old adolescent is diagnosed with hereditary UDP (uridine diphosphate) glucuronyltransferase deficiency. Laboratory tests revealed hyperbilirubinemia caused mostly by increased blood content of the following substance:

- A. Unconjugated bilirubin
- B. Conjugated bilirubin
- C. Urobilinogen
- D. Stercobilinogen
- E. Biliverdine

37. A patient complains of frequent diarrheas, especially after consumption of rich food, weight loss. Laboratory examination revealed steatorrhea; his feces were hypocholeic. What might have caused such condition?

- A. Obturation of biliary tracts
- B. Inflammation of mucous membrane of small intestine
- C. Lack of pancreatic lipase
- D. Lack of pancreatic phospholipase
- E. Unbalanced diet

38. A patient suffers from hepatocirrhosis. State of antitoxic liver function can be characterized by examination of the following substance excreted by urine:

- A. Hippuric acid
- B. Ammonium salts
- C. Creatinine
- D. Uric acid
- E. Amino acids

39. After severe viral hepatitis a 4 year old boy presents with vomiting, occasional loss of consciousness, convulsions. Blood test revealed hyperammonemia. Such condition is caused by a disorder of the following biochemical hepatic process:

- A. Disorder of ammonia neutralization
- B. Disorder of biogenic amines neutralization
- C. Protein synthesis inhibition
- D. Activation of amino acid decarboxylation
- E. Inhibition of transamination enzymes

40. A drycleaner's worker has been found to have hepatic steatosis. This pathology can be caused by the disruption of synthesis of the following substance:

- A. Phosphatidylcholine
- B. tristearin
- C. Urea
- D. Phosphatidic acid
- E. Cholic acid

41. Feces of a patient contain high amount of undissociated fats and have grayish-white color. Specify the cause of this phenomenon:

- A. Obturation of bile duct
- B. Hypoactivation of pepsin by hydrochloric acid

- C. Hypovitaminosis
- D. Enteritis
- E. Irritation of intestinal epithelium

42. An infectious disease unit admitted a patient with signs of jaundice caused by hepatitis virus. Select an indicator that is specific only for parenchymatous jaundice:

- A. Increase in ALT and AST rate
- B. Hyperbilirubinemia
- C. Bilirubinuria
- D. Cholaemia
- E. Urobilinuria

43. Cells of a healthy liver actively synthesize glycogen and proteins. What organelles are the most developed in them?

- A. Granular and agranular endoplasmic reticulum
- B. Cell center
- C. Lysosomes
- D. Mitochondria
- E. Peroxisomes

44. A drycleaner's worker has been found to have hepatic steatosis. This pathology can be caused by the disruption of synthesis of the following substance:

- A. Phosphatidylcholine
- B. Tristearin
- C. Urea
- D. Phosphatidic acid
- E. Cholic acid

45. Biochemical analysis of an infant's erythrocytes revealed evident glutathione peroxidase deficiency and low concentration of reduced glutathione. What pathological condition can develop in this infant?

- A. Hemolytic anemia
- B. Pernicious anemia
- C. Megaloblastic anemia
- D. Sickleemia
- E. Iron-deficiency anemia

46. A 16-year-old adolescent is diagnosed with hereditary UDP (uridine diphosphate) glucuronyltransferase deficiency. Laboratory tests revealed hyperbilirubinemia caused mostly by increased blood content of the following substance:

- A. Unconjugated bilirubin
- B. Conjugated bilirubin
- C. Urobilinogen
- D. Stercobilinogen
- E. Biliverdin

47. Steatosis is caused by the accumulation of triacylglycerols in hepatocytes. One of the mechanisms of this disease development is a decrease in the utilization of VLDL neutral fat. What lipotropics prevent the development of steatosis?

- A. Methionine, B₆, B₁₂

- B. Arginine, B₂, B₃
- C. Alanine, B₁, P P
- D. Valine, B₃, B₂
- E. Isoleucine, B₁, B₂

48. An experimental animal that was kept on protein-free diet developed fatty liver infiltration, in particular as a result of deficiency of methylating agents. This is caused by disturbed generation of the following metabolite:

- A. Choline
- B. DOPA
- C. Cholesterol
- D. Acetoacetate
- E. Linoleic acid

49. Examination of a patient suffering from chronic hepatitis revealed a significant decrease in the synthesis and secretion of bile acids. What process will be mainly disturbed in the patient's bowels?

- A. Fat emulsification
- B. Protein digestion
- C. Carbohydrate digestion
- D. Glycerin absorption
- E. Amino acid absorption

50. A 53-year-old male patient complains of acute pain in the right hypochondrium. Objective examination revealed scleral icterus. Laboratory tests revealed increased ALT activity, and stercobilin was not detected in the stool. What disease is characterized by these symptoms?

- A. Cholelithiasis
- B. Hemolytic jaundice
- C. Hepatitis
- D. Chronic colitis
- E. Chronic gastritis

51. Patients with bile duct obstruction typically present with inhibited blood clotting and develop hemorrhages due to insufficient assimilation of vitamin:

- A. K
- B. A
- C. D
- D. E
- E. C

52. Encephalopathy has developed in a child with hemolytic disease of the newborn. What substance had increased in the child's blood, resulting in damage to the CNS?

- A. Unconjugated bilirubin
- B. Bilirubin-albumin complex
- C. Bilirubin glucuronide
- D. Verdohemoglobin
- E. Bile acids

53. In dietary deficiency or insufficient production of endogeneous lipotropic factors in humans is developing fat degeneration of liver. What substances from listed below can be considered as lipotropic factor?

- A. Choline
- B. Fatty acids
- C. Pyridoxine
- D. Triacylglycerols
- E. Cholesterol

54. To obese patient with risk of liver fat degeneration is recommended diet enriched with lipotropic factors. What nutritional component is the most important in diet?

- A. Methionine
- B. Cholesterol
- C. Vitamin C
- D. Glycine
- E. Glucose

TOPIC 14. BIOTRANSFORMATION OF XENOBIOTICS. MICROSOMAL OXIDATION, CYTOCHROME P-450.

1. A patient suffers from hepatic cirrhosis. What substance excreted in urine should be analyzed to characterize the antitoxic function of liver?
 - A. Hippuric acid
 - B. Ammonium salts
 - C. Creatinine
 - D. Uric acid
 - E. Amino acids
2. Neutralization of xenobiotics and active endogenous metabolites often occurs via introduction of an oxygen atom into the substrate molecule. What process occurs as the result?
 - A. Hydroxylation
 - B. Decarboxylation
 - C. Transamination
 - D. Phosphorilation
 - E. Deaminization
3. Study of conversion of a food colouring agent revealed that neutralization of this xenobiotic takes place only in one phase - microsomal oxydation. Name a component of this phase:
 - A. Cytochrome P-450
 - B. Cytochrome B
 - C. Cytochrome
 - D. Cytochrome A
 - E. Cytochrome oxidase
4. A 37 year old patient suffering from obliterating vascular endarteritis of lower limbs takes daily 60 microgram/kilogram of phenylin. Because of presentations of convulsive disorder (craniocerebral trauma in anamnesis) he was prescribed phenobarbital. Withholding this drug caused nasal hemorrhage. What is this complication connected with?
 - A. Induction of enzymes of microsomal oxidation in liver caused by phenobarbital
 - B. Aliphatic hydroxylation of phenobarbital
 - C. Conjugation of phenylin with glucuronic acid
 - D. Oxidative deamination of phenylin
 - E. Inhibition of microsomal oxidation in liver caused by phenobarbital
5. Liver is often called the biochemical laboratory of the body, since thousands of crucial for life-sustaining activity reactions occur in this organ. The process of microsomal oxidation has the next physiological significance:
 - A. Utilization of unusual carbohydrates
 - B. Oxidative deamination of amino acids
 - C. Biosynthesis of steroid hormones
 - D. Degradation of bile acids
 - E. Oxidation of fatty acids
6. Pharmacological effects of antidepressants are connected with inhibition of an enzyme catalyzing biogenic amines noradrenaline and serotonin in the mitochondrions of cerebral neurons. What enzyme participates in this process?

- A. Monoamine oxidase
- B. Transaminase
- C. Decarboxylase
- D. Peptidase
- E. Lyase

7. Reactions of methylation take place in biosynthesis of catecholamins, creatine, lecithin, as well as in detoxification of some xenobiotics. As donor of methyl groups serves the next substance:

- A. Methionine
- B. Leucine
- C. Glutathion
- D. Choline
- E. Adenosine

8. Reduced NADPH₂ is necessary for biosynthesis of fatty acids, cholesterol, for detoxification of ammonia and xenobiotics. In what metabolic pathway is generated NADPH₂?

- A. Hexosomonophosphate shunt
- B. Oxidation of fatty acids
- C. Gluconeogenesis
- D. Glycolysis
- E. Tricarboxylic acid (TCA) cycle

9. Ethanol is a toxic compound for human body since acetic aldehyde is one of the products of its metabolism. Utilization and detoxification of ethanol in liver is performed by the next pathway:

- A. Oxidation by dehydrogenases
- B. Conjugation with glucuronic acid
- C. Conjugation with sulfuric acid
- D. Acetylation
- E. Reduction with participation of glutathione

10. In oxidation of ethanol by microsomal oxidizing system besides acetaldehyde is generated the next additional harmful product:

- A. Hydrogen peroxide
- B. Superoxide anion
- C. Hypochlorite anion
- D. Malone dialdehyde
- E. Carbonyl monoxide

11. Development of resistance toward drugs and medicinals (drug tolerance) appears due to the following process:

- A. Increase in activity of microsomal oxidation
- B. Decrease in activity of mitochondrial oxidation
- C. Increase in activity of mitochondrial oxidation
- D. Decrease in activity of microsomal oxidation
- E. Activation of peroxide oxidation

12. Monooxygenase systems of liver cell endoplasmic reticulum contain cytochrome P 450, NADPH₂ cytochrome P 450 reductase, FAD and FMN dependent enzymes. All these enzymes catalyze the following type of chemical reaction:

- A. Hydroxylation
- B. Acylation
- C. Dehydrogenation
- D. Methylation
- E. Conjugation

13. Harmful effect of alkaloid cocaine on liver cells is caused by its bioactivation and formation of nitroxide derivative, which is a strong oxidant. The transformation is initiated by the following chemical reaction:

- A. N-dealkylation
- B. Deacylation
- C. O-dealkylation
- D. Hydrolysis
- E. N-hydroxylation

14. Besides cytochrome P-450 microsomal oxidation system in liver cell exists the second monooxygenase system, which is provided by the next enzyme:

- A. Glutathion peroxidase
- B. Catalase
- C. FAD containing oxygenase
- D. Monoamine oxidase
- E. Xanthine oxidase

15. Sulfatation is one of the evolutionised reactions of our body to detoxify xenobiotics. Sulfate is used in conjugation step of detoxification as the following active form:

- A. Phosphoadenosyl phosphosulfate
- B. UDP-sulfate
- C. Sulfuryl-CoA
- D. Guanosine sulfate
- E. Thionyl chloride

16. Detoxification of xenobiotics is a multistage process in our liver, requiring numerous reactions. The aim of conjugation stage in detoxification of xenobiotics is as follows:

- A. To make substance more soluble in water medium
- B. To make substance fat soluble
- C. To transform substance to insoluble form and deposit it in vesicles
- D. To induce ingestion of substance by macrophages
- E. To accumulate a new substance

17. During the investigation of detoxification function of liver a patient was given 4 g of sodium benzoate per os. From urine, collected during four subsequent hours, it was obtained 1 g of hippuric acid. What indicates this result?

