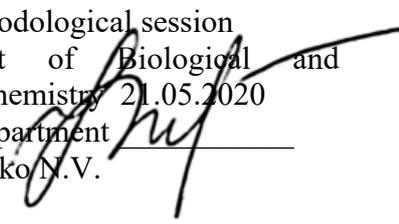


ONLINE EDUCATION

Approved
at the methodological session
Department of Biological and
General Chemistry 21.05.2020
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THEORETICAL QUESTIONS FOR THE EXAM (on-line)

1. The main part - for 2nd year students of all faculties
2. Applications: specialized issues
 - 2.1 for medical faculty students
 - 2.2 for stomatological faculty students
 - 2.3 for pharmaceutical faculty students

1. The main part (for students of all faculties)

Enzymes and cofactors.

1. Enzymes: definition, nomenclature, classification, properties.
2. The chemical nature and structure of enzymes. Active and allosteric centers. The mechanism of action of enzymes.
3. Multienzymes and isoenzymes. The clinical significance of isoenzymes. Enzymodiagnosis and enzyme therapy.
4. Activators and inhibitors of enzymes. Competitive and non-competitive enzyme inhibitors in medicine.
5. Principles and units for determining the activity of enzymes. Methods of regulation of enzymatic activity.
6. Coenzymes involved in redox reactions: vitamin (NAD, NADP, FAD, FMN, ubiquinone), heme, glutathione: mechanisms of action, significance.
7. Coenzymes - carriers of chemical groups (TDF, PALF, CoA, biotin, THFK, methylcobalamin, vitamins K and A): mechanism of action, biological significance.

Common metabolic pathways. Bioenergetics.

1. Concept of bioenergetics. The general ways of catabolism and stages of formation of energy from organic substances.
2. Oxidative decarboxylation of pyruvate. Characteristic of multienzymatic complex.
3. Krebs cycle (citric acid cycle): mechanism, regulation, significance, recruitment of metabolites.
4. Modern concept of tissue respiration. Structural organization of mitochondrial respiratory chain. Inhibitors of tissue respiration.
5. Oxidative phosphorylation: definition, mechanism, significance The formation and role of electrochemical potential $\Delta\mu H$ in the ATP synthesis. Coefficient P/O. Disconnector of tissue respiration and oxidative phosphorylation. Macroergic compounds: examples, structure and significance of ATP.

Carbohydrates metabolism

1. Carbohydrates: classification, representatives, structure, biological role.
2. The norm of carbohydrates in the diet. Digestion and absorption of carbohydrates in the digestive tract. The role of fiber (cellulose) and other dietary fiber in digestion.
3. Glycogen: structure, biological significance. Glycogen exchange and its hormonal regulation. Glycogen storage diseases
4. Anaerobic glycolysis: determination, localization, stages, biological significance. Substrate phosphorylation and glycolytic oxidoreduction.
5. Gluconeogenesis: definition, substrates, hormonal regulation and biological significance. Glucose-lactate and glucose-alanine cycles.
6. The pentose phosphate cycle: determination, localization, stages, biological significance. Hereditary impairment of glucose-6-phosphate dehydrogenase activity
7. Aerobic oxidation of glucose: stages, regulation, energy balance. Pasteur effect.
8. Neurohumoral regulation of carbohydrate metabolism. Hypoglycemia, hyperglycemia and glucosuria: definition, types and causes.
9. Biochemical characteristics and diagnosis of diabetes.

Lipids metabolism

1. Lipids: definition, classification, representatives and biological significance.
2. The concept of lipid peroxidation (lipid peroxidation). Formation and neutralization of reactive oxygen species. Cascade of arachidonic acid. Eicosanoids and their biological significance.
3. The norm of lipids in the diet. Digestion of lipids in the digestive tract and absorption of hydrolysis products. The structure and role of bile acids.
4. Transport forms of lipids: structure, composition, clinical diagnostic value
5. Intracellular lipolysis: determination, localization, mechanism, hormonal regulation and biological significance.
6. Oxidation of fatty acids and glycerin in tissues: mechanism, enzymes, coenzymes, value, energy balance.
7. Synthesis of saturated fatty acids: mechanism, the role of biotin (Vit B8), the structure of the multienzyme complex. Features of the synthesis of unsaturated fatty acids.
8. Neutral fats (triacylglycerides): definition, structure, biosynthesis, biological significance
9. Phosphoglycerides: definition, representatives, structure, biosynthesis, biological values. Lipotropic and lipogenic factors
10. Ketone bodies: definition, representatives, biological significance. Blood levels are normal and pathological. Metabolism of ketone bodies. Ketogenic and anti-ketogenic factors.
11. Cholesterol: structure, biosynthesis, biological significance. The norm of blood content. Transport forms
12. Neurohumoral regulation of lipid metabolism. Pathology of lipid metabolism: atherosclerosis, steatorrhea, cholelithiasis, obesity.

