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ZAPORIZHZHIA STATE MEDICAL AND PHARMACEUTICAL UNIVERSITY  
DEPARTMENT OF BIOLOGICAL CHEMISTRY

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***BIOCHEMISTRY***

SECTION 2

MOLECULAR BIOLOGY. BIOCHEMISTRY OF INTERCELLULAR  
COMMUNICATIONS, TISSUES AND PHYSIOLOGICAL FUNCTIONS

TESTS

for students of the second year study  
speciality 222 "Medicine"

Zaporizhzhia

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*and it is recommended for the use in educational process for foreign students*

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This manual is recommended to use for students of II International faculty (the second year of study) for independent work in Biochemistry discipline at home and in class.

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## INTRODUCTION

“Biochemistry: tests. Section 2. Molecular Biology. Biochemistry of intercellular communications, tissues and physiological functions: for students of the second year study, speciality 222 "Medicine" was compiled by the teachers of Biochemistry department for the use by foreign students of the 2nd course of International faculty studying Biochemistry in English. This collection contains various test tasks for all topics of Section 2 of the work program to study discipline "Biological Chemistry" speciality "Medicine". It may be used by students in independent work during preparation for each of the classes (tests are divided by classes), to control the mastery of basic themes and to the final control of mastery of Section 2.

With the help of the test material, students have the opportunity to master the topic they are studying in more depth, to self-monitor, in case of identifying questions that are unclear for the student, to ask the teacher for help in a practical session. As a result of this form of work, the student is well prepared for the final control of Section 2, for the comprehensive exam and for the license exam "KROK 1".

The content of the manual corresponds to the work program of the discipline "Biological Chemistry" study for the preparation of masters of speciality 222 "Medicine" and covers all topics of section 2.

BASIC THEME 7. EXCHANGE OF NUCLEOPROTEINS AND CHROMOPROTEINS. FUNDAMENTALS OF MOLECULAR BIOLOGY AND GENETICS

**Topic 1. Nucleoproteins, nucleic acids and nucleotides: structure and functions in humans. Biological membranes**

1. Name organic compounds which may be used for the purine nucleotide structure creation:

- A. Erythrose-5-phosphate
- B. Fructose
- C. Uracil
- D. Guanine
- E. Thymine

2. Name organic compounds formed after cleavage of N-glycosidic bond in deoxythymidine-5'-monophosphate:

- A. Thymine and ribose
- B. Thymine, deoxyribose and phosphoric acid
- C. Thymine and deoxyribose
- D. Thymine and deoxyribose-5'-phosphate
- E. Thymidine and phosphoric acid

3. Name the processes which are in need for the participator DNA molecule:

- A. Translation
- B. Post-transcriptional processing
- C. Replication
- D. Splicing
- E. Post-translational modification

4. NAD structure may be synthesized from initial substrate – special amino acid.

Name it:

- A. Tryptophan
- B. Phenylalanine
- C. Tyrosine

- D. Two amino acids are in need: tryptophan and tyrosine
- E. Glycine
5. cAMP is special nucleotide produced by adenylate cyclase to be secondary messenger for hormone action in the intracellular space of target cell. Name the substrate for adenylate cyclase:
- A. Adenosine triphosphate
  - B. Guanosine triphosphate
  - C. Adenosine monophosphate
  - D. Cytidine triphosphate
  - E. Adenosine diphosphate
6. Find the nucleotides which are found in function as allosteric regulators for enzymes with trivial name "Protein kinases":
- A. UTP, CTP and ATP, only
  - B. cAMP, cGMP, ATP, ADP, AMP
  - C. cAMP, cGMP, only
  - D. NADH, NADPH and ATP, only
  - E. ADP, AMP, only
7. Name cellular membrane protein with function to be transporter for some molecules and ions:
- A. Adenylate cyclase
  - B. Na<sup>+</sup>, K<sup>+</sup>-ATPase
  - C. Phospholipase C
  - D. Protein kinase A
  - E. Guanylate cyclase
8. t-RNA molecule is in need to transfer amino-acid residue to the site of protein synthesis in a cell. The linkage of amino acyl to t-RNA is due to special triplet in t-RNA structure. Name it:
- A. AAA triplet
  - B. GGA triplet
  - C. CCA triplet

D. AUG triplet

E. UUC triplet

9. Find out lipids used for the formation of cellular membrane:

A. Cholesterol

B. Phosphatidyl choline

C. Phosphatidyl ethanol amine

D. Phosphatidyl serine

E. All positions are correct

10. The increase of unsaturated fatty acid residues number in phospholipids creating the membrane will cause:

A. The increase of fluidity of membrane

B. The decrease of fluidity of membrane

C. The increase of instability of membrane

D. The decrease of penetration rate for molecules across the membrane

E. Nothing is changed

11. Name organic compounds which may be used for the pyrimidine nucleotide structure creation:

A. Ribulose-5-phosphate

B. Deoxyribose-2-phosphate

C. Adenine

D. Guanine

E. Thymine

12. Name the processes which are in need for the use of messenger RNA molecule:

A. Translation and transcription

B. Translation, only

C. Transcription, only

D. Transcription and processing

E. Replication, only

13. Find a nucleotide which is used in the cell as non-protein part of enzymes, mainly:



- A. Biotin
- B. Haem
- C. Pyridoxal phosphate
- D. NADPH
- E. cAMP

14. The phosphorylation of organic compound is in need the donor of phosphate group. Name the most probable donor of this group in any type of cell:

- A. ADP
- B. TTP
- C. GDP
- D. ATP
- E. AMP

15. All the types of ribonucleic acids are involved in protein synthesis but only one among proposed is involved in splicing process. Name it:

- A. t-RNA
- B. m-RNA
- C. r-RNA
- D. sn-RNA
- E. DNA

16. Name the lipid that is not present in the inner membrane of mitochondria:

- A. Phosphatidyl inositol
- B. Phosphatidyl choline
- C. Phosphatidyl ethanol amine
- D. Cholesterol
- E. Phosphatidyl serine

17. The increase of cholesterol content in the cellular membrane will cause:

- A. The increase of fluidity of membrane
- B. The decrease of fluidity of membrane
- C. The increase of mobility of membrane components
- D. The increase of penetration rate for molecules across the membrane

E. Nothing is changed

18. Point out the type of the bond, which stabilizes the primary structure of nucleic acid:

A. Hydrogen

B. Disulfide

C. Peptide

D. Phosphodiester

E. Van-der-Waal's forces

19. Point the type of bonds that stabilizes the DNA double helix and are formed between the complementary nitrogenous bases:

A. Phosphodiester

B. Hydrophobic

C. Hydrogen

D. Peptide

E. Disulfide

20. Nucleic acids have acidic properties due to the presence of residues in their structure like:

A. Adenosine

B. Guanine

C. Deoxyribose

D. Ribose

E. Phosphoric acid

21. Point out the role of proteins located in the cellular membrane:

A. To be receptor for hormone

B. Ion transport channel

C. Enzyme

D. Glucose transport channel

E. All the positions are right

22. In a human genome project scientists notice, that one strand of the DNA molecule contains 20 thymine (T), 25 cytosine (C), 30 guanine (G) and 22 adenine

(A) residues. How many of each of the bases is found in complete double-stranded molecule

A. T=44, C=60, G=50, A=40

B. T=22, C=30, G=25, A=20

C. T=40, C=50, G=60, A=44

D. T=42, C=55, G=55, A=42

E. T=42, C=50, G=60, A=42

23. Which of the following membrane has the highest protein content per gram tissue:

A. Inner mitochondrial membrane

B. Outer mitochondrial membrane

C. Plasma membrane

D. Myelin sheath

E. Nuclear membrane

24. Membrane fluidity is increased by increased content of:

A. Stearic acid

B. Palmitic acid

C. Cholesterol

D. Linoleic acid

E. Lauric acid

25. The basic protein, which functions in the packaging of DNA in chromosomes, is:

A. Histone

B. Collagen type I

C. Collagen type V

D. Hyaluronic acid binding protein

E. Fibrinogen

26. Chargaff rule states that:

A.  $A+G=T+C$

B.  $A/T=G/C$

C.  $A=U=T=G=C$

D.  $A+T=G+C$

E. None of the above

27. Triple hydrogen bonds are found between which base pairs:

A. A-T

B. C-G

C. A-G

D. C-T

E. C-U

28. The major driving force for the formation of membrane bilayer is:

A. Hydrogen bond

B. Van der Waals forces

C. Hydrophobic interactions

D. All proposed

E. Electrostatic attractions

29. Biological membrane contains all the following except

A. Steroid receptors

B. Cholesterol

C. Prostaglandins

D. Cytochrome P450

E.  $\text{Na}^+/\text{K}^+$  - ATPase

30. At the physiological pH the DNA molecules are:

A. Positively charged

B. Negatively charged

C. Neutral

D. Amphipathic

E. Uncharged

31. Which of the following is responsible for increasing the fluidity of the membrane:

A. Stearic acid

- B. Palmitic acid
  - C. Linoleic acid
  - D. Cholesterol
  - E. Cholesterol ester
32. Choose the correct definition of the term “modified base”:
- A. Purine or pyrimidine attached to deoxyribose
  - B. Purine or pyrimidine attached to ribose
  - C. A purine or pyrimidine that has been altered
  - D. A nitrogen containing ring other than a purine or pyrimidine that is part of a nucleotide
  - E. A purine or pyrimidine attached to a sugar by O-glycoside linkage
33. Which one of the following is the complementary sequence of 5'-TTAAGCTAC-3'?:
- A. 5'GTAGCTTAA3'
  - B. 5'AATTCGCATG3'
  - C. 5'CATGCGAATT3'
  - D. 5'TTAAGCGTAC3'
  - E. 5'CCGGATCGT3'
34. Name nucleotides which are main energy sources for protein synthesis promotion as energy sources^
- A. ATP, UTP
  - B. ATP only
  - C. ATP, GTP
  - D. ATP, CTP
  - E. CTP, UTP
35. Name the nucleotide that is very important participator of synthetic pathways in human organism such as: fatty acid synthesis, cholesterol synthesis, steroidal hormones synthesis, etc.:
- A. NADPH
  - B. NAD+

C. NADH

D. FAD

E. FMN

**Topic 2. The metabolism of purine and pyrimidine nucleotides. The disorders of nucleotide metabolism**

1. Choose the correct sequence of the appearance of intermediates in the degradation of adenosine:

A. Adenosine --> hypoxanthine --> xanthine --> inosine --> uric acid

B. Adenosine --> inosine --> hypoxanthine --> xanthine --> uric acid

C. Adenosine --> adenine --> inosine --> xanthine --> uric acid

D. Adenosine --> xanthosine --> hypoxanthine --> xanthine --> uric acid

E. Adenosine --> uric acid --> xanthine --> inosine --> hypoxanthine

2. Which of the following compounds **may be not** used in the conversion of ribonucleotide to deoxyribonucleotide?

A. Ribonucleotide reductase

B. Thioredoxin

C. NADPH

D. ATP

E. ADP

3. Which of the following compounds contributes to the structure of **both** purine and all pyrimidine nitrogenous bases during nucleotide biosynthesis?

A. Aspartic acid

B. Methylene-THF

C. Carbamoyl phosphate

D. Glycine

E. Phosphoribosyl pyrophosphate (PRPP)

4. Two enzymatic activities are supplied by two domains of a single protein. A defect in this bifunctional enzyme causes orotic aciduria. Choose the correct name for these domains:

- A. Carbamoyl phosphate synthase II & aspartate transcarbamoylase
  - B. Dihydroorotase & dihydroorotate dehydrogenase
  - C. Orotate phosphoribosyltransferase & orotidine monophosphate decarboxylase
  - D. Phosphoribosyl pyrophosphate (PRPP) synthase & PRPP glutamyl amidotransferase
  - E. Adenosine deaminase & xanthine oxidase
5. Lesch-Nyhan syndrome is due to the complete deficiency in hypoxanthine guanine phosphoribosyl transferase (HGPRTase) and as result impossibility to produce certain product. Point out it:
- A. Urea
  - B. Uric acid
  - C. GMP
  - D. AMP
  - E. Phosphoribosyl pyrophosphate (PRPP)
6. Which of the following nucleotides **does not** undergo a ring deamination during catabolism?
- A. GMP
  - B. AMP
  - C. CMP
  - D. ATP
  - E. UMP
7. The first purine nucleotide that is formed de novo in metabolism is:
- A. IMP
  - B. AMP
  - C. GMP
  - D. XMP
  - E. ADP
8. The regulatory enzyme in the pyrimidine synthesis in animals is:
- A. Aspartate transcarbamoylase
  - B. Carbamoyl phosphate synthase II

- C. Dihydroorotase
  - D. Dihydroorotate dehydrogenase
  - E. Orotate phosphoribosyltransferase
9. The purine nucleotide synthesis is well coordinated to meet the cellular demands. Which intermediate concentration regulates purine synthesis to a large extent?
- A. AMP
  - B. GMP
  - C. Carbamoyl phosphate
  - D. Thioredoxin
  - E. Phosphoribosyl pyrophosphate (PRPP)
10. Choose the end product of purine catabolism in humans:
- A. Urea
  - B. Uric acid
  - C. Xanthine
  - D. Beta-alanine
  - E. Beta-aminoisobutyrate
11. Choose the correct sequence of intermediates appearance in the degradation of guanosine:
- A. Guanosine --> hypoxanthine --> xanthine --> uric acid
  - B. Guanosine --> inosine --> hypoxanthine --> xanthine --> uric acid
  - C. Guanosine --> guanine --> xanthine --> uric acid
  - D. Guanosine--> xanthozine --> hypoxanthine -->uric acid
  - E. Guanosine --> uric acid --> xanthozine --> hypoxanthine
12. Complete this analogy: "According their structure norepinephrine is related to epinephrine as uracil is done to...:
- A. Cytosine
  - B. Beta-alanine
  - C. Xanthine
  - D. Thymine
  - E. Orotic Acid



13. Which of the following amino acids **is not** used during nucleotide biosynthesis?
- A. Glutamine
  - B. Tyrosine
  - C. Aspartate
  - D. Glycine
  - E. All positions are correct
14. Choose the correct characteristic for hypoxanthine guanine phosphoribosyl transferase:
- A. It is utilized in the synthesis of the purine ring
  - B. It converts hypoxanthine to guanine
  - C. It is required for the conversion of guanine and hypoxanthine to GMP and IMP due to "salvage pathway"
  - D. It is inhibited by methotrexate
  - E. It is required to convert purines to uric acid
15. The Gout is characterized by elevated uric acid concentrations in blood and urine due to a variety of metabolic abnormalities that lead to the overproduction of purine nucleotides. Allopurinol is used in the treatment of the gout because this drug, and its metabolic product, alloxanthine, act as inhibitors of:
- A. Xanthine oxidase
  - B. Phosphoribosyl pyrophosphate (PRPP) synthase
  - C. Adenyl succinate synthase
  - D. Hypoxanthine-guanine phosphoribosyl transferase
  - E. PRPP glutamyl amidotransferase
16. Both the salvage and de novo synthesis pathways of purine and pyrimidine nucleotides lead to the production of nucleoside-5'-monophosphates through the utilization of an activated sugar. Point out the activated sugar intermediate used for this purpose:
- A. Glucose 6-phosphate
  - B. Ribose 5-phosphate
  - C. Deoxyribosyl 5-pyrophosphate

D. 5-Phosphoribosyl- 1-pyrophosphate

E. Ribosyl- 1-pyrophosphate

17. Three amino acids that donate amine groups for the purine biosynthesis are:

A. Lysine, glutamine, aspartate

B. Lysine, glutamate, asparagine

C. Lysine, glycine, asparagine

D. Glycine, alanine, aspartate

E. Glycine, glutamine, aspartate

18. Hereditary orotic aciduria is characterized by severe anemia, growth retardation, and high levels of orotic acid excretion. It is produced by deficit of enzymes related with:

A. Synthesis of pyrimidine nucleotides

B. Catabolism of pyrimidine nucleotides

C. Synthesis of purine nucleotides

D. Catabolism of purine nucleotides

E. Synthesis of Haem

19. All the following enzymes defects are associated with primary gout development **except** one. Point out it:

A. Phosphoribosyl pyrophosphate (PRPP) synthase

B. PRPP glutamyl amidotransferase

C. Carbamoyl phosphate synthase II

D. Hypoxanthine guanine phosphoribosyl transferase

E. Glucose 6-phosphatase

20. Choose the end product(s) of pyrimidine degradation in humans:

A. Uric acid

B. Xanthine

C. Orotate

D. Uracil

E. Urea, CO<sub>2</sub>, H<sub>2</sub>O

21. Choose a nucleoside related to purines:

A. Deoxythymidine

B. Cytidine

C. Adenine

D. Guanosine

E. Uridine

22. Point the main organic compounds formed in the small intestine after nucleic acid digestion:

A. Dinucleotides

B. Mononucleoside triphosphates

C. Nucleosides

D. Mononucleoside monophosphates

E. Amino acids

23. Choose the enzyme class that takes part in the removal of pentose sugar fragment from guanosine:

A. Transferases

B. Lyases

C. Hydrolases

D. Ligases

E. Oxidoreductases

24. The end product of purine nucleoside catabolic pathway in human organism is:

A. Beta-alanine

B. Beta-aminoisobutyric acid

C. Uric acid

D. Oxaloacetate

E. Pyruvate

25. Choose the intermediate metabolite of purine nucleotide degradation used in the salvage pathway:

A. PRPP

B. Hypoxanthine

C. Adenylic acid

D. Phosphoribosylamine

E. Imidazole

26. Point the amino acid used both in AMP and UMP de novo synthesis:

A. Glutamic acid

B. Aspartic acid

C. Serine

D. Inosinic acid

E. Alanine

27. Choose the vitamin that is actively used in the purine and pyrimidine nucleotide de novo syntheses:

A. Pangamic acid

B. Ascorbic acid

C. Pantothenic acid

D. Folic acid

E. Linolenic acid

28. Two carbon atoms and the nitrogen one of the imidazole fragment in purine base skeleton are got from only one amino acid in the de novo synthesis. Name it:

A. Glutamic acid

B. Aspartic acid

C. Glycine

D. Folic acid

E. Asparagine

29. The pyrimidine nucleotide synthesis features are all right except:

A. Synthesis starts with the aspartic acid

B. The initial substrate (carbamoyl phosphate) may be formed from glutamine, CO<sub>2</sub> with ATP use

C. Phosphoribosyl pyrophosphate is used

D. All the UMP nitrogen atoms are got from ammonia molecules

E. Carbamoyl-phosphate synthase II is activated by PRPP

30. The pyrimidine nucleotide UMP degradation end product in human organism is:

- A. Beta-alanine
- B. Beta-aminoisobutyric acid
- C. Aspartic acid
- D. Inosinic acid
- E. Uric acid

31. A doctor administered allopurinol to a 26-year-old young man with the symptoms of gout. What pharmacological action of allopurinol ensures the effect in treatment?