- A. Normal value of detoxification function of liver
- B. Insufficient detoxification function of liver
- C. Enhanced detoxification function of liver
- D. The test is not informative to judge about the function of liver
- E. The test should be repeated in 2 days

18. Liver plays central role in xenobiotics detoxification in our body. Find the correct definition of the term "xenobiotic":

- A. A substance that is unnatural for humans
- B. A substance that is an obligatory component of food products
- C. A substance that is synthesized in small quantities in humans
- D. A substance that regulates metabolism in organism
- E. A substance that is a terminal product of metabolism

19. A patient was treated with paracetamol because influenza symptoms. This drug is detoxified in liver in the course of microsomal oxidation. Find the enzyme participating in the function of the microsomal monooxygenase chain:

- A. Cytochrome P450
- B. Cytochrome b
- C. Cytochrome c1
- D. Cytochrome c
- E. NADH - dehydrogenase

20. A patient is undergoing radiation therapy because of breast cancer. This resulted in increased lipid peroxidation processes, in the course of which active forms of oxygen including superoxide anion radical are formed in the human body. By means of what enzyme is this anion inactivated?

- A. Superoxide dismutase
- B. Glutathione reductase
- C. Peroxidase
- D. Catalase
- E. Glutathione peroxidase

21. Liver is a central organ, involved in the detoxification of drugs, poisons and other xenobiotics. Choose from the mentioned below a liver enzyme participating in the neutralization of xenobiotics, their metabolites and harmful endogenous products:

- A. UDP -glucuronyl transferase
- B. Glutamate dehydrogenase
- C. Alanine aminotransferase
- D. Carbomoyl phosphate synthetase
- E. Glutamine synthetase

22. Heterocyclic alcohols in human body are exposed to the processes of detoxification in liver. Choose from the mentioned below a conjugation agent, responsible for heterocyclic alcohols detoxification of in the liver:

- A. Phosphoadenosine-5'-phosphosulphate (PAPS)
- B. Glycine
- C. Valine
- D. Glutathione
- E. Histidine

23. Benzoic acid (C_6H_5-COOH) is one of the harmful compounds that can cause toxic effects if accumulated in the liver. Choose the main conjugative agent for this substance:

- A. Glycine
- B. PAPS
- C. S-adenosyl methionine
- D. Glutathione

E. Urea

24. A patient treated with antiinflammatory drug to reduce symptoms of Crohn's disease has been constantly requiring higher and higher dose of medication. What is the reason for reduced efficacy of drug during treatment?

- A. Increased microsomal oxidation
- B. Decreased microsomal oxidation
- C. Bad quality of drug
- D. Impaired metabolism of the drug in liver
- E. Accumulation of drug in the organism

25. A doctor treating a patient with bronchial asthma for many years noted that the drugs are no more effective in traditional dosage. What is the cause for decreased effectiveness of drugs after longterm use?

- A. Increased microsomal oxidation
- B. Decreased microsomal oxidation
- C. Loss of antioxidant enzymes genes expression
- D. Inhibited metabolism of the drug in liver
- E. Accumulation of drug in the lungs

26. A patient with encephalopathy was admitted to the neurological in patient department. There was revealed a correlation between increasing of encephalopathy and substances absorbed by the bloodstream from the intestines. What substances that are formed in the intestines can cause endotoxemia?

- A. Indole
- B. Ornithine
- C. Acetacetate
- D. Butyrate
- E. Biotin

27. Study of conversion of a food colouring agent revealed that utilization of this xenobiotic takes place only in one phase – microsomal oxidation (modification phase). Name an enzyme of this phase:

- A. CytochromeP-450
- B. Cytochrome C oxidase
- C. Cytochrome aa3
- D. Cytochrome C1
- E. Cytochrome b

28. A patient was undergoing chemotherapy and radiation treatment because of blood malignancy. This resulted in the overproduction of free radicals. Administration of which vitamin drugs wil facilitate antioxidant defense system in liver?

- A. E
- B. D
- C. K
- D. B12
- E. PP

29. UDP-glucuronosyltransferase is the enzyme responsible for conjugation of bilirubin, i.e. making it soluble. Choose the exogenous factor (the drug) that can induce the UDP-glucuronosyltransferase gene expression in the liver:

- A. Phenobarbital

- B. Thyroxine
- C. Riboxin
- D. Calcitriol
- E. Thiaminediphosphate

30. Antioxidant drugs are commonly used to manage side effects of toxic drugs, i.e. after chemotherapy and irradiation therapy. All of the following may have a physiological antioxidant role except

- A. Vitamin B2
- B. Vitamin C
- C. Selenium
- D. Iron E.
- E. Vitamin E

31. Many toxic agents are metabolized in liver in the course of conjugation reactions. Name the compound metabolized in the liver across conjugation reaction like xenobiotics:

- A. Bilirubin
- B. Cholesterol
- C. Urea
- D. Acetylcholine
- E. Uric acid

32. A patient, poisoned with methanol was brought to emergency care unit with life-threatening symptoms. Choose metabolites of methanol which may be produced in the liver:

- A. Formaldehyde + Formic acid
- B. Acetaldehyde + Acetic acid
- C. Pyruvate + Pyruvic acid
- D. Fumarate + Fumeric acid
- E. Glyceroaldehyde + Glycerol

33. The patients, requiring constant use of drugs because of chronic conditions, are often prescribed hepatoprotective compounds, since liver is the main organ of xenobiotics detoxification. Which following cytochrome participates in drug metabolism?

- A. Cytochrome P450
- B. Cytochrome C1
- C. Cytochrome C
- D. Cytochrome aa3
- E. Cytochrome b

34. A family of cytochrome P450 plays important roles in the processes of detoxification of xenobiotics. P-450 belongs to the next class of enzymes:

- A. Oxidoreductases
- B. Transferases
- C. Hydrolases
- D. Lyases
- E. Isomerases

35. Glucuronic acid is involved in numerous reactions of xenobiotics detoxification, namely in conjugation stage. Glucuronic acid, which is used for conjugation reaction in detoxification of xenobiotics exists in the next active form:

- A. UDP-glucuronate

- B. Glucuronyl pyrophosphate
- C. AMP-glucuronate
- D. CDP-glucuronate
- E. Glucuronyl-CoA

36. Certain reactions of microsomal detoxification implicate the introduction of oxygen atoms into organic compounds. If only one oxygen atom is incorporated, how do we call the enzymes, catalyzing these reactions?

- A. Monooxygenases
- B. Peroxidases
- C. Catalases
- D. Dioxygenases
- E. Oxidases

37. Evaluation of detoxification function of liver has significant diagnostic significance. Which test is commonly used in patients for this purpose?

- A. Quick test (hippuric acid synthesis)
- B. Glucose tolerance test
- C. Bilirubin concentration in blood
- D. LDL content in blood serum
- E. Protein content in blood

38. The antipyretic and analgetic drug paracetamol, being metabolized in liver, accelerates the production of active forms of oxygen. The people, who have genetic defect of pentose phosphate pathway enzyme may develop hemolytic anemia in response to paracetamol.

Name this enzyme:

- A. Glucose-6-phosphate dehydrogenase
- B. Glucose-6-phosphatase
- C. Catalase
- D. Lactate dehydrogenase
- E. Enolase

39. The patient, who accidentally drunk some methanol, was introduced ethanol for detoxification purpose. Explain the mechanism of beneficial effect of ethanol therapy in methanol poisoning:

- A. Ethanol competes with methanol for the active site of alcohol dehydrogenase
- B. Ethanol binds methanol
- C. Ethanol activates cytochrome P-450 in liver
- D. Ethanol inhibits alcohol dehydrogenase
- E. Ethanol activates alcohol dehydrogenase

40. A patient suffering from depression and insomnia was prescribed barbiturates. At first the drugs were effective and patient was quickly falling asleep. But with time he noted that became tolerant to these drugs. Explain the reason why:

- A. Activation of microsomal oxidation
- B. Inhibition of microsomal oxidation
- C. Uncoupling of oxidative phosphorylation
- D. Hepatotoxic effect of barbiturates
- E. Development of complications of his disorder

41. The patients suffering from drugs abuse or alcoholism require higher doses of anesthetics during narcosis or anesthesias when being carried out surgical interventions. This is because both alcohol and narcotics are inductors of the following process:

- A. Microsomal oxidation
- B. Tissue respiration
- C. Crebs cycle
- D. Anaerobic glycolysis
- E. Oxidative phosphorylation

42. A 40 year old man compains with headache, fatigue, nausea, vomiting, increased thirst. Yesterday he was at a birthday party by his friends and drank about 500 ml of cognac. Formation of which compound in the course of ethanol metabolism mediated the symptoms in this patient?

- A. Acetic aldehyde
- B. Carbon monoxide
- C. Pyruvate
- D. Glucose
- E. Fructose

43. A patient suffering from atherosclerosis was prescribed a hypolipidemic drug lovastatin. After one week of lovastatin therapy the level of cholesterol in the blood of patient got normal. But after several months the level of cholesterol in blood again was overexceeding the normal values. Induction of the synthesis of which enzyme occurred under the effect of hydrophobic drug lovastatin?

