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Department of Pathological Physiology with a Course of Normal Physiology

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PHYSIOLOGY OF VISCERAL SYSTEMS (PART 2)

WORKSHOP FOR THE STUDENTS OF THE 2nd COURSE

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educational qualification «Master of Medicine»

professional qualification «Physician»

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T99 **Tykhonovska M. A.**

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Preface

The workshop was compiled in accordance with the standard program in physiology for higher medical educational institutions of Ukraine III and IV levels of accreditation for the specialty "Medicine" 7.12010001, approved by the Ministry of Health of Ukraine in 2015 ., which is drawn up in accordance with the following regulatory documents: the curriculum developed on the principles of the European Credit Transfer System (ECTS) and approved by the order of the Ministry of Health of Ukraine dated 10.19.2009 No. 749 and changes to the curriculum approved by the Ministry of Health of Ukraine (letter No. 08.01- 47/8986 dated 24.03.2015), the instruction on the evaluation of students' educational activities in the context of the implementation of the European credit transfer system for the organization of the educational process, approved by the Ministry of Health of Ukraine on 15.04.2014.

The workshop is built on the basic topics and topics of classes that are included in part #1, in accordance with the requirements of the "Recommendations regarding the development of programs of educational disciplines" (order of the Ministry of Health of Ukraine dated October 12, 2004, No. 492) and is focused on studying the course of normal physiology during IV (spring) of the semester of the 2nd year of study (Part No. II when studying the discipline "Physiology").

The workshop is intended for use during practical classes by students of medical universities studying the specialty "Medicine",

Physiology is the most important subject in basic medical education. Human physiology is the study of the mechanical, physical, and biochemical processes that support the body's function. The subject matter of physiology is the foundation of the practice of medicine, and a firm grasp of its principles is essential for the physician. Physiology studies the species and individual development of functions and their alteration and adaptation to the continuously changing conditions of their environment.

The purpose of training the discipline "Physiology" is:

- Learn to draw conclusions about the state of physiological functions of organs, systems and the body as a whole.
- Analyze physiological parameters and draw conclusions about the mechanisms of nervous and humoral regulation of the physiological functions of the body and its systems.
- Analyze the state of human health under various conditions based on physiological criteria.
- Interpret the mechanisms and regularities of the functioning of excitatory structures of the body.
- To analyze the state of sensory processes in ensuring human vital activity.
- Explain the physiological basis of the methods of researching body functions.
- Explain the mechanisms that ensure the integration activity of the organism.
- Analyze the age-related features of body functions and their regulation.

This Manual is based on many years of experience in teaching physiology at the Zaporizhzhia State Medical University, as well as methodological materials for studying the subject in the system of higher medical education. The discipline program is structured into sections (logically completed parts of the curriculum), which include thematic sections represented by topics of practical classes.

Wishing you success in Physiology studying and hope that this knowledge will be useful to you in your future professional activities!

Maryna Anatoliivna Tykhonovska,
Associate Professor of Pathophysiology
with Course of Normal Physiology Department

LECTURE PLAN (PART 2, 4th semester)

4th semester - 135 hours: lectures – 32, pr.classes – 51, independent work - 52

#	Topic names	Hours
1.	Blood system. Erythrocyte physiology. Analyze the physico-chemical qualities of the blood, erythrocytes and hemoglobin of the blood.	2
2.	Leukocyte physiology. Protection functions of the blood. The white blood cells. Cooperative interactions between Innate immunity and Acquired immunity.	2
3.	Types and physiological mechanisms of homeostasis. Homeostasis and Blood coagulation.	2
4.	Physiological properties of Cardiac Muscle. Origin of the Heartbeat. Electrical activity of the Heart. Physiological basis of ECG.	2
5.	The cardiac cycle. Cardiac output and stroke volume.	2
6.	Control of cardiac activity.	2
7.	Hemodynamics.	
8.	Regulation of Arterial pressure.	2
9.	Physiology of the respiration. Transport of gases.	2
10.	Regulation of the Respiratory system's functions.	2
11.	Digestion system. Digestion in the oral cavity and in the stomach.	2
12.	Digestion in the Stomach and Pancreas. Physiology regulatory of Digestion system.	2
13.	Metabolism	2
14.	Thermoregulation.	2
15.	Excretory system. Urine formation mechanisms. Regulation of urine formation and egestion.	2
16.	Kidneys role in the homeostasis providing.	2
	TOTAL	32

