Vinnytsya National Pirogov Memorial Medical University

Department of Biological and General Chemistry

**ONLINE EDUCATION**

Apporoved

at the methodological session

Department of Biological and General Chemistry 21.05.2020

Head of depatment _____

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**SITUATIONAL TASKS FOR EXAM (on-line)**

**1.** In a patient with hypoacidity gastritis found reduce pepsin activity in gastric juice.

To what class of enzymes belongs pepsin?

What kind of reactions catalyzed by this enzyme?

What class does this enzyme belong to?

**2.** In a patient with myocardial infarction found increased activity of lactate dehydrogenase in blood serum

To what class of enzymes belongs lactate dehydrogenase?

What kind of reactions catalyzed by this enzyme?

What class does this enzyme belong to?

**3.** In a patient with chronic gastritis observed decrease in activity of pepsin, gastric juice pH is 5.0.

Explain the reason for decreased activity of pepsin.

Why for such patients administered to take weak solution of hydrochloric acid before meals?

What type specificity typical for this enzyme?

**4**. At acute pancreatitis to prevent autolysis of the pancreas at the preclinical stage recommended starvation and cooling of the abdominal wall in the pancreas region.

What can explain necessity of use these measures?

What enzymes are activated in pancreatitis?

Determination of which enzymes are used for the diagnosis of acute pancreatitis?

**5.** Patients after a stroke, among other drugs, are prescribed proserin to restore muscle mobility.

What enzyme activity inhibits proserin?

What is the type of inhibition?

The concentration of which metabolite (neurotransmitters) in the muscles will increase under the influence of proserin?

**6.** After receiving sulfanilamides patient appeared abdominal distension and diarrhea.

What is the mechanism underlying the bactericidal action of sulphanilamides?

What type inhibitors belong sulfanilamide drugs?

What vitamin expedient to assign patient?

**7.** A patient with suspected acute pancreatitis was delivered to the emergency clinic.

An increase in the activity of which enzymes in the blood and urine will confirm the diagnosis?

What pancreatic enzyme activity is determined by the Volgemut method in urine?

Indicate the normal activity values of this enzyme in Volgemut units.

**8.** Patient 58 years old was hospitalized with complaints on pain in the retrosternal area, sudden weakness, sweating, fear, dizziness. The preliminary diagnosis - myocardial infarction.

What three enzymes activity will increase during myocardial infarction?

Which of them have isozyme form?

What isoenzyme is the most informative in the first hours of myocardial infarction?

**9.** In hypoxia cases toxic product - hydrogen peroxide ($H_2O_2$) accumulate in the tissues, which causes oxidative damage of cell membranes.

Which enzymes neutralize $H_2O_2$ in the cells?

Which cofactors involved in $H_2O_2$ neutralization?

Explain the mechanism of action of these enzymes.

**10.** To improve the redox processes in clinical practice, patients prescribed vitamin E and $B_2$.

Which coenzyme form of these vitamins do you know?

Give examples of redox processes in which they participate.

Explain the mechanism of action of one of them

**11.** After surgical removal of part of stomach, in patients often arises malignant macrocytic Addison-Biermer anemia, due to malabsorption vitamin B12.

Name the coenzyme forms of vitamin $B_{12}$.

Explain the metabolic role of vitamin $B_{12}$ .

Which biochemical process violation leads to Addison-Biermer anemia?

**12.** The 6-month-old baby who is on artificial feeding has epileptiform convulsions. After the appointment GABA (gamma-aminobutyric acid) indicated symptoms disappeared.

Deficiency of which coenzyme takes place in the child?

Explain the cause of convulsion in children.

In which biochemical processes involved this coenzyme?

**13.** The patient entered to hospital with a diagnosis of diabetes mellitus. Among the metabolic disorders is a reduction of oxalacetate, citrate and α-ketoglutarate.

Name metabolic process which activity decreases in these conditions.

What are the consequences for the organism have decreased activity of this metabolic process?

Name anaplerotic reactions which replenishes reserves of oxaloacetate.

**14.** In patients with chronic alcoholism observed increase of pyruvate content in blood serum and increase its excretion in the urine due to thiamine deficiency.