- A. Cytochrome P-450
- B. HMG-CoA-reductase
- C. HMG-CoA-synthase
- D. Monooxygenase
- E. NADPH

44. A patient in the condition of acute alcohol intoxication was brought to hospital. Physical examination revealed ascites and increased size of liver. His skin and mucous membranes are icteric. Which enzyme is responsible for the breakdown of alcohol?

- A. Alcohol dehydrogenase
- B. Carbamoyl phosphatase
- C. Lactate dehydrogenase
- D. Pyruvate dehydrogenase
- E. Hexokinase

TOPIC 15. WATER AND MINERALS METABOLISM

1. A patient had several fractures during the last 2 years and was diagnosed to have urolithiasis. Blood test revealed hypercalcemia and hypophosphatemia. These changes are associated with abnormal synthesis of the following hormone:
 - A. Parathyroid hormone
 - B. Calcitonin
 - C. Cortisol
 - D. Aldosterone
 - E. Calcitriol
2. Experimental stimulation of the sympathetic nerve branches that innervate the heart caused an increase in the force of heart contractions because the membrane of typical cardiomyocytes permitted an increase in:
 - A. Calcium ion entry
 - B. Calcium ion exit
 - C. Potassium ion exit
 - D. Potassium ion entry
 - E. Calcium and potassium ion exit
3. A 66-year-old woman had intravenous injection of magnesium sulfate solution to stop hypertensive crisis. However her arterial pressure did not decrease and after repeated introduction of the same preparation she developed sluggishness, slow response to stimuli; the patient is unconsciousness and her respiration is inhibited. What macroelement is antagonist to magnesium and its solution could help to counteract magnesium overdose?
 - A. Calcium chloride
 - B. Potassium chloride
 - C. Sodium chloride
 - D. Activated carbon
 - E. Potassium permanganate
4. During acute hemorrhage the body loses not only fluid but also electrolytes. What substance solution can be used as a simple blood substitute?
 - A. Sodium chloride
 - B. Sodium bromide
 - C. Albumin
 - D. Sodium nucleotide
 - E. Calcium chloride
5. In the course of an experiment there has been increase in nerve conduction velocity. This may be caused by increase in concentration of the following ions that are present in the solution around the cell:
 - A. Na^+
 - B. K^+ and Cl^-
 - C. K^+ and Na^+
 - D. Ca^{2+} and Cl^-
 - E. Ca^{2+}

6. A 35-year-old male developed acute heart failure while running for a long time. What changes in the ionic composition can be observed in the cardiac muscle?
- A. Accumulation of Na^+ and Ca^{2+} ions in the myocardium cells
 - B. Accumulation of K^+ and Mg^{2+} ions in the myocardium cells
 - C. Reduction of Na^+ and Ca^{2+} ions in the myocardium cells
 - D. Reduction of K^+ and Mg^{2+} ions in the extracellular space
 - E. Reduction of Na^+ and Ca^{2+} ions in the extracellular space
7. A person felt thirsty after staying under the conditions of hot weather for a long time. Signals of what receptors mediate the feeling of thirst first of all?
- A. Osmoreceptors of hypothalamus
 - B. Sodium receptors of hypothalamus
 - C. Osmoreceptors of liver
 - D. Glucoreceptors of hypothalamus
 - E. Baroreceptors of aortic arch
8. A patient ill with enteritis accompanied by massive diarrhea has low water rate in the extracellular space, high water rate inside the cells and low blood osmolarity. What is such disturbance of water-electrolytic metabolism called?
- A. Hypo-osmolar hypohydration
 - B. Hyperosmolar hypohydration
 - C. Osmolar hypohydration
 - D. Hypo-osmolar hyperhydration
 - E. Hyperosmolar hyperhydration
9. A 3 y.o. child has seizures. Blood analysis revealed decreased concentration of calcium ions in plasma. Hypocalcemia may be caused by reduced function of:
- A. Parathyroid glands
 - B. Hypophysis
 - C. Adrenal cortex
 - D. Pineal gland
 - E. Thymus
10. Dietary intake of a 30 year old nursing woman contains 1000 mg of calcium, 1300 mg of phosphorus and 20 mg of iron per day. Content of which mineral is it necessary to increase?
- A. To increase phosphorus content
 - B. To increase calcium content
 - C. To reduce fluorine content
 - D. To increase iron content
 - E. To reduce iron content
11. Periodic renal colics attacks are observed in a woman with primary hyperparathyroidism. Ultrasonic examination revealed small stones in the kidneys. What is the most plausible reason of the stones's formation?
- A. Hypercalcemia
 - B. Hyperphosphatemia
 - C. Hypercholesterinemia
 - D. Hyperuricemia
 - E. Hyperkalemia

12. A patient was admitted to the infectious department. His symptoms: dry skin, decreased skin turgor, rice-water stool. The patient was diagnosed with cholera. What disorder of water-electrolytic balance is most often observed in this disease?

- A. Isoosmotic hypohydration
- B. Hyperosmotic hyperhydration
- C. Hypoosmotic hypohydration
- D. Hyperosmotic hypohydration
- E. Hypoosmotic hyperhydration

13. A patient with enteritis accompanied by massive diarrhea has low water rate in the extracellular space, high water rate inside the cells and low blood osmolarity. What is such disturbance of water-electrolytic metabolism called?

- A. Hypo-osmolar hypohydration
- B. Hyperosmolar hypohydration
- C. Osmolar hypohydration
- D. Hypo-osmolar hyperhydration
- E. Hyperosmolar hyperhydration

14. Examination of a patient revealed hyperkalemia and hyponatremia. The doctor suspected endocrine dysfunction. Low secretion of which hormone may cause such changes?

- A. Aldosterone
- B. Vasopressin
- C. Cortisol
- D. Parathormone
- E. Natriuretic

15. A child has abnormal formation of tooth enamel and dentin as a result of low concentration of calcium ions in blood. Such abnormalities might be caused by deficiency of the following hormone:

- A. Parathormone
- B. Thyrocalcitonin
- C. Thyroxin
- D. Somatotrophic hormone
- E. Triiodothyronine

16. A 12-year-old teenager has significantly put off weight within 3 months; glucose concentration rose up to 50 millimole/l. He fell into a coma. What is the main mechanism of its development?

- A. Hyperosmolar
- B. Hypoglycemic
- C. Ketonemic
- D. Lactacidemic
- E. Hypoxic

17. A 50-year-old patient complains about general weakness, appetite loss and cardiac arrhythmia. The patient presents with muscle hypotonia, flaccid paralyzes, weakened peristaltic activity of the bowels. Such condition might be caused by:

- A. Hypokalemia
- B. Hypoproteinemia

- C. Hyperkalemia
- D. Hypophosphatemia
- E. Hyponatremia

18. A patient who suffers from severe disorder of water-salt metabolism experienced cardiac arrest in diastole. What is the most probable mechanism of cardiac arrest in diastole?

- A. Hyperkalemia
- B. Hyponatremia
- C. Organism dehydration
- D. Hypokalemia
- E. Hyponatremia

19. The menopause woman visited an orthopedist because of pain in joints, especially knee joints. She also had a hand fracture during the recent year. The doctor advised a drug, containing predominant mineral of bones. Which mineral and in which form dominating in bones?

- A. Calcium hydroxyapatite
- B. Calcium silicate
- C. Calcium carbonate
- D. Calcium sulphate
- E. Calcium phosphate

20. Zinc-containing food supplements are increasingly recommended by nutritionists in many countries. Choose an enzyme, for which Zn serves as a cofactor:

- A. Carbonic anhydrase
- B. Pepsin
- C. Monooxygenase
- D. Aminotransferase
- E. Galactosidase

21. Selenium is increasingly included in the treatment of patients after radiation therapy together with tocopherols, vitamin C and other antioxidant compounds to scavenge free radicals. Antioxidant properties of Selenium are supported by the fact that it is incorporated in the structure of enzyme:

- A. Glutathione peroxidase
- B. Lactate dehydrogenase
- C. Catalase
- D. Myeloperoxidase
- E. Pyruvate kinase

22. Trace element molybdenum is a cofactor of the enzyme, catalyzing the last reaction of purine nucleotides catabolism. Choose it:

- A. Xanthine oxidase
- B. Tyrosinase
- C. Tryptophan hydroxylase
- D. Myeloperoxidase
- E. Cytochrome c

23. Steroid hormones, regulating mineral metabolism, are the next:

- A. Aldosterone
- B. Glucocorticoids

- C. Progesteron
- D. Cortisol
- E. Norepinephrin

24. A doctor prescribed a homeless malnourished patient a polyvitamin drug, also containing trace elements. Trace element cobalt is an element of the structure of vitamin:

- A. Vitamin B₁₂
- B. Biotine
- C. Vitamin B₁
- D. Vitamin B₆
- E. Pantothenic acid

25. The patient was all day sunbathing and playing volley-ball on the beach. In the evening his physical condition much worsened and his friend, who was a medical student, suspected hypohydration. Choose the accepted norm of daily requirement of water in adult humans:

- A. 1.5-2 l
- B. 0.25-0.5 l
- C. 0.5-0.75 l
- D. 3-4 l
- E. 5 l

26. Retention of water in blood plasma and prevention of tissue swelling depends on the oncotic pressure of plasma, which depends on the content of the next compounds:

- A. Albumins
- B. Immunoglobulins
- C. Fibrinogen
- D. Lipids of lipoproteins
- E. Inorganic ions

27. Sodium and potassium are one of the main electrolytes, playing a variety of pivotal roles for cell homeostasis. The asymmetry of sodium and potassium ions distribution across plasma membrane of the cell is supported by the next membrane constituent:

- A. K,Na-dependent ATP-ase
- B. Sodium selective channel
- C. Lecithine content of the membrane
- D. Alkaline phosphatase
- E. Cholesterol content

28. Water and minerals balance is very important for the maintenance of homeostasis and performance of normal biochemical and physiological functions. Changes of water and electrolytes balance may be a life-threatening condition, i.e. extracellular hyperhydration. The latter can be induced by:

- A. Oncotic pressure decreased, caused by hypoproteinemia after proteins loosing through kidneys
- B. Decreasing of sodium level
- C. Increasing of hydrostatic pressure of the blood
- D. Alterations in a heart work
- E. Increasing of sodium level