Simple proteins and amino acids metabolism

1. Proteins: definition, composition, structure (levels of structural organization, types of chemical bonds), physicochemical properties and biological role.
2. The norm of proteins in food. Complete and defective proteins. Dynamic state of proteins: protein wear coefficient (Rubner), protein minimum and optimum, nitrogen balance.
3. Digestion of proteins in the gastrointestinal tract: mechanism, enzymes (endo- and exopeptidase) and their activation. The role of HCl in the digestion of proteins. Inhibitors of proteolytic enzymes.
4. Decay of proteins in the large intestine. Toxic products of decay: formation and disposal. Laboratory diagnosis of the intensity of decay (the value of an animal indican).
5. Decarboxylation of amino acids: determination, enzymes, coenzymes. The formation, biological

significance and neutralization of biogenic amines (histamine, serotonin, catecholamines, gamma-aminobutyric acid).

6. Transamination of amino acids: definition, mechanism, enzymes and coenzymes. Clinical and diagnostic value determination of transaminases activity in the blood
7. Amino acid deamination: definition, species, enzymes and significance. Sources of ammonia in the body. The ammonia content in the blood in normal and pathological. The mechanisms of the toxic effects of ammonia.
8. Pathways of ammonia detoxification in the body. Transport forms of ammonia. Ornithine cycle: mechanism, biological significance, genetic defects. The level of urea in the blood and urine is normal and pathological.
9. The metabolism and importance of acyclic amino acids (glycine, serine, cysteine, methionine, aspartate, glutamate, arginine and branched chain amino acids). Hereditary enzymopathies (maple syrup disease, hyperhomocysteinemia).
10. Features of the exchange and the importance of cyclic amino acids (phenylalanine and tyrosine). Hereditary enzymopathies (phenylpyruvate oligophrenia, albinism, alcaptonuria).

Nucleic acids. Molecular biology

1. Nucleic acids: definition, species, structural components, biological significance. The primary and secondary structure of nucleic acids. The rules of Chargaff. Watson-Crick Model.
2. Purine nucleotides: definition, structure, biological significance. Features of the synthesis and decay of purine nucleotides in tissues. Pathology of purine metabolism.
3. Pyrimidine nucleotides: definition, structure and biological significance. Features of the synthesis and decomposition of pyrimidine nucleotides. Orotaciduria.
4. DNA replication: definition, factors and mechanism. Replication inhibitors.
5. Transcription: definition, factors and mechanism. Promoters and palindromes. Processing. Transcription inhibitors
6. Genetic code and its properties. Translation: definition and translation factors. Activation of amino acids.
7. Characteristics of the main stages of translation. Post-translational modification. translation inhibitors
8. Regulation of matrix protein synthesis in prokaryotes according to the Jacob and Mono scheme. Operon structure
9. Regulation of gene expression in eukaryotes at the level of structural organization of the genome, transcription and translation.
10. Molecular mechanisms of point mutations. DNA repair: definition, mechanism, enzymes, biological significance, pathology.

Hormones. Molecular mechanisms of regulatory signals transduction

1. Hormone-like substances: definition, characteristics, mechanisms of isocrine action. Representatives and biological role of cytomedines and hormone-like substances of the gastrointestinal tract.
2. Hormones: definition, characteristics, classification by chemical nature (representatives). Regulation of hormone secretion. Cascade mechanism of amplification of the hormonal signal.
3. Membrane mechanism of action of hormones of protein-peptide nature. Characteristics of secondary messengers: c-AMP, c-GMP, Ca-calmodulin, diacylglycerol and inositol triphosphate.
4. The cytosolic mechanism of action of hormones of a steroid nature. Lipid messengers.
5. Hormones of the central endocrine glands (hypothalamus, pituitary, pineal gland): representatives, chemical nature, mechanism of action, biological role, pathology.
6. Hormones of the peripheral endocrine glands (parathyroid, thyroid, adrenal glands): representatives, chemical nature, mechanism of action, biological role, pathology.

7. Hormones of the glands of mixed functions (pancreas, sex glands, thymus): representatives, chemical nature, mechanism of action, biological role, pathology.