The activity of what metabolic process is reduced in these patients?

Name of this process, indicate enzymes and coenzymes.

Using of which coenzyme enhance the metabolic activity of this pathway?

**15.** X gas poisoning that has the smell of rotten eggs, is accompanied by tissue respiration disorders, consciousness and can cause instant death.

Name the substance X

Explain the mechanism of toxic action of a substance X in tissue respiration.

What substances have similar mechanism of action to the X on the respiratory chain?

**16.** During poisoning antimycin A patient observed signs of tissue hypoxia due to violation of the mitochondrial respiratory chain.

Explain the mechanism of toxic action antymycin A in tissue respiration.

Should this patient designate ubiquinone for therapeutic purposes?

Introduction of which vitamin can improve tissue respiration under these conditions?

**17.** High resistance of "winter-swimmers" (so-called "walruses") to low temperatures is explained by the 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.

Name this hormon.

How the electrochemical potential does change as a whole and its parts ($\Delta\varphi$ and $\Delta pH$) in the mitochondria at high concentrations of thyroxine?

What is the name of substances with have such effect on the electrochemical potential?

**18.** One of the side effects of prolonged use of antibiotic gramicidin is fever.

Explain the mechanism of pyrogenic action of this antibiotic.

How the electrochemical potential does change as a whole and its parts ($\Delta\varphi$ and $\Delta pH$) in the mitochondria at gramicidin presens?

How gramicidin influence the activity of tissue respiration?

**19.** The patient, who has long suffers from chronic enterocolitis, after drinking milk appeared flatulence, diarrhea, colic.

Lack of which intestine enzyme is the reason?

On what substance and bond this enzyme acts?

Can a patient take cultured milk foods and as so, why?

**20.** Clinical examination of the patient M. revealed presumptive diagnosis: stomach cancer. Lactic acid was found in gastric juice.

What type of glucose catabolism occurs in cancer cells?

Which enzyme involved in the formation of lactate?

Name the reaction that catalyses by this enzyme and its cofactor.

**21.** Scientist and anthropologist who was going in an expedition to South Africa to prevent malaria appointed quinacrine. On the background quinacrine intake hemolytic jaundice appeared of the patient.

What is the reason haemolysis of red blood cells while taking the antimalaria drug?

The formation of which reducing agent violated in a red blood cells?

Which pathway of carbohydrate metabolism provides it?

**22.** After the restoration of blood flow in damaged tissue the accumulation of lactate stops and glucose consumption rate increases.

Activation of which processes are caused by these metabolic shifts?

What are the biochemical mechanisms underlying the Pasteur effect?

What allosteric enzymes (in glycolysis) are inhibited by ATP?

**23.** Chronic glucocorticoid use causes hyperglycemia in patients.

What is the process of carbohydrate metabolism that caused an increase in glucose levels?

What enzyme activity increases under the influence of glucocorticoids?

Which hormone, on the contrary, inhibits this process?

**24.** The 10-month-old child was found mental retardation, liver enlargement, blurred vision. The physician connects these symptoms with congenital enzymopathies and recommends to exclude all dairy products from the diet.

Which enzyme deficiency occurs in a child?

Which reaction does this enzyme catalyzes?

High concentration of what substance in the blood can confirm the diagnosis?

**25.**To determine the cause of hypoglycemia newborn held glucagon test, that caused no increase in blood glucose.

Which way glucagon raises blood glucose level?

Name the possible reasons for the lack hyperglycemic effect of glucagon.

What other biochemical tests allow establish the diagnosis of a child?

**26.** The child has a delay in physical and mental development, deep disorders of the connective tissue of the internal organs, keratan sulfate in the urine is detected.

Metabolism of what compounds is impaired in a child?

What is this disease and the reason for its development.

What is the class of compounds excreted in the urine?

**27.** Inorganic iron is absorbed only in the reduced state, and for that reason the presence of reducing agents will enhance absorption.

What compounds stimulate iron absorption?

The iron in meats is readily absorbed but iron in plants is not as readily absorbed.

Explain why?