29. The patient complains for severe fatigue, dizziness, hair loss, fragility of nails. Physical examination revealed that the patient's skin and mucous membranes were very pale. Blood analysis revealed microcytic anemia and the patient was prescribed an iron-

containing drug. Find from the list a biologically active compound of human body, which does not contain iron:

- A. Histamine
- B. Muscle's myoglobin
- C. Ferritin and hemosiderin
- D. Cytochromes
- E. Hemoglobin of RBCs

30. In highlander woman the thyroid gland is bigger than normal. The patient also manifests fatigue, somnolentia, is overweight and can not get pregnant during 2 years. It is associated with lack of the next microelement in nutrition:

- A. Iodine
- B. Bromine
- C. Copper
- D. Iron
- E. Manganese

31. Calcium is an important macroelement, playing crucial role in many life-sustaining processes in mammals. Specify the function, which is not characteristic for calcium in human organism:

- A. Calcium ions are cofactors for many enzymes
- B. Calcium ions are the second messenger in cell signaling
- C. Calcium ions play a role in hemostasis
- D. Calcium ions play a role in skeletal muscles contraction
- E. Calcium salts are responsible for hard structure of bones

32. The menopause woman after the fracture hip was administered tests for the evaluation of calcium supply in her body. Concentration of calcium ion in urine of healthy adult is:

- A. 2,5-7,5 mmol
- B. 5,5-10,5 mmol
- C. 25-75 mmol
- D. 55-105 mmol
- E. 0,25-0,75 mmol

33. The patient after severe radiation injury was prescribed a trace element that has an ability to accumulate in the thyroid gland. This trace element is also necessary for the synthesis of T3 and T4. Choose it from the mentioned below:

- A. Iodine
- B. Fluorine
- C. Bromine
- D. Iron
- E. Selenium

34. A patient after radiation therapy because of brain tumor was prescribed vitamin E and a microelement with antioxidant function. Choose it from the mentioned below

- A. Selenium
- B. Fluorine
- C. Bromine
- D. Iron
- E. Iodine

35. A patient has a disorder in taste perception. He was suspected to have a deficiency of the trace element Zn, manifesting with this symptom. Choose from the mentioned below the role of zinc in taste perception.

- A. Constituent of salivary protein gustin
- B. Constituent of carbonic anhydrase
- C. Constituent of alkaline phosphatase
- D. Constituent of lactate dehydrogenase
- E. Constituent of thymidine kinase

36. Zinc is a component of numerous enzymes in our body. Its deficiency may have negative impact on nucleic acids synthesis, growth, sexual function. Find from the list below the symptom of zinc deficiency:

- A. Everything mentioned
- B. Taste disorders
- C. Impaired tolerance to glucose
- D. Olfaction disorders
- E. Alterations in the hair growth and dermatitis

37. The patient treated with diuretics because of arterial hypertension developed severe fatigue, dizziness, increased heart rate. He was suspected to have decreased level of the main intracellular macroelement. Name it

- A. K^+
- B. Na^+
- C. I^+
- D. Fe^{3+}
- E. Ca^{2+}

38. This trace element is especially important for growing organism. Its deficiency in childhood is associated with mental and growth retardation. It is also used for the prevention of radiation injury. Choose it from the mentioned below:

- A. Iodine
- B. Iron
- C. Zinc
- D. Copper
- E. Manganese

39. In addition to well known macroelements, human organism requires trace and ultra trace elements. The latter are important constituents of numerous enzymes. Copper as trace element is essential component of the next enzyme:

- A. Cytochrome oxidase
- B. Amylase
- C. Trypsin
- D. Xantine oxidase
- E. Carbonic anhydrase

40. The mother brought her 9 year old boy for a regular check-up. The doctor revealed no pathology but since the child does not like dairy products the doctor recommended supplementation with calcium. What is the daily requirement for calcium for a child of this age?

- A. 1200 mg
- B. 500 mg
- C. 3000 mg

- D. 200 mg
- E. 100 mg

41. The patient manifests with increased irritability, tachycardia, spontaneous muscular contractions. For several months the patient was combining low calory diet days with fasting days trying to lose weight. Which macroelement has the doctor administer to the patient?

- A. Mg
- B. Ca
- C. K
- D. Na
- E. Cl

42. A patient suffering from arterial hypertension was administered diuretics in the scheme of his complex antihypertensive treatment. To prevent electrolytes disturbances under the effect of diuretics the patient was also prescribed a mineral in pills for everyday use. What mineral was prescribed to a patient?

- A. K
- B. Na
- C. Cl
- D. Ca
- E. Na and Ca

43. A pregnant woman was recommended to include dairy products in her everyday diet. A specific feature of milk proteins, being beneficial for health, is their binding with salts of the following mineral:

- A. Ca
- B. Mg
- C. Na
- D. Fe
- E. K

44. Dehydration without timely adequate treatment may become a life-threatening condition. Which of the mentioned below factors can not cause dehydration:

- A. Increased production of ADH
- B. Decreased water consumption
- C. Diuretics treatment
- D. Drinking sea water
- E. Diarhea

45. Sodium is the most important extracellular electrolyte, performing a variety physiological functions. Which level of hyponatremia is supposed to be life-threatening?

- A. Below 122 mmol/l
- B. Below 150 mmol/l
- C. Below 90 mmol/l
- D. Below 200 mmol/l
- E. Beow 250 mmo/l

46. Edema is an important manifestation of many diseases and a sign of alteration of water-minerals turnover. Which of the mentioned below is not typical for edema?

- A. Hyperproteinemia
- B. Increase of extracellular fluid
- C. Decrease of osmotic pressure of blood

- D. Increase of hydrostatic pressure
- E. Hyponatremia

47. A 16-year old girl visited a gynaecologist because of absence of menstruation, she has never had her period. She also presents arterial hypertension. The growth of pubic hair can not be noted and her breasts are not developed according to age. USG examination confirms normal uterus and normal ovaries. Which mineral will probably be decreased in the blood of this patient?

- A. K
- B. Na
- C. Ca
- D. Cl
- E. Mg

TOPIC 16. URINE PRODUCTION IN KIDNEYS. NORMAL AND PATHOLOGICAL CONSTITUENTS OF URINE

1. Chronic glomerulonephritis was diagnosed in a 34-year-old patient 3 years ago. Edema has developed within the last 6 months. What caused the edema?
 - A. Proteinuria
 - B. Hyperproduction of vasopressin
 - C. Liver dysfunction of protein formation
 - D. Hyperosmolarity of plasma
 - E. Hyperaldosteronism
2. Urine analysis of a 12-year-old boy reveals high concentration of all aliphatic amino acids with the highest excretion of cystine and cysteine. Ultrasound examination of kidneys revealed kidney concrements. What is the most likely pathology?
 - A. Cystinuria
 - B. Alkaptonuria
 - C. Cystitis
 - D. Phenylketonuria
 - E. Hartnup disease
3. A 19-year-old male was found to have an elevated level of potassium in the secondary urine. These changes might have been caused by the increase in the following hormone level:
 - A. Aldosterone
 - B. Oxytocin
 - C. Adrenaline
 - D. Glucagon
 - E. Testosterone
4. Due to the use of poor-quality measles vaccine for preventive vaccination, a 1-year-old child has developed an autoimmune renal injury. The urine was found to contain macromolecular proteins. What process of urine formation has been disturbed?
 - A. Filtration
 - B. Reabsorption
 - C. Secretion
 - D. Reabsorption and secretion
 - E. Secretion and filtration
5. A 58-year-old patient with acute cardiac insufficiency has decreased volume of daily urine - oliguria. What is the mechanism of this phenomenon?
 - A. Decreased glomerular filtration
 - B. Decreased number of functioning glomerules
 - C. Drop of oncotic blood pressure
 - D. Rise of hydrostatic blood pressure in capillars
 - E. Reduced permeability of renal filter
6. According to the results of glucose tolerance test, the patient has no disorder of carbohydrate tolerance. Despite that, glucose is detected in the patients's urine (5 mmol/l). The patient has been diagnosed with renal diabetes. What renal changes cause glucosuria in this case?
 - A. Decreased activity of glucose reabsorption enzymes
 - B. Increased activity of glucose reabsorption enzymes

- C. Exceeded glucose reabsorption threshold
- D. Increased glucose secretion
- E. Increased glucose filtration

7. In case of alkaptonuria, homogentisic acid is excreted in urine in large amounts. The development of this disease is associated with a disorder of metabolism of the following amino acid:

- A. Tyrosine
- B. Phenylalanine
- C. Alanine
- D. Methionine
- E. Asparagine

8. A therapist has an appointment with a 40-year-old patient complaining of recurrent pain attacks in his hallux joints and their swelling. Urine analysis revealed its marked acidity and pink colour. What substances can cause such changes in the urine?

- A. Uric acid salt
- B. Chlorides
- C. Ammonium salts
- D. Calcium phosphate
- E. Magnesium sulfate

9. Glomerular filtration of a person, who has been starving for a long time, has increased by 20%. The most likely cause of filtration changes in the given conditions is:

- A. Decrease of blood plasma oncotic pressure
- B. Increase of systemic blood pressure
- C. Increase of renal filter permeability
- D. Increase of filtration factor
- E. Increase of renal plasma flow

10. Osmotic pressure of a man's blood plasma is 350 mosmole/l (standard pressure is 300 mosmole/l). First of all it will result in high secretion of the following hormone:

- A. Vasopressin
- B. Aldosterone
- C. Cortisol
- D. Adrenocorticotropin
- E. Natriuretic

11. A 20 year old patient complains of morbid thirst and hyperdiuresis (up to 10 l daily). Glucose concentration in blood is normal but it is absent in urine. The patient has been diagnosed with diabetes insipidus. What hormonal drug is the most appropriate for management of this disorder?

- A. Vasopressin
- B. Cortisol
- C. Thyroxin
- D. Oxytocin
- E. Insulin

12. A man has a considerable decrease in diuresis as a result of 1,5 l blood loss. The primary cause of such diuresis disorder is the hypersecretion of the following hormone:

- A. Vasopressin
- B. Corticotropin

- C. Natriuretic
- D. Cortisol
- E. Parathormone

13. A man presents with glomerular filtration rate of 180 ml/min., while norm is 125 ± 25 ml/min. The likely cause of it is the decreased:

- A. Plasma oncotic pressure
- B. Effective filtration pressure
- C. Hydrostatic blood pressure in the glomerular capillaries
- D. Renal blood flow
- E. Permeability of the renal filter

14. To lose some weight a woman has been limiting the amount of products in her diet. 3 months later she developed edemas and her diuresis increased. What dietary component deficiency is the cause of this?

