

# ***THE BASIC EXAMINATION QUESTIONS TO BIOCHEMISTRY FOR 2<sup>ND</sup> YEAR STUDENTS OF THE PHARMACEUTICAL FACULTY (2016-2017 academic years)***

## ***GENERAL QUESTIONS***

1. Biochemistry as science. Methodological fundamentals of biochemistry. Methods and divisions of biochemistry.
2. Eminent scientists-biochemists. The contribution of Ukrainian scientists in the development of world biochemistry.

## ***SIMPLE PROTEINS***

1. Proteins: common characteristic, definition, composition, structure and functions.
2. Classification of simple proteins (by structure and behaviour), characteristic of some classes.
3. Physicochemical property of proteins (molecular weight, amphotericity, isoelectric point, solubility, hydrophilism). Denaturation and sedimentation of proteins. Proteins as antigens.
4. Classification and properties of amino acids. Glucogenic and ketogenic amino acids.
5. Nonpolar (hydrophobic) amino acids, its structure, properties and significances.
6. Polar (hydrophilic) uncharged amino acids, its structure and significances.
7. Negative charged (acidic) amino acids, its structure, properties and significances.
8. Positive charged (basic) amino acids, its structure and significances.
9. Peculiarity of metabolism and biological role of amino acids: Gly, Ser, Cys, Met, Glu, Asp.
10. The levels of structure organization of proteins (primary, secondary, tertiary, quaternary, domainary). Kinds of chemical bonds in proteins.
11. Nitrogen balance, its types. Daily needs of proteins in human organism. The dynamic state of the proteins in a human body. The norm of the proteins in nutrition. Protein minimum and optimum. Rubner's wear coefficient. Complete and incomplete value proteins. Biological value of proteins.
12. Digestion and absorption of proteins in the GIT. Activation and characteristic of digestive enzymes. Role of HCl in digestion.
13. Putrefaction of proteins in large intestinal. Mechanism of detoxification of its putrefactive products. Laboratory diagnostics of intensity of proteins Putrefaction in intestines.
14. Deamination of amino acids: types, enzymes and significance.
15. Transamination: definition, enzymes, coenzymes, mechanism. Clinical significance of transaminase's blood activity determination.
16. Amino acids decarboxylation. Formation and biological action of biogenic amines (histamine, serotonin, GABA, epinephrine), its deactivation.
17. Sources of ammonia in organism. The ways of ammonia detoxification. Transport forms of ammonia.
18. The role of liver in protein metabolism.
19. Biochemical indexes of protein metabolism. Methods of qualitative determination of proteins. Urea as a final product of nitrogen (proteins) metabolism.

## ***COMPLEX PROTEINS. NUCLEIC ACIDS***

1. Complex proteins: classification, structure, biological significance.
2. Forms and connections of hemoglobin. Biosynthesis of hem. Pathology of hemoglobin. Hemoglobinoses.
3. Hemoglobin catabolism in tissues. Normal levels of bilirubins fractions in blood serum.
4. Pathology of pigmentary metabolism. Types of jaundices, its biochemical diagnostics.
5. Nucleoproteins. Nucleic acids: classification, structure and biological significance.
6. Components of nucleic acids: nitrogenous bases, carbohydrates (ribose, deoxyribose). Structure and nomenclature nucleosides and nucleotides.
7. DNA: characteristic, composition, biological significance The model by Watson and Crick. The Chargaff's rules.
8. RNA: composition, classification, characteristics of different types.
9. Replication – definition, factors, mechanism, biological significance. Damages and reparation of DNA.

10. Transcription - definition, factors, mechanism, biological significance. Processing.
11. Mechanisms and factors of translation. Post-translational modification of proteins.
12. Molecular bases of genetic code and its characteristics. Molecular mechanisms of point mutations: definition, types, significance.
13. Protein biosynthesis regulation by Jacob and Monod. Features of protein biosynthesis and its regulation in eucaryotes. Molecular diseases.
14. Digestion of nucleoproteins in the digestive tract, absorption of hydrolysis products.
15. Biosynthesis and catabolism of purine mononucleotides in tissues. Final products of its catabolism. Pathology of purine metabolism.
16. Biosynthesis and catabolism of pyrimidine mononucleotides in tissues.