- A. By inhibiting of uric acid formation
- B. By general analgetic effect
- C. By increasing of uric acid excretion
- D. By general anti-inflammatory effect
- E. By inhibiting of leucocyte migration into the joint

32. A 42-year-old man suffering from the gout has increased level of uric acid in blood. Allopurinol was prescribed to decrease the level of uric acid. It competes with this substrate to be in linkage at active site of xanthine oxidase:

- A. Adenosine
- B. Hypoxanthine
- C. Inosine
- D. Guanine
- E. Orotic acid

33. Point the index, whose concentration is determined in the blood plasma of patients with the gout:

- A. Urea
- B. Uric acid
- C.  $\alpha$ -Alanine
- D.  $\beta$ -Alanine
- E.  $\beta$ -Aminoisobutyric acid

34. The gout is developed in patients when the activity of certain enzyme of purine nucleotide de novo synthesis is higher (genetic defect of enzyme), then normal. Point out it:

- A. Adenyl succinate lyase
- B. PRPP aminotransferase
- C. Adenylate cyclase
- D. Adenylic acid deaminase
- E. 5'-nucleotidase

35. An oncological patient was administered methotrexate. With the lapse of time the target cells of the tumour lost sensitivity to the preparation. We can observe changes in the gene expression of the following enzyme:

- A. Dihydrofolate reductase
- B. Folate decarboxylase
- C. Folate oxidase
- D. Desaminase
- E. Thiaminase

36. Increased serum uric acid levels occur at:

- A. Von Gierke`s disease
- B. Leukemia
- C. Disturbances of PRPP synthetase regulation
- D. Lesh-Nyhan syndrome
- E. All the proposed

### **Topic 3. Biosynthesis of nucleic acids**

1. Which of the following statements is **incorrect** concerning replication?

- A. It is a process in which DNA is copied to produce identical daughter molecule of DNA
- B. It is semiconservative in humans
- C. It is bidirectional
- D. It requires RNA primer

- E. It requires RNA polymerase III which binds to the promoter region of DNA
2. Transcription in eukaryotes requires certain enzymes. Which enzyme **is not** related to this process?
- A. RNA polymerase I
  - B. RNA polymerase II
  - C. RNA polymerase III
  - D. Primase
  - E. Ter-binding protein
3. Point out the main substrates for the replication:
- A. ATP, GTP, TTP, CTP
  - B. ADP, GDP, TDP, CDP
  - C. dATP, dGTP, dTTP, dCTP
  - D. dATP, dGTP, dUTP, dCTP
  - E. dADP, dGDP, dTDP, dCDP
4. Thymine-thymine dimers may be formed under ultraviolet light exposure and may result in the block the DNA replication. Choose the enzyme participating in the reparation of this damage:
- A. UV specific endonuclease
  - B. UV specific exonuclease
  - C. UV sensitive DNA polymerase
  - D. UV sensitive RNA polymerase
  - E. UV dependent reparate
5. Choose the chemical nature of the primer required for the synthesis of DNA:
- A. Neutral fat
  - B. Olygosaccharide
  - C. Polypeptide
  - D. Olygoribonucleotide
  - E. Olygodeoxyribonucleotide
6. Retroviruses possess RNA as genetic material. They use a special enzyme for formation of DNA from RNA. Name the enzyme:

- A. RNA polymerase III
- B. Primase
- C. Reverse transcriptase
- D. Topoisomerases
- E. DNA ligase

7. Which of the following enzymes catalyzes the formation of phosphodiester bond between the adjoining Okazaki fragments?

- A. RNA polymerase III
- B. Primase
- C. DNA polymerase III
- D. DNA ligase
- E. DNA polymerase I

8. Point out the specific protein which can bind to the growing RNA, terminate transcription and release RNA:

- A. RNA polymerase III
- B. RNA polymerase II
- C. RNA polymerase I
- D. DNA polymerase III
- E.  $\rho$  (rho) factor

9. Point out an inhibitor of transcription:

- A. Rifampin
- B. Methotrexate
- C. ATP
- D. GTP
- E. Allopurinol

10. Which of following descriptions is not correct for promoter:

- A. A promoter is a region of DNA that facilitates the transcription of a particular gene
- B. A promoter is typically located near the gene that will be transcribed
- C. A promoter is recognized by RNA polymerase



D. A promoter represents critical elements that can work in concert with other regulatory regions (enhancers, silencers etc) to direct the level of transcription of a given gene

E. A promoter stops the transcription by formation of hairpins of newly synthesized RNA.

11. Which of the following statements is **incorrect** concerning transcription?

A. It is the process of creating an equivalent RNA copy of a sequence of DNA

B. It is carried out in 3 stages: initiation, elongation and termination

C. It requires DNA primer and enzyme primase

D. It proceeds in 5'-3' direction

E. It is stopped by the termination signals

12. Replication requires certain enzymes. Which enzyme **is not** related to this process?

A. Helicase

B. Primase

C.  $\rho$  (rho) factor

D. DNA polymerase III

E. Topoisomerase

13. Point out the substrates for transcription:

A. ATP, GTP, UTP, CTP

B. ADP, GDP, TDP, CDP

C. dATP, dGTP, dTTP, dCTP

D. dATP, dGTP, dUTP, dCTP

E. dADP, dGDP, dTDP, dCDP

14. There are four different types of damages to DNA. Which of the following cases are not attributable to DNA damage?

A. Single base alteration

B. Two base alteration

C. Chain breaks

D. Splicing

E. Cross-links

15. Not all portions of m-RNA code for polypeptide. Which part of **m-RNA** is **never** translated into protein?

- A. The 5'-leader sequence
- B. Transcribed cistron
- C. Codon
- D. Exons
- E. All positions placed above except D

16. Choose the name for the small fragments of DNA produced during replication:

- A. Primer
- B. Okazaki fragment
- C. Polyadenylate tail
- D. Promoter
- E. Watson fragment

17. The transcription may be stopped by the formation of hairpins of newly synthesized RNA. This occurs due to the presence of palindromes in the DNA template. Point out a palindrome among placed hereunder:

- A. 5'--AGCCCGC-----TCGGGCG-3'  
3'--TCGGGCG-----AGCCCGC-5'
- B. 5'--AGCCCGC-----CGCCCGA-3'  
3'--TCGGGCG-----GCGGGCA-5'
- C. 5'--AGCCCGC-----GCGGGCT-3'  
3'--TCGGGCG-----CGCCCGA-5'
- D. 5'--AAAAAAA-----GGGGGGG-3'  
3'--TTTTTTT-----CCCCCCC-5'
- E. 5'--AGCCCGC-----GCGGGCT-3'  
3'--CGCCCGA-----TCGGGCG -5'

18. DNA strands are separated by certain enzyme for replication process. Choose the enzyme:

- A. Helicase

- B. Primase
  - C. DNA polymerase I
  - D. DNA polymerase III
  - E. Topoisomerase
19. All the descriptions relating to post-transcriptional processing of pre-mRNA hereunder are correct **except one**. Choose it:
- A. The 5' end of pre-mRNA is capped with 7-methylguanosine
  - B. Thymine-thymine dimers are formed to protect mRNA against nucleases
  - C. Polyadenylate tail is added to stabilize mRNA
  - D. Introns are excised from the pre-mRNA
  - E. Exons are connected to re-form a single continuous molecule
20. A genetic disorder caused by a defect in DNA reparation is called:
- A. Gout
  - B. Xeroderma pigmentosum
  - C. Xanthinuria
  - D. Lesch-Nyhan syndrome
  - E. Von Gierke's disease
21. Choose the type of bonds formed during the processes of replication and transcription:
- A. Peptide
  - B. Hydrogen
  - C. N-glycoside
  - D. 3', 5'- phosphodiester
  - E. Disulfide
22. The complimentary nature of pairs A - T; G - C is determined by:
- A. The similarity of each couple structure
  - B. The capability to form the hydrogen bonds between them
  - C. The equal concentration of A=T; G=C
  - D. The capability to form glycoside bonds between them
  - E. The capability to form covalent bonds between them

23. Choose the type of ribonucleic acid whose polynucleotide chain formation is without post-transcriptional processing in prokaryotes:

- A. DNA
- B. rRNA
- C. mRNA
- D. tRNA
- E. dATP

24. Choose the name of enzyme needed for unwinding of double helix of DNA into two templates at the initiation of replication:

- A. DNA- endonuclease
- B. Helicase
- C. DNA nuclease
- D. DNA-RNA polymerase
- E. Primase

25. Point the type of subunit in the structure of holoenzyme of RNA polymerase of prokaryotes whose function is recognition of promoter region on the coding DNA strand:

- A. Alpha subunit
- B. Beta subunit
- C. Gamma subunit
- D. Sigma-factor subunit
- E. Delta-factor subunit

26. The polynucleotide chain of mRNA in prokaryotes contains sites called cistrons. Choose the content of the information kept in a single cistron:

- A. The sequence of amino acid residues in one subunit of protein
- B. The sequence of mononucleoside monophosphates of the initial transcript
- C. The sequence of amino acid residues in all subunits of protein
- D. The sequence of mononucleoside triphosphates in tRNA
- E. The sequence of mononucleoside triphosphates in rRNA

27. Choose the term of the uninformative site of the primary transcript (a precursor of mRNA):
- A. Promoter
  - B. Intron
  - C. Exon
  - D. Operon
  - E. Structural gene
28. Point the enzyme participating in the stabilization of the replication fork of DNA at E.coli:
- A. Topoisomerase
  - B. DNA-polymerase III
  - C. DNA-polymerase I
  - D. DNA-ligase
  - E. Restrictase
29. Point the site of DNA polynucleotide chain, which RNA-polymerase attaches to at the initiation phase of transcription:
- A. Reverse transcriptase
  - B. Primer
  - C. Gene-operator
  - D. Promoter
  - E. Gene-regulator
30. Point the enzyme that is capable to replace Okazaki fragments by newly synthesized fragments:
- A. Topoisomerase
  - B. Primase
  - C. DNA-polymerase I
  - D. DNA-ligase
  - E. DNA-polymerase II

31. In some regions of South Africa there is a spread sickle-shaped cell anemia, in which erythrocytes have shape a sickle as a result of substitution of glutamine by valine in the hemoglobin molecule. What is the cause of this disease?

- A. Gene mutation
- B. Disturbance of mechanisms of genetic information realization
- C. Post-translational modification mistake
- D. Crossingover
- E. Transduction

32. RNA that contains AIDS virus penetrated into a leukocyte and by means of reverse transcriptase forced a cell to synthesize a viral DNA. This process is based upon:

- A. Reverse transcription
- B. Convariant replication
- C. Operon depression
- D. Operon repression
- E. Reverse translation

33. Methotrexate (structural analogue of the folic acid which is competitive inhibitor of the dihydrofolate reductase) is prescribed for the treatment of the malignant tumor. On which level does methotrexate hinder synthesis of the nucleic acids?

- A. Reparation
- B. Mononucleotide synthesis
- C. Replication
- D. Processing
- E. Transcription

34. RNA-polymerase B (II) is blocked due to alpha-amanitin poisoning (poison of death-cup). What process is disturbed? :

- A. Primer synthesis
- B. Synthesis of t-RNA
- C. Reverse transcription
- D. Synthesis of m-RNA

E. Maturation of m-RNA

35. An experiment proved that UV-radiated cells of patients with xeroderma pigmentosum restore the native DNA structure slower than cells of healthy individuals as a result of reparation enzyme defection. What enzyme helps this process?

- A. DNA polymerase III
- B. DNA gyrase
- C. RNA ligase
- D. Endonuclease
- E. Primase

36. Transcription is inhibited by:

- A. Amanitin
- B. Streptomycin
- C. Sulfonylamide
- D. Chloramphenicol
- E. Puromycin

37. Which of the following is an example of a reverse transcriptase?

- A. Gyrase
- B. Helicase
- C. Telomerase
- D. RNA Polymerase
- E. DNA Polymerase

38. Which of the following is not a post-transcriptional modification of RNA?

- A. Splicing
- B. 5'-capping
- C. 3'-polyadenylation
- D. Glycosylation
- E. None of the above

39. During replication of DNA, which one of the following enzymes produces the Okazaki fragments?

- A. DNA Polymerase I
  - B. DNA Polymerase II
  - C. DNA Polymerase III
  - D. RNA Polymerase I
  - E. RNA Polymerase II
40. Which one of the following is the function of small nuclear ribonucleoprotein particles (snRNP)?
- A. Initiation of protein synthesis
  - B. Activation of amino acids
  - C. Processing of hn-RNA
  - D. Replication of DNA
  - E. Termination of protein synthesis

#### **Topic 4. Biosynthesis of proteins and its regulation**

1. Which of the following characteristics is **not** related to genetic code?
- A. Universal
  - B. Specific
  - C. Individual
  - D. Non-overlapping
  - E. Degenerate
2. Point out the initiating codon:
- A. AUG
  - B. UAG
  - C. GUA
  - D. UAG
  - E. UGA
3. A patient is found to have an abnormal form of  $\beta$ -globin (as component of haemoglobin) 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  $\rightarrow$  UAG



- B. UAA → CAA
- C. UGA → UAG
- D. GAA → GAA
- E. AUG → GUG

4. An antibiotic is added to an *in vitro* protein synthesis system that is translating the mRNA sequence AUGAAACCCUUUAG. The only product formed is dipeptide fMet-Lys. What step in translation is most likely inhibited by the antibiotic?

- A. Aminoacyl t-RNA synthetase activity
- B. Peptidyl transferase activity
- C. Translocase activity
- D. Binding of aminoacyl tRNA to ribosomal A site
- E. Binding of aminoacyl tRNA to ribosomal P site

5. Which statement about the “genetic code” is true?

- A. Information is stored as sets of dinucleotide repeats called codons
- B. The code is generate (i.e., only one codon exist for a single amino acid)
- C. Information is stored as sets of tetranucleotide repeats called codons
- D. There are 64 codons, all of which code for amino acids
- E. The three nucleotide base sequences in mRNA that act as code words for amino acids in protein constitute the genetic code

6. A defective aminoacyl tRNA synthase attaches valine to tRNA instead glutamate. What will be the fate of this valine residue during protein synthesis?

- A. It won't be used during translation
- B. It will be incorporated sometimes into protein at any codon
- C. It will be incorporated into protein in response to a valine codon
- D. It will be incorporated into protein in response to a glutamate codon
- E. It will be transformed to glutamate by special enzyme

7. Which of the following descriptions **is not** related to rRNA?

- A. It represents about 70-80% of cellular RNA
- B. It is associated with specific set of ribosomal proteins
- C. It functions as non-specific ‘workbench’ for the assembly of polypeptides

- D. Many copies of genes coding for rRNA are located in nucleolar organizer regions of certain chromosomes
- E. Each rRNA molecule is specific for one amino acid
8. There are signal sequences before the real coding sequence in mRNA at the translation initiation sites. This marker sequence for the identification of initiation codon is named in prokaryotes as:
- A. Okazaki sequence
  - B. John-Lynn sequence
  - C. Shine-Dalgarno sequence
  - D. Kozak consensus sequence
  - E. Amber-ochre-opal sequence
9. The following antibiotics can inhibit protein synthesis. Find out the inhibitor of peptidyl transferase:
- A. Chloramphenicol
  - B. Puromycin
  - C. Erythromycin
  - D. Streptomycin
  - E. Tetracycline
10. The lactose operon is negatively controlled by the lactose repressor but positively controlled by:
- A. Increased concentrations of glucose and cyclic AMP (cAMP)
  - B. Decreased concentrations of glucose and cAMP
  - C. Increased concentrations of glucose, decreased concentration of cAMP
  - D. Decreased concentrations of glucose, increased concentration of cAMP
  - E. Increased concentrations of glucose and adenosine triphosphate (ATP)
11. Which of the following statements is correct interpretation such genetic code characteristic as degeneracy?
- A. The genetic code is read from a fixed point as a continuous base sequence
  - B. Most of the amino acids are coded by more than one codon
  - C. Each amino acid has just one codon

- D. A particular codon codes always for the same amino acid
- E. The same codons are used to code the same amino acids in all the living organisms
12. The proteins synthesized due to translation are usually not functional and undergo post-translational modification. These modifications include all listed reaction types **except** one. Choose it:
- A. Phosphorylation
  - B. The 5' capping
  - C. Hydroxylation
  - D. Glycosylation
  - E. Carboxylation
13. A t-RNA comprising anticodon for cysteine is connected with tyrosine. What will be the fate of this tyrosine residue during protein synthesis?
- A. It will be incorporated into protein in response to a tyrosine codon
  - B. It won't be used during translation
  - C. It will be incorporated into protein in response to a cysteine codon
  - D. It will be incorporated sometimes into protein at any codon
  - E. It will be transformed to cysteine by special enzyme
14. Which of following descriptions **is not** related to tRNA?
- A. It represents about 15-20% of cellular RNA
  - B. It contains the sequence of bases coding for a particular amino acid sequence in a polypeptide chain
  - C. There is an enzyme which recognizes the amino acid and its specific tRNA and joins them together
  - D. The specific joining of tRNA to amino acid is the only place where the genetic code is realized
  - E. Each tRNA molecule is specific for one amino acid
15. The initiation codon recognition is facilitated by a specific sequence of nucleotides generally located 8 basepairs upstream of the start codon. This specific nucleotide sequence is named in eukaryotes as:

- A. Okazaki sequence
  - B. John-Lynn sequence
  - C. Shine-Dalgarno sequence
  - D. Kozak consensus sequence
  - E. Amber-ochre-opal sequence
16. Point out the termination codons:
- A. UAG, UGA, UAA
  - B. AUG, AUC, UUG
  - C. GUA, CUU, CUC
  - D. UGG, AUU, ACA
  - E. UCA, GGG, CCC
17. Which of the following structural units is **not** component of operon in prokaryotes?
- A. Promoter
  - B. Operator
  - C. Anticodon
  - D. Structural genes
  - E. Pribnow box
18. In eukaryotic cells, the 60S (28S component) ribosome subunit contains the catalytically active component acting as the ribozyme. Name it:
- A. Peptidyl transferase
  - B. Translocase
  - C. Aminotransferase
  - D. Endonuclease
  - E. RNA polymerase
19. Which of the following molecules is required for certain types of eukaryotic protein synthesis but not for prokaryotic protein synthesis?
- A. Ribosomal RNA
  - B. Messenger RNA
  - C. eIF2

D. Peptidyl transferase

E. GTP

20. A potent inhibitor of protein synthesis that acts as an analogue of aminoacyl tRNA is:

A. Chloramphenicol

B. Puromycin

C. Erythromycin

D. Streptomycin

E. Tetracycline

21. Point out the derivative of the residue of N- terminal amino acid used in the protein synthesis at E. coli:

A. Isoleucine

B. Formyl-threonine

C. Methionine

D. Formyl-methionine

E. Leucine

22. Point out the ribozyme that takes part in the peptide bond formation at the elongation phase in prokaryotes:

A. Translocase

B. Peptidase

C. Peptidyl transferase

D. Aminoacyl-tRNA-synthetase

E. Hydroxylase

23. Choose the component that doesn't take part in the initiation stage of protein synthesis in prokaryotes:

A. mRNA

B. Release factor

C. Amino acyl-tRNA

D. 30S subunit of the ribosome

E. 50S subunit of the ribosome

24. Point out the last stage of protein molecule formation:

- A. Activation of amino acids
- B. Termination
- C. Initiation
- D. Post-translational modification
- E. Elongation

25. Point out the medicine used for inhibition of initiation of protein synthesis in microorganisms due to misreading of mRNA and as result defective protein synthesis:

- A. Streptomycin
- B. Aurintricarboxylic acid
- C. Actinomycin D
- D. Chloramphenicol
- E. Tetracyclin

26. Point out the function for amino acyl-tRNA-synthetase in protein synthesis:

- A. It forms the peptide bond
- B. It promotes the ribosome movement along the mRNA
- C. It binds tRNA with amino acid residue
- D. It takes part in the ribosome structure formation
- E. It binds tRNA with the ribosome

27. Point out the quantity of ATP that is used during amino acid linkage to t-RNA:

- A. 0
- B. 1
- C. 3
- D. 4
- E. 5

28. Point out the maintenance of information keeping in the triplet A-U-G of mRNA:

- A. Protein synthesis beginning from initial N-terminal amino acid
- B. Protein synthesis elongation
- C. Doesn't contain any information