PRACTICAL CLASSES PLAN (PART 2, 4TH semester)

No	Topic	Hours
1.	Blood system. Erythrocyte physiology. Analyze the physico-chemical qualities of the blood, erythrocytes and hemoglobin of the blood.	3
2.	Leukocyte physiology. Protection functions of the blood. The white blood cells. Cooperative interactions between Innate immunity and Acquired immunity.	3
3.	Types and physiological mechanisms of homeostasis. Homeostasis and Blood coagulation.	3
4.	Common characteristic of blood circulation system. Physiological properties of Cardiac Muscle. Origin of the Heartbeat. Electrical activity of the Heart. Physiological basis of ECG.	3
5.	The Heart as a Pump. Regulation of heart activity.	3
6.	Dynamics of Blood and Lymph Flow. Functions of the individual segments of the vascular system.	3

7.	Mechanisms of blood tonus regulation. Peculiarities of systemic blood circulation. Circulation through special Regions.	3
8.	Credit lesson: Physiology of visceral systems. Blood system. Blood circulation system	3
9.	The Respiratory System. Research of external breath	3
10	Regulation of Respiration. Respiratory Adjustments in health.	3
11	General principles of gastrointestinal function. Digestion and absorption of substances.	3
12	Digestion into the Mouth. Digestion functions of Esophagus, Stomach and Pancreas.	3
13	Digestion functions of Liver. Secretions of the Intestine. Mechanisms of digestion regulation.	3
14	Regulation of the Energy metabolism. Physiology of thermoregulation.	3
15	Kidney role in the egestion process, mechanism of urine formation.	3
16	Analyze of the kidney role in the homeostasis formation. Kidney role in the homeostasis support.	3
17	Credit lesson: Physiology of visceral systems. Respiration system. Digestion system. Content Sections. Energy metabolism. Thermoregulation. Kidney system. Physiological processes of adaptation.	3
	TOTAL	51

SECTION# 2: Physiology of visceral systems: blood, respiratory organs, blood circulation

Content Sections #10. Blood system

PRACTICAL LESSON 1

Theme: Blood system. Analysis of the physiological constants of blood. Physiology of erythrocytes. Hemoglobin.

THE GOALS OF OCCUPATION:

To study the basic physical and chemical properties and functions of blood. To study a physiological role of Erythrocytes.

Initial level of the knowledge

1. Anatomy and histology of the Bone Marrow

THE CONTROL OF THE INITIAL LEVEL OF KNOWLEDGE

1. Functions of Blood.
2. Composition of Blood.
 - a. Plasma.
 - b. Organic Substances. Inorganic Substances. Hematocrit Value.
 - c. Plasma Proteins and its function. The Origin of Plasma Proteins.
 - d. Osmotic pressure.
 - e. Oncotic pressure or colloid osmotic pressure.
 - f. Fluid exchange and Osmotic equilibrium between Intracellular and Extracellular Fluid.
- a. Hypoproteinemia and Hyperproteinemia.
3. Red Blood Cells. Morphology of red blood cells
4. Hematocrit Value
5. Hemoglobin and Iron Metabolism.
 - a. Structure of Hemoglobin
 - b. Reactions of Hemoglobin
 - c. Types of Normal Hemoglobin
6. Lifespan of red blood cells. Explain the role of the Spleen for the Red Cells.
7. Erythropoiesis. **Regulation of Erythropoiesis.**
8. The red Cell Fragility.
9. Erythrocyte Sedimentation Rate.

PRACTICAL WORK

TASK 1. Research of the red blood cells resistance

Put 10 test tubes into a support, number them with a marker. Add the distilled water into each test tube according to the table. Then add the 1 % solution of sodium chloride (NaCl) into test tubes according to the table and add about two drops of tinned blood into each test tube.