### ***ENZYMES. COENZYMES. VITAMINS.***

1. Enzymes: definition, nomenclature and classification. Chemical nature and structure of enzymes. Properties of enzymes, conditions of its action.
2. Concept of active and allosteric sites of enzymes, its significance. Mechanism of enzyme action.
3. Multienzymatic complexes and isoenzymes: definition, significance. Clinical significance of isoenzymes determination.
4. Activators and inhibitors of enzymes. Types of inhibitors.
5. Principles of determination and units of enzyme activity. Use of enzyme preparations in medicine. Enzyme's diagnostics.
6. Method of regulation of enzymatic activities.
7. Cell organization of enzymatic activities.
8. The coenzymes of I group: mechanism of action, biological significance.
9. The coenzymes of II group: mechanism of action, biological significance.
10. The basic concepts of vitaminology: hypo - polihypo - hyper- an avitaminosis, antivitamin, provitamins. The reasons of development of vitamin insufficiency.
11. Classification of vitamins.
12. Water-soluble vitamins: group **B** (B<sub>1</sub>, B<sub>2</sub>, B<sub>3</sub>, B<sub>5</sub>, B<sub>6</sub>, B<sub>8</sub>, B<sub>9</sub>, B<sub>12</sub>), vitamins **C** and **P**: structure, coenzymatic forms, participation in a metabolism, clinical signs of insufficiency, food sources.
13. Lipid-soluble vitamins: **A**, **D**, **E**, **K**: the chemical nature, participation in a metabolism, clinical signs of insufficiency. Hypervitaminosis of A and D, hormonal forms of vitamins D<sub>2</sub> and D<sub>3</sub>. Food sources. Provitamin A. Medical products - analogues and antagonists of vitamin K.

### ***BIOENERGETICS. BIOLOGICAL OXIDATION.***

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. Disconnectors of tissue respiration and oxidative phosphorylation. Macroergic compounds: examples, structure and significance of ATP.
6. Concept of xenobiotics (alien substances). The general scheme of xenobiotics metabolism and excretion. Formation of reactive metabolites. Reaction of xenobiotics conjugation. Significance of cytochrome P-450.
9. Metabolism of ethanol and the mechanism of its toxic action. Significance of endogenous ethanol.

### ***CARBOHYDRATES***

1. Carbohydrates: classification, structure and biological.
2. The main representatives of mono- and disaccharides: structure, biological significance.

3. Polysaccharides: definition, classification. Homopolysaccharides: structure, properties and biological significance.
4. Heteropolysaccharides (mucopolysaccharides): hyaluronic acid, heparine, chondroitinesulptates: structure, biological significance.
5. Alimentary significance and daily need of carbohydrates. Digestion and absorbtion of carbohydrates into digestive tract. Roles of cellulose and other alimentary fibers in digestion.
6. Glycogene: significance, synthesis and breakdown.
7. Anaerobic and aerobic glycolysis and glycogenolysis: mechanism, biological significance, regulation. Substrate phosphorylation.
8. Reciprocation of pyruvate and lactate. Gluconeogenesis and its significance.
9. The pentose phosphate pathway of carbohydrates metabolism: biological significance, localization, mechanism, regulation.
10. Aerobic and anaerobic oxidation of glucose: stages, energy balance, significance.
11. The roles of nervous and endocrine systems in the regulation of carbohydrates' metabolism. Participation of hormones (adrenaline, glucagon, glucocorticoid, insulin and others) in regulation of the glucose blood level. Biological effects of insulin's action.
12. Reasons and types of hyperglycemia, hypoglycemia.
13. Diabetes mellitus: types, biochemical diagnostics. Sugar curves.
14. Role of liver in carbohydrate metabolism. Biochemical markers of carbohydrates metabolism. Qualitative determination of glucose in urine (demonstration).

### ***LIPIDS***

1. Lipids: definition, biological significance and classification.
2. Neutral fats (triacylglycerols) and fatty acids: physicochemical properties and significance. Prostaglandins.
3. Glycerophospholipids: classification, structure, characteristics, significance, biosynthesis.
4. Cholesterol: structure, biological significance, biosynthesis, normal level in blood serum. Transport forms of cholesterol. Pathology of cholesterol metabolism.
5. Biological membrane: structure, properties, common and specifically functions of membrane. Kinds of compound transfer across membrane.
6. Conception of lipid peroxidation. Enzymatic and nonenzymatic lipid peroxidation. Active form of oxygen. Antioxidants (natural and synthetic) and their application in medical practice.
7. Alimentary significance and daily need of lipids. Digestion and absorbtion of carbohydrates into digestive tract. Bile acids: structure and biological significance.
8. Transport forms of lipids: structure, classification, significance.
9. Fatty acids  $\beta$ -oxidation and glycerol oxidation in tissues: mechanism, enzymes and coenzymes of this process, significance, energy balance. Role of carnitine.
10. Biosynthesis of saturated fatty acids: characteristic of multienzymatic complex - fatty acids synthetase. Role of biotin (vitamin B<sub>8</sub>). Peculiarity of unsaturated fatty acids biosynthesis.
11. Biosynthesis of neutral fats (triacylglycerols) and glycerophospholipids.
12. Ketone (acetone bodies): structure, significance and normal level in blood. Ketogenic and antiketogenic factors.
13. Biosynthesis of acetone bodies (ketogenesis) and utilization of acetone bodies (ketolysis). Reasons of ketonemia and ketonuria at diabetes mellitus. Normal level of acetone bodies in blood. Qualitative determination of acetone bodies in urine (demonstration).
14. Regulation of lipids metabolism. Intracellular lipolysis. Lipogenic and lipotropic factors, mechanism of its action.
15. Pathology of lipids metabolism: atherosclerosis, adiposity, cholelithiasis. Biochemical indexes of lipid metabolism.