- A. Proteins
- B. Fats
- C. Carbohydrates
- D. Vitamins
- E. Minerals

15. A patient has insufficient blood supply to the kidneys, which caused the development of pressor effect due to the constriction of arterial resistance vessels. This is the result of the vessels being greatly affected by the following substance:

- A. Angiotensin II
- B. Angiotensinogen
- C. Renin
- D. Catecholamines
- E. Norepinephrine

16. Leading symptoms of primary hyperparathyroidism are osteoporosis and renal damage resulting in urolithiasis development. What substances are the basis of uroliths in such cases?

- A. Calcium phosphate
- B. Uric acid
- C. Cystine
- D. Bilirubin
- E. Cholesterol

17. As a result of continuous starvation the glomerular filtration rate has increased by 20%. The most probable cause of the glomerular filtration alteration under the mentioned conditions is:

- A. Decrease in the oncotic pressure of blood plasma
- B. Increase in the systemic arterial pressure
- C. Increase in the permeability of the renal filter
- D. Increase of the filtration quotient
- E. Increase of the renal blood flow

18. A child has mental and physical retardation, grave damage of internal connective tissue. Urine analysis reveals keratan sulfates. What metabolic process is disturbed?

- A. Glycosaminoglycans

- B. Collagen
- C. Elastin
- D. Fibronectin
- E. Hyaluronic acid

19. For a long time a 49-year-old woman had suffered from glomerulonephritis which caused death. The autopsy revealed that the size of her kidneys was 7 x 3 x 2,5 cm, weight 65,0 g, they were dense and small-grained. Microscopically: fibrinogenous inflammation of serous and mucous membranes, dystrophic changes of parenchymatous organs, brain edema. What complication can cause such changes of serous membranes and inner organs?

- A. Uraemia
- B. Anemia
- C. Sepsis
- D. DIC-syndrome
- E. Thrombopenia

20. In kidney diseases a decrease of glomerular filtration is observed, which leads to decrease of elimination of final metabolic products from the body. What substances are mostly retained in the body?

- A. Creatinine and urea
- B. Uric acid and indican
- C. Amino acids
- D. Ammonia and polyamines
- E. Glucose and glucosamine

21. A part of food protein is not digested in intestinal tract and is decomposed by bacterial enzymes in large intestine. This is defined as putrefaction. of protein. Detection of what substance in urine may serve as indicator of the intensity of putrefaction processes?

- A. Animal indican
- B. Protein
- C. Urea
- D. Creatine and creatinine
- E. Urates

22. A 35 y.o. patient who often consumes alcohol was treated with diuretics. There appeared serious muscle and heart weakness, vomiting, diarrhea, AP- 100/60 mm Hg, depression. This condition is caused by intensified excretion with urine of:

- A. Potassium
- B. Sodium
- C. Chlorine
- D. Calcium
- E. Phosphates

23. A 19-year-old male was found to have an elevated level of potassium in the secondary urine. These changes might have been caused by the increase in the following hormone level:

- A. Aldosterone
- B. Oxytocin
- C. Adrenaline
- D. Glucagon
- E. Testosterone

24. Leading symptoms of primary hyperparathyroidism are osteoporosis and renal damage resulting in urolithiasis development. What substances are the basis of uroliths in such cases?

- A. Calcium phosphate
- B. Uric acid
- C. Cystine
- D. Bilirubin
- E. Cholesterol

25. The doctor suspected a kidney failure in a patient with signs of severe intoxication, brought by the ambulance. One of the reasons for his conclusion was decreased diuresis in patient. Normal diuresis in healthy adults is about:

- A. 1500 ml
- B. 400-700 ml
- C. 2000-3000 ml
- D. 700-900 ml
- E. 3000-4000 ml

26. Biochemical analysis of urine is one of the most important laboratory tests, providing valuable information about patient's condition. Point out the pathological component of urine:

- A. Haemoglobin
- B. Urea
- C. Uric acid
- D. Creatinine
- E. Amino acids

27. Based on the urine analysis the doctor suspected a liver failure in the patient. Based on what index has the physician made this conclusion?

- A. Urea
- B. Glucose
- C. Protein
- D. Lipids
- E. Carbohydrate

28. A patient after the traffic accident was brought to clinic by ambulance. The doctor suspected kidney injury. Point out the qualitative reaction to prove the presence of blood pigments in urine:

- A. Benzidine test
- B. Heller's test
- C. Lugol's test
- D. Trommer's reaction
- E. Rozine's reaction

29. A patient complains about dyspnea provoked by the physical activity. Clinical examination revealed anaemia and presence of the para-protein in the zone of gamma-globulins. To confirm the myeloma diagnosis it is necessary to determine the following index in the patient's urine:

- A. Bence Jones protein
- B. Ceruplasmin
- C. Bilirubin
- D. Antitrypsin
- E. Haemoglobin

30. A biochemical urine analysis has been performed for a patient with progressive muscular dystrophy. In the given case muscle disease can be confirmed by the high content of the following substance in urine:

- A. Creatinine
- B. Porphyrin
- C. Hippuric acid
- D. Creatine
- E. Urea

31. In chronic alcoholic the pyruvate concentration in the patient's urine is increased 10 times compared to normal level. Choose the vitamin, the deficiency of which in the organism can be the reason of this change:

- A. Vitamin B1
- B. Vitamin K
- C. Vitamin A
- D. Vitamin C
- E. Vitamin B2

32. One way of acid-base balance maintenance in organism by means of kidney is ammonia salts formation. Point out the enzyme in kidney that takes part in this process:

- A. Glutaminase
- B. Arginase
- C. Carbamoyl phosphate synthetase
- D. Monooxygenase
- E. Alanine amino transferase

33. A boy (of 10 years) complains of general weakness, dizziness, and tiredness. A mental retardation is observed. A concentration of valine, leucine, isoleucine is high in blood and urine. Urine has a specific odour. Name the probable diagnosis:

- A. Maple syrup urine disease
- B. Phenylketonuria
- C. Histidinemia
- D. Tyrosinemia
- E. Hartnup disease

34. Point out the pathological urine component that appears in the urine during nephritis, some cardiac diseases, some forms of idiopathic hypertension and pregnancy pathology. Test with sulphosalicylic acid for that component is the most sensitive reaction:

- A. Protein
- B. Urea
- C. Uric acid
- D. Hippuric acid
- E. Amino acids

35. Creatinine levels in the urine and blood are used to test kidney function. Creatinine is useful for this test because it is not significantly reabsorbed nor secreted by kidney, and metabolically it is:

- A. Produced at a constant rate
- B. Produced only in kidney
- C. A storage form of energy
- D. An acceptor of protons in renal tubules

E. A precursor for phosphocreatine

36. The patient with kidney failure, who is treated with hemodialysis, developed severe anemia. What drug should be used for the management of anemia in this patient?

A. Erythropoietin

B. Iron

C. Vitamin B12

D. Folic acid

E. Transfusion of red blood cells

37. The patients with chronic kidney failure, treated by hemodialysis, who is on waiting list for kidney transplant, was diagnosed anemia and prescribed injections of erythropoietin. What is the substantiation of erythropoietin administration in kidney failure patients?

A. Erythropoietin is synthesised by kidney

B. Kidney failure patients have higher requirement for erythropoietin

C. In kidney insufficiency erythropoietin is excreted with urine

D. Erythropoietin is broke down in kidney

E. Erythropoietin is activated by kidney

38. A kidney failure patient, treated with hemodialysis, developed hypocalcemia and hypophosphatemia. What drug should be used for the management and future prevention of these biochemical disorders in kidney failure patients?

A. Vitamin D3 supplementation

B. Calcium supplementation

C. Vitamin D2 supplementation

D. Phosphorus supplementation

E. Calcium and phosphorus supplementation

39. A patient with a suspect for glomerulonephritis was hospitalized in nephrology department. The doctor decided to estimate the glomerular filtration rate in this patient. What test should be used?

A. Urinary clearance of creatinine

B. Urinary clearance of inulin

C. Urinary clearance of urea

D. Urinary clearance of glucose

E. Urinary clearance of bilirubin

40. A patient suffers from arterial hypertension. The level of cholesterol in blood is increased, the level of low density lipoproteins is also increased and high density lipoproteins decreased. Ultrasonography of renal arteries revealed advanced atherosclerosis. What compound, overproduced by the kidney of the described patient, contributes to the arterial hypertension in this case?

A. Renin

B. Aldosterone

C. Epinephrin

D. Erythropoietin

E. Vitamin D

41. A patient was injured during an accident in the street. Arterial pressure 80/40 mm Hg, heart rate 90/min. The patient is consciousnessless. The doctor suspected internal bleeding. What compound, produced by kidney under conditions of blood loss is important for the prevention of blood loss?

- A. Renin
- B. Creatinine
- C. Epinephrin
- D. Norepinephrin
- E. Erythropoietin

42. A patient addressed to a doctor because of arterial hypertension, edema, arrhythmia. Ultrasonography revealed a tumor of adrenal cortex in the region of zona glomerulosa. The doctor suspected Conn disease. What index of urine analysis will confirm the diagnosis?

- A. Increased content of K
- B. Increased content of Na
- C. Increased content of Ca
- D. Glucose
- E. Ketone bodies

43. The diabetic patient was recommended to stay in the in-patient department for deeper examination and correction of insulin dosage. The doctor made a conclusion about necessity to correct the hypoglycemic treatment of this patient in particular based on significant glucosuria in this patient despite therapeutic measures. What is the normal level of glucose in urine?