Cautiously mix contents of test tubes and leave to stand during 15 minutes. After that note, in which test tube initial and final Hemolysis of RBCs takes place. Concentration of the solution in these test tubes is a parameter of osmotic resistance for RBCs.

The maximal resistance of RBCs or the bottom value of osmotic resistance is within the limits of 0,30 - 0,25.

The minimal resistance or the top value of osmotic resistance ranges within the limits of 0,45-0,40.

№ test tubes	1	2	3	4	5	6	7	8	9	10
Solution's concentration	0,6	0,55	0,5	0,45	0,4	0,35	0,3	0,25	0,2	0,15
1% NaCl, ml	1,2	1,1	1,0	0,9	0,8	0,7	0,6	0,5	0,4	0,3
Distilled water, ml	0,8	0,9	1,0	1,1	1,2	1,3	1,4	1,5	1,6	1,7

RESEARCH PROBLEMS

- Describe a work. Write the results into the table. Use symbols ("-" - hemolysis is absent; "+" - full hemolysis; « + - » - partial hemolysis)
- Write a conclusion. Explain in conclusions:
 - The mechanism of hemolysis
 - Estimate all results of research from the physiological point of view.

TASK 2. Examination of the erythrocyte sedimentation rate

Collect the 5 % solution of sodium citrate to a level 50 (P) from a bottle. Release a solution on a glass.

Lower a capillary into a bottle with blood. Collect the blood into a capillary to a point 0(K). The blood must be without air. Then release the blood into a solution of sodium citrate on a watch glass. Repeat the procedure. Mix the blood with a glass stick. Collect a mix of blood with sodium citrate into a capillary to a point 0(K). Close the top end of a capillary with a finger.

The solution of blood should not leak out. Put the bottom end of a capillary into the bottom rubber ring of Panchenkov's device. Then insert the top end of a capillary into the top rubber ring.

Note the time. In one hour, determine the height of a transparent plasma column. You should answer at what distance the red blood cells sedimented. This result is the sedimentation rate (SR).

In healthy men SR is about 3-7 mm/ hour. In healthy women SR is about 7-12 mm/ hour.

RESEARCH PROBLEMS

1. Describe the work. Draw the Panchenkov's device.
2. Write a conclusion. Explain in conclusions:
 - a) What physiological factors influence the SR;
 - b) Estimate all results of research from the physiological point of view.

TASK 3. Determination of the red blood cell count in 1 liter of the blood

Situate the glass chamber under a microscope and view the Goriaiev's grid on it at small and big magnification. Cover the chamber with a glass and fix it to the chamber. Stop the fixation of a glass when iridescent rings appear. Immerse the Salli's capillary into tinned blood and collect the blood up to a level of 0,02 ml without air. Wipe the end of the capillary with a filtering paper and carry the blood to a test tube. The test tube should be filled with 4 ml of 3% sodium chloride solution. Mix it all with a glass stick.

Take a drop of diluted (in 200 times) blood with a glass stick. Put a drop of blood onto a middle platform of the chamber. The capillary forces should pull a drop under integumentary glass.

Put the chamber under a microscope and start the calculation. View with a small object lens (X8), but use ocular lens X15.

Count up the red blood cells in some 5 big squares located on a diagonal of Goriaiev's grid. Draw 5 big squares on a paper. Divide each big square to 16 small ones, write the found number of cells in each small square. Count cells inside the small square and on its upper and left borders.

Write the found quantity of the RBCs in the formula:

$$X = \{(E \times 4000 \times 200)/80\} \times 10^6$$

Where

X - number of RBCs in 1 L of the blood;

E - amount of RBCs in 80 small squares;

4000 - volume of one small square;

200 - mathematic degree for the blood;

10⁶ - coefficient for recalculation in international system SI.

RESEARCH PROBLEMS

1. Describe the work. Draw the chamber and the Goriaiev's grid.
2. Write a conclusion. Explain in conclusions:
 - a) What physiological factors influence the RBC count;
 - b) Estimate all results of research from the physiological point of view.

TASK 4. Estimation of blood hemoglobin content by Sali's method.