- D. Protein synthesis termination
- E. The operation of post-translational modification of protein
29. Low level of albumins and fibrinogen was detected in the patient's blood. Decreased activity of what organelle in the hepatocyte can most probably cause it?
- A. Golgi complex
  - B. Agranular endoplasmatic reticulum
  - C. Lysosomes
  - D. Mitochondrions
  - E. Granular endoplasmatic reticulum
30. The secondary t-RNA structure (the model of “clover leaf”) has several sites, which are responsible for a certain biologic function. Name the site, including the special order of three nucleotides that are complementary to the m-RNA triplet:
- A. Codon
  - B. Supplementary loop
  - C. Pseudouracil loop
  - D. Anticodon
  - E. Acceptor part
31. According to the operon hypothesis the induction of transcription is possible without active protein – repressor, only. Please, point out the term of the DNA site that keeps the information about the structure of this protein:
- A. Promoter
  - B. Gene-operator
  - C. Gene-regulator
  - D. Operon
  - E. Structural gene
32. Protein biosynthesis depends on energy. Point out the type of high-energy bonds containing substances that is used in this process in a phase of elongation:
- A. TTP
  - B. ADP
  - C. UTP

D. GTP

E. CTP

33. Peptidyl-tRNA transport from amino acyl site (A) to peptide site (P) takes place during the elongation stage of protein synthesis. Name the enzyme that promotes this transport:

A. Aminoacyl-tRNA-synthetase

B. Translocase

C. Peptidyltransferase

D. Transaminase

E. Amino peptidase

34. Choose the substance that can stimulate LAC-operon expression in E.coli:

A. Sucrose

B. Glucose

C. Lactose

D. Mannose

E. Fructose

35. You are studying functioning of a bacteria operon. The operator gene has been released from the repressor. Immediately after this the following process will start in the cell:

A. Translation

B. Replication

C. Repression

D. Processing

E. Transcription

36. The primary role of chaperones is to help in:

A. Protein synthesis

B. Protein degradation

C. Protein denaturation

D. Protein folding

E. None



37. What is the average number of high energy bonds required for the synthesis of 1 peptide bond:

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

38. Regarding cytosolic eukaryotic translation false is:

- A. Capping helps in attachment of mRNA to 40 S Ribosome
- B. N-formyl -methionyl-tRNA will be the first to come into action
- C. eIF2 shifts between GDP & GTP
- D. Releasing factor releases the polypeptide chain from the P site
- E. The ribozyme peptidyltransferase catalyses the formation of peptide bond

39. CAP (Catabolite active gene protein) in Lac operon is an example of:

- A. Positive regulator of transcription
- B. Negative regulator of transcription
- C. Constitutive expression
- D. Attenuation
- E. Regulatory region of DNA

40. Leucine zipper motif is a mediator for:

- A. Membrane attack complexes
- B. Ligand membranes
- C. Binding of regulatory proteins to DNA
- D. Cyclic GMP
- E. Cyclic AMP

## **Topic 5. Chromoproteins. Metabolism of hemoglobin and its disorders.**

### **Metabolism of porphyrins**

1. The oxidation of  $\text{Fe}^{2+}$  to  $\text{Fe}^{3+}$  in haemoglobin results in the formation of a compound named:

- A. Carboxyhaemoglobin
  - B. Oxyhaemoglobin
  - C. Biliverdin
  - D. Methaemoglobin
  - E. Bilirubin
2. Erythrocytes of people with sickle cell anaemia contain:
- A. Only haemoglobin S
  - B. Only haemoglobin C
  - C. Only haemoglobin A
  - D. Both haemoglobin A and F
  - E. Both haemoglobin A and haemoglobin S
3. A 25 years old woman was admitted to the ER (Emergency Room) with polyneuropathy, psychological symptoms and pain in the abdomen. The clinical diagnosis is porphyria cutanea tarda. Which one from following enzymes is defective in this case:
- A. Uroporphyrinogen decarboxylase
  - B. 5-Amino-levulinate synthase
  - C. Uroporphyrinogen III co-synthase
  - D. Uroporphyrinogen III synthase
  - E. Amino-levulinic acid dehydratase
4. Haem and haemin primarily feedback inhibit the following enzyme to control haem production in the liver:
- A. Uroporphyrinogen decarboxylase
  - B. 5-Amino-levulinate synthase
  - C. Uroporphyrinogen III co-synthase
  - D. Amino-levulinic acid dehydratase
  - E. Ferrochelatase
5. Which of the following compounds is the main product made from a reaction of haemoglobin metabolism where carbon monoxide (CO) is generated as a byproduct:
- A. Haem

- B. Indirect bilirubin
  - C. Direct bilirubin
  - D. Biliverdin
  - E. Bile
6. Increased hemolysis of erythrocytes is observed in patient after incompatible blood transfusion. This type of jaundice is characterized by:
- A. Normal concentration of unconjugated bilirubin in serum, urine and stools with normal color
  - B. Normal concentration of total bilirubin in serum, normal urine and light-colored stools
  - C. High concentration of unconjugated bilirubin in serum, dark-colored urine (increased urobilinogen bodies) and stools
  - D. High concentration of conjugated bilirubin in serum, urine with a normal color and dark stools
  - E. High concentration of conjugated and unconjugated bilirubin in serum, dark urine and dark colored stools.
7. The binding of one oxygen molecule to a molecule of hemoglobin results in:
- A. The movement of hemoglobin to muscular tissue.
  - B. Decrease in hemoglobin ability to bind a second oxygen molecule
  - C. The release of any other oxygen molecule that may have bound earlier
  - D. Increased affinity of the hemoglobin molecule to oxygen molecule in the remaining subunits (which have not yet bound oxygen molecule)
  - E. Dissociation of the hemoglobin subunits
8. Bilirubin is insoluble in aqueous solution and in the blood too. It is transported in the plasma in a bound form with:
- A. Hemoglobin
  - B. Methemoglobin
  - C. Alpha-globulin
  - D. Albumin
  - E. Beta-globulin

9. A patient is with diabetes mellitus that is accompanied with hyperglycemia of over 7,2 mmole/L on empty stomach. The level of what blood plasma protein can estimate the hyperglycemia rate retrospectively {4-8 weeks before examination}?
- A. Fetal hemoglobin (HbF)
  - B. Myoglobin
  - C. Adult hemoglobin (HbA1)
  - D. Methemoglobin (metHb)
  - E. Glycosylated hemoglobin (HbA1c)
10. Which fragment is not a structural component of hemoglobin molecule HbA1:
- A. Pyrrole rings
  - B. Globin
  - C. Ferric ion ( $\text{Fe}^{3+}$ )
  - D. Propionyl radical
  - E. Histidine residue
11. Which one of the following compounds is not a chromoprotein? :
- A. Hemoglobin
  - B. Myoglobin
  - C. Catalase
  - D. Amylase
  - E. Cytochrome b
12. Which of the following statements is incorrect concerning bilirubin or its metabolism?
- A. Its formation involves two NADPH-requiring reactions
  - B. It is carried by albumin in the blood
  - C. It originates from heme
  - D. It and its derivatives are excreted in the urine
  - E. It is made more soluble in the liver by the conjugation with UDP-glucuronate
13. Congenital erythropoietic prophyria is due to a defect in the enzyme used for haem synthesis. Name it:
- A. Uroporphyrinogen III cosynthase

- B. Coproporphyrinogen oxidase
  - C. Uroporphyrinogen I synthetase
  - D. Uroporphyrinogen decarboxylase
  - E. Photoporphyrinogen oxidase
14. A patient is suffering from lead poisoning. This inhibits the following Zn-containing enzyme:
- A. Uroporphyrinogen decarboxylase
  - B. Uroporphyrinogen III co-synthase
  - C. 5-Amino-levulinate synthase
  - D. 5-Amino-levulinate dehydratase
  - E. Porphobilinogen deaminase
15. What level of organization for hemoglobin A1 is changed mostly during the transformation of its oxygenated form to deoxygenated one:
- A. Primary structure
  - B. Quaternary structure
  - C. Sextic structure
  - D. Tertiary structure
  - E. Secondary structure
16. A critical enzyme in the conversion of heme to biliverdin is:
- A. Biliverdin oxygenase
  - B. Biliverdine reductase
  - C. Biliverdine hydroxylase
  - D. Heme reductase
  - E. Heme oxygenase
17. In a patient, already diagnosed as suffering from a carcinoma of pancreas head, the tumor provokes a gradual compression of the common bile duct, and the patient begins to develop jaundice. The findings related with bilirubin metabolism that you expect to see in this patient include:
- A. High concentration of unconjugated bilirubin in serum, dark urine, and light-colored stools

- B. High concentration of conjugated bilirubin in serum, dark urine (bilirubinuria) and dark stools
  - C. High concentration of conjugated bilirubin in serum, urine with a normal color and dark stools
  - D. Normal concentration of conjugated bilirubin in serum, dark urine and dark colored stools
  - E. High concentration of conjugated bilirubin in serum, dark urine (bilirubinuria) and light- colored stools
18. Which of the following compounds are the substrates for heme synthesis:
- A. Glycine and succinyl-CoA
  - B. Glutamine and acetyl-CoA
  - C. Glutamate and malonyl-CoA
  - D. Serine and palmitoyl-CoA
  - E. Glycine and acetyl-CoA
19. The examination of primary structure of hemoglobin revealed substitution of the glutamic acid by valine in the sixth position from N-terminal of beta-chains. What inherited pathology is typical for?
- A. Crigler-Najjar syndrome
  - B. Hemoglobinosis
  - C. Thalassemia
  - D. Gilbert's disease
  - E. Sickle-cell anemia
20. Point the normal form of hemoglobin that is represented mostly in the blood of adults:
- A. HbA1
  - B. HbA2
  - C. HbF
  - D. HbS
  - E. HbC

21. One of the hemoglobin forms is dominated after the child's birth. This form retains in adults, but in smaller concentration. Point it:

- A. HbA1
- B. HbA2
- C. HbF
- D. HbS
- E. HbC

22. Point the derivative of hemoglobin that is produced under the CO↑ poisoning:

- A. Oxyhemoglobin
- B. Carbohemoglobin
- C. Methemoglobin
- D. Carboxyhemoglobin
- E. HbS

23. The concentration of this hemoglobin derivative increases in the patient's blood under the nitrates poisoning. Choose it:

- A. Oxyhemoglobin
- B. Carbohemoglobin
- C. Methemoglobin
- D. Carboxyhemoglobin
- E. HbS

24. Point out the correct description for the reason of iron deficiency anemia:

- A. Inhibited heme synthesis due to delta-aminolevulinate synthetase inactivation
- B. Fe<sup>2+</sup> incorporation into the protoporphyrin IX is disturbed
- C. Intensive erythrocytes hemolysis
- D. The hemoglobin affinity to oxygen molecule is increased
- E. The transferrin concentration in blood is increased

25. Point the first color pigment that is produced in spleen after HbA1 cleavage:

- A. Biliverdin
- B. Verdoglobin
- C. Bilirubin diglucuronide

D. Stercobilin

E. Mesobilirubin

26. Point a bile pigment that appears in the urine as a result of its elevated excretion under the obstructive jaundice development in patients:

A. Mesobilirubin

B. Conjugated bilirubin

C. Unconjugated bilirubin

D. All the bilirubin forms

E. Biliverdin

27. Choose the form of the bile pigment that is normal urine component:

A. Hemoglobin

B. Stercobilin

C. Mesobilirubin

D. Unconjugated bilirubin

E. Conjugated bilirubin

28. A patient who suffers from congenital erythropoietic porphyria has skin photosensitivity. The accumulation of what compound in skin cells can cause it?

A. Uroporphyrinogen I

B. Uroporphyrinogen III

C. Protoporphyrin IX

D. Coproporphyrinogen III

E. Heme

29. Specify the substance that is used for the incomplete denaturation of hemoglobin:

A. Sulfuric acid

B. Nitric acid

C. Toluene

D. Sodium hydroxide

E. Urea

30. A patient suffers from diabetes mellitus that is accompanied with hyperglycemia of over 7,2 mmole /L on an empty stomach. The level of what blood plasma protein



can estimate the hyperglycemia rate retrospectively {4-8 weeks before examination}?

- A. C-reactive protein
- B. Ceruloplasmin
- C. Fibrinogen
- D. Albumin
- E. Glycosylated hemoglobin

31. A 48 y.o. patient was admitted to the hospital with complaints about weakness, irritability, sleep disturbance. Objectively: skin and sclera are yellow. In the blood: conjugated bilirubin level is increased, cholaemia. Feces are acholic, dark color urine. What jaundice is it?

- A. Hemolytic
- B. Gilbert's syndrome
- C. Mechanic (obstructive)
- D. Crigler-Najjar syndrome
- E. Parenchymatous

32. The decrease of hemoglobin concentration was noted in the total blood analysis of the patient. Name the presumable diagnosis:

- A. Diabetes mellitus
- B. Anemia
- C. Atherosclerosis
- D. Myocardial infarction
- E. Bronchial asthma

33. Point the liver enzyme participating in the neutralization of toxic bilirubin:

- A. Glutamine synthetase
- B. Glutamate dehydrogenase
- C. Alanine amino transferase
- D. UDP – glucuronyl transferase
- E. Carbomoyl phosphate synthetase

34. Choose the form of the bile pigment that is the normal urine component found in trace amounts:
- A. Glucuronic acid
  - B. Urobilinogen
  - C. Mesobilirubin
  - D. Unconjugated bilirubin
  - E. Conjugated bilirubin
35. The affinity of the hemoglobin molecule to molecular oxygen is depended on:
- A.  $P_{CO_2}$
  - B.  $P_{O_2}$
  - C. pH of the blood
  - D. Concentration of 2,3-biphosphoglycerate in RBC
  - E. All the positions are correct

#### BASIC THEME 8. MOLECULAR MECHANISMS OF HORMONES ACTION

##### **Topic 6. Classification and properties of hormones. The mechanisms of protein-peptide hormones and biogenic amines action**

1. The content of the hormone in the blood is determined usually using method:
  - A. Spectrophotometry method
  - B. Photocolourimetry method
  - C. X-ray Radiation method
  - D. Radio Immulological Assay method
  - E. Nephelometry method
2. Find the hormone classified as oligopeptide:
  - A. Vasopressin
  - B. Thyroxin
  - C. Cortisol
  - D. Insulin
  - E. Growth hormone
3. What hormone synthesis starts from free tyrosine as initial substrate?

- A. Thyroxin
  - B. Epinephrine
  - C. Calcitonin
  - D. Parathyroid hormone
  - E. Aldosterone
4. What hormone receptor is placed in the cytoplasm of target cell?
- A. Insulin
  - B. Epinephrine
  - C. Glucagon
  - D. Parathyroid hormone
  - E. Corticosterone
5. Name secondary messenger whose level will be increased in muscular cell after the linkage of epinephrine with beta1-adrenoreceptor:
- A. cGMP
  - B. Inositol triphosphate
  - C. cAMP
  - D. Diacylglycerol
  - E.  $\text{Ca}^{2+}$
6. What enzyme is stimulated in the cellular membrane of the target cell at the contact of epinephrine with alpha1- adrenoreceptor:
- A. Adenylate cyclase
  - B. Guanylate cyclase
  - C. Phospholipase C
  - D. Phospholipase A2
  - E. There is no any enzyme in the cellular membrane whose activity will be increased
7. Find out the terminal result for the hormone action if its signal is transmitted across the activation of Gi-protein in the cellular membrane:
- A. There is the stimulation of Guanylate cyclase in the cellular membrane
  - B. There is the inhibition of Adenylate cyclase in the cellular membrane

- C. There is the stimulation of Adenylate cyclase in the cellular membrane
  - D. There is the stimulation of cAMP- dependent protein kinase in the cellular membrane
  - E. There is the inhibition of cAMP- dependent protein kinase in the cellular membrane
8. Name the metabolic process located in the liver whose duration rate is stimulated after secretion of insulin to the blood circulation:
- A. Protein degradation
  - B. Glycogenesis
  - C. Gluconeogenesis
  - D. Beta oxidation of fatty acids
  - E. Glycogenolysis
9. Find out secondary messengers formed due to the action of Phospholipase C on phosphatidyl inositol-4,5-diphosphate:
- A. Inositol free and high fatty acid (usually palmitate)
  - B. Inositol –3,4,5- triphosphate and glycerol-3-phosphate
  - C. Inositol –1,4,5- triphosphate and diacylglycerol
  - D. Inositol and phosphatidic acid
  - E. Inositol –1,4,5- triphosphate and monoacylglycerol
10. The action of a hydrophilic hormone on its target cell is promoted if:
- A. The receptor to the hormone has been synthesized and placed in the cellular membrane
  - B. Special proteins-transducers such as G-proteins are located in the cellular membrane
  - C. Enzymes-producers of secondary messengers are placed in the cellular membrane
  - D. Substrates for enzymes-producers of secondary messengers are present in the cell
  - E. All the statements are right

11. Scientists propose to determine the content of hormone-protein in the blood using the Radio Immune Assay method because it is:

- A. The most inexpensive method
- B. Specific method taking into account the high affinity of antibodies to the determined hormone
- C. Method which is spread in use
- D. Readily made method using very small volume of the blood, only
- E. In need to use exactly known reagents to any hormone determined in the blood

12. Find the hormone classified as amino acid derivative:

- A. Cholecalciferol
- B. Somatotropin
- C. Beta-endorphin
- D. Epinephrine
- E. Prostaglandin E

13. Name the location of insulin receptor in its target cells:

- A. Cytoplasm
- B. Endoplasmic reticulum (smooth part)
- C. Mitochondrial matrix
- D. Mitochondrial outer membrane
- E. Cellular membrane

14. Hormone insulin is secreted by beta-cells of Langerhans islets only at condition of:

- A. Hyperglycemia
- B. Hyperuricemia
- C. Hypoglycemia
- D. Malonic aciduria
- E. Aminoaciduria

15. Name the hormone whose mechanism of action may be associated with the decrease of cAMP levels in the cytoplasm of this hormone target cell:

- A. Epinephrine

- B. Cortisol
- C. Thyroxin
- D. Insulin
- E. Glucagon

16. What enzyme is stimulated in the cellular membrane of the target cell at the contact of epinephrine with alpha2- adrenoreceptor:

- A. Adenylate cyclase
- B. Guanylate cyclase
- C. Phospholipase C
- D. Phospholipase A2
- E. There is no any enzyme in the cellular membrane whose activity will be increased

17. Find out the terminal result for the hormone action if its signal is transmitted across the activation of Gs-protein in the cellular membrane:

- A. There is the stimulation of guanylate cyclase in the cellular membrane
- B. There is the stimulation of adenylate cyclase in the cellular membrane
- C. There is the inhibition of adenylate cyclase in the cellular membrane
- D. There is the stimulation of cAMP-dependent protein kinase in the cellular membrane
- E. There is the inhibition of cAMP-dependent protein kinase in the cellular membrane

18. Name the catabolic process located in muscles whose duration rate is stimulated after secretion of epinephrine to the blood circulation:

- A. Gluconeogenesis
- B. Desaturation of high fatty acids
- C. Glycogenolysis
- D. Glycogenesis
- E. Hexose monophosphate shunt

19. What secondary messenger release may be secreted from sarcoplasmic reticulum of myocardium after the contact of epinephrine with alpha1-adrenoreceptor:

- A. cGMP
- B. Inositol triphosphate
- C. cAMP
- D. Diacylglycerol
- E.  $\text{Ca}^{2+}$