Named transport form of iron in the blood

**28.** In obstetric practice for the induction of labor and termination of pregnancy using drugs - derivatives of prostaglandin E2 and F2 (dynoprost etc.).

From what substances are formed prostaglandins?

What  enzymes involved in this?

Which other eicosanoids do you know?

**29.** The patient, who was in the area of radiation injury, increased blood concentrations of malondialdehyde, hydroperoxides.

What is the probable reason for these changes?

What are reactive oxygen species you know?

What are ways of their neutralization?

**30.** The man '35 pheochromocytoma. Blood test revealed elevated levels of catecholamines - adrenalin and noradrenalin, the concentration of free fatty acids increased by 11 times.

Why by these conditions increase the concentration of fatty acids in the blood?

What lipolysis enzyme is hormone-dependent and activated by catecholamines?

How by these conditions will change blood glucose levels?

**31.** In patients with diabetes glucose revenues in adipocytes reduced. In accordance glucose-dependent inhibition of fatty acid mobilization decreases. Last come into the bloodstream and other tissues used them as an energy source.

Deficiency of which hormone causes this condition?

Explain the mechanism of action of this hormone on intracellular lipolysis.

How this hormone dependent enzyme of lipolysis goes from inactive to active form?

**32.** Excessive intake of carbohydrates (600 g / day) in excess of energy needs, a woman in '28 has led to obesity.

Which process activation occurs in these conditions?

What products of carbohydrate catabolism is the metabolic precursors of the biosynthesis of fat?

Which hormone activates lipogenesis?

**33.** A dry cleaner has detected fatty liver disease.

The synthesis of what class of lipids in the liver is suppressed and which increases under these conditions?

How does vitamin like substanes choline acts in lipid metabolism in the liver? Write the structure.

Give examples of substances that prevent fatty liver

**34.** The patient detected hereditary lipoprotein lipase deficiency.

What role in lipid metabolism does lipoprotein lipase play?

Which lipoproteins content will be elevated in these conditions in the blood?

Which classes representative of lipids are the main components of lipoproteins?

**35**. Atherosclerosis is a multifactorial process which caused by dyslipidemia, hypertension and diabetes.

Indicate the dietary factors that can lower the plasma cholesterol and atherogenic lipoprotein levels.

Explain their influence.

Indicate the normal range of plasma cholesterol

**36.** In norm cholesterol is present in high concentrations in bile, being solubilized in micelles. With an increase in the viscosity of bile, gallstone disease (cholelithiasis) develops.

What components of bile keep cholesterol in micelles and prevent formation of cholesterol stones?

Administration of what drugs results in a gradual dissolution of cholesterol gallstones and excretion via the gut?

Why elevation the activity of blood alkaline phosphatase is a marker of blockage of the bile duct or cholestasis?

**37.** Atherosclerosis development (atherogenesis) is a results in a gross disruption of the structure of the arterial wall and the formation of atherosclerotic plaque, which narrows the lumen of the affected artery.

What blood lipoproteins are the most atherogenic? Why?

What blood lipoproteins are the most antiatherogenic? Why?

Which enzyme catalyzes a rate-limiting reaction in cholesterol synthesis? Name its cofactor.

**38.** A man with Zollinger-Ellison syndrome (hypergastrinemia) has peptic ulcers.

Name the functions of gastrin and explain why hypersecretion of gastrin results in peptic ulceration.

Measurement of gastric acid secretion in this man shows the elevated level of basal acid output (BAO). Indicate the normal levels of BAO.

What is MAO? Indicate its normal levels.

**39.** The patient systematically consumes alcohol, had developed swelling. The total protein level in blood plasma is 58 g / l, albumin - 32 g / l, a low content of prothrombin and urea.

Damages of which organs can be suspected in a patient?

What functions of the affected organ are impaired accordingly the test results?

How will the level of ammonia in the blood change?

**40.** A patient with yellow skin was admitted to the infectious department. During the laboratory examination, the content of indirect bilirubin is 52 μmol / l, direct 100 μmol / l, urine the color of "dark beer".

What kind of jaundice does the patient have?

What bile pigments can be found in a patient's urine?

What serum enzymes can confirm liver damage?