Sali's hemometer is a support. The back wall of the hemometer is made of a matted glass. Three test tubes of identical diameter are inserted into a support. Two outer test tubes are sealed. They contain a solution of muriatic hematine. Middle test tube, which has divisions, is not closed. The capillary has a label (20 mm³).

Fill the middle test tube with 0,1N solution of HCl to the bottom label. Collect the blood into a capillary to a label. Place blood on a bottom of the middle test tube. The top layer of a hydrochloric acid should remain uncolored. Strike a bottom of the test tube with a finger for mixing.

Leave it to stand for 5-10 minutes. This time should be used by blood's full transformation of hemoglobin to muriatic hematine. Add the distilled water to a solution drop by drop. Color of a solution in a test tube should not differ from standard.

The bottom meniscus of a solution is an equivalent of hemoglobin in blood in grams per liter after multiplying the result by 10.

In healthy men the blood hemoglobin content is about 130-160 g/L. In healthy women - about 120-140 g/L.

RESEARCH PROBLEMS

1. Describe a work. Draw the hemometer.
2. Write a conclusion. Explain in conclusions:
 - a) What physiological factors influence the blood hemoglobin content;
 - b) Estimate all results of research from the physiological point of view.

TASK 5. Map of calculation of the color index of the blood

The color index characterizes a degree of saturation of the red blood cells by hemoglobin. Calculate the index using the formula:

$$CI = \{\text{Blood hemoglobin (g/L)} \times 30\} / \text{by first 4 figures of the RBC count}$$

RESEARCH PROBLEMS

1. Describe a work.
2. Write a conclusion. Explain in conclusions:
 - a) What physiological factors influence the value of a color index of blood

- b) Estimate all results of research from the physiological point of view.

THE CONTROL OF THE LEVEL OF KNOWLEDGE

The signature of the report by teacher

Content Sections #10. Blood system

PRACTICAL LESSON 2

THEME: Leukocyte physiology. Protective functions of blood. Cooperative interactions between innate immunity and acquired immunity.

THE GOALS :

to study the basic physiological functions of Immunity and to study a physiological role of White blood cells. To study group blood belonging, rhesus factor. basics of blood transfusion

Initial level of the knowledge

1. Anatomy and histology of the Bone Marrow
2. The histological structure of a White blood cell

THE CONTROL OF THE INITIAL LEVEL OF KNOWLEDGE

CONTROL QUESTIONS:

1. Functions of the White Blood Cell.
2. Properties of White Blood Cells (diapedesis, ameboid movement, chemotaxis, phagocytosis).
3. Concentrations of the Different White Blood Cells in the Blood.
4. Life span of White Blood Cells.
5. Neutrophils and its physiological functions.
6. Eosinophils and its physiological functions.
7. Basophils and its physiological functions.
8. The Mast Cells and its physiological functions.
9. Monocytes and its physiological functions.

10. Explain the role of the Granulocytes and Macrophage Colony-Stimulating factors.
11. The Lymphocytes and its physiological functions.
12. Innate Immunity or Non-Specific Immunity.
13. Acquired Immunity or Specific Immunity.
14. Antigenic properties of blood. The ABO system.
15. The inheritance of A and B Antigens, other Agglutinogens.
16. ABO blood groups. Rh Factor. Hemolytic Disease of the Newborn.

PRACTICAL WORK

TASK 1. Determination of the white blood cell count in 1 liter of the blood

Put the glass chamber under a microscope and view Goriaiev's grid on it at small and big magnification. Cover the chamber with a glass and fix it to the chamber. Stop the fixation of a glass when iridescent rings appear. Immerse the Salli's capillary into tinned blood and collect the blood up to a level of 0,02 ml without air. Wipe the end of a capillary with filtering paper and carry the blood to a test tube. The test tube should be filled with 0,5 ml of 5% acetic acid and methylene blue for destruction of red blood cells.

Mix it all with a glass stick. After that take a drop of blood with a glass stick and put it on a middle platform of the chamber. The capillary forces should pull a drop under integumentary glass.