- A. 0,00 g/l
- B. 0,1 g/l
- C. 30 mg%
- D. 10 mMole/l
- E. 2 mMole/l

44. Urine serves as important biological material for laboratory investigations, allowing to judge about different alterations of the metabolism. What is the end product of purine metabolism, excreted with urine is:

- A. Uric acid
- B. Ammonium ion
- C. Urea
- D. Arginine
- E. Creatinine

45. After consumption of water melon the urine of a patient became slightly alkaline. What is the normal pH of urine?

- A. 5.0-7.0
- B. 2.0-3.0
- C. 4.0-5.0
- D. 10.0-12.0
- E. 3.0-4.0

TOPIC № 17. INVESTIGATION OF MUSCLE CONTRACTION

1. Coronary artery thrombosis resulted in development of myocardial infarction. What mechanisms of cell damage are leading in this disease?
 - A. Calcium
 - B. Lipid
 - C. Acidotic
 - D. Electroosmotic
 - E. Protein
2. People, who for a long time remained in hypodynamic state, develop intense pain in the muscles after a physical exertion. What is the most likely cause of this pain?
 - A. Accumulation of lactic acid in muscles
 - B. Intensive breakdown of muscle proteins
 - C. Accumulation of creatinine in muscles
 - D. Decreased content of lipids in muscles
 - E. Increased content of ADP in muscles
3. After intensive training session an athlete presents with significant loss of vascular tone in the working muscles. These changes are caused by accumulation of the following in the vessels:
 - A. Metabolites
 - B. Renin-angiotensin
 - C. Histamine
 - D. Natriuretic hormone
 - E. Serotonin
4. A traumatology unit received a patient with crushed muscular tissue. What biochemical indicator of urine will be raised in this case?
 - A. Creatinine
 - B. Total lipids
 - C. Glucose
 - D. Mineral salts
 - E. Uric acid
5. Experimental stimulation of the sympathetic nerve branches that innervate the heart caused an increase in the force of heart contractions because the membrane of typical cardiomyocytes permitted an increase in:
 - A. Calcium ion entry
 - B. Calcium ion exit
 - C. Potassium ion exit
 - D. Potassium ion entry
 - E. Calcium and potassium ion exit
6. Characteristic sign of glycogenosis is muscle pain during physical work. Blood examination usually reveals hypoglycemia. This pathology is caused by congenital deficiency of the following enzyme:
 - A. Glycogen phosphorylase
 - B. Glucose 6-phosphate dehydrogenase
 - C. α -amylase
 - D. γ -amylase
 - E. Lysosomal glycosidase

7. A 46-year-old female patient has continuous history of progressive muscular (Duchenne's) dystrophy. Which blood enzyme changes will be of diagnostic value in this case?
- Creatine phosphokinase
 - Lactate dehydrogenase
 - Pyruvate dehydrogenase
 - Glutamate dehydrogenase
 - Adenylate cyclase
8. *A patient is diagnosed with cardiac infarction. Blood test for cardiospecific enzymes activity was performed. Which of the enzymes has three isoforms?
- Creatine kinase
 - Lactate dehydrogenase
 - Aspartate transaminase
 - Alanine transaminase
 - Pyruvate kinase
9. *A biochemical urine analysis has been performed for a patient with progressive muscular dystrophy. In the given case muscle disease can be confirmed by the high content of the following substance in urine:
- Creatine
 - Porphyrin
 - Urea
 - Hippuric acid
 - Creatinine
10. For biochemical diagnostics of myocardial infarction it is necessary to measure activity of a number of enzymes and their isoenzymes. What enzymatic test is considered to be the best to prove or disprove the diagnosis of infarction in the early period after the chest pain is detected?
- Creatine kinase isoenzyme CK-MB
 - Creatine kinase isoenzyme CK-MM
 - LDH₁ lactate dehydrogenase isoenzyme
 - LDH₂ lactate dehydrogenase isoenzyme
 - Aspartate aminotransferase cytoplasmic isoenzyme
11. Negative environmental factors have caused the dysfunction of myosatellite cells. What function of the whole muscle fibre is likely to be changed in this case?
- Regeneration
 - Contraction
 - Trophism
 - Contractile thermogenesis
 - Relaxation
12. During an operation a patient got injection of muscle relaxant dithylinum. Relaxation of skeletal muscles and inhibition of respiration lasted two hours. This condition was caused by absence of the following enzyme in blood serum:
- Butyrylcholin esterase
 - Catalase
 - Acetylcholinesterase
 - Glucose 6-phosphatase

E. Glutathione peroxidase

13. An animal with aortic valve insufficiency got hypertrophy of its left heart ventricle. Some of its parts have local contractures. What substance accumulated in the myocardiocytes caused these contractures?

- A. Calcium
- B. Potassium
- C. Lactic acid
- D. Carbon dioxide
- E. Sodium

14. A patient had to go through an operation. Doctors introduced him dithylinum (listenone) and performed intubation. After the end of operation and cessation of anesthesia the independent respiration wasn't restored. Which enzyme deficit prolongs the action of muscle relaxant?

- A. Pseudocholinesterase
- B. Succinate dehydrogenase
- C. Carbanhydrase
- D. N-acetyltransferase
- E. K-Na-adenosine triphosphatase

15. A patient presents high activity of LDH_{1,2}, aspartate aminotransferase, creatine phosphokinase. In what organ (organs) is the development of a pathological process the most probable?

- A. In the heart muscle (initial stage of myocardium infarction)
- B. In skeletal muscles (dystrophy, atrophy)
- C. In kidneys and adrenals
- D. In connective tissue
- E. In liver and kidneys

16. During the experiment on the influence of chemical substances in the muscles the reaction of Ca²⁺-pump is weakened. Which phenomenon will be observed?

- A. Prolonged relaxation
- B. Prolonged duration of the AP
- C. Decreased AP
- D. Activation of the sodium-potassium pump
- E. Decreased velocity of the AP distribution

17. Untrained people often have muscle pain after sprints as a result of lactate accumulation. This can be caused by intensification of the following biochemical process:

- A. Glycolysis
- B. Gluconeogenesis
- C. Pentose phosphate pathway
- D. Lipogenesis
- E. Glycogenesis

18. 12 hours after an acute attack of retrosternal pain a patient presented a jump of aspartate aminotransferase activity in blood serum. What pathology is this deviation typical for?

- A. Myocardium infarction
- B. Viral hepatitis
- C. Collagenosis

- D. Diabetes mellitus
- E. Diabetes insipidus

19. 6 hours after the myocardial infarction a patient was found to have elevated level of lactate dehydrogenase in blood. What isoenzyme should be expected in this case?

- A. LDH₁
- B. LDH₂
- C. LDH₃
- D. LDH₄
- E. LDH₅

20. A 5-month-old boy was hospitalized for tonic convulsions. He has a lifetime history of this disease. Examination revealed coarse hair, thinned and fragile nails, pale and dry skin. In blood: calcium - 1,5 millimole/l, phosphor - 1,9 millimole/l. These changes are associated with:

- A. Hypoparathyroidism
- B. Hyperparathyroidism
- C. Hyperaldosteronism
- D. Hypoaldosteronism
- E. Hypothyroidism

21. Anaerobic glycolysis occur under conditions of relative oxygen insufficiency. This biochemical process is accompanied by the pH decrease in tissues resulting from the accumulation of:

- A. Lactate
- B. Citrate
- C. Oxaloacetate
- D. Succinate
- E. Fumarate

22. The fastest mechanism of ATP production for the urgent muscular contraction is:

- A. ATP generation from creatine phosphate
- B. Aerobic glycolysis
- C. Anaerobic glycolysis
- D. Glycogenolysis in muscles
- E. Triglycerides oxidation

23. In muscular dystrophies the production and excretion of creatinine is inhibited. But what index is increased in urine under these conditions?

- A. Creatine
- B. Urates
- C. Porphyrins
- D. Indicanes
- E. Bilirubin

24. Organ-specific enzymes are evaluated for the diagnosis of some diseases. What enzymes are determined to diagnose muscular dystrophies?

- A. Aspartate aminotransferase, kreatine kinase
- B. Arginase, pyruvate decarboxylase
- C. Alanine aminotransferase, urease
- D. Hexokinase, phosphorylase
- E. Fumarase, superoxide dismutase

25. The huge amount of nitrogen, derived from the amino acids, is excreted from the human organism with urea in the form of creatinine. Which amino acids participate in biosynthesis of creatine?
- A. Glycine, arginine, methionine
 - B. Glycine, phenylalanine, cysteine
 - C. Valine, serine, tyrosine
 - D. Tryptophan, lysine, alanine
 - E. Leucine, histidine, glutamine
26. Indicate the right sequence of the biochemical information transfer in the mechanism of muscular contraction?
- A. Ca → Troponin → Tropomyosin → Actin → Myosin
 - B. Ca → Troponin → Tropomyosin → Myosin → Actin
 - C. Ca → Actin → Myosin → Troponin → Tropomyosin
 - D. Ca → Tropomyosin → Troponin → Actin → Myosin
 - E. Ca → Tropomyosin → Troponin → Myosin → Actin
27. The sportsman ran a marathon distance, resulting in a production of lactate in his muscles. The biggest amount of this lactate:
- A. Gets to blood, is caught by liver where it is converted to glucose
 - B. Gets to mitochondrias and is oxidized to pyruvate
 - C. Is excreted with urea
 - D. Is used for the glucose synthesis in the muscular tissue
 - E. Is accumulated in the organism, causing acidosis
28. What reaction in skeletal muscles causes ATP production for the urgent muscular contraction?
- A. Creatine phosphokinase
 - B. Phosphofructokinase
 - C. Adenylate kinase
 - D. Glucokinase
 - E. Hexokinase
29. A 30 year old patient manifested a decreased tolerance to physical exercises, whereas the content of glycogen in his muscles increased. The decrease of what enzyme caused this condition?
- A. Glycogen phosphorylase
 - B. Phosphofructokinase
 - C. Glycogen synthase
 - D. Fumarase
 - E. Succinate dehydrogenase
30. The main biochemical regulator of the muscular contraction and relax is the change of the ions of:
- A. Ca²⁺
 - B. K⁺
 - C. Mg²⁺
 - D. Cl⁻
 - E. Na⁺

31. In the course of studies it was evaluated that muscular contraction needs energy in the form of:
- A. ATP
 - B. GTP
 - C. CTP
 - D. ADP
 - E. AMP
32. The fibrillar proteins include:
- A. F-actin
 - B. Myosin
 - C. Troponin
 - D. Tropomyosin
 - E. a- and b – actinin
33. A 1 year child got to clinic with the signs of muscular involvement. The examination evaluated carnitine deficiency in muscles. The disturbance of what process is the biochemical background for this pathology?
- A. The fatty acids transport to mitochondrias
 - B. Regulation of Ca^{2+} level in mitochondrias
 - C. Substrate phosphorylation
 - D. Lactate utilization
 - E. Actin and myosin synthesis
34. In which organs is creatine phosphate synthesized?
- A. Kidneys and liver
 - B. Adrenal glands
 - C. Lungs
 - D. Pancreas
 - E. Spleen
35. Which statements on the white muscular fibers are right?
- A. They are characterized by anaerobic carbohydrates catabolism
 - B. Contain more glycogen than the red fibers
 - C. Fatigue faster compared to the red fibers
 - D. Contract faster than the red fibers
 - E. Contain more hemoglobinum than the red fibers
36. Chose from listed proteins a ONE which is NOT a component of thin filaments of sarcomere.
- A. Myosine
 - B. Actin
 - C. Tropomyosine
 - D. Troponine
 - E. –
37. Thick filaments of sarcomere are composed from the next protein:
- A. Myosine
 - B. Tropomyosine
 - C. Actin
 - D. Troponine
 - E. α -Actinin