**41.** Nitrogen is being excreted from the body mainly as urea. Defects in any of the enzymes of the urea cycle have serious consequences.

Deficiency of which enzyme of the ornithine cycle causes the most severe consequences and occurs with the greatest frequency?

What is the name of this pathology?

What are normal levels of urea in blood serum?

**42.** One of the most common genetic diseases associated with the metabolism of amino acids is phenylketonuria (PKU).

What enzyme deficiency causes PKU?

Name specific tests for the diagnosis of PKU in newborns.

Many children with PKU have light skin color, blond hair and blue eyes. Explain why.

**43.** A 25-year-old man suffers from arthritis. He has brown-black discolouration (ochronosis) in skin and sclerae. His urine becomes brown-dark on standing.

Name this inherited disease.

What enzyme is defective?

What reaction does this enzyme catalyze?

**44.** A baby has maple syrup urine disease. The urine smells like maple syrup or burnt sugar. The disease results in acidosis, convulsions, lethargy, mental retardation.

What enzyme is defective?

What reaction does this enzyme catalyze?

Explain the mechanisms of the development of acidosis and CNS dysfunction by this inherited disease.

**45.** DNA denaturation - is a violation of its native conformation to form single-stranded disordered molecules.

What structure of DNA stored after denaturation?

What bonds involved in the formation of DNA single chain?

Which proteins are providing stability for DNA molecules?

**46.** The 19-month-old baby detected retardation, spasticity, impulsive behavior, auto aggression (with causing damage to itself). The content of uric acid in the blood - 1.96 mmol / L.

Name this inherited disease.

Which enzyme deficiency occurs in a child?

What is the normal level of uric acid in the blood?

**47.** The patient was diagnosed with pneumonia doctor prescribed antibacterial drag (macrolides group) - azithromycin.

Inhibitor of which matrix process in bacterial cells is azithromycin?

Explain the mechanism of action of antibiotic azithromycin.

Give examples of antibacterial drugs with similar mechanism of action of azithromycin.

**48.** In patients with diphtheria occurs typical lesions of the mucous membrane of the upper respiratory tract, due to the action of diphtheria toxin.

What stage of realization of genetic information in the epithelium of the upper respiratory tract diphtheria toxin inhibits?

What is the molecular mechanism underlying its cytotoxic action?

What epithelial cells coenzyme destroys the diphtheria toxin?

**49**. Diabetics prescribed hormone replacement therapy with insulin

How does insulin affect carbohydrate metabolism?

What is the chemical nature of the hormone?

How is insulin secretion regulated normally?

**50.** The patient 20 years (no pregnancy) was admitted to the hospital complaining of occurrence milk in the breast (galactorrhoea) and the absence of menstruation for 6 months, strong headaches.

Increased synthesis and secretion of which hormone is observed in this disease?

To which group of adenohypophysis hormones it belongs?

What is the name of this pathology.

**51.** The patient was found hypernatremia, hypokalemia, increase in osmotic blood pressure, swelling.

With the increase secretion of which hormone this pathology is related ?

Name this hormone of the adrenal cortex, its chemical nature and mechanism of action

What is the name of this pathology?

**52.** In 6 years old boy suffering from convulsions found hypocalcaemia, hyperphosphatemia, hypophosphaturia.

With the lack of what hormone synthesis it related?

What is the name of this disease?

Introduction of which substances reduce the manifestations of this disease?

**53.** A patient 20 years entered the endocrinological clinic, diagnosed with diabetes type I.

The lack of which hormone synthesis related to this pathology?

Is it appropriate to define the content of insulin in the blood of the patient?

Content of which substance in the blood indicates the activity of insulin synthesis?

**54.** For the 60 years patient with thrombosis of lower extremities, doctor appointed Fenilin (group of coumarins).

Explain the mechanism of action of this drug

For which vitamin this drug as antivitamin?

What are the reason that can cause vitamin deficiency of this vitamin?

**55**. The deficiency of vitamine B12 in adults is manifested by a specific form of anemia and neurological disorders.

Indicate the possible causes of B12 deficiency.

Explain why the strict vegetarians (vegans) are at risk of developing B12 deficiency.