Put the chamber under a microscope and start the calculation. View with a small object lens (X8) but use ocular lens X15. Count up the white blood cells in some 25 big squares, located on a diagonal of Goriaiev's grid. Draw 25 big squares on a paper. Divide each big square to 16 small ones, write the found number of cells in each small square. Count cells inside a small square and on its upper and left borders. Write the found quantity of the WBCs in the formula:

$$X = \{(L \times 4000 \times 20) / 400\} \times 10^6$$

Where **X** — number of WBCs in 1 litre of the blood; **L** — amount of WBCs in 400 small squares; **4000** — volume of one small square; **20** — mathematic degree for the blood; **10⁶** — coefficient for recalculation in international system SI.

RESEARCH PROBLEMS

1. Describe the work.
2. Write a conclusion. Explain in conclusions:
 - a) What physiological factors influence the WBC count;
 - b) Estimate all results of research from the physiological point of view.

TASK 2. Determination of blood groups of the person

There are specific antigens in red blood cells of the person. They are called agglutinogens. There are A agglutinogen and B agglutinogen in the human blood. There are two types of antibodies in human plasma. They are called agglutinin α and β . They stick together with the agglutinogens.

The equipment for work: cup of Petry, tinned blood, laboratory glasses, standard serums of groups I, II, III. The I group serum contains two types of agglutinins (α , β), the II group serum contains $-\beta$ agglutinin, the III group serum contains $-\alpha$ agglutinin.

Put one drop of standard serum (of I, II, III groups) into cup of Petry. Add the person's blood into each serum's drop (in ratio 1:10). Mix with a glass stick.

Reaction of agglutination comes in 15 minutes. Evidence of reaction - drop of blood is transparent. Small lumps of the RBCs float in it.

RESEARCH PROBLEMS

Determine the group of blood according to the presence or absence of agglutination reaction.

1. Which blood group does a person have?
2. Explain in conclusions:
 - a) What recipients can receive this blood?
 - b) What pathological transfusion reactions can be observed?

TASK 3. Map of estimation of Rh-group

Put one drop of anti - **Rh** serum with a pipette into the cup of Petry. It should be 2 times larger than a drop of person's blood and after that add a drop of blood and mix with a glass stick.

You can observe this result in 5 min.

Don't forget! "Rh – positive" blood – when the agglutination is present.

"Rh – negative" blood – when the Agglutination is absent.

RESEARCH PROBLEMS

1. Describe the work.
2. Write a conclusion.
 - a) Explain all results of research from the physiological point of view.

THE CONTROL OF THE LEVEL OF KNOWLEDGE

The signature of the report by teacher

Content Sections #10. Blood system

PRACTICAL LESSON 3

Theme: Types and physiological mechanisms of hemostasis. Hemostasis and blood coagulation.

THE GOALS:

To study the physiological functions of Platelets; to study the mechanism of Blood coagulation.

Initial level of the knowledge

1. Histology of Platelets
2. The physiological functions of Blood's Proteins

THE CONTROL OF THE INITIAL LEVEL OF KNOWLEDGE

CONTROL QUESTIONS:

1. Physical and Chemical characteristics so physiological functions of Platelets?
2. Events in Hemostasis". Stages of hemostasis.
3. Response to Injury: vascular contraction.
4. Formation of the Platelet Plug and its mechanism.
5. Importance of the Platelet mechanism for Closing Vascular Holes.
6. Blood Coagulation in the Ruptured Vessels.
7. Mechanism of Blood Coagulation:
 - a. Conversion of Prothrombin to Thrombin;
 - b. Conversion of Fibrinogen to Fibrin- Formation of the Clot
 - c. Initiation of Coagulation: formation of Prothrombin Activator
8. Extrinsic Pathway for Initiating Clotting.
- 9 Intrinsic Pathway for Initiating Clotting.
10. Role of Calcium Ions in the Intrinsic and Extrinsic Pathway for Initiating Clotting
11. Fibrinolysis
 - a. Formation of Plasmin
 - b. Sequence of Events Involved in the Activation of Plasminogen
12. Anticlotting mechanism in the body (Physical Factors)
13. Anticlotting mechanism in the body (Chemical Factors – Natural Anticoagulants).
 - a. Heparin and it function
 - b. Antithrombin III;
14. Anticoagulants for Clinical use?
15. Blood Coagulation Tests?
 - a. Bleeding Time;
 - b. Clotting Time;
 - c. Prothrombine Time.