### ***HORMONES***

1. General characteristic of neuroendocrinal regulation. Intercellular integration of functions of an organism. The chemical nature, classification and the characteristic of hormones.
2. Hormone-like substances, definition, varieties of isocrinic (local) action.

3. Action mechanism of hormones of protein-peptide nature and catecholamins (through cell membrane receptors). Formation and roles secondary messengers: cAMP, cGMP, Ca<sup>2+</sup>-CaM, I3P, DAG, NO and CO<sub>2</sub>.
4. The mechanism of action of lipid nature (steroids) hormones (through cytosol receptors).
5. Hormones of central endocrine glands - hypothalamus, pituitary, epiphysis: presentatives, chemical nature mechanism of action, biological role, pathology.
6. Hormones of peripheral and mixed function endocrine glands: pancreas, parathyroid, thyroid, brain substance and cortex of adrenal glands, sexual: chemical nature mechanism of action, biological role. Pathology. Concept about biogeochemical regions and endemic [adenomatous] goiter. Hormones as medical products.

### ***BLOOD***

1. Blood: functions, kinds of blood, blood preparations as medicines. Plasma and serum of blood. Physico-chemical constants of blood, their regulation. Osmotic and oncotic pressures of blood. Acidosis and alkalosis: types and causes. Buffer capacity of blood.
2. Blood chemical compounds. Rest [nonprotein] nitrogen of blood: normal level, components, clinical significance Red blood cells: peculiarity of structure, chemical composition and metabolism.
3. Characteristic and significance of main protein fractions: albumins, globulins and fibrinogen. Albumin-globulin coefficient, its diagnostic significance.
4. The characteristic and significance such blood proteins as: haptoglobin, ceruloplasmin, transferrin, transcobalamin, C-reactive protein, cryoglobulin, interferon, fibronectin et al.
5. Enzymes of blood: classification, diagnostic significance. Kinins blood system.

### ***WATER-SALT METABOLISM, URINE***

1. Water: kinds, biological functions, the maintenance in an organism. Neuroendocrinal regulation of water-salt metabolism.
2. Mineral substances: classification and a biological role.
3. Roles of Na, Ca, K, Mg, P, Fe, Cl in metabolism. Biological significance value of the normal level Ca in blood.
4. Biological significance trace substances (microelement): I, Br, F, Mn, Cu, Co, Se et al.
5. Physico-chemical properties and chemical compound of urine in norm and at a pathology.

### ***OTHER QUESTIONS***

1. Biochemistry of muscular tissue. Energy supply of contraction. Creatine, phosphocreatine, creatinine - formation, significance.
2. Biochemistry of connective tissue: cellular structure, fibrous structures, the basic intercellular substance, their significance. Synthesis and chemical compound of collagen and elastin.
3. Biochemistry of nervous tissue and cerebrospinal fluid. Features of a chemical compound and metabolism in a brain tissue.

### ***EXAMINATION MINIMUM OF PRACTICAL SKILLS***

1. Determination of protein in urine by the tests with sulfosalicylic and trichloroacetic acids. Biuret reaction.
2. Determination of glucose in urine (reactions by Fehling, Nilander, gluco-test).
3. Detection of ketone bodies in urine by reaction with sodium nitroprusside.
4. Detection of the blood remains on medical instruments with azopyrime.

### ***THE LIST OF FORMULAS AND PROCESSES WHICH IS NECESSARY FOR KNOWING ON EXAM***

1. 20 amino acids.
2. Products of amino acids decarboxylation - biogenic amines (histamine, serotonin, GABA et al.).
3. Putrefactive products of proteins (phenol, cresol, indole).
4. The formula of urea.
5. Nitrogenous bases of nucleic acids. Uric acid.

6. ATP.
7. Reciprocation of pyruvate and lactate.
8. Glucose, fructose, their phosphoric esters. Ribose and deoxyribose.
9. Glycerol.
10. Fatty acids: palmitic, stearic, oleic, arachidonic (common formulaes). Structure of neutral fats (triacylglycerols).
11. Ketone (acetone bodies).
12. Cholesterol.
13. Vitamins C, B<sub>5</sub> (PP), B<sub>6</sub>, B<sub>8</sub>.
14. Epinephrine, choline.
15. Common metabolites of proteins, lipids and carbohydrates metabolisms.

**Head of Biochemistry  
Department**

**Associate prof.  
Zaichko N.V.**