Why are the hemopoietic problems associated with a B12 deficiency identical to those observed in a folate deficiency?

**56.** A general thiamine deficiency is often associated with chronic alcoholism and is manifested as encephalo-cardiopathy.

What is the name of this syndrome?

What metabolic process is disturbed?

Indicate the enzymes and cofactors of this process

**57.** Vitamin K is the cofactor for the carboxylation of glutamate residues in the post-translational modification of proteins to form γ-carboxyglutamate, which chelates the calcium ion.

Explain why γ-carboxyglutamate binds easily ion $Ca^{2+}$.

Name 4 proteins of the blood clotting system that need vitamin K-dependent carboxylation for their activation.

Where are they synthesized and carboxylated?

**58.** Derivatives of vitamin A (retinoic acid) and D (calcitriol), like as steroid hormones, take part in the regulation of gene expression.

Where in the cell are their receptors located?

Indicate the mechanism of their action.

Give the examples of corresponding proteins that are induced by retinoic acid and calcitriol.

**57.** The results of biochemical analysis of women: serum copper level - 8 μmol/L (normal range 13-19 μmol/L [80-120 μg/dL]), urinary excretion of copper - 2.2 mmol/24 h (normal range 2-3.9 μmol/24 h [13-25 μg/dL]), and a liver biopsy established the diagnosis of Wilson's disease.

Genetic defect in the synthesis of which protein (enzyme) leads to Wilson's disease?

What other functions does this protein perform?

Explain why excessive amounts of copper accumulate in liver and brain that lead to their damage.

**58.** Severe diarrhea is one of the most common causes of death in young children. One of the principal effects of diarrhea is the excretion of large quantities of sodium bicarbonate.

In which direction does the bicarbonate buffer system shift under diarrhea?

How is the resulting condition called?

What will be the exchange of water between the circulating fluid and the tissue fluid?

**59.** A 44-year-old woman was admitted to hospital because of weakness, anorexia, recurrent infections, bilateral leg edema, and breathlessness. Her plasma albumin concentration was 19 g/L and her urinary protein excretion 10 g/24 h (normal value <0.15 g/24 h). There was microscopic haematuria. Renal biopsy confirmed the diagnosis as glomerulonephritis.

Indicate the change of plasma albumin level.

What are normal levels of albumin in plasma?

Explain the mechanisms of the development of proteinuria and edema.

**60.** The patient have hemorrhagic stroke. In the blood found increased concentration of kinins. The doctor assigned to the patient contrykal (protease inhibitor).

For inhibition of which proteases was made this appointment?

From what blood protein produced kinins?

What is biological role of kinins, give examples?

**61.** When porphyrinogens accumulate, they may be converted by sunlight to porphyrins, which react with molecular oxygen to form oxygen radicals. These radicals may cause severe damage to the skin. Thus, individuals with excessive production of porphyrins are photosensitive.

The synthesis of which substance is violated?

What enzyme deficiency of this synthesis does not lead to photosensitivity, but causes abdominal pain and neuropsychiatric symptoms?

What is the name of this disease??

**62.** A massive rise in the plasma bilirubin in infants occurs in the Crigler-Najjar syndrome. If its concentration exceeds approximately 340 μmol/L (20 mg/dL) in infants, bilirubin uptake into the brain may cause severe, irreversible brain damage (kernicterus).

What form of bilirubin accumulates?

What possible mechanisms of bilirubin toxic action on the brain?

Explain why hyperbilirubinemia in jaundiced babies can be decreased by exposure to blue light (phototherapy) and by administration of phenobarbital.

**63.** A woman of 40 years old, who suffered from cholelithiasis, experienced acute pain in the right hypochondrium. After 2 days, jaundice appeared, urine - the color of "dark beer", feces gray-white. The total serum bilirubin is 100 μmol / l, the Florence test (urine urobilin) is negative.

What type of jaundice does the patient have?

What fraction of blood bilirubin is increased in this condition?

What is the normal levels of total bilirubin?