PRACTICAL WORK

TASK 1. Examination of the clotting time

Take the blood from a caudal vein of a rat. Put a drop of blood on a glass. Dip a thin glass stick into a drop of blood every 30 seconds. Determine the moment of appearance of the first fibrinous string. Use a stopwatch. The normal value of clotting time is 6-10 minutes.

RESEARCH PROBLEMS

1. Describe the work.
2. Write a conclusion. Explain in conclusions:
 - a) What physiological factors influence the clotting time;
 - b) Explain all results of research from the physiological point of view.

TASK 2. Examination of the bleeding time

Make an incision with scissors in a tail of a rat. Note the time of the beginning of a bleeding with a stopwatch. Remove a drop of blood every 30 seconds. Put each new sector of filtering paper to a drop of blood. Repeat procedure up to a full stop of bleeding.

Observe the rules of the work: a) don't press the bleeding tail; b) don't remove the first drop of blood; c) don't touch a wound with filtering paper. The normal value of bleeding time is 1-6 minutes.

RESEARCH PROBLEMS

1. Describe the work.
2. Write a conclusion. Explain in conclusions:
 - a) What physiological factors influence the bleeding time;
 - b) Explain all results of research from the physiological point of view.

TASK 3. Determination of blood tolerance to heparin test

Heparin is anticoagulant. Its functions are opposite to thrombin. Heparin prevents transformation of fibrinogen to fibrin. After that the clotting time is prolonged.

Place 3 drops of blood of a rat on a glass with a pipette. Add a drop of heparin. Mix with a glass stick.

Dip a thin glass stick into a drop of blood every 30 seconds. Determine the moment of appearance of the first fibrinous string. Use a stop watch.

RESEARCH PROBLEMS

1. Describe the work.
2. Write a conclusion. Explain in conclusions:
 - a) What physiological factors influence the blood tolerance to heparin test;
 - b) Explain all results of research from the physiological point of view.

TASK 4. Estimation of a degree of the capillaries resistance

Put a cuff of sphygmomanometer on a patient's arm. Maintain the pressure in a cuff at a level of the maximal arterial pressure. Compress the arm during 10 to 15 minutes.

Isolated hemorrhages normally can be on a place of pressure.

If the fragility of capillaries is increased there can be a lot of hemorrhages.

RESEARCH PROBLEMS

1. Describe the work.

2. Write a conclusion. Explain in conclusions:

a) What physiological factors influence the fragility of capillaries;

b) Explain all results of research from the physiological point of view

TASK 5. Explain the scheme of the clotting process in the traumatized blood vessels.

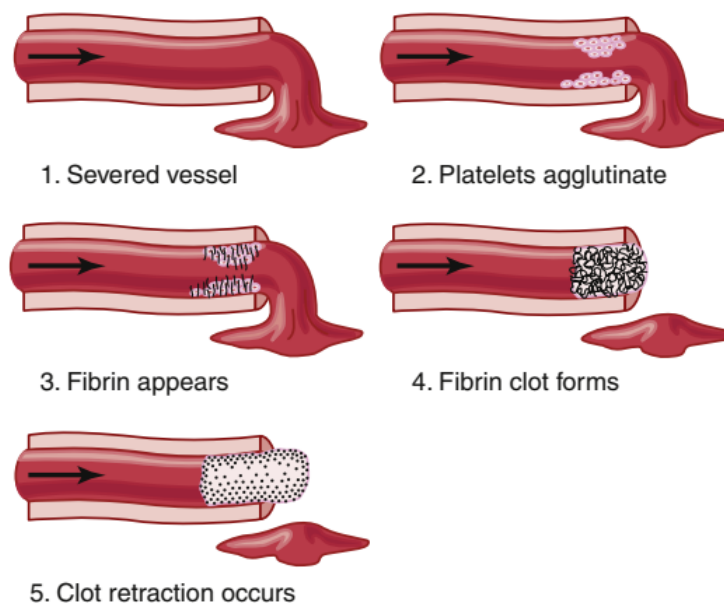


Figure 1. Source: Hall J. E., Hall M. E., Guyton A. C. Guyton and Hall Textbook of Medical Physiology: 14th ed. Philadelphia: Elsevier, 2021. P. 478

TASK 6. Explain the scheme of conversion of prothrombin to thrombin and polymerization of fibrinogen to fibrin.