20. Choose the biologically active agents that are regulators of homeostasis and are secreted by special glands:

- A. Triacylglycerols
- B. Vitamins
- C. Enzymes
- D. Hormones
- E. High Fatty Acids

21. Choose the biological action that is typical for hormones, only:

- A. To regulate some processes in the target cell
- B. To catalyze chemical reaction
- C. To be linked to the active center of an enzyme
- D. To change the pH of the environment
- E. To transfer the substance across the blood stream

22. Choose the term of hormonal compounds that are secreted from hypothalamus:

- A. Neurotransmitters
- B. Conjugation Agents
- C. Releasing factors
- D. Eicosanoids
- E. Antioxidants

23. Choose the department of CNS, where tropic hormones are secreted from:

- A. Cerebral cortex
- B. Pituitary gland
- C. Hypothalamus
- D. Striate body
- E. Yellow spot

24. Point out the chemical nature of hormonal receptors:

- A. Nucleic acids
- B. Carbohydrates
- C. Proteins
- D. Vitamins
- E. Lipids

25. Choose the name of the secondary messenger that takes part in the transmission of hormonal signal:

- A. Transferrin
- B. Cupper ion
- C. Calcium ion
- D. Inosine triphosphate
- E. Cyclopentano perhydrophenanthrene

26. Point the function for G-protein alpha-subunit linked to GTP (the case for G<sub>s</sub> protein):

- A. The receptor to hormone
- B. The energy source for target cell
- C. The stimulator of adenylate cyclase
- D. The inductor of transcription
- E. The protein channel in the cellular membrane

27. Find the tropic hormone whose secretion will be suppressed under excess glucocorticoid levels in the blood:

- A. STH
- B. ACTH
- C. FSH
- D. SIH
- E. LH

28. Point the product of adenylate cyclase reaction:

- A. cGMP
- B. Protein kinase A



C. cAMP

D. Diacylglycerol

E. Inositol 1, 4, 5 -triphosphate

29. The formation of a secondary mediator is obligatory in membrane-intracellular mechanism of hormone action. Point the substance that is unable to be a secondary mediator:

A. Diacylglycerol

B. cAMP

C. Inositol-1,4,5-triphosphate

D.  $\text{Ca}^{2+}$

E. Glycerol

30. There is only one hormone among neurohormones which refers to the derivatives of amino acids according to classification. Point it:

A. Melatonin

B. Vasopressin

C. Oxytocin

D. Thyroliberin

E. Somatotropin

31. Specify the type of protein that is stimulated under the influence of epinephrine- $\beta_1$ -receptor complex in the cellular membrane:

A. Nucleoprotein

B.  $G_i$ -protein

C.  $G_s$ -protein

D.  $G_{\text{PLC}}$ -protein

E. Glycoprotein

32. The membrane-intracellular mechanism of hormone action is possible for epinephrine. Find the explanation for the reason of this type of action for epinephrine:

A. Great molecular mass of epinephrine

B. Epinephrine is a hydrophilic hormone

- C. There are no receptors for epinephrine on cellular membrane
- D. Receptors for epinephrine are in cytoplasm
- E. There are no secondary messengers for epinephrine in metabolic processes regulation
33. The formation of a secondary messenger is obligatory in the membrane-intracellular mechanism of hormone action. Point the substance that is able to be secondary messenger:
- A.  $\text{Ca}^{2+}$  ions
- B. Diacylglycerol
- C. Inositol-1,4,5-triphosphate
- D. cAMP
- E. All the positions are correct
34. The intracellular mechanism of hormone action is in close correlation with the high lipophilicity of the hormone structure. Name a suitable hormone:
- A. Insulin
- B. Thyroxin
- C. ACTH
- D. Glucagon
- E. Adrenalin
35. Hormone-sensitive triacylglycerol lipase is activated in adipocytes under the emotional stress. Choose the secondary messenger, whose concentration is increased in adipose tissue in this state:
- A. cGMP
- B. cAMP
- C. AMP
- D. Diacylglycerol
- E.  $\text{Ca}^{2+}$
36. Find the type of activity that is considered for insulin-receptor complex function in the intracellular space of target cell:
- A. Tyrosine aminotransferase activity

- B. cAMP-dependent polymerase activity
- C. cAMP-dependent protein kinase activity
- D. Tyrosine kinase activity
- E. Similar to Phospholipase C activity

37. Find the feature of releasing factors (RF) structure:

- A. RF are glycoproteins
- B. Both of RF contain sialic acid
- C. RF are simple proteins with quaternary structure
- D. RF are short peptides
- E. RF are amino acid derivatives

38. Name a membrane bound enzyme that catalyzes the formation of cyclic AMP from ATP:

- A. Tyrosine kinase
- B. RNA polymerase
- C. ATP synthase
- D. Adenylate cyclase
- E. Lactate dehydrogenase

39. Try to name a small  $\text{Ca}^{2+}$ -binding protein that modifies the activity of many enzymes and other proteins in response to changes of  $\text{Ca}^{2+}$  concentration in the cytoplasm:

- A. Cycline
- B. Calmodulin
- C. Collagen
- D. Kinesin
- E. Elastin

40. Name the class of proteins which have ability to be receptors for hormones:

- A. Nucleoprotein
- B. Metalloprotein
- C. Chromoprotein
- D. Glycoprotein

E. Phosphoprotein

**Topic 7. Mechanism action and influence on metabolism of steroid and thyroid hormones. The regulation of calcium and phosphates homeostasis by hormones in the blood**

1. Name the enzyme whose function is to make conversion of  $I^-$  to  $I^+$  in the thyroid gland hormone synthesis:

- A. Iodinase
- B. NADPH-dependent peroxidase
- C. Transmethylase
- D. Special hydroxylase
- E. This conversion is without enzyme action

2. The secretion of glucocorticoids by adrenal cortex is superstimulated in healthy person at special state, only. Name it:

- A. Hyperglycemia
- B. Hypouricemia
- C. Hypoglycemia in 24 hours of starvation
- D. Hypoglycemia after 24 hours of starvation
- E. Anemia

3. The secretion of estradiol by ovaries is in follicular phase, and is stimulated mainly by:

- A. ACTH
- B. TSH
- C. FSH
- D. LH
- E. STH

4. There is the conversion of testosterone in peripheral target cell to form its more active derivative, name it:

- A. Dehydrotestosterone
- B. Progesterone

- C. Estrone
  - D. Androstenedione
  - E. 17-alpha-dihydroxyprogesterone
5. Estrogens promote these biochemical changes in the woman organism:
- A. Stimulation of lipogenesis in adipose tissue
  - B. The decrease of LDL levels in the blood
  - C. The increase of HDL levels in the blood
  - D. Stimulation of calcification and bone growth
  - E. All the positions are right
6. The transport of estrogens across blood circulation depends on the synthesis of special protein in the liver. Name it:
- A. Albumin
  - B. Ceruloplasmin
  - C. Sex hormone-binding globulin
  - D. HDL
  - E. Sex hormone influenced protein
7. The location of receptors for sex hormones in their target cells is found in:
- A. Endoplasmic reticulum (rough part)
  - B. The cellular membrane, only
  - C. The cytoplasm, only
  - D. The cytoplasm and nucleus
  - E. The nucleus, only
8. Adrenal cortex produces the hormone whose function is to stimulate reabsorption of sodium and chloride ions in renal tubules. Name it:
- A. Pregnenolone
  - B. Aldosterone
  - C. Progesterone
  - D. Androstenedione
  - E. Corticosterone

9. Name the process of carbohydrate metabolism whose rate is regulated by glucocorticoids:
- A. Glycogenolysis
  - B. Glycogenesis
  - C. Aerobic glycolysis
  - D. Gluconeogenesis
  - E. Anaerobic glycolysis
10. Find sex hormones whose production mainly is associated with a period of pregnancy in women:
- A. FSH and progesterone
  - B. LH and progesterone
  - C. Estradiol and progesterone
  - D. Testosterone and estriol
  - E. Progesterone and human chorionic gonadotropin
11. What signal is the most important for stimulation of T3 and T4 secretion by thyroid gland:
- A. The change of  $P_{O_2}$  in the blood
  - B. The change of glucose levels in the blood
  - C. The increase of TSH levels in the blood
  - D. The decrease of TSH levels in the blood
  - E. The increase of thyrotropin releasing hormone levels in the blood circulation
12. The secretion of male sex hormone testosterone by Leydig cells is stimulated mainly by:
- A. ACTH
  - B. TSH
  - C. FSH
  - D. LH
  - E. STH
13. Mid-luteal phase of menstrual cycle in women is associated with:
- A. Decrease of LH secretion and increase of FSH secretion

- B. Decrease of FSH secretion and increase of LH secretion
  - C. Increase of LH secretion and mild increase of progesterone production
  - D. Decrease of LH secretion, mild increase of estradiol levels and excess levels of progesterone
  - E. Increased levels of all female sex hormones in the blood
14. The main important biochemical functions for androgens are:
- A. Stimulation of digestion in GIT
  - B. Stimulation of transcription
  - C. Stimulation of glycolysis
  - D. They enhance the reabsorption for sodium, chloride ions in renal tubules
  - E. All the positions are right
15. The main signal for the stimulation of cortisol secretion by adrenal cortex is:
- A. The change of urea in the blood
  - B. The increase of glucose levels in the blood
  - C. The increase of LH levels in the blood
  - D. The increase of ACTH levels in the blood
  - E. The increase of Corticotropin Releasing Hormone levels in the blood
16. The transport of T3 and T4 across the blood is made by:
- A. Thyroxin-binding globulin
  - B. Thyroxin-binding prealbumin
  - C. Both two proteins (placed in positions A,B) may be used
  - D. All the Globulins of alpha-fraction of the blood plasma
  - E. Gamma-Globulins of the blood plasma
17. The location of receptors for thyroid gland hormones in the target cell is found in:
- A. The cellular membrane, only
  - B. The cytoplasm, only
  - C. The cytoplasm, nucleus and mitochondria
  - D. The nucleus, only
  - E. Endoplasmic reticulum (rough part)

18. The main signal to stimulate the secretion of aldosterone by adrenal cortex is:
- A. The increased levels of testosterone in the blood
  - B. The increased levels of sodium ions in the blood
  - C. The decreased levels of calcium ions in the blood
  - D. The increased levels of magnesium ions in the blood
  - E. The appearance of angiotensin II in the blood plasma
19. Name the amino acid residues placed in the polypeptide chain of thyroglobulin whose structure is modified to form linked T3 and T4:
- A. Tryptophan
  - B. Phenylalanine
  - C. Tyrosine
  - D. Both tryptophan and tyrosine
  - E. Both tyrosine and phenylalanine
20. Calcium absorption in the small intestine is stimulated primarily by:
- A. Calcitonin
  - B. Parathyroid hormone
  - C. Calcitriol
  - D. All the hormones placed above
  - E. Estradiol
21. Choose the enzyme name whose deficiency in kidney tissue causes the osteoporosis development in patient:
- A. Prostaglandin synthase
  - B. Cyclooxygenase
  - C. Lipooxygenase
  - D.  $\alpha$ 1-Hydroxylase
  - E. 25-Hydroxylase
22. Parathyroid hormone is found as stimulator of calcitriol synthesis in kidneys across the activation of one enzyme in calcitriol synthesis. Name it:
- A. Cytochrome c oxidase
  - B. Cytochrome P450-linked sequenation system



- C. Alpha1-hydroxylase
  - D. Calcidiol hydroxylase
  - E. Calciferol hydroxylase
23. Physiological levels of calcitriol in the blood cause primarily the:
- A. Decrease of cholecalciferol levels in the blood
  - B. Increase of cholecalciferol levels in the blood
  - C. Increase of calcium ions absorption in the intestine
  - D. Decrease of calcitonin production
  - E. Increase of parathyroid hormone production
24. Point the hormone that is intermediate metabolite for testosterone and estradiol synthesis:
- A. Aldosterone
  - B. Cortisol
  - C. Progesterone
  - D. 25-hydroxy cholecalciferol
  - E. 17-ketosteroid
25. Find the substance whose content will be increased in the blood after the influence of glucocorticoids on the liver metabolic pathways:
- A. Glucose
  - B. Alanine
  - C. Glycerol
  - D. Oxygen
  - E. Carbon monoxide
26. What function may be found for thyroxin in the target cell at its levels which are higher, then physiological ? :
- A. Catalytic function
  - B. Secondary messenger function
  - C. Uncoupler for oxidative phosphorylation and tissue respiration
  - D. Allosteric inhibitor for ATP synthetase
  - E. Suppressor of calcium transport across cellular membrane

27. Find out the main target tissues for parathyroid hormone (PTH):
- A. Liver tissue, only
  - B. Kidney, bone tissue
  - C. Nervous tissue
  - D. Spleen tissue
  - E. Skeletal muscular tissue
28. Name the index of blood plasma whose content will be increased after parathyroid hormone secretion:
- A. Calcium ions
  - B. Ammonia
  - C. Urea
  - D. Uric acid
  - E. Zinc ions
29. What influence of calcitriol on kidney tissue is observed at its excess levels in the blood?
- A. Protein degradation induction
  - B. The feed-back inhibition of alpha-1-hydroxylase
  - C. The allosteric activation of alpha-1-hydroxylase
  - D. Activation of calcidiol formation
  - E. Inhibition of calcidiol formation
30. A patient is followed up in endocrinological dispensary on account of hyperthyroidism. Weight loss, tachycardia, finger tremor are accompanied with hypoxia similar symptoms – headache, fatigue, eye flicker. Find the result for the influence of high level of thyroid hormones on tissue respiration causing the development of hypoxia similar symptoms:
- A. Specific binding of active centers of respiratory enzymes
  - B. Intensification of respiratory enzymes synthesis
  - C. Competitive inhibition of respiratory enzymes
  - D. Inhibition of respiratory enzymes synthesis
  - E. Uncoupling of oxidation and oxidative phosphorylation

31. Some diseases reveal symptoms of aldosteronism with hypertension and edema due to sodium retention in the organism. What organ of the internal secretion is affected on aldosteronism?

- A. Hypophysis
- B. Testicle
- C. Ovaries
- D. Pancreas
- E. Adrenal glands

32. Thyrotoxicosis leads to increased production of thyroidal hormones T3 and T4, weight loss, tachycardia, psychic excitement. How do thyroidal hormones influence energy metabolism in the mitochondrion of cells?

- A. Stop respiratory chain
- B. Activate oxidative phosphorylation
- C. Stop substrate phosphorylation
- D. Activate substrate phosphorylation
- E. Uncouple the oxidative phosphorylation and tissue respiration

33. A 2 y.o child has convulsions as a result of reduced concentration of calcium ions in the blood plasma. It may be due to the reduced function of:

- A. Adrenal cortex
- B. Pineal gland
- C. Parathyroid glands
- D. Hypophysis
- E. Thymus

34. The biochemical research of the patient's blood confirmed the hypoglycemia, abnormally high potassium concentration and low sodium concentration. Point the hormones whose secretion is violated:

- A. Glucocorticoids, aldosterone
- B. Thyroid hormones T3, T4
- C. Calcitonin
- D. All the hormones from anterior lobe of pituitary gland

E. Insulin

35. The most important function of androgens in muscles is:

- A. To stimulate lipolysis
- B. To stimulate protein synthesis
- C. To stimulate protein degradation
- D. To inhibit lipogenesis
- E. To stimulate muscular contraction

36. Total calcium in the blood plasma is controlled mainly by three hormones: PTH, calcitonin and calcitriol. Choose the hormone that will be secreted if the total calcium level is 2,9 mmole /L:

- A. PTH
- B. Calcitonin
- C. Calcitriol
- D. PTH and calcitriol
- E. All the proposed

37. Among lipophilic hormones the derivatives of amino acids are found. Choose those one:

- A. Testosterone
- B. Cortisol
- C. Estrodiole
- D. Thyroxin
- E. Calcitriol

38. Total calcium and level of phosphates in the blood plasma are controlled mainly by three hormones: PTH, calcitonin and calcitriol. Choose the description of PTH influence on the phosphates reabsorption mechanism:

- A. It stimulates the phosphate ions reabsorption
- B. It doesn't control the phosphate ions reabsorption
- C. It suppressed the phosphate ions reabsorption
- D. It stimulates reabsorption of phosphates using stimulation of protons secretion
- E. It stimulates reabsorption of phosphates with the decrease of water reabsorption

39. The receptors for steroidal hormone Cortisol have specific conformational fragment that is in use after the formation of hormone receptor complex to make linkage with DNA response elements. Name this fragment:

- A. Zinc-finger
- B. Leucine zipper
- C. Helix-turn-helix
- D. Rel domains
- E. All the proposed may be

40. Chronic renal insufficiency is coupled with the beginning of osteoporosis in patients because:

- A. The PTH has no receptors in renal tubules
- B. The abnormalities for calcitriol synthesis are found at renal insufficiency
- C. The Calcitonin is secreted in excess levels at renal insufficiency
- D. Calcitriol is produced in excess levels at renal insufficiency
- E. The correct explanation is absent

## **Topic 8. The role of hormones in the regulation of metabolic processes.**

### **Formation and functions of eicosanoids**

1. Name the high fatty acid represented mainly as residue in phospholipids structure and used for eicosanoids formation in human organism:

- A. Oleic acid
- B. Palmitic acid
- C. Acetic acid
- D. Arachidonic acid
- E. Stearic acid

2. Prostaglandin E is synthesized in adipose tissue to suppress the process:

- A. Lipolysis of triacylglycerols (TAG)
- B. TAG synthesis
- C. Cholesterol synthesis
- D. Chylomicrons degradation

- E. VLDL utilization
3. Find out the organic compound whose presence in a cell can inhibit the prostaglandin synthesis:
- A. Aldosterone
  - B. Butanol
  - C. Aspirin
  - D. Epinephrine
  - E. Progesterone
4. The aggregation of platelets in the blood is found under the influence of this compound mainly. Name it:
- A. Thromboxane TXA<sub>2</sub>
  - B. Prostaglandin PGE
  - C. Prostaglandin PGF<sub>2</sub>
  - D. Prostaglandin PGH<sub>2</sub>
  - E. Prostacyclin PGI<sub>2</sub>
5. Interleukin-2 is produced by T-lymphocytes to stimulate their proliferation. Name the class of hormones which is related to according this feature of action:
- A. Endocrine hormones
  - B. Paracrine hormones
  - C. Autocrine hormones
  - D. Neurotransmitters
  - E. Secondary messengers
6. Special protein is produced by CD4-complement cells of immune system in a response of virus attack on human organism. Name it:
- A. Ceruloplasmin
  - B. Alpha<sub>2</sub>-macroglobulin
  - C. Interferon
  - D. Serum albumin
  - E. C-reactive protein

7. Cyclooxygenase is found in tissues of humans as the key enzyme for the production of prostaglandins. Name the substrate for this enzyme:
- A. Phosphatidyl choline
  - B. Cholesterol
  - C. Methionine
  - D. Arachidonic acid
  - E. Stearic acid
8. Name the hormone whose function may be associated with stimulation of Phospholipase A<sub>2</sub> needed for the release of arachidonic acid from phospholipid molecule:
- A. Epinephrine
  - B. Insulin
  - C. Growth hormone
  - D. Glucagon
  - E. Cortisol
9. Name the prostaglandin that is precursor for a number of prostaglandins including prostacyclins and thromboxanes:
- A. Pregnenolone
  - B. Prostaglandin PGH<sub>2</sub>
  - C. Prostaglandin PGF<sub>2</sub>
  - D. Prostaglandin PGE<sub>2</sub>
  - E. Prostaglandin PGI<sub>2</sub>
10. Find out the organic compound whose presence in a cell can inhibit the prostaglandin synthesis:
- A. Glucagon
  - B. Benzoic acid
  - C. Ibuprofen
  - D. Barbituric acid
  - E. GABA