38. The next statement about myosine II is correct:
- A. The molecule contains one pair of heavy chain and two pairs of light chains
 - B. The molecule contains two heavy chains and two of light chains
 - C. The molecule contains two long polypeptide chains folded as β -pleated sheets
 - D. It is a globular protein possessing ATP-ase activity
 - E. It binds calcium ions tightly
39. After short distance run untrained people develop delayed onset muscle soreness, resulting from lactate accumulation in muscles. The enhanced activity of what biochemical process in the organism may be associated with this condition?
- A. Glycolysis
 - B. Glycogenesis
 - C. Penthosophosphate pathway
 - D. Gluconeogenesis
 - E. Lipogenesis
40. Calcium ions binds with the highest affinity with the next myofibrillar protein:
- A. Troponin C
 - B. Actin
 - C. Tropomyosine
 - D. Troponine I
 - E. Myosine
41. Concerning cardiac and skeletal muscle, which statement is most accurate?
- A. Cardiac muscle contains structures known as intercalated discs
 - B. Cardiac muscle fibres are not striated whereas skeletal muscle fibres are striated
 - C. Cardiac myofibril nuclei are eccentrically placed whereas skeletal myofibril nuclei are centrally placed
 - D. Skeletal muscle fibres exhibit more branching than cardiac muscle fibres
 - E. None of the above
42. Creatine is synthesized from the next amino acid precursor:
- A. Arginine
 - B. Alanine
 - C. Histidine
 - D. Glutamate
 - E. Lysine
43. Creatine is reversibly phosphorylated by the following macroergic compound:
- A. ATP
 - B. Phosphoenolpyruvate
 - C. Carbamoyl phosphate
 - D. NADP
 - E. UTP
44. The end product of creatine catabolism, which is excreted with urine is the next compound:
- A. Creatinine
 - B. Cretine phosphate
 - C. Uric acid
 - D. Urea

E. β -Alanine

45. Chose the correct statement about Cori cycle:

- A. Exchange with lactate-and glucose between muscles and liver
- B. Exchange with glutamate-and glutamine between muscles and liver
- C. Exchange with lactate-and glycogen between muscles and liver
- D. Transfer of ketone bodies from liver to muscles
- E. Production of glucose from glycogen in liver and its transport to muscles

46. What amino acid derivative excreted with urine may serve as indicator of muscle tissue damage?

- A. Methylhistidine
- B. Indolilacetate
- C. Mandelic acid
- D. Citrulline
- E. Isovaleric acid

47. Duchenne's myodystrophy is hereditary disease caused by mutation of specific gene in X chromosome. Deficiency of what protein as gene product is involved in the mechanism of disease manifestation?

- A. Dytrophin
- B. Myosine
- C. Actine
- D. Troponin
- E. Nebulin

48. People after prolong hypodynamia after intensive physical exercises manifest severe pain in muscles. What is the most probable cause of such a phenomenon?

- A. Hyperproduction and retention of lactate in muscles
- B. Decrease of lipids in myocytes
- C. Increase of ADP in myocytes
- D. Accumulation of creatinine in muscles
- E. Increased proteolysis in muscles

49. The excessive intake of vitamin A is accompanied by increased membrane permeability or membrane destruction with the release of the acid proteases and acid phosphatase from the lysosomes, The excretion of what muscular cells metabolite is indicative for their damage?

- A. Creatine
- B. Lactate
- C. Pyruvate
- D. Creatinine
- E. Glucose

50. What motor proteins analogous to myosin provide intracellular transport of subcellular particles?

- A. Dynein and kinesin
- B. Actinin
- C. Vimentin and integrin
- D. Titin and nebulin
- E. Tubulin and actin

Topic № 18. BIOCHEMICAL CONSTITUENTS OF CONNECTIVE TISSUE

1. Collagenosis patients typically present with connective tissue destruction processes. The presence of these processes can be confirmed by the increase in:
 - A. Blood oxyproline and oxylysine
 - B. Blood creatine and creatinine
 - C. LDH-isoenzyme activity in the blood
 - D. Transaminase activity in the blood
 - E. Blood urates
2. X-ray examination of a 57-year-old man indicates local areas of hard bone tissue resorption in some of the patient's bones. These changes can be associated with increased activity of:
 - A. Osteoclasts
 - B. Chondroblasts
 - C. Osteocytes
 - D. Osteoblasts
 - E. Chondrocytes
3. A 36-year-old woman suffers from a connective tissue disease (collagenosis). What metabolite is the most likely to be increased in her urine?
 - A. Oxyproline
 - B. Indican
 - C. Creatinine
 - D. Urea
 - E. Urobilinogen
4. A 30-year-old woman first developed pain, swelling, and skin redness in the area of joints about a year ago. Provisional diagnosis is rheumatoid arthritis. One of the likely causes of this disease is change in the structure of the following connective tissue protein:
 - A. Collagen
 - B. Mucin
 - C. Myosin
 - D. Ovalbumin
 - E. Troponin
5. During regular check-up a child is determined to have interrupted mineralization of the bones. What vitamin deficiency can be the cause?
 - A. Calciferol
 - B. Riboflavin
 - C. Tocopherol
 - D. Folic acid
 - E. Cobalamin
6. Inherited diseases, such as mucopolysaccharidoses, manifest in metabolic disorders of connective tissue, bone and joint pathologies. The sign of this disease is the excessive urinary excretion of the following substance:
 - A. Glycosaminoglycans
 - B. Amino acids
 - C. Glucose
 - D. Lipids
 - E. Urea

7. A 53-year-old man is diagnosed with Paget's disease. Concentration of oxyproline in daily urine is sharply increased, which primarily means intensified disintegration of:
- A. Collagen
 - B. Keratin
 - C. Albumin
 - D. Hemoglobin
 - E. Fibrinogen
8. A patient with signs of osteoporosis and urolithiasis has been admitted to an endocrinology department. Blood test revealed hypercalcemia and hypophosphatemia. These changes are associated with abnormal synthesis of the following hormone:
- A. Parathyroid hormone
 - B. Calcitonin
 - C. Cortisol
 - D. Aldosterone
 - E. Calcitriol
9. A 6-year-old child suffers from delayed growth, disrupted ossification processes, decalcification of the teeth. What can be the cause?
- A. Vitamin D deficiency
 - B. Decreased glucagon production
 - C. Insulin deficiency
 - D. Hyperthyroidism
 - E. Vitamin C deficiency
10. A 20-year-old male patient complains of general weakness, rapid fatigability, irritability, decreased performance, bleeding gums, petechiae on the skin. What vitamin deficiency may be a cause of these changes?
- A. Ascorbic acid
 - B. Riboflavin
 - C. Thiamine
 - D. Retinol
 - E. Folic acid
11. Human skin has a high breaking strength. It is known that the skin consists of epithelial tissue and two kinds of connective tissue. Which of the following tissues provides the skin strength?
- A. Unformed dense connective tissue
 - B. Stratified squamous epithelium
 - C. Loose connective tissue
 - D. Single-layer epithelium
 - E. Transitional epithelium
12. A child has abnormal formation of tooth enamel and dentin as a result of low concentration of calcium ions in blood. Such abnormalities might be caused by deficiency of the following hormone:
- A. Parathormone
 - B. Thyrocalcitonin
 - C. Thyroxin
 - D. Somatotropic hormone
 - E. Triiodothyronine

13. Examination of a child who hasn't got fresh fruit and vegetables during winter revealed numerous subcutaneous hemorrhages, gingivitis, carious cavities in teeth. What vitamin combination should be prescribed in this case?

- A. Ascorbic acid and rutin
- B. Thiamine and pyridoxine
- C. Folic acid and cobalamin
- D. Riboflavin and nicotinamide
- E. Calciferol and ascorbic acid

14. A patient has a slowly healing fracture. What medicine can be used to accelerate formation of connective tissue matrix?

- A. Methyluracil
- B. Prednisolone
- C. Cyclophosphan
- D. Methotrexate
- E. Cyclosporine

15. Osteolaterism is characterized by a decrease in collagen strength caused by much less intensive formation of crosslinks in collagen fibrils. This phenomenon is caused by the low activity of the following enzyme:

- A. Lysyl oxidase
- B. Monoamino-oxidase
- C. Prolyl hydroxylase
- D. Lysyl hydroxylase
- E. Collagenase

16. A 50 year old patient has been taking treatment thrice for the last 6 months because of fractures caused by domestic accidents. Microscopical examination of bony tissue revealed foci of lacunar resorption, giant-cell granulomas in the tumour-like formations, cysts. Bony tissue was substituted by fibrous connective tissue. Examination revealed also adenoma of parathyroid gland and hypercalcemia. What is the most probable diagnosis?

- A. Parathyroid osteodystrophy
- B. Myelomatosis
- C. Osteomyelitis
- D. Osteopetrosis
- E. Paget's disease

17. A 10-year-old girl has a history of repeated acute respiratory viral infection. After recovering she presents with multiple petechial hemorrhages on the sites of friction from clothing rubbing the skin. What kind of hypovitaminosis has this girl?