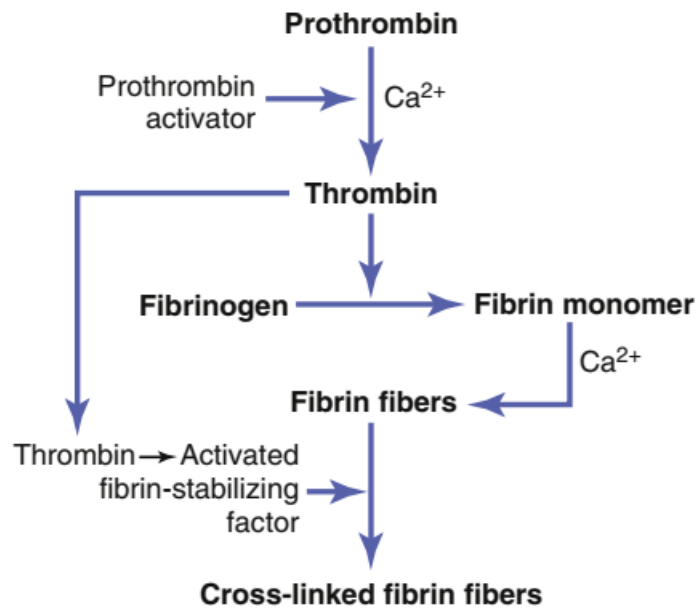


Figure 2. Source: Hall J. E., Hall M. E., Guyton A. C. Guyton and Hall Textbook of Medical Physiology: 14th ed. Philadelphia: Elsevier, 2021. P. 479

TASK 7. Explain the scheme of intrinsic pathway for initiating the blood clotting.