11. Slow-reacting substances of anaphylaxis are produced from arachidonic acid due to enzyme:

- A. Cyclooxygenase
- B. PGG<sub>2</sub> peroxidase
- C. 5-Lipoxygenase
- D. 5-Transmethylase
- E. Gamma-glutamyltransferase

12. Name the hormone produced by cells related to immune system of humans:

- A. Insulin
- B. Insulin-like growth factor I
- C. Somatomedin C
- D. Interleukin-6
- E. Gastrin

13. Name the type of cells whose function is to be involved in humeral answer of immune system and to produce special hormones to regulate their proliferation:

- A. Monocytes
- B. Platelets
- C. Erythrocytes
- D. Lymphocytes
- E. Macrophages

14. Name the index of blood plasma whose content will be increased after TSH secretion:

- A. Calcium ions
- B. Ammonia
- C. Thyroxin
- D. Uric acid
- E. Cortisol

15. What influence on anterior lobe of pituitary gland is found for somatostatin?

- A. Protein degradation induction
- B. The feed-back inhibition of all tropic hormones secretion



- C. The suppression of growth hormone (GH) secretion, only
  - D. The suppression of GH, TSH secretion
  - E. Calcium mineralization stimulation
16. What factor can decrease the ACTH secretion by anterior lobe of pituitary gland:
- A. Excess levels of glucocorticoids in the blood
  - B. Melanoliberein
  - C. Corticoliberin
  - D. Excess calcium levels in the blood
  - E. Low levels of glucose in the blood
17. Find the condition for glucagon secretion:
- A. High levels of calcium in the blood
  - B. Low levels of glucose in the blood
  - C. High levels of glucose in the blood
  - D. High levels of cholesterol in the blood
  - E. Low levels of cholesterol in the blood
18. Find the ions content whose levels in the blood plasma is regulated by aldosterone:
- A. Calcium ions
  - B. Copper ions
  - C. Iron ions
  - D. Sodium ions
  - E. Phosphate ions
19. Point the hormone that can stimulate lipogenesis in adipose tissue at hyperglycemia state:
- A. Insulin
  - B. Aldosterone
  - C. Glucagon
  - D. Thyroxin
  - E. Prostacyclin

20. Name the hormone whose function is to suppress the cholesterol synthesis in the liver:

- A. Growth hormone
- B. Aldosterone
- C. Glucagon
- D. Insulin
- E. Prostacyclin

21. Find the key enzyme for all prostanoids formation in humans:

- A. Cyclooxygenase
- B. Prostaglandin isomerase
- C. Transferase
- D. Monoamino oxidase
- E. Hemoglobin oxygenase

22. Name the drug whose function is to inhibit the cyclooxygenase of arachidonic acid in human tissues:

- A. Vicasol
- B. Leukomycin
- C. Indomethacin
- D. Cortisol
- E. Hydrocortisone

23. Examination of the patient revealed hyperkalaemia and hyponatraemia. Low secretion of which hormone may cause such changes?

- A. Aldosterone
- B. Parathyroid hormone
- C. Atrial natriuretic peptide
- D. Cortisol
- E. Vasopressin

24. A 44-year-old woman complains of common weakness, heart pain, 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 pathogenic mechanism of obesity?

- A. Decreased production of glucagon
- B. Decreased production of thyroid hormones
- C. Increased production of mineralocorticoids
- D. Increased production of insulin
- E. Increased production of glucocorticoids

25. A man after 1,5 liter blood loss has suddenly reduced diuresis. The increased secretion of what hormone caused this diuresis alteration?

- A. Vasopressin
- B. Corticotropin
- C. Cortisol
- D. Parathyroid gland hormone
- E. Atrial natriuretic hormone

26. 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 blood serum of this woman?

- A. ACTH
- B. Mineralocorticoids
- C. Cortisol
- D. Insulin
- E. Thyroxin

27. Secretion of what gastrointestinal hormones will be primarily decreased as a result of duodenum removal?

- A. Neurotensin
- B. Gastrin and histamine
- C. Cholecystokinin and secretin
- D. Gastrin
- E. Histamine

28. A person has reduced diuresis, hypernatremia, hypokalemia. Hypersecretion of what hormone can cause such changes?

- A. Adrenalin
- B. Aldosterone
- C. Vasopressin
- D. Atrial natriuretic peptide
- E. Parathyroid gland hormone

29. People adapted to high external temperatures have such peculiarity: profuse sweating isn't accompanied by loss of large volumes of sodium chloride. This is caused by the effect of the following hormone upon the respiratory glands:

- A. Cortisol
- B. Natriuretic
- C. Aldosterone
- D. Vasopressin
- E. Thyroxin

30. A patient suffering from pheochromocytoma complains of thirst, dry mouth, hunger. Blood test for sugar revealed hyperglycemia. What type of hyperglycemia is it?

- A. Hypercorticoid
- B. Adrenal
- C. Alimentary
- D. Hypoinsulinemic
- E. Somatotropic

31. A patient who suffers from pneumonia has high body temperature. What biologically active substances play the leading part in origin of this phenomenon?

- A. Leukotrienes
- B. Histamine
- C. Serotonin
- D. Bradykinin
- E. Interleukin

32. Utilization of arachidonic acid via cyclooxygenase pathway results in formation of some bioactive substances. Name them:

- A. Biogenic amines
- B. T3 and T4
- C. Somatomedins
- D. Insulin-like growth factors
- E. Prostaglandins

33. Insulin stimulates one process of lipid metabolism in adipose tissue, when the glucose intake is abnormally high. Name it:

- A. Lipolysis
- B. High Fatty Acids (HFA) synthesis
- C. HFA  $\beta$ -oxidation
- D. Glyconeogenesis
- E. Ketogenesis

34. How does epinephrine influence the glucose level in the blood?

- A. Increases, stimulating glycogen destruction in the liver
- B. Decreases, stimulating gluconeogenesis in the liver
- C. Does not influence
- D. Decreases, inhibiting the glycogen synthesis in the liver
- E. Decreases, inhibiting the glycolysis in muscles

35. Point the hormone that decreases the rate of lipolysis:

- A. Epinephrine
- B. Thyroxin
- C. Insulin
- D. Somatotropin
- E. Glucagon

36. Point the hormone that can stimulate phosphorolysis of glycogen in the liver:

- A. Insulin
- B. Glucagon
- C. Somatostatin

D. Aldosterone

E. Thyroxin

37. Find the factor causing the suppression of thyroliberin production in hypothalamus:

A. High levels of glucose in the blood

B. High levels of Triiodothyronine in the blood

C. Low levels of Thyroxin in the blood

D. Low levels of Triiodothyronine in the blood

E. High levels of Somatomedin C in the blood

38. Find the eicosanoid that stimulates aggregation of platelets in the blood stream:

A. Prostaglandin E2

B. Leukotriene

C. Ceruloplasmin

D. Thromboxane A2

E. Prostacyclin

39. Point the substance that is used as mediator of inflammation process in human tissue:

A. Citrate

B. Leukotriene

C. Serotonin

D. Prostaglandin E2

E. Glucose

40. Name the factor of protein nature produced by lymphocytes at viral infections in patients:

A. Calcitonin

B. Interferon gamma

C. Calmodulin

D. Parathyroid hormone

E. Calcitriol

**Topic 10. Biochemistry of muscular and connective tissues**

1. The high levels of creatine phosphokinase (CPK, MB-isozyme) and lactate dehydrogenase LDH1 activity were revealed in patient`s blood serum. Point the most probable pathology in the patient:

- A. Hepatitis
- B. Myocardium infarction
- C. Osteoarthritis
- D. Pancreatitis
- E. Cholecystitis

2. Name the polysaccharide represented in connective tissue:

- A. Collagen
- B. Elastin
- C. Laminin
- D. Hyaluronic acid
- E. Fibrillin

3. Name the metabolic pathway used as the main energy source for myocardium contraction at healthy humans:

- A. Anaerobic glycolysis
- B. Aerobic glycolysis
- C. Glycogen breakdown
- D. Oxidation of High Fatty Acids
- E. Pentose Phosphate cycle

4. It is established that there is specific system of energy supply in muscular cell. Point the name of this system:

- A. Renin-angiotensinogen system
- B. Creatine phosphate kinase system
- C. Adenylate cyclase system
- D. Translation system of a cell

- E. Palmitate synthase complex
5. There are some proteins in muscles: actin, myosin, actomyosin, tropomyosin, troponin. What a specific group of proteins they are related to?:
- A. Enzymes
  - B. Fibrilla proteins
  - C. Stroma proteins
  - D. Calcium conjugated proteins
  - E. Coagulants
6. It is established that creatine synthesis is in need of three amino acids as substrates. Find their names:
- A. Ala, Ser, Glu
  - B. Arg, Gly, Met
  - C. Tre, Ile, Val
  - D. Phe, Trp, Val
  - E. Ala, Val, Leu
7. Point the substance whose level in the blood plasma correlates with the volume of physical loading for skeletal muscular tissue:
- A. Ammonia
  - B. Urea
  - C. Creatine
  - D. Creatinine
  - E. Uric acid
8. Vitamin C deficiency causes the disorder in collagen synthesis because two enzymes in this synthesis are in need for the use of ascorbic acid. Name one of them:
- A. Pyruvate dehydrogenase
  - B. Acetyl – CoA carboxylase
  - C. Prolyl hydroxylase
  - D. Lactate dehydrogenase
  - E. Phenylalanine hydroxylase



9. The metabolism disturbance in myocardium in a case of ischemic heart disease is followed by the decrease of ATP and creatine phosphate concentrations. Point the reason of this event:

- A. Glycolysis is activated in myocardium
- B. Ischemic hypoxia causes the inhibition of all the processes in mitochondria
- C. Glucose is not destroyed in myocardium
- D. The oxidative phosphorylation is activated in myocardium
- E. The accumulation of glucose is in myocardium

10. Point the factors whose levels in the intracellular space of muscular cell influence the rate of muscular contraction:

- A. ATP levels
- B. Calcium ions content
- C. Magnesium ions content
- D. Stroma proteins content
- E. All the factors above are important

11. 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 protein structure alteration in connective tissue. Name it:

- A. Ovalbumin
- B. Collagen
- C. Myosin
- D. Troponin
- E. Mucin

12. 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 and lysine radicals
- B. Detaching of N-ended peptide
- C. Formation of polypeptide chains

D. Glycosylation of hydroxylysine residues

E. Removal of C-terminal peptide from procollagen

13. A patient with serious damage of muscular tissue was admitted to the trauma department. What biochemical urine index will be increased in this case?

A. Creatinine

B. Common lipids

C. Uric acid

D. Glucose

E. Mineral salts

14. A 46-year-old female patient has a continuous history of progressive muscular Duchenne dystrophy. What enzyme activity changes in the blood will be of diagnostic value in this case?

A. Lactate dehydrogenase

B. Glutamate dehydrogenase

C. Adenylate cyclase

D. Pyruvate dehydrogenase

E. Creatine phosphokinase

15. A 53-year-old male patient is diagnosed with Paget's disease. The concentration of oxyproline in his daily urine is sharply increased, which primarily means the intensified disintegration of:

A. Albumin

B. Hemoglobin

C. Collagen

D. Fibrinogen

E. Keratin

16. Collagen is represented in different types, which are usually classified on the basis of the:

A. Type of carbohydrate present

B. Cysteine content

C. Hydroxyproline and hydroxylysine content

- D. Types of peptide chains present
  - E. Glycine content
17. ATPase activity needed for muscle contraction is a component of:
- A. The amino-terminal globular head of myosin
  - B. The carboxy-terminal tail region of myosin
  - C. Troponin T
  - D. Actin
  - E. Troponin C
18. Correct statements regarding creatinine include all of the following **except**:
- A. Creatinine is formed by the spontaneous cyclization of a constant fraction of muscular creatine phosphate
  - B. The excretion of creatinine in the urine of adults is very constant from day to day
  - C. Creatinine is a precursor of creatine
  - D. Urinary creatinine levels help to estimate the muscular mass in person
  - E. Blood level of creatinine is a good indicator of kidney function
19. It's suspected that a child has a progressing muscular dystrophy. What urine component is increased and will confirm the diagnosis:
- A. Hippuric acid
  - B. Creatine
  - C. Ketone bodies
  - D. Glucose
  - E. Urea
20. Choose the enzyme of the blood plasma, whose activity increases in ten or more times for 3-4 hours after myocardium infarction:
- A. Aspartate transaminase
  - B. Leucine aminopeptidase
  - C. Alkaline phosphatase
  - D. Acidic phosphatase
  - E. Arginase
21. Point the amino acids that are determined in the structure of collagen, only:

- A. Glycine and glutamic acid
  - B. Proline and lysine
  - C. Hydroxyproline and hydroxylysine
  - D. Desmosin and proline
  - E. Glutamate and aspartate
22. Choose an enzyme which takes part in ATP resynthesis in the muscle tissue:
- A. Glucokinase
  - B. Creatine kinase
  - C. Hexokinase
  - D. Pyruvate kinase
  - E. Pyruvate carboxylase
23. Choose a substance that can be the product of enzymatic hydrolysis of elastin, only:
- A. Glycine
  - B. Pepsin
  - C. Nucleic acid
  - D. Desmosin
  - E. Ribose
24. Choose the location of guanidoacetate formation as the step of creatine synthesis in human organism:
- A. Liver
  - B. Kidney
  - C. Lungs
  - D. Heart tissue
  - E. Skin
25. Triple helix conformation is seen in one compound from proposed. Choose it:
- A. Collagen
  - B. Fibrinogen
  - C. Histone H1
  - D. Serum amylase

E. F-actin

26. The cardiac muscle utilizes all of the following compounds from the blood except one. Point it:

A. Glucose

B. Acetone

C. Fatty acids

D. Acetoacetic acid

E. Alanine

27. A deficiency of copper affects the formation of normal collagen by reducing the activity of one enzyme from following list. Choose it:

A. Glucosyl transferase

B. Galactosyl transferase

C. Prolyl hydroxylase

D. Lysyl oxidase

E. Collagenase

28. What does cardiac muscle prefer as source of energy for contraction?

A. Fatty acids

B. Glucose

C. Ketone bodies

D. Glycogen

E. Fructose

29. Hydroxylation of proline to hydroxyproline in collagen synthesis requires all **except one. Point it:**

A. Pyridoxal phosphate

B. Ascorbic acid

C. O<sub>2</sub>

D. Specific hydroxylase

E. Iron ion

30. Creatine is formed metabolically using one compound listed below. Choose it:

A. Tryptophan

- B. S-adenosyl methionine
- C. Aspartic acid
- D. Valine
- E. Leucine

31. Three residues (Gly-X-Y-) are repeated many times, and it is the absolute requirement for formation of the triple helix of collagen molecule type 1. What amino acid and its derivative mainly is represented as letters X and Y?

- A. Proline
- B. Tryptophan
- C. Lysine
- D. Valine
- E. Leucine

32. Choose the mechanism for proline conversion to hydroxyproline:

- A. Vitamin C mediated hydroxylation
- B. Reverse hydroxylation
- C. Vitamin H mediated carboxylation
- D. Post translation induction
- E. Vitamin K mediated hydroxylation

33. Name biochemical tests used for diagnostics of muscular dystrophy development:

- A. Creatine content in the blood plasma and urine
- B. Creatinine content in the blood plasma
- C. Creatine phosphate kinase activity in the blood plasma
- D. Myofibril proteins content in tissue homogenate obtained due to biopsy method
- E. All that is placed above

34. Point the location of guanidoacetate synthesis and substrates for it:

- A. Kidney; Arginine+Glycine
- B. Liver; Methionine+Glycine
- C. Liver; Cysteine+Arginine
- D. Muscle; Citrulline+Aspartate

E. Brain; Methionine+Arginin

35. Glucose aminoglycans are carbohydrate components of proteoglycans represented in connective tissues. Main of them are shown in this list, but there is **one exception. Find it:**

- A. Hyaluronic acid
- B. Chondroitin sulfate
- C. Heparin
- D. Dermatan sulfate
- E. Phospho adenosyl phospho sulfate

36. Find the protein of myofibril that is able to attract calcium ions in the mechanism of skeletal muscular tissue contraction:

- A. Troponin C
- B. Troponin I
- C. Troponin F
- D. Actin
- E. Myosin

37. Name the pathways that are main for the promotion of ATP production in skeletal muscular tissue under extensive physical loading (short time duration):

- A. Aerobic glycolysis and Pyruvate oxidative decarboxylation
- B. Anaerobic glycolysis and Glycogenolysis
- C. Pyruvate oxidative decarboxylation and Citric acid cycle
- D. High fatty acids oxidation and Citric acid cycle
- E. Hexose monophosphate shunt and Anaerobic glycolysis

38. Name the type of reaction that is in use to produce Creatine from Guanidoacetate:

- A. Transmethylation
- B. Decarboxylation
- C. Hydroxylation
- D. Hydration
- E. Carboxylation

39. The investigation of creatine and creatinine contents in the blood plasma and urine of patient was made, and the probable diagnosis was proposed by the doctor: muscular dystrophy. Choose the correct correlations for values of these parameters that proved the diagnosis:

- A. Blood creatine ↑, blood creatinine ↓
- B. Blood creatine is normal, blood creatinine ↑
- C. Urine creatine ↑, urine creatinine ↓
- D. Urine creatine is absent, urine creatinine ↑
- E. Positions A and C are correct

40. High levels of sugars called glycosaminoglycans (GAGs) in the urine or deficient activity of the enzyme, alpha-L-iduronidase, in the blood of kid may indicate the pathology:

- A. Mucopolysaccharidosis type 1
- B. Collagenosis type 1
- C. Tay-Sax syndrome
- D. Goshe disease
- E. The correct answer is absent

### **Topic 11. Biochemistry of nervous tissue**

1. Simple and conjugated proteins are in the composition of nervous tissue. Point simple proteins of this tissue type:

- A. Albumins, globulins
- B. Prolamins, glutelins
- C. Phosphoproteins
- D. Nucleoproteins
- E. Lipoproteins

2. Point out the amino acids which function as neurotransmitters in CNS:

- A. Glutamic acid
- B. Aspartic acid
- C. Glycine



- D. Dihydroxyphenylalanine
  - E. All the amino acids named above
3. There are special supportive proteins in the white matter of nervous tissue. Point them:
- A. Actins
  - B. Myosins
  - C. Troponins
  - D. Albumins
  - E. Neuroscleroproteins
4. Choose the main catabolic pathway for glucose in the brain tissue:
- A. Aerobic oxidation up to carbon dioxide and water
  - B. Anaerobic glycolysis
  - C. Pentose Phosphate Cycle
  - D. Glycogenesis
  - E. Gluconeogenesis
5. The myelin substance is a complex of some compounds. What prevailing components are in it?
- A. Protein, lipids
  - B. Carbohydrates, lipids
  - C. Nucleic acids
  - D. Adenine-linked nucleotides, creatine phosphate
  - E. Amino acids, mineral substances
6. Point the lipid which really not synthesized in the brain of adults:
- A. Sphingomyelin
  - B. Cerebroside
  - C. Ganglyoside
  - D. Sulfatide
  - E. Cholesterol
7. Point the neurotransmitter that is isolated from neuron synapses of the sympathetic nervous system, mainly:

- A. Epinephrine
  - B. Dopamine
  - C. Acetylcholine
  - D. Glycine
  - E. Serotonin
8. Name the main energy source substrate for the brain:
- A. Phospholipids
  - B. Fatty acids
  - C. Glucose
  - D. Ketone bodies
  - E. Amino acids
9. Point the enzyme that catalyzes the degradation of some neurotransmitters in the brain:
- A. Aldolase
  - B. Glutamate dehydrogenase
  - C. Monoamino oxidase
  - D. Hexokinase
  - E. Malate dehydrogenase
10. There is the feature of the chemical composition of neuroglia: one acidic protein has very high concentration. Name it:
- A. Protein S-100
  - B. Myosin
  - C. Albumin
  - D. Choline esterase
  - E. Neuroscleroprotein
11. Depressions and emotional insanities result from the deficit of noradrenalin, serotonin and other biogenic amines in the brain. Their concentration in the synapses can be increased by means of the antidepressants that inhibit the following enzyme:
- A. Phenylalanine-4-monoxygenase
  - B. Monoamine oxidase

C. D-amino-acid oxidase

D. L-amino-acid oxidase

E. Diamine oxidase

12. 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. Urea

B. Histamine

C. Glutamine

D. Ammonia

E. Bilirubin

13. Disruption of nerve fiber myelinogenesis causes neurological disorders and mental retardation. These symptoms are typical for hereditary and acquired alterations in the metabolism of:

A. Phosphatidic acid

B. Cholesterol

C. Sphingolipids

D. Neutral fats

E. Higher fatty acids

14. Decarboxylation of glutamate induces production of gamma-aminobutyric acid (GABA) neurotransmitter. After inactivation GABA is converted into a metabolite of the citric acid cycle, that is:

A. Fumarate

B. Succinate

C. Oxaloacetate

D. Malate

E. Citric acid

15. 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. Serotonin
- C. Dopamine
- D. Noradrenalin
- E. Adrenalin

16. Name the enzyme which produces acetylcholine (neurotransmitter):

- A. Acetylcholinesterase
- B. Cholinesterase
- C. Acetylcholine dehydrogenase
- D. Acetylcholine carboxykinase
- E. Choline acetyltransferase

17. The peptides with opiate-like activity (endorphins and enkephalins) have been shown to be derivatives of:

- A.  $\beta$ -Lipotropin
- B. Adrenocorticotrophic hormone
- C. Growth hormone
- D. Luteotropin
- E. Proinsulin

18. A special role in the metabolism of catecholamine mediators is assigned to the enzyme:

- A. Glutamate decarboxylase
- B. S-adenosylmethionine decarboxylase
- C. Acetylcholinesterase
- D. Monoamine oxidase
- E. Glutamate dehydrogenase

19. Ammonia is a strong poison, and the nervous system is highly susceptible to it. Choose the amino acid that plays a special role in the neutralization of ammonia:

A. Alanine

B. Arginine

C. Valine

D. Methionine

E. Glutamic acid

20. Point the major fuel for the brain after several weeks of starvation:

A. Glucose

B. Fatty acid

C. Beta hydroxy butyrate

D. Tyrosine

E. Phenylalanine

21. Neurotransmitter serotonin is derived from one amino acid. Choose it:

A. Phenylalanine

B. Serine

C. Tryptophan

D. Cysteine

E. Proline

22. In the brain ammonia is converted to product from following list. Point out it:

A. Aspartate

B. Glutamine

C. Alanine

D. Histidine

E. Urea

24. Which substance does not cross the blood brain barrier?

A. Insulin

B. Ascorbic acid

C. Bilirubin

D. Glucose

E. Oxygen

24. The brain contains relatively high amounts of all compounds from the following list except one. Point out it:

- A. Glutamine
- B. N-Acetylaspartate
- C. Gamma-aminobutyric acid (GABA)
- D. Glycogen
- E. Proteolipid

25. Point the main pathways of catabolism in brain:

- A. Glycolysis and Citric Acid Cycle
- B. Glycogenolysis and Glycogenesis
- C. Glycogenolysis and Citric Acid Cycle
- D. Embden-Meyerhof pathway and HMP shunt
- E. Oxidation of fatty acids and ketogenesis

26. Choose the neurotransmitter from following list:

- A. Serine
- B. Glutathione
- C. Glutamate
- D. Phenylalanine
- E. Alanine

27. The application of drug atropine is based on its ability to block the muscarinic receptors. Name a neurotransmitter that takes place in the transmission of impulses binding with this type receptor in the autonomic nervous system:

- A. Acetylcholine
- B. Nor-epinephrine
- C. Dopamine
- D. Serotonin
- E. Glycine

29. The content of certain substance is sharply decreased in a striate body of a brain at Parkinson`s disease. Point it:

- A. Dopamine

B. Acetylcholine

C. GABA

D. Histamine

E. Nor-epinephrin

30. Name energy sources that will be utilized in neurons under starvation more than 3 days in duration:

A. Ketone bodies

B. Glucose

C. Fructose

D. Glucose-6-phosphate

E. Citrate

31. Mental retardation develops in patient at this disorder:

A. Viral hepatitis

B. Muscular dystrophy

C. Phenylketonuria

D. Sickle-cell anemia

E. Renal insufficiency

32. Name enzymes whose activity promotes utilization of ammonia in brain tissue:

A. Glutamate dehydrogenase

B. Glutamine synthetase

C. Asparagine synthetase

D. Glutaminase

E. Correct answers are in positions A, B, C

33. What compounds are present in myelin substance? :

A. Sphingomyelin

B. Cholesterol

C. Proteins

D. Cerebrosides

E. All the proposed

34. Name the neurotransmitter that is derived from amino acid due to vitamin B6-dependent alpha-decarboxylase action:

- A. GABA
- B. Dopamine
- C. Tryptamine
- D. Serotonin
- E. All the proposed

35. What amino acids are real neurotransmitters in the brain tissue? :

- A. GABA
- B. Glutamic acid
- C. Glycine
- D. N-acetyl-aspartic acid
- E. All the proposed

36. Name the mechanism of acetyl choline action on muscular cell if it is linked to nicotinic receptor at muscular endplate:

- A. Sodium-Potassium ion channel mediated mechanism
- B. Calcium-Calmodulin-dependent protein kinase stimulation
- C. Troponin I stimulation
- D. G<sub>s</sub>-coupled Adenylate cyclase stimulation
- E. G<sub>i</sub>- coupled Adenylate cyclase suppression

37. Name the lipids which are completely absent in cells of nervous tissue:

- A. Cholesterol
- B. Phosphatidyl choline
- C. Phosphatidyl inositol
- D. Phosphatidic acid
- E. Triacylglycerol

38. Name the exogenous factor which can suppress the melatonin synthesis from serotonin in healthy person:

- A. Sunlight
- B. Dark medium



C. Overcooling

D. The decrease of Methionine, Tryptophan content in food sources

E. Positions A and D are correct

39. Vitamin B6 and C severe deficiency obligatory will be associated with abnormalities in nervous tissue function, because specific neurotransmitters will be not produced in required content. Name one of them:

A. Nor-epinephrine

B. Acetyl choline

C. Tryptamine

D. Glutamic acid

E. Glycine

40. Toxicity of ammonia in the brain tissue is explained using those notion: **“Accumulation of NH<sub>3</sub> in neurons causes the...”** Choose the correct continuation:

A. Stimulation of reductive amination of alpha-ketoglutarate

B. Suppression of Citric acid cycle

C. Change pH of the medium in intracellular space

D. Decrease of NADH content in use by electron transport chain

E. All the positions are correct

## **Topic 12. Biochemical functions of the liver at healthy and diseased people**

1. Point the conjugation agent used for conjugated bilirubin formation in the liver cell:

A. Glycine

B. Cysteine

C. UDP-glucuronic acid

D. PAPS

E. Acetyl-CoA

2. Find the protein name that is synthesized in the liver, only:

A. Albumin of blood plasma

- B. Alpha2-macroglobulin
  - C. Alpha1-antitrypsin
  - D. Ceruloplasmin
  - E. All the names above are right answers
3. Find the enzyme of liver tissue participating in the detoxification of cyanides:
- A. NADH - dehydrogenase
  - B. Cytochrome b
  - C. Thiosulfate transferase
  - D. Cytochrome c
  - E. Cytochrome P450
4. Point the enzyme whose activity is determined in the blood plasma of patients to estimate the liver parenchyma damage:
- A. Lactate dehydrogenase
  - B. Palmitate synthase complex
  - C. Alanine amino transferase
  - D. Cytochrome c<sub>1</sub>
  - E. Adenylate cyclase
5. Propose the enzyme name which is specific for liver tissue, only:
- A. Succinate dehydrogenase
  - B. Arginase
  - C. Alanine amino transferase
  - D. Aspartate amino transferase
  - E. Isocitrate dehydrogenase
6. Point the amino acid that is conjugative agent at Quick`s test:
- A. Lactic acid
  - B. Glycine
  - C. Valine
  - D. Leucine
  - E. Histidine

7. Point out the liver enzyme participating in the neutralization of ammonia:
- A. Glutamine synthetase
  - B. Glutamate dehydrogenase
  - C. Carbomoyl phosphate synthetase
  - D. Alanine amino transferase
  - E. Positions A, B, C are correct
8. Name the lipid mainly synthesized in the liver:
- A. Ganglyoside
  - B. Phospatidyl ethanol amine
  - C. Cholesterol
  - D. Phosphatidyl choline
  - E. Phosphatidyl inositol
9. This lipoprotein class is synthesized mostly in the liver, and is the main for the transport of triacylglycerols and cholesterol from the liver to the blood. Name it:
- A. IDL
  - B. HDL
  - C. LDL
  - D. VLDL
  - E. Chylomicrons
10. Point the enzyme whose activity is decreased in the blood plasma at liver cirrhosis in patient:
- A. Glutamine synthetase
  - B. Glutamate dehydrogenase
  - C. Alanine amino transferase
  - D. Choline esterase
  - E. UDP - glucoronyl transferase
11. Examination of which of the following substances excreted with urine can characterize the state of antitoxic function of the liver?
- A. Uric acid
  - B. Creatinine

- C. Ammonium salts
- D. Hippuric acid
- E. Amino acids

12. A patient with symptoms of acute alcohol poisoning was brought to the hospital. What carbohydrate metabolism changes are typical for this condition?

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

13. Disulfiram 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

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

15. Confirmation of elevation of alkaline phosphatase of hepatic origin at cholestasis is by:

- A. SGOT (Serum glutamic oxaloacetic transaminase)
- B. SGPT (Serum glutamic pyruvic transaminase)

C. GGT (Gamma-glutamyl transferase)

D. LDH (Lactate dehydrogenase)

E. Acid phosphatase

16. Choose the urine index that is used to estimate detoxification function of the liver:

A. Citric acid

B. Acetyl-CoA

C. Pyruvate

D. Hippuric acid

E. Uric acid

17. One of liver functions is the maintenance of glucose concentration in the blood. Point the carbohydrate metabolic pathway in the liver that provides realization of this function at exception of diet carbohydrates:

A. Aerobic oxidation of glucose

B. Anaerobic oxidation of glucose

C. Gluconeogenesis

D. Pentose phosphate cycle

E. Glycogenesis

18. There is yellowness of the skin at newborn. The content of total bilirubin in the blood is moderately increased due to indirect bilirubin. The fecal level of stercobilinogen is raised, bilirubin is not present in the urine. What type of a jaundice take place:

A. Prehepatic jaundice

B. Hepatic jaundice

C. Posthepatic jaundice

D. Crigler-Najjar syndrome

E. Gilbert syndrome

19. The activity of UDP-glucuronyl transferase is reduced at Gilbert Syndrome. What metabolite concentration will raise in the blood at these patients?

A. Direct bilirubin

- B. Indirect bilirubin
- C. Mesobilirubinogen
- D. Stercobilinogen
- E. Mesobilinogen

20. Liver does not produce one compound from the following list. Point it:

- A. Albumin
- B. Gamma-globulin
- C. Fibrinogen
- D. Prothrombin
- E. Haptoglobin

21. Choose the right continuation of the statement: “In mammalian bile, the bile acids are normally present \_\_\_\_\_”.

- A. In their free form
- B. As cholesterol esters
- C. As conjugated with glycine or taurine
- D. As conjugated with beta-glucuronic acid
- E. As conjugated with bilirubin

22. Liver synthesizes all the compounds from the following list **EXCEPT**:

- A. Clotting factor II
- B. Clotting factor XII
- C. Urea
- D. Stercobilin
- E. Cholesterol

23. Choose the process that is not placed in the liver:

- A. Urea synthesis
- B. Bile acid synthesis
- C. Detoxification of xenobiotics
- D. Cortisol synthesis
- E. Deposition of fat soluble vitamins

24. Glucose-6-Phosphate is the key metabolite of carbohydrate metabolism. Point the metabolic pathway for its utilization which is present in liver:

- A. Glycogenesis
- B. Gluconeogenesis
- C. Glycolysis
- D. Hexose Monophosphate Shunt
- E. All of the above

25. What process is stimulated in the liver at starvation? :

- A. Glycogenolysis
- B. Gluconeogenesis
- C. Non-oxidative phase of HMP
- D. Ketogenesis
- E. All of the above

26. The rate of high fatty acids synthesis in the liver is very fast. Point the precursor for this process and its intracellular location:

- A. Acetyl CoA, Matrix
- B. Acetyl CoA, Cytoplasm
- C. Glucose, Matrix
- D. Amino acids, Cytoplasm
- E. Amino acids, Matrix

27. Point the pathways placed mainly in the liver:

- A. 25-hydroxycholecalciferol synthesis
- B. Taurine synthesis
- C. Cholic acid synthesis
- D. Sex hormone binding protein synthesis
- E. All of the above

28. Liver cirrhosis in patient is accompanied with:

- A. Disturbed production of urea
- B. Accumulation of bililrubin total in the blood
- C. Hypoproteinemia

- D. Disturbed function of coagulation system of the blood
  - E. All that is placed above
29. Point the process of carbohydrate metabolism which is occurred only in liver:
- A. Glycogenolysis
  - B. Glycogenesis
  - C. Heparin synthesis
  - D. Pentose phosphate pathway
  - E. Aerobic glycolysis
30. What blood serum enzyme is elevated specifically to prove the diagnosis: alcoholic cirrhosis of liver?:
- A. Alcohol dehydrogenase
  - B. Creatine kinase
  - C. Acidic phosphatase
  - D. Gamma-glutamyl transpeptidase
  - E. Aspartate transaminase

**Topic 13. Xenobiotic transformation in humans. Microsomal oxidation**

1. Point the main place for the microsomal oxidation location in a cell:
- A. Nucleus
  - B. Cytoplasm
  - C. EPR, smooth part
  - D. EPR, rough part
  - E. Lysosomes
2. Find the correct definition of the term "xenobiotic":
- A. A substance that is an obligatory component of food products
  - B. A substance that is unnatural for humans
  - C. A substance that is synthesized in small quantities in humans
  - D. A substance that regulates metabolism in the organism
  - E. A substance that is a terminal product of metabolism



3. Find the enzyme participating in the function of the microsomal monooxygenase chain:

- A. НАДН - dehydrogenase
- B. Cytochrome b
- C. Cytochrome c<sub>1</sub>
- D. Cytochrome c
- E. Cytochrome P450

4. Point the enzyme of monooxygenase chain as a final electron acceptor from NADPH:

- A. Cytochrome b<sub>5</sub>
- B. Cytochrome b
- C. Cytochrome P450
- D. Cytochrome c<sub>1</sub>
- E. Cytochrome aa<sub>3</sub>

5. Monooxygenase and reductase chains of EPR (smooth part) are necessary for:

- A. Saturated HFA synthesis
- B. Structure modification of endogenous substrates only
- C. Structure modification of xenobiotics and endogenous substrates
- D. Structure modification of xenobiotics only
- E. Energy reception at the oxidation of xenobiotics

6. Point conjugative agent for the detoxification of heterocyclic alcohols in the liver:

- A. Taurine
- B. Glycine
- C. Valine
- D. PAPS
- E. Histidine

7. Name the liver enzyme participating in the neutralization of xenobiotics, their metabolites and harmful endogenous products:

- A. Glutamine synthetase

- B. Glutamate dehydrogenase
  - C. Alanine amino transferase
  - D. Carbomoyl phosphate synthetase
  - E. UDP - glucoronyl transferase
8. What peptide participates in the conjugation of some harmful products in the liver:
- A. Glutathione
  - B. Methionine
  - C. Trialanine
  - D. Oxytocin
  - E. Prolylproline
9. Benzoic acid has the formula  $C_6H_5-COOH$  and causes the toxic effect at its accumulation in the liver. Choose the main conjugative agent for this substance:
- A. Glycine
  - B. PAPS
  - C. S-adenosyl methionine
  - D. Glutathione
  - E. Urea
10. Point the enzyme located in the cytoplasm of hepatocytes and participating in the modification of a xenobiotic:
- A. Glutamine synthetase
  - B. Alcohol dehydrogenase
  - C. Alanine amino transferase
  - D. Carbomoyl phosphate transferase
  - E. Glutamate dehydrogenase
11. In course of metabolic process active forms of oxygen including superoxide anion radical are formed in the human body. By means of what enzyme is this anion inactivated?
- A. Catalase
  - B. Glutathione reductase
  - C. Peroxidase

D. Superoxide dismutase

E. Glutathione peroxidase

12. 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. Ornithine

C. Acetoacetate

D. Butyrate

E. Biotin

13. Study of a food colouring agent conversion revealed that utilization of this xenobiotic takes place only in one phase – microsomal oxidation (modification phase). Name an enzyme of this phase:

A. Cytochrome *aa3*

B. Cytochrome C oxidase

C. Cytochrome P-450

D. Cytochrome C1

E. Cytochrome b

14. Name the donor of sulfate group in the conjugation phase of xenobiotics transformation:

A. Glutathione

B. UDP-glucuronic acid

C. 3'-Phospho-adenosine-5'-phospho sulfate

D. Acetyl-CoA

E. S-adenosyl methionine

15. What is the chemical nature of cytochrome P450 prosthetic group? :

A. Nucleotide

B. Heme containing  $\text{Fe}^{3+}$

C. Heme containing  $\text{Fe}^{2+}$

D. Phosphate

E. Heme containing  $\text{Fe}^{2+}/\text{Fe}^{3+}$

16. Choose the exogenous factor (the drug) that can induce the UDP-glucuronyl transferase gene expression in the liver:

A. Calcitriol

B. Thyroxine

C. Riboxin

D. Phenobarbital

E. Thiamine diphosphate

17. All of the following may have a physiological antioxidant role **EXCEPT**:

A. Beta-carotene

B. Vitamin C

C. Selenium ion

D. Iron ion

E. Vitamin E

18. Choose one wrong continuation of a phrase: Oxidation of ethanol...:

A. Occurs, basically, in a liver

B. Is catalyzed by alcohol dehydrogenase

C. Is slowed down at increase  $\text{NADH}/\text{NAD}^+$  in a cell

D. Can proceed under microsomal system action

E. Results in the formation of an intermediate product of Pentose phosphate cycle

19. Choose one wrong continuation of a phrase: Phase I of xenobiotics transformation:

A. Is carried out by enzymes of endoplasmic reticulum

B. Demands presence of NADPH

C. Results in increase of polarity of a substance

D. Occurs in anaerobic conditions

E. Proceeds at participation of cytochrome P450

20. Name the compound metabolized in the liver across detoxification using conjugation agent as xenobiotics do:

A. Bilirubin IX

B. Cholesterol

C. Urea

D. Acetylcholine

E. Uric acid

21. Choose metabolites of methanol which may be produced in the liver:

A. Acetaldehyde + Acetic acid

B. Formaldehyde + Formic acid

C. Pyruvate + Carbon dioxide

D. Fumarate + H<sub>2</sub>O

E. Glyceroaldehyde + NADH

22. Choose the correct statement about hepatic monooxygenases linked with cytochrome P450 :

A. Located mainly in smooth EPR

B. Catalyzes oxidation, reduction and hydrolysis reactions at the same time

C. Certain drug inactivate and certain drug enhance their reactions

D. Positions A, C are correct

E. Their action always causes the detoxification of xenobiotics

23. Point the liver enzyme participating in the neutralization of xenobiotics, their metabolites and harmful endogenous products:

A. Glutamine synthetase

B. Glutamate dehydrogenase

C. Alanine amino transferase

D. Carbomoyl phosphate synthetase

E. UDP-glucuronyl transferase

24. Benzoic acid causes the toxic effect at its accumulation in the liver. Choose the main conjugative agent to detoxify it:

A. Glycine

B. PAPS

C. S-adenosyl methionine

D. Glutathione

E. Acetyl-CoA

25. Conjugation agent Glutamine is in extensive use in the liver to detoxify the back-side product of one amino acid transformation (phenyl acetate) under condition of genetic disorder presence in patient. Name the amino acid and genetic disorder:

A. Valine, Maple syrup urine disease

B. Proline, Prolinuria

C. Phenyl alanine, Phenyl ketonuria

D. Tryptophan, Hartnup`s disease

E. Cystine, Cystinuria

26. Sulfur containing compounds, present in food sources, usually in the large intestine modified by microflora enzymes into methyl mercaptans. They are very toxic for humans. Propose the conjugation agent to detoxify them in the liver:

A. Glycine

B. PAPS

C. S-adenosyl methionine

D. Glutathione

E. Acetyl-CoA

27. Name the detoxification product for indole utilization in the liver found in the urine of any human person:

A. Hippuric acid

B. Phenyl acetyl amine

C. Indican

D. Ammonium thiocyanate

E. The product is absent

28. This endogenous substance undergoes transformations into useful metabolites due to microsomal oxidation reactions using monooxygenases systems linked with isoforms of cytochrome P450. Name it:

A. Cholesterol

B. Glucose

C. Oleic acid

D. Choline

E. Alanine

29. All these compounds are xenobiotics **EXCEPT**:

A. Chloroform

B. Benzene

C. Acetone

D. Toluene

E. Acetylsalicylic acid

30. The detoxification of harmful metabolites and xenobiotics is in need of specific conjugation agents in the liver. Name the conjugation agent that mostly is in use to detoxify different amines:

A. Glycine

B. PAPS

C. S-adenosyl methionine

D. Glutathione

E. UDP-glucuronic acid

## BASIC THEME 10. BIOCHEMICAL PARAMETERS OF BLOOD AND URINE IN THE DIAGNOSIS OF METABOLIC DISORDERS

**Topic 14. Biochemistry of blood. Protein and non-protein components of blood plasma at healthy and diseased people. Buffer systems. Acid-base balance. Blood clotting system. Immune processes**

1. Name the enzyme which is the indicator of myocardium damage if its activity will be increased in the blood plasma in 10 times or more:

A. Alkaline phosphatase

B. Malate dehydrogenase

C. Glutamate dehydrogenase

D. Guanine transaminase

- E. Aspartate transaminase
2. Point the most probable location of the plasma proteins synthesis:
- A. Kidneys
  - B. Muscle tissue
  - C. Nervous tissue
  - D. Liver
  - E. Lungs
3. Name the main blood plasma protein, participating in the blood oncotic pressure maintaining:
- A. Globulin
  - B. Lipoprotein
  - C. Ceruloplasmin
  - D. Hemoglobin
  - E. Albumin
4. Choose the protein, which is not observed in the blood serum of healthy people:
- A. Cryoglobulin
  - B. Albumin
  - C. Transferrin
  - D. Haptoglobin
  - E. Alpha-2-macroglobulin
5. Name the excretory enzyme of the blood plasma:
- A. Alkaline phosphatase
  - B. Malate dehydrogenase
  - C. Glutamate dehydrogenase
  - D. Alanine transaminase
  - E. Aspartate transaminase
6. Blood is the tissue needed for the transport of all absorbed products in the gut after digestion processes. Name the function of the blood that is associated with previous notions:
- A. Body temperature regulatory function



- B. Transport of hormones
  - C. Nutrition function
  - D. The maintenance of acid-base balance in the organism
  - E. Protection against microbial agents
7. Name the blood plasma protein used as inhibitor of some proteolytic enzymes:
- A. Albumin
  - B. Immunoglobulin G
  - C. C-reactive protein
  - D. Alpha-1-antitrypsin
  - E. Ceruloplasmin
8. Name the method used as modern technique for the separation and determination of some proteins content in the blood plasma at the same time:
- A. Dialysis
  - B. Immunoelectrophoresis
  - C. Spectrophotometry method
  - D. X-ray radiation method
  - E. Densitometry method
9. Name the factor of blood coagulation system needed for fibrin formation from fibrinogen:
- A. Plasmin
  - B. Heparin
  - C. Thrombin
  - D. Prothrombin
  - E. Lysine
10. Point the protease of blood that helps to solvate the fibrin clot:
- A. Plasminogen
  - B. Lysolipase
  - C. Plasmin
  - D. Antifibrinogen
  - E. Thromboplastin

11. Point out the permissible range of the pH fluctuation in the blood:

- A. 8.0-8.61
- B. 7.36-7.44
- C. 7.81-7.94
- D. 6.2-6.84
- E. 6.85-7.0

12. Point the non-protein nitrogenous component of the blood plasma that is in a level about 50% of total non-protein nitrogen:

- A. Uric acid
- B. Creatine
- C. Creatinine
- D. Amino acids
- E. Urea

13. Point the blood microelement:

- A. Sodium
- B. Copper
- C. Calcium
- D. Potassium
- E. Magnesium

14. Choose the most powerful buffer system of the blood:

- A. The bicarbonate buffer system
- B. The phosphate buffer system
- C. The protein buffer system
- D. Hemoglobin buffer system
- E. The acetate buffer system

15. Name the index of blood plasma which helps to recognize the change in biliary system function at cholestasis state:

- A. Fibrinogen
- B. Conjugated bilirubin
- C. Uric acid

D. Urea

E. Creatine

16. What is the major transport form of triacylglycerols from the intestine to the liver and other tissues:

A. Chylomicrons

B. LDL

C. VLDL

D. IDL

E. HDL

17. Creatinine level is much higher than normal in the blood plasma, creatinine level in the urine is lower than normal. Choose the probable diagnosis for the patient:

A. Myocardium infarction

B. Renal insufficiency

C. Viral hepatitis

D. Phenylketonuria

E. Muscular dystrophy

18. Metabolic acidosis is observed in patient's organism due to the accumulation of:

A. Sodium ions

B. Glucose

C. Pyruvate

D. Fructose

E. Glycerol

19. Renal insufficiency was proposed to look at patient due to the change of the ratio [Urea]/Residual nitrogen (80%). Name the index of the blood plasma whose content will prove this diagnosis:

A. High levels of sodium ion

B. Low levels of copper ion

C. High levels of glucose

D. High levels of creatinine

E. High levels of creatine

20. Name the indexes of blood plasma whose content may be higher at insulin-dependent diabetes mellitus:

A. Glucose

B. Acetone

C. Pyruvate

D. Acetoacetate

E. All the indexes named above

21. A patient who had been working hard under condition of elevated temperature of the environment has now a changed quantity of blood plasma proteins. What phenomenon is the case?

A. Absolute hyperproteinemia

B. Relative hyperproteinemia

C. Absolute hypoproteinemia

D. Disproteinemia

E. Paraproteinemia

22. 62 y.o. woman complains of frequent pains in the area of her chest and backbone, rib fractures. A doctor assumed myelomatosis (plasmocytoma). What of the following laboratory characteristics will be of the greatest diagnostic importance?

A. Proteinuria

B. Hypoproteinemia

C. Hypoglobulinemia

D. Hyperalbuminemia

E. Paraproteinemia

23. A 4 y.o. child with signs of durative proteinic starvation was admitted to the hospital. The signs were as follows: growth inhibition, anemia, oedema, mental deficiency. Choose the cause of oedema development:

A. Reduced synthesis of lipoproteins

B. Reduced synthesis of glycoproteins

C. Reduced synthesis of hemoglobin

- D. Reduced synthesis of globulins
- E. Reduced synthesis of albumins
24. There is high activity of LDH<sub>1,2</sub>, aspartate aminotransferase, creatine phosphokinase in the blood of patient. In what organs (tissues) the development of pathological process is the most probable?
- A. In the heart muscle {initial stage of myocardium infraction}
- B. In skeletal muscle {dystrophy, atrophy}
- C. In kidneys and adrenals
- D. In liver and kidneys
- E. In connective tissue
25. Analysis of blood serum of a patient revealed the increase of alanine aminotransferase and aspartate aminotransferase levels. What cytological changes can cause such a situation?
- A. Disturbance of genetic apparatus of cells
- B. Cellular breakdown
- C. Disorder of enzyme systems of cells
- D. Disturbance of cellular interrelations
- E. Disturbed energy supply of cells
26. Blood sampling for bulk analysis is recommended to be performed on an empty stomach and in the morning. What changes in blood composition can occur if to perform blood sampling after food intake?
- A. Reduced contents of erythrocytes
- B. Increased contents of erythrocytes
- C. Increased contents of leukocytes
- D. Increased plasma proteins
- E. Reduced contents of thrombocytes
27. A 34-year-old patient was diagnosed with chronic glomerulonephritis 3 years ago. Edema has developed within the last 6 months. What caused the edema?
- A. Liver dysfunction of protein formation
- B. Hyperosmolarity of plasma

C. Proteinuria

D. Hyperproduction of vasopressin

E. Hyperaldosteronism

28. 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 the blood?

A. Metabolic alkalosis

B. Metabolic acidosis

C. Respiratory alkalosis

D. Respiratory acidosis

E. Any changes won't happen

29. A 63-year-old woman developed symptoms of rheumatoid arthritis. Their increase of which blood values indicators could be most significant in proving the diagnosis?

A. R-glycosidase

B. Acid phosphatase

C. Lipoproteins

D. General cholesterol

E. Additive glycosaminoglycans

30. A worker has decreased buffer capacity of blood due to exhausting muscular work. What acidic substance that came to blood caused this phenomenon?

A. 3-phosphoglycerate

B. 1,3-bisphosphoglycerate

C. Lactate

D.  $\alpha$ -ketoglutarate

E. Pyruvate

31. Examination of 27-year-old patient revealed pathological changes in the 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. Leucine aminopeptidase
- B. Xanthine oxidase
- C. Alcohol dehydrogenase
- D. Ceruloplasmin
- E. Carbonic anhydrase

32. After a surgery a 36-year-old woman was given an intravenous injection of concentrated albumin solution. This has induced intensified water movement in the following direction:

- A. From the intercellular fluid to the capillaries
- B. No changes of water movement will be observed
- C. From the intercellular to the cells
- D. From the cells to the intercellular fluid
- E. From the capillaries to the intercellular fluid

33. 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.  $\gamma$ -globulins
- B. Albumins
- C.  $\alpha_1$ -globulins
- D.  $\beta$ -globulins
- E.  $\alpha_2$ -globulins

34. Examination of a 56-year-old female patient 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. Decrease in the concentration of amino acids in blood
- C. Albuminosis

D. Increase in the oncotic pressure in the blood plasma

E. Increase in low-density lipoprotein level

35. 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. Immunoglobulin

B. Ceruloplasmin, transferrin

C.  $\alpha_2$ -macroglobulin,  $\alpha_1$ -antitrypsin

D. Cryoglobulin, interferon

E. Hemopexin, haptoglobin

36. A patient is diagnosed with hereditary coagulopathy that is characterized by factor VIII deficiency. Specify the phase of blood clotting during which coagulation will be disrupted in the given case:

A. Clot retraction

B. Thromboplastin formation

C. Fibrin formation

D. Plasmin formation

E. Thrombin formation

37. Human red blood cells do not contain mitochondria. What is the main pathway for ATP production in these cells?

A. Creatine kinase reaction

B. Anaerobic glycolysis

C. Cyclase reaction

D. Aerobic glycolysis

E. Oxidative phosphorylation

38. 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. Megaloblastic anemia
- C. Sickle-cell anemia
- D. Iron-deficiency anemia
- E. Pernicious anemia

39. A 28-year-old patient undergoing treatment in a pulmonological department has been diagnosed with pulmonary emphysema caused by splitting of alveolar septum by elastase and trypsin. The disease is caused by the congenital deficiency of the following protein:

- A. Alpha-1-proteinase inhibitor
- B. Haptoglobin
- C. Cryoglobulin
- D. Alpha-2-macroglobulin
- E. Transferrin

40. A patient has experienced thirst, frequent urination, weight loss, and fatigue. Analysis of his blood reveals below normal pH, above normal glucose level. What is the primary cause for the decrease of normal pH in this patient?

- A Hyperventilation
- B Water loss due to frequent urination
- C Diabetes insipidus
- D Renal failure
- E Ketoacidosis

**Topic 15. The role of kidneys in the regulation of water and mineral exchange.**

**The normal and pathological components of urine**

1. Point the substance that appears in the urine in a case of alkaptonuria:

- A. Fructose
- B. Protein
- C. Homogentisic acid
- D. Glucose
- E. Tryptophan

2. The diuresis in healthy adults is about:

- A. 400-700 ml
- B. 1000-2000 ml
- C. 2000-3000 ml
- D. 700-900 ml
- E. 3000-4000 ml

3. Name the pathological component of urine:

- A. Haemoglobin
- B. Urea
- C. Uric acid
- D. Creatinine
- E. Amino acids

4. Point the normal component of urine:

- A. Coniugated bilirubin
- B. Glucose
- C. Ketone bodies
- D. Uric acid
- E. Albumins

5. What is the urine color when intestinal rotting processes are intensified:

- A. Brown
- B. Straw-yellow
- C. Red
- D. Green or blue
- E. Beer like color

6. Choose the urine component, whose concentration increases at consuming a lot of meat food:

- A. Glucose
- B. Protein
- C. Uric acid
- D. Ketone bodies

E. Fructose

7. The concentration of what urine component will decrease in a case of viral hepatitis?:

A. Glucose

B. Protein

C. Urea

D. Lipids

E. Carbohydrates

8. Point the qualitative reaction to prove the presence of blood pigments in the urine:

A. Heller's test

B. Benzidine test

C. Lugol's test

D. Trommer's reaction

E. Rozine's reaction

9. The violation of the hormone secretion is followed by polyuria. Choose this hormone:

A. Adrenalin

B. Insulin

C. Testosterone

D. Vasopressin

E. Oxytocin

10. Point the qualitative reaction to prove the presence of proteins in urine:

A. Heller's test

B. Benzidine test

C. Lugol's test

D. Trommer's reaction

E. Rozine's reaction

11. Examination of 43 y.o. anephric patient revealed anemia symptoms. What is the cause of these symptoms?

A. Folic acid deficit

- B. Vitamin B<sub>12</sub> deficit
- C. Reduced synthesis of erythropoietins
- D. Enhanced destruction of erythrocytes
- E. Iron deficit

12. A patient complains about dyspnea provoked by the physical activity. Clinical examination revealed anemia 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. Ceruplasmin
- B. Bilirubin
- C. Antitrypsin
- D. Bence Jones protein
- E. Haemoglobin

13. 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. Urea
- B. Porphyrin
- C. Hippuric acid
- D. Creatine
- E. Creatinine

14. Which is a physiological constituent of urine?:

- A. Globulins
- B. Glucose
- C. Albumin
- D. Creatinine
- E. Bilirubin

15. Arthritis occur in:

- A. Alkaptonuria
- B. Cystinosis

C. Maple syrup diseases

D. Homocystinuria

E. Addison's disease

16. Pyruvate concentration in the patient's urine is increased 10 times than the normal level. Choose the vitamin, the deficiency of which in the organism can be the reason of this change:

A. Vitamin B<sub>1</sub>

B. Vitamin K

C. Vitamin A

D. Vitamin C

E. Vitamin B<sub>2</sub>

17. 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. Monooxygenase

B. Arginase

C. Carbamoyl phosphate synthetase

D. Glutaminase

E. Alanine amino transferase

18. 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

19. Choose the form of the bile pigment, which is the normal urine component:

A. Uroporphyrin

B. Unconjugated bilirubin

C. Conjugated bilirubin

D. Mesobilinogen

E. Stercobilinogen

20. Point 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. Amino acids

B. Urea

C. Uric acid

D. Hippuric acid

E. Protein

21. Kidney insufficiency in patient is accompanied with:

A. Excess levels of urea in the blood plasma

B. Excess levels of potassium ions in the blood plasma

C. Disturbed clearance

D. Disturbed filtration and reabsorption processes

E. All that is placed above

22. Point the main source of ammonia in kidney tissue:

A. Urea

B. Aspartate

C. Glutamine

D. Glutamate

E. Uric acid

23. Choose normal amount of proteins excreted in urine/24 hours.

A. Less than 150 mg

B. 200 mg - 225 mg

C. 450 mg – 500 mg

D. More than 800 mg

E. 150 mg – 250 mg

24. Name organic compound which is terminal for humans and not reabsorbed in renal tubules:

- A. Globulins
- B. Glucose
- C. Albumin
- D. Creatinine
- E. Bilirubin

25. Choose the specific gravity region (g/ml) for urine of healthy person:

- A. 1.005-1.015
- B. 1.030-1.040
- C. 1.015-1.020
- D. 1.030-1.040
- E. Less than 1.010

26. 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

27. Appearance of albumins in the urine of diseased person may be at:

- A. Acute nephritis
- B. Chronical nephritis
- C. Severe form of diabetes mellitus
- D. Pyelonephritis
- E. All that is placed above

28. Choose the main biochemical tests for diagnostics of kidney diseases:

- A. Urea content in the blood plasma and in the urine
- B. Creatinine content in the blood and urine

- C. Sodium ions content in the blood and urine
  - D. N-acetyl-beta-D-glucosaminidase activity (blood serum, urine)
  - E. All that is placed above
29. What organic compounds accumulate in final urine at severe form of diabetes mellitus?
- A. Albumins
  - B. Glucose
  - C. Ketone bodies
  - D. Bilirubin conjugated
  - E. All that is placed in positions A, B, C
30. Kidney insufficiency development will cause the infringements in those processes:
- A. Erythropoietin synthesis and secretion
  - B. Calcitriol synthesis
  - C. Mineralization of bone tissue
  - D. Creatine synthesis
  - E. All that is placed above

**Topic 16. The integration of metabolic pathways. General principles of metabolic regulation**

1. Three non-essential amino acids are substrates for de novo synthesis of purine nucleotides. Name them:
- A. Glycine, aspartate, glutamine
  - B. Glutamate, alanine, proline
  - C. Cysteine, glycine, alanine
  - D. Valine, proline, aspartate
  - E. Leucine, valine, histidine
2. Name the pathway or reaction that does not depend on a change in the amount of respiratory control:
- A. Glycolysis



B. Pentose phosphate pathway, oxidative phase

C. The cycle of three carboxylic acids

D. Beta-oxidation of higher fatty acids

E. Oxidative decarboxylation of pyruvate

3. The formation of free energy in aerobic cell occurs only due to catabolic pathways.

Name the process that occurs without the formation of ATP molecules, but belongs to catabolic pathways:

A. Aerobic glycolysis

B. The cycle of three carboxylic acids

C. Beta-oxidation of fatty acids

D. Pentose phosphate pathway

E. Anaerobic glycolysis

4. Name the regulatory enzyme of Citric acid cycle, whose activity is stimulated by the allosteric activator ADP under the condition of its accumulation in the mitochondrial matrix:

A. Citrate synthase

B. Cis-aconitase

C. Isocitrate dehydrogenase

D. Alpha-ketoglutarate dehydrogenase

E. Succinate dehydrogenase

5. Urea is named as the end product of human metabolism because:

A. Urea is not formed in human tissues

B. Urea is really terminal for human cells as a substrate for reactions

C. Urea is removed by the liver thanks to bile secretion

D. It is the only molecule whose violation occurs in human urine

E. Urea is determined in small amounts in human saliva

6. A catabolic reaction is named a reaction of tissue respiration if:

A. It is a CO<sub>2</sub> producer

B. It is a user of NADPH as a substrate

C. It is a producer of ATP

- D. It is a producer of NADH or FADH<sub>2</sub> under aerobic conditions
- E. It flows in the cytoplasm of the cell
7. The ATP/ADP ratio is 0.5 in the mitochondrial matrix. What enzyme systems need to be stimulated in the matrix and in the inner mitochondrial membrane to increase this value to 1?:
- A. Enzymes of the tricarboxylic acid cycle
- B. Enzymes-participators of electron transport chain
- C. ATP- synthetase
- D. ATP/ADP translocase
- E. All the enzymes named
8. Oxidative decarboxylation of pyruvate produces acetyl-CoA and NADH in the mitochondrial matrix. How many moles of ATP are formed due to the process of oxidative phosphorylation, if we take into account the use of acetyl-CoA in the Krebs cycle as well (use the modern values for P/O ratio)?
- A. 12
- B. 10
- C. 9
- D. 11.5
- E. 14
9. Name the human tissue (organ) that produces ketone bodies, but does not use them as metabolic fuel:
- A. Brain
- B. Liver
- C. Kidney
- D. Myocardium
- E. Skeletal muscles
10. What metabolic pathway forms a pentose derivative for the synthesis of nucleotides - the substrates of replication and transcription in the cell:
- A. Glycolysis
- B. Glycogenolysis

C. Pentose phosphate pathway

D. Glycogenesis

E. Krebs cycle

11. Glutamic acid is converted into alpha-ketoglutarate and ammonia under the action of NAD<sup>+</sup>-dependent dehydrogenase in the mitochondrial matrix. What energy effect (moles of ATP) may be calculated at converting of one mole of glutamate, if alpha-ketoglutarate is included in the Citric acid cycle with the formation of oxaloacetate (use the modern values for P/O ratio):

A. 12

B. 10

C. 11

D. 9

E. 14

12. Fructose-2,6-bisphosphate in the metabolism of carbohydrates is:

A. An intermediate metabolite of the Krebs cycle

B. A positive allosteric effector for phosphofructokinase-1

C. A negative allosteric effector for phosphofructokinase-1

D. A positive allosteric effector for phosphofructokinase-2

E. A positive allosteric effector for phosphofructokinase-3

13. Intermediate products of pyruvate metabolism (using only one chemical reaction with it) are all of the listed metabolites **EXCEPT**:

A. Acetyl-CoA

B. Alanine

C. Lactate

D. Oxaloacetate

E. 2-phosphoglycerate

14. The substrate for cholesterol synthesis is a metabolite that may be formed during the aerobic oxidation of monosaccharides. Name it:

A. Succinic acid

B. Acetyl-CoA

C. Oxaloacetate

D. Pyruvate

E. Lactate

15. Choose an alpha-amino acid, which in its transformations is a precursor for coenzyme NAD<sup>+</sup>:

A. Glycine

B. Phenylalanine

C. Tryptophan

D. Lysine

E. Leucine

16. With a genetic defect of glucose-6-phosphate dehydrogenase of erythrocytes, the patient suffers from hemolytic anemia due to a developed deficiency of NADPH, which is a coenzyme of:

A. Glutathione reductase

B. Glutaminase

C. Arginase

D. Catalase

E. Phosphofructokinase 1

17. The accumulation of acetyl-CoA in the matrix of mitochondria of hepatocyte is stimulated when there is an excess levels of glucose in the blood plasma and in the cytoplasm of the cell. In this case, insulin stimulates two pathways there:

A. Synthesis of higher fatty acids and synthesis of cholesterol

B. Synthesis of ketone bodies and the urea cycle

C. Krebs cycle and oxidation of higher fatty acids

D. Synthesis of nucleotides and oxidative phosphorylation

E. Lipolysis of triacylglycerols and synthesis of phosphatidyl choline

18. Indicate the value of the ATP/ADP ratio in the cytoplasm, which may be a signal to stimulate catabolic pathways in the cell:

A. 0.3

B. 3.0

- C. 6.2
- D. 4.5
- E. 2.0

19. What situation in the liver cell will cause the inclusion of glucose-6-phosphate mainly in the oxidative phase of the pentose phosphate pathway?:

- A. Accumulation of xenobiotics in hepatocytes
- B. Accumulation of peroxides in hepatocytes
- C. High rate of synthesis of higher fatty acids
- D. High rate of cholesterol synthesis
- E. Any suggested reason may be

20. The value of respiratory control in an aerobic cell is 0.1. What processes must be stimulated in this cell to maintain its homeostasis?

- A. Oxidative phosphorylation
- B. Glycolysis
- C. Cycle of tricarboxylic acids
- D. All of the above processes
- E. There is no answer

21. The erythrocyte receives NADPH due to the oxidative phase of the pentose phosphate pathway and uses this coenzyme mainly for:

- A. Glycolysis
- B. For the action of glutathione peroxidase system
- C. Function of methemoglobin reductase
- D. For all specified processes
- E. Positions B, C are correct

22. Hepatocytes produce a large amount of NADPH to ensure:

- A. Microsomal oxidation of xenobiotics
- B. Hydroxylation reactions of some amino acids
- C. Synthesis of palmitic acid
- D. Cholesterol synthesis
- E. All answers are correct

23. Choose the name of the pyruvate converting enzyme that acts in the hepatocyte at respiratory control value 7.0:
- A. Pyruvate carboxylase
  - B. Pyruvate dehydrogenase
  - C. Lactate dehydrogenase
  - D. Apple enzyme
  - E. All these enzymes work under these conditions
24. What factors influence the value of respiratory control in an aerobic cell?
- A. The concentration of molecular oxygen in the cell
  - B. Flow rate of catabolic pathways
  - C. Activity of key enzymes of de novo synthesis of purine nucleotides
  - D. Respiratory chain inhibitors
  - E. All the above factors
25. What factors can affect the rate of catabolic pathways in the hepatocyte?
- A. The value of respiratory control
  - B. Provision of molecular oxygen for the cell
  - C. Deficiency of vitamin-dependent non-protein parts of enzymes
  - D. The presence of inhibitors for key enzymes of the process
  - E. All the above factors
26. Pyridoxal phosphate (a derivative of vitamin B6) functions as a coenzyme in the structure of many enzymes, name some of them:
- A. Alanine aminotransferase
  - B. Delta-aminolevulinate synthase
  - C. Muscle glycogen phosphorylase
  - D. Positions A, B, C are correct
  - E. Positions A, B are correct
27. Why does the accumulation of ATP in the mitochondrial matrix reduce the rate of the Krebs cycle?
- A. High concentration of ATP is an allosteric inhibitor of isocitrate dehydrogenase and citrate synthetase

- B. Accumulation of ATP stops the action of all NAD-dependent enzymes of the cycle
  - C. ATP is actively used in these conditions in the nucleic acids metabolism
  - D. Succinate dehydrogenase is blocked
  - E. All the specified mechanisms of the influence are possible
28. If the patient's diet is enriched with simple carbohydrates and neutral fats, what changes in the metabolism of this patient's liver will lead to?
- A. Stimulation of the synthesis of higher fatty acids
  - B. Stimulation of the synthesis of triacylglycerols
  - C. Stimulation of cholesterol synthesis
  - D. Stimulation of glycogen synthesis
  - E. All answers are correct
29. What effects of insulin create conditions for the lowering the concentration of glucose in human blood plasma?
- A. Stimulation of glucose transport through the cell membrane
  - B. Activation of glucokinase in the hepatocyte cytosol
  - C. Stimulation of glycogen synthetase
  - D. Stimulation of glucose-6-phosphate dehydrogenase
  - E. All the answers are correct
30. The Stimulation of ammonia utilization processes in hepatocytes is accompanied by the:
- A. Reducing the concentration of ornithine
  - B. Increasing the concentration of arginine and glutamine
  - C. Reducing the concentration of alpha-ketoglutarate
  - D. Increasing the concentration of urea
  - E. Positions B, C, D are correct
31. With a deficiency of glucose-6-phosphatase in the liver, the following occurs in hepatocytes:
- A. Accumulation of glucose-6-phosphate
  - B. Accumulation of glycogen

- C. The increase of ribose-5-phosphate level
  - D. Hyperproduction of purine nucleotides
  - E. All the answers are correct
32. With emotional stress (the first 5 minutes), the following increases in human blood plasma:
- A. Adrenaline concentration
  - B. Glucose concentration
  - C. Concentration of higher fatty acids
  - D. Concentration of free glycerol
  - E. All the answers are correct
33. The loading of hepatocytes with drugs causes the:
- A. Increased activity of cytochrome P450 isoforms
  - B. Increase in monooxygenase system activity
  - C. Decrease in the concentration of NADPH in a cell
  - D. Positions A, B, C are correct
  - E. Increasing the rate of cholesterol synthesis



**CORRECT ANSWERS FOR TOPICS:**

BASIC THEME 7. EXCHANGE OF NUCLEOPROTEINS AND CHROMOPROTEINS. FUNDAMENTALS OF MOLECULAR BIOLOGY AND GENETICS

**Topic 1. Nucleoproteins, nucleic acids and nucleotides: structure and functions in humans. Biological membranes**

1	D	11	E	21	E	31	C
2	D	12	B	22	B	32	C
3	C	13	D	23	A	33	B
4	A	14	D	24	D	34	C
5	A	15	D	25	A	35	A
6	C	16	D	26	A		
7	B	17	B	27	B		
8	C	18	D	28	C		
9	E	19	C	29	A		
10	A	20	E	30	B		

**Topic 2. The metabolism of purine and pyrimidine nucleotides. The disorders of nucleotide metabolism**

1	B	11	C	21	D	31	A
2	D	12	D	22	C	32	B
3	E	13	B	23	C	33	B
4	C	14	C	24	C	34	B
5	C	15	A	25	B	35	A
6	E	16	D	26	B	36	E
7	A	17	E	27	D		
8	B	18	A	28	C		
9	E	19	C	29	D		
10	B	20	E	30	A		

### Topic 3. Biosynthesis of nucleic acids

1	E		11	C		21	D		31	A
2	D		12	C		22	B		32	A
3	C		13	A		23	C		33	B
4	A		14	D		24	B		34	D
5	D		15	E		25	D		35	D
6	C		16	B		26	A		36	A
7	D		17	A		27	B		37	C
8	E		18	A		28	A		38	D
9	A		19	B		29	D		39	C
10	E		20	B		30	C		40	C

### Topic 4. Biosynthesis of proteins and its regulation

1	C		11	B		21	D		31	C
2	A		12	B		22	C		32	D
3	B		13	C		23	B		33	B
4	C		14	C		24	D		34	C
5	E		15	D		25	A		35	E
6	D		16	C		26	C		36	D
7	E		17	B		27	B		37	D
8	C		18	D		28	A		38	B
9	A		19	B		29	E		39	A
10	D		20	A		30	D		40	C

### Topic 5. Chromoproteins. Metabolism of hemoglobin and its disorders.

#### Metabolism of porphyrins

1	D		11	D		21	C		31	C
2	A		12	D		22	D		32	B

3	A		13	A		23	C		33	D
4	B		14	C		24	B		34	B
5	D		15	B		25	A		35	E
6	C		16	E		26	B			
7	D		17	E		27	B			
8	D		18	A		28	B			
9	E		19	E		29	E			
10	C		20	A		30	E			

**BASIC THEME 8. MOLECULAR MECHANISMS OF HORMONES ACTION**

**Topic 6. Classification and properties of hormones. The mechanisms of protein-peptide hormones and biogenic amines action**

1	D		11	B		21	A		31	C
2	A		12	D		22	C		32	B
3	B		13	E		23	B		33	E
4	E		14	A		24	C		34	B
5	C		15	A		25	C		35	B
6	C		16	E		26	C		36	D
7	B		17	B		27	B		37	D
8	B		18	C		28	C		38	D
9	C		19	E		29	E		39	B
10	E		20	D		30	A		40	D

**Topic 7. Mechanism action and influence on metabolism of steroid and thyroid hormones. The regulation of calcium and phosphates homeostasis by hormones in the blood**

1	B		11	C		21	D		31	E
2	D		12	D		22	C		32	E

3	C		13	D		23	C		33	C
4	A		14	B		24	C		34	A
5	E		15	D		25	A		35	B
6	C		16	C		26	C		36	B
7	D		17	C		27	B		37	D
8	B		18	E		28	A		38	B
9	D		19	C		29	B		39	A
10	C		20	C		30	E		40	B

**Topic 8. The role of hormones in the regulation of metabolic processes.**

**Formation and functions of eicosanoids**

1	D		11	C		21	D		31	A
2	A		12	D		22	C		32	E
3	C		13	D		23	A		33	B
4	A		14	C		24	E		34	A
5	C		15	D		25	A		35	C
6	C		16	A		26	E		36	B
7	D		17	B		27	C		37	B
8	A		18	D		28	B		38	D
9	B		19	A		29	C		39	B
10	C		20	C		30	B		40	B

**BASIC THEME 9. FUNCTIONAL BIOCHEMISTRY OF ORGANS AND TISSUES**

**Topic 10. Biochemistry of muscular and connective tissues**

1	B		11	B		21	C		31	A
2	D		12	A		22	B		32	A
3	D		13	A		23	D		33	E
4	B		14	E		24	B		34	A

5	B		15	C		25	A		35	E
6	B		16	D		26	B		36	A
7	D		17	A		27	D		37	B
8	C		18	C		28	A		38	A
9	B		19	B		29	A		39	E
10	E		20	A		30	B		40	A

**Topic 11. Biochemistry of nervous tissue**

1	A		11	B		21	C		31	C
2	E		12	D		22	B		32	E
3	E		13	C		23	A		33	E
4	A		14	B		24	D		34	E
5	A		15	A		25	A		35	E
6	E		16	E		26	C		36	A
7	A		17	B		27	A		37	E
8	C		18	D		28	A		38	E
9	C		19	E		29	A		39	A
10	A		20	C		30	A		40	E

**Topic 12. Biochemical functions of the liver at healthy and diseased people**

1	C		11	D		21	C
2	E		12	D		22	D
3	C		13	A		23	D
4	C		14	D		24	E
5	B		15	C		25	E
6	B		16	D		26	B
7	E		17	C		27	E
8	C		18	A		28	E
9	D		19	B		29	C

10	D		20	B		30	D
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**Topic 13. Xenobiotic transformation in humans. Microsomal oxidation**

1	C		11	D		21	B
2	B		12	A		22	D
3	E		13	C		23	E
4	C		14	C		24	A
5	C		15	E		25	C
6	D		16	D		26	D
7	E		17	D		27	C
8	A		18	E		28	A
9	A		19	D		29	C
10	B		20	A		30	E

**BASIC THEME 10. BIOCHEMICAL PARAMETERS OF BLOOD AND URINE IN THE DIAGNOSIS OF METABOLIC DISORDERS**

**TOPIC 14. Biochemistry of blood. Protein and non-protein components of blood plasma at healthy and diseased people. Buffer systems. Acid-base balance. Blood clotting system. Immune processes**

1	E		11	B		21	B		31	D
2	D		12	E		22	E		32	A
3	E		13	B		23	E		33	A
4	A		14	D		24	A		34	A
5	A		15	B		25	B		35	C
6	C		16	A		26	C		36	E
7	D		17	B		27	C		37	B
8	B		18	C		28	B		38	A
9	C		19	D		29	E		39	A
10	C		20	E		30	C		40	E

**Topic 15. The role of kidneys in the regulation of water and mineral balance.**

**The normal and pathological components of urine**

1	C		11	C		21	E
2	B		12	D		22	C
3	A		13	D		23	A
4	D		14	D		24	C
5	D		15	A		25	A
6	C		16	A		26	A
7	C		17	D		27	E
8	B		18	A		28	E
9	D		19	E		29	E
10	A		20	E		30	E

**Topic 16. The integration of metabolic pathways. General principles of metabolic regulation**

1	A		11	B		21	E		31	E
2	B		12	B		22	E		32	E
3	D		13	E		23	A		33	D
4	C		14	B		24	E			
5	B		15	C		25	E			
6	D		16	A		26	D			
7	E		17	A		27	A			
8	D		18	A		28	E			
9	B		19	E		29	E			
10	C		20	D		30	E			

## RECOMMENDED LITERATURE

### Basic

1. Biological and bioorganic chemistry : national textbook : in 2 books. Book 2. Biological chemistry / Yu. I. Gubsky [et al.] ; ed. by: Yu. I. Gubsky, I. V. Nizhenkovska. - 2nd ed. - Kyiv : AUS Medicine Publishing, 2021. - 544 p.
2. Gubsky, Yu. I. Biological chemistry : textbook for students of medical and pharmaceutical faculties / Yu. I. Gubsky ; ed. by.: Yu. I. Gubsky. - 2nd ed. - Vinnytsya : Nova Knyha, 2018. - 488 p.
3. Skorobogatova, Z. M. Biochemistry. Short course : study guide. Pt. 2 / Z. M. Skorobogatova ; ed. by of the English version: O. V. Matviyenko ; reviewed by.: A. L. Zagaiko, D. A. Novikov. - Kyiv : Biocomposite, 2019. - 127 p.
4. Skorobogatova, Z. M. Metabolic pathways atlas : study guide / Z. M. Skorobogatova. - Kyiv : Biocomposite, 2018. - 76 p.

### Additional

1. Biochemistry. Module 2. Molecular biology. The biochemistry of cell-to-cell interrelations : laboratory manual for students of second year study specialty "Medicine" / The Ministry of Health of Ukraine, Zaporizhzhia State Medical University ; ed. by.: K. V. Aleksandrova [et al.]. - Zaporizhzhia : ZSMU, 2018. - 106 p.
2. Biological and bioorganic chemistry : national textbook : in 2 books. Book 1. Bioorganic chemistry / B. S. Zimenkovsky [et al.] ; ed. by.: B. S. Zimenkovsky, I. V. Nizhenkovska ; reviewers: V. P. Chernykh, V. O. Kalibabchuk, V. P. Novikov. - 3rd ed. - Kyiv : AUS Medicine Publishing, 2020. - 288 p.
3. Skorobogatova, Z. M. Biochemistry. Short course : study guide. Pt. 1 / Z. M. Skorobogatova ; ed. of the English version: O. V. Matviyenko ; reviewed by.: A. L. Zagaiko, D. A. Novikov. - Kyiv : Biocomposite, 2018. - 108 p.
4. USMLE. Step 1. 2018. Biochemistry and Medical Genetics : lecture notes / ed. by.: S. Turco ; contributor: R. Lane, R. M. Harden. - New York : Kaplan Medical USMLE, 2018. - 423 p.



### **Informational resources:**

1. Electronic catalog of ZSMPPhU library. URL: <http://library.zsmu.edu.ua>
2. Site of the Department of Biological Chemistry of the Zaporizhzhia State Medical and Pharmaceutical University. URL: <https://biochem.zsmu.zp.ua>
3. The channel of the Department of Biological Chemistry of ZSMPPhU on YouTube. URL: <https://www.youtube.com/channel/UCUzG8k3I7BKA61F8LDeomvA/>