**64.** A patient in the depressive phase of manic-depressive psychosis (MDP) was treated with monoamine oxidase (MAO) inhibitors. After eating soaked apples and sauerkraut - salivation, loss of consciousness, respiratory and cardiac disorders.

What substances caused the poisoning?

As a result of what reactions they formed?

Why a decrease in MAO activity can cause the development of a pathological condition?

**65.** The hemoproteins referred to as cytochrome P450 are so named because of the complexes they form with carbon monoxide. In the presence of CO, light is strongly absorbed at a wavelength of 450 nm.

Where in the cell are cytochromes P450 located?

What other cytochromes are present in the cell?

Indicate the likeness and difference of cytochrome P450 and mitochondrial cytochrome oxidase.

**66.** Paracetamol, which is widely used as an antipyretic, partially transforms into N-acetyl para-benzoquinoneimine, which is direct hepatotoxin and causes centrilobular necrosis of the liver as a result of biotransformation.

What is called the increase in xenobiotic toxicity during biotransformation?

Under what conditions can the toxic effect of paracetamol appear?

What should the patient be warned about when prescribing paracetamol?

**67**. A doctor prescribed an anti-tuberculosis drug, isoniazid, to a patient with pulmonary tuberculosis.

What metabolic transformations can be associated with its side effects?

Who is called slow and fast acetylators?

What biomedical significance does this phenomenon have?

**68.** Water and electrolyte disturbances may result from an imbalance between the intake of fluids and electrolytes and their loss through either renal or extrarenal routes, a movement of water and electrolytes between body compartments, or both. A decreased sodium concentration (hyponatremia) usually indicates that the extracellular fluid is being 'diluted', whereas an increasing sodium concentration means that the extracellular fluid is being 'concentrated'.

Indicate the causes of hyponatremia.

Indicate the causes of hypernatremia.

What are normal levels sodium in blood?

**69.** Metabolic processes in the kidneys have their own characteristics

Oxygen consumption in the kidneys is high: it approximately equals that of the cardiac muscle, and is three times greater than that of the brain. Why?

Compare the pathways of glucose catabolism in the kidney cortex and medulla.

Indicate the main energy substrates that are used in the renal cortex?

**70.** Metabolic processes in the kidneys have their own characteristics

Indicate the main energy substrates that are used in the renal cortex.

Renal tubular cells contain a high activity of enzymes glutaminase and glutamate dehydrogenase. Why?

Renal tubular cells contain a high activity of enzyme carbonic anhydrase. What reaction does this enzyme catalyze?

**71.** There are three isoenzymes of creatine kinase (CK): CK-MM, CK-MB, CK-BB. The CK normally present in plasma is mainly the CK-MM. What changes are specific for:

Skeletal muscle diseases, for example polymyositis, rhabdomyolysis, Duchenne muscular dystrophy;

Myocardial infarction (MI) and other heart diseases?

Where is CK-BB present?

**72.** Sensitive early indicators of cardiac damage are myoglobin and troponins. Concentration of cardiac-specific troponin isoform in plasma increases within a few hours after a heart attack, peaks at up to 300 times normal plasma concentration, and may remain elevated for 1-2 weeks.

What isoform of troponin is specific for an adult myocardium?

What other enzyme activity increases in the first hours after a heart attack?

Explain why high level of myoglobin in plasma has not diagnostic significance but if myoglobin is not elevated within 2-6 hours after the onset of symptoms, MI did not occur.

**73**. Ethanol in small quantities is synthesized in the human body, but when it is consumed, a dose-dependent toxic effect occurs.

Which organ is central to alcohol metabolism?

Which enzymes are involved in the biotransformation of alcohols?

In the metabolism of which of the vitamins it is involved?

**74.** Parkinson’s disease is a movement disorder caused by damage to brain structures called the basal ganglia and substantia nigra.

What neurotransmitter deficiency is associated with this disease?

What amino acid derivative is it?

What enzyme catalyzes this reaction?

**75.** In patients with Lesch-Nyhan syndrome, the severity of the condition is associated with a degree of hyperuricemia

What enzyme deficiency causes this disease?

Metabolism of which substance is disturbed in Lesch-Nyhan syndrome?

What is the normal level of uric acid in the blood?