- A. C
- B. B₆
- C. B₁
- D. A
- E. B₂

18. A 35 year old man consulted a dentist about reduced density of dental tissue, high fragility of teeth during eating solid food. This patient suffers the most probably from the deficiency of the following mineral element:

- A. Calcium
- B. Potassium
- C. Sodium

- D. Magnesium
- E. Iron

19. Examination of a patient with frequent haemorrhages from the internal organs and mucous membranes revealed proline and lysine within the collagen fibers. Disorder of their hydroxylation is caused by lack of the following vitamin:

- A. Vitamin C
- B. Vitamin K
- C. Vitamin A
- D. Vitamin B₁
- E. Vitamin E

20. During examination of an 11 month-old infant a pediatrician revealed osteoectasia of the lower extremities and delayed mineralization of cranial bones. Such pathology is usually provoked by the deficit of the following vitamin:

- A. Cholecalciferol
- B. Thiamin
- C. Pantothenic acid
- D. Bioflavonoids
- E. Riboflavin

21. A 30 y.o. woman had been ill for a year when she felt pain in the area of joints for the first time, they got swollen and skin above them became reddened. Provisional diagnosis is rheumatoid arthritis. One of the most probable causes of this disease is a structure alteration of a connective tissue protein:

- A. Collagen
- B. Mucin
- C. Myosin
- D. Ovoalbumin
- E. Troponin

22. Examination of a patient with frequent hemorrhages from internals and mucous membranes revealed proline and lysine being a part of collagene fibers. What vitamin absence caused disturbance of their hydroxylation?

- A. Vitamin C
- B. Vitamin K
- C. Vitamin A
- D. Thiamine
- E. Vitamin E

23. Increased fragility of vessels, enamel and dentine destruction resulting from scurvy are caused by disorder of collagen maturation. What stage of procollagen modification is disturbed under this avitaminosis?

- A. Hydroxylation of proline
- B. Formation of polypeptide chains
- C. Glycosylation of hydroxylysine residues
- D. Removal of C-ended peptide from procollagen
- E. Detaching of N-ended peptide

24. A 63-year-old woman shows symptoms of rheumatoid arthritis. The increase of what blood indices could be the most significant for proving the diagnosis?

- A. Additive glycosaminoglycans

- B. Lipoproteids
- C. Acid phosphatase
- D. General cholesterol
- E. R-glycosidase

25. Hydroxylation of endogenous substrates and xenobiotics requires a donor of protons. Which of the following vitamins can play this role?

- A. Vitamin C
- B. Vitamin P
- C. Vitamin B₆
- D. Vitamin E
- E. Vitamin A

26. A child with signs of rickets has been prescribed a certain liposoluble vitamin drug by pediatrician and dentist. This drug affects the metabolism of phosphorus and calcium in the body and facilitates calcium accumulation in bone tissue and dentine. If its content in the body is insufficient, there develop disruptions of ossification process, dental structure and occlusion. Name this drug:

- A. Ergocalciferol
- B. Retinol acetate
- C. Tocopherol acetate
- D. Menadione (Vicasolum)
- E. Thyroidin

27. Calcification of dental tissues is significantly influenced by osteocalcin protein that can bind calcium ions due to the presence of the following modified amino acid residues in the polypeptide chain:

- A. γ -carbon glutamine
- B. Alanine
- C. γ -aminobutyric
- D. Carboxy asparagine
- E. δ -aminopropionic

28. Calcification of the intercellular substance of bone tissue is accompanied by the deposition of hydroxyapatite crystals along the collagen fibers. This process requires the presence of alkaline phosphatase in the intercellular substance. What cell produces this enzyme?

- A. Osteoblast
- B. Osteocyte
- C. Osteoclast
- D. Chondroblast
- E. Chondrocyte

29. A 34-year-old patient has a history of periodontitis. As a result of increased collagen degradation, there is a significantly increased urinary excretion of one of the amino acids. Which one?

- A. Hydroxyproline
- B. Valine
- C. Alanine
- D. Glycine
- E. Serine

30. When a wound heals, a scar takes its place. What substance is the main component of its connective tissue?
- A. Collagen
 - B. Elastin
 - C. Keratan sulfate
 - D. Chondroitin sulfate
 - E. Hyaluronic acid
31. Wound healing is accompanied by the development of a connective tissue cicatrice which is formed on the site of the tissue defect. What cells are responsible for this process?
- A. Fibroblasts
 - B. Macrophages
 - C. Fibrocytes
 - D. Mastocytes
 - E. Melanocytes
32. A 35-year-old female patient with a chronic renal disease has developed osteoporosis. The cause of this complication is the deficiency of the following substance:
- A. 1,25-dihydroxy-D3
 - B. 25-hydroxy-D3
 - C. D3
 - D. D2
 - E. Cholesterol
33. In spring a patient experiences petechial haemorrhages, loosening of teeth, high liability to colds. A doctor suspects hypovitaminosis C. In this respect loosening of teeth can be explained by:
- A. Structural failure of collagen in the periodontal ligaments
 - B. Structural change of glycosaminoglycans
 - C. Increased permeability of periodont membranes
 - D. Mechanical damage of teeth
 - E. Disturbed oxidation-reduction process in the periodont
34. Examination of a patient with Slaj syndrome revealed urinary excretion of heparin sulphate and chondroitin sulfate. This condition is likely to be caused by the deficiency of the following substance.
- A. β -Glucuronidase
 - B. α -amylase
 - C. Lactate dehydrogenase
 - D. Arylsulfatase A
 - E. Cathepsin D
35. Alport syndrome is inherited diseases. The patients exhibit hematuria and renal diseases, hearing loss and eye disorders. Which of the following mutation can result Alport syndrome?
- A. Type IV collagen gene mutation
 - B. Defect in type I procollagen
 - C. Mutation of the fibrillin-1 gene
 - D. Type III collagen gene mutation
 - E. Type II collagen gene mutation

36. A 34-year-old female patient complains of an acute headache that started suddenly. Examination of a patient revealed hypertension, highly stretchable, thin skin with varicosities. Patient complains that she bruises easily from minor trauma. This patient's symptoms is most consistent with vascular Ehler-Danlos syndrome. Name which genetic defect is associated with this syndrome?

- A. Structural abnormality in type III collagen
- B. Type II collagen gene mutation
- C. Type I procollagen gene mutation
- D. Type IV collagen gene mutation
- E. Mutation in the gene for fibrillin

37. Increased content of oxyproline in blood and urine with lesions of joints and bones is observed due to increased catabolism of:

- A. Collagen
- B. Hyaluronic acid
- C. Glycosaminoglycans
- D. Proteoglycans
- E. Elastin

38. An 9-year-old girl is brought to the hospital because broken arm. Examination of patient revealed blue tinge to the whites of the eye. This patient's symptoms is most consistent with osteogenesis imperfect. Which of the following is the most likely cause of this patient's disease?

- A. Abnormal type I collagen synthesis
- B. Type II collagen gene mutation
- C. Type IV collagen gene mutation
- D. Mutation in the gene for fibrillin
- E. Abnormal type IV collagen synthesis

39. Influence of hypovitaminosis C on the structure of collagen fibers caused by decreased activity of enzymes:

- A. Lysyl hydroxylase, proline hydroxylase
- B. Lysyl oxidase, lysyl hydroxylase
- C. Glycosyl transferase
- D. Procollagen peptidase
- E. Collagenase

40. Gram-positive bacteria produce a protective capsule of hyaluronic acid, which increases their pathogenicity. What enzyme can "destroy" the protective capsule?

- A. Hyaluronidase
- B. Carboxypeptidase
- C. Aminopeptidase
- D. Alpha glycosidase
- E. Collagenase

41. What class of glycosaminoglycans, due to the large number of carboxyl groups, binds large amounts of water and supports tissue turgor?

- A. Hyaluronic acid
- B. Dermatan sulfate
- C. Keratan sulfate
- D. Heparin
- E. Chondroitin sulphate

42. Insolubility of collagen connective tissue and its metabolic resistance to various agents is caused by amino acid composition and special structure of the protein. Indicate amino acids that quantitatively dominate in the structure of collagen?
- A. Glycine, proline, lysine
 - B. Methionine, serine, threonine
 - C. Phenylalanine, tyrosine, tryptophan
 - D. Cysteine, threonine, glutamine
 - E. Arginine, histidin, phenylalanine
43. Protein procollagen is synthesized by fibroblasts of connective tissue. There after glycosylation occurs. What carbohydrates bind to procollagen?
- A. Galactose, glucose
 - B. Fructose, mannose
 - C. Ribose, deoxyribose
 - D. Arabinose, sucrose
 - E. Ribulose, xylulose
44. Collagen and elastin are fibrillar elements of connective tissue. Specify the amino acid, which is a component only of the collagen and its determination is used to diagnose several disorders of connective tissue:
- A. Hydroxyproline
 - B. Proline
 - C. Glycine
 - D. Lysine
 - E. –
45. In a 63 years old women suffering from rheumatism, increased concentration of oxyproline in blood and urine was detected. What is the main reason of this state?
- A. Degradation of collagen
 - B. Activation of prolyl hydroxylase
 - C. Renal impairment
 - D. Activation of cathepsins
 - E. –
46. Results of blood and urine tests indicate that the content of glucuronic and sialic acids are above normal. Catabolism of which of the following compounds is enhanced?
- A. Glucosamine glican
 - B. Glycoprotein
 - C. Collagen
 - D. Elastin
 - E. Calmodulin
47. For the resorption of keloids a hyaluronidase is used. What biochemical process causes advantages of enzymotherapy?
- A. Cleavage of hyaluronic acid
 - B. Cleavage of heparin
 - C. Cleavage of chondroitin sulfate
 - D. The synthesis of glycosaminoglycans
 - E. Cleavage of collagen

48. Mukopolysaccharydoses are hereditary diseases that manifested pathological changes during bones and joints formation. What urine index indicates this disease?

- A. Excessive excretion of glycosaminoglycans
- B. Excessive excretion of amino acids
- C. Excessive excretion of lipids
- D. Excessive excretion of glucose
- E. Excessive excretion of proteins

49. Examination of a 2 years old child revealed deformation of the spine, joints; lagging in growth, progressive coarsening of the face, deafness, thickening of the skin. Increased excretion of dermatine sulfate and heparin sulfate were determined in urine. Deficit of which from the following enzymes caused these changes?

- A. α -L-iduronidase
- B. N-sulfamidase
- C. N-acetyl glucose aminidase
- D. Glucose-6-phosphatase
- E. β -glucoseamine– N-acetyltransferase

50. In inflammatory diseases of joints decreasing in viscosity of synovial fluid is observed. The reason of this disorder might be:

- A. Reducing of the number and depolymerization of hyaluronic acid
- B. Reduction of the number and depolymerization of proteoglycans
- C. Reducing of the number and depolymerization of glycoproteins
- D. Reduction of protein concentration
- E. Reducing of the number and depolymerization of chondroitin sulfate

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