Vitamins

1. Classification of vitamins. Vitamine-like compounds. The basic concepts of vitaminology: hypo - polihypo - hyper- an avitaminosis, antivitamin, provitamins. The reasons of development of vitamin insufficiency.
2. Water-soluble vitamins: group B (B1, B2, B3, B5, B6, B8, B9, B12), vitamins C and P: structure, coenzymatic forms, participation in a metabolism, clinical signs of insufficiency, food sources.
3. Lipid-soluble vitamins: A, D, E, K: the chemical nature, participation in a metabolism, clinical signs of insufficiency. Hypervitaminosis of A и D, hormonal forms of vitamins D2 and D3. Food sources. Provitamin A. Medical products - analogues and antagonists of vitamin K.

Biochemistry of blood

1. Blood as a biological fluid, functions and blood products. Plasma and blood serum. The chemical composition of the blood. Residual blood nitrogen. Azotemia: definition, types and causes
2. Physico-chemical constants of blood and their regulation. Blood buffer systems. Alkaline reserve of blood. Violation of acid-base balance.
3. Characteristics and significance of the main protein fractions of blood plasma (albumin, globulin and fibrinogen). Albumin-globulin ratio. The norm of the content of total protein in blood plasma. Hypo - and hyperproteinemia.
4. Characteristics and significance of individual blood proteins: α 1-antitrypsin, haptoglobin, ceruloplasmin, transferrin, immunoglobulins. Proteins of the acute phase of inflammation and pathological blood proteins.
5. Plasma enzymes: classification, representatives, clinical diagnostic value. The kinin system of blood.
6. Features of the structure, chemical composition and metabolism in red blood cells. Molecular basis of hemolytic anemia (pathology of erythrocyte proteins, pentose phosphate pathway enzymes and glycolysis).
7. Hemoglobin: structure, species, derivatives, biosynthesis and biological significance. Hemoglobinosis (hemoglobinopathies, thalassemies) and porphyries.

Biochemistry of liver

1. Functions of the liver. Its role in carbohydrates, proteins and fats metabolism
2. Hemoglobin catabolism in tissues - pigmentary metabolism. Characteristics of indirect and direct bilirubin. The norm of bilirubin in the blood.
3. Pathology of pigmentary metabolism. Jaundice: types and biochemical diagnostics.
4. Detoxification function of the liver. Xenobiotic metabolism - the main phases. Induction of xenobiotic metabolizing enzymes. Metabolic activation.
5. I phase of xenobiotic metabolism: name, localization, types of reactions, enzymes, coenzymes, electron transport chains, biological significance. The role of cytochromes P450.
6. II phase of xenobiotic metabolism: name, localization, types of reactions, enzymes, endogenous substrates, biological significance.
7. Ethanol metabolism in the human body. The mechanisms of the toxic effects of ethanol. The value of endogenous ethanol.

Water-mineral metabolism. Biochemistry of kidneys and urine.

1. Water and its biological role. The content and distribution of water in the body. Hormonal regulation of water metabolism. Pathology of water metabolism.
2. Mineral substances: classification and a biological role.

3. The biological role, participation in the metabolism and the normal content of sodium and potassium in the blood serum. Regulation and pathology of their metabolism.
4. The biological role, participation in metabolism and the normal content of serum calcium and phosphorus. Regulation and pathology of their metabolism.
5. Biochemical mechanisms of urination and their regulation. Creatinine clearance and its importance
6. Biochemical mechanisms of kidney involvement in the regulation of blood pressure and acid-base balance
7. Urine as a biological fluid. Physico-chemical properties of urine. Inorganic and organic components of urine are normal and pathological.

2.1 For medical faculty students

1. Biochemistry of muscle tissue: features of the chemical composition, energy-supplying processes of muscle contraction. Creatine, creatine phosphate: synthesis, value.
2. Biochemistry of connective tissue: chemical composition features (collagen, elastin, extracellular matrix) and significance. Stages of collagen synthesis. Biochemical indices of the state of connective tissue.
3. Biochemistry of nerve tissue: features of the chemical composition and metabolism. Neurotransmitters and neuropeptides: representatives, biological significance. Cerebrospinal fluid.

2.2 For stomatological faculty students

1. Biochemical composition of tooth tissues (enamel, dentin, pulp) and metabolic features. Soluble and insoluble proteins of tooth tissue, the role of collagen. Mineral matrix of the tooth and mineralization processes.
2. Biochemical changes in tooth tissues in pathology. Vitamins and hormones as regulators of the metabolism of tooth tissues.
3. The biological role of saliva. Physico-chemical properties, chemical composition of saliva. Changes in the chemical composition of saliva and its properties with age and pathological conditions

2.3 For pharmaceutical faculty students

1. Enzymes, their activators and inhibitors (competitive, non-competitive) as drugs
2. Vitamins (water-soluble, fat-soluble) as drugs: examples, mechanism of action
3. Hormones as drugs