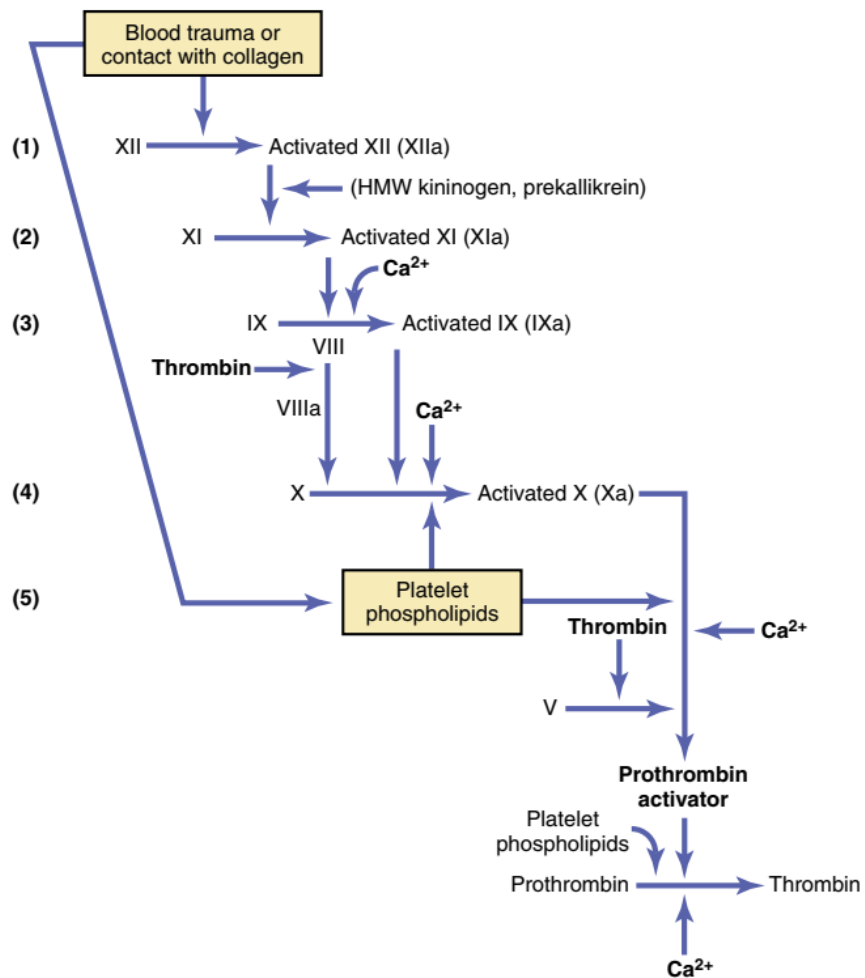


Figure 3. Source: Hall J. E., Hall M. E., Guyton A. C. Guyton and Hall Textbook of Medical Physiology: 14th ed. Philadelphia: Elsevier, 2021. P. 482

THE CONTROL OF THE LEVEL OF KNOWLEDGE

The signature of the report by teacher

Content Sections #11. Blood circulation system

PRACTICAL LESSON 4.

Theme: Origin of the heartbeat. The electrical activity of the heart.

THE GOALS:

Study properties of the Cardiac muscle. Study the characteristics of Heart Electrical activity.

The initial level of knowledge

1. Anatomical and histological structure of the Heart .

CONTROL OF THE INITIAL LEVEL OF KNOWLEDGE

CONTROL QUESTIONS:

1. Physiological properties of Cardiac Muscle.

a. excitability (Explain the properties of the Resting Membrane and Action Potential of Cardiac Muscle)

b. conductivity

c. contractility

d. refractory period

2. Specialized excitatory and conductive system of the heart. Automatic electrical rhythmicity of the sinus fibers:

a. mechanism of sinus nodal rhythmicity (Explain the Morphology properties of Pacemaker tissue and.),

b. self-excitation of sinus nodal fibers (Pacemaker Potentials),

c. the atrioventricular node delays impulse conduction from the atria to the ventricles,

d. rapid transmission in the ventricular Purkinje system,

e. transmission of the cardiac impulse in the ventricular muscle.

3. Describe the Origin of Electrocardiogram

a. bipolar leads, unipolar (v) leads,

b. chest leads (precordial leads),

c. augmented unipolar limb leads,

d. principles of vectorial analysis of electrocardiograms,

b. characteristics of the normal ECG (waves of normal ECG, intervals and segments of ECG)

4. Describe the Mechanical properties of Cardiac Muscle. The Contractile Response of heart muscle.

PRACTICAL WORK

TASK 1. Explanation about ionic basis of action potential and pacemaker potential in cardiac tissues. Put the results into this table.

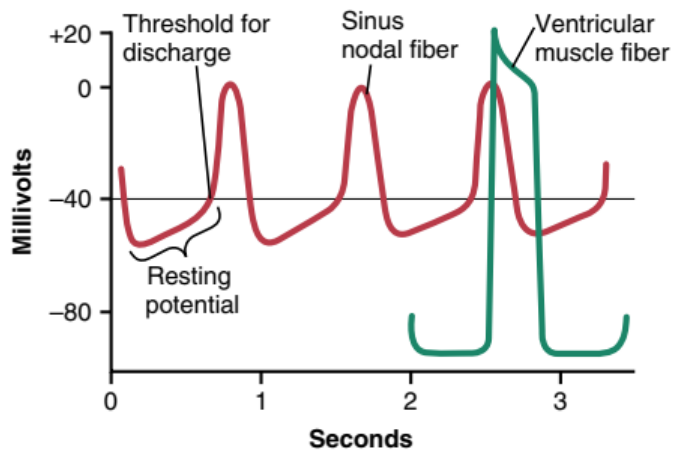


Figure 4. Source: Hall J. E., Hall M. E., Guyton A. C. Guyton and Hall Textbook of Medical Physiology: 14th ed. Philadelphia: Elsevier, 2021. P. 128

	Ionic basis	
	Action potential	Pacemaker potential
<i>How does depolarization start?</i>		
<i>What's threshold level?</i>		
<i>Describe the depolarization phase</i>		
<i>Describe the initial rapid repolarization phase</i>		
<i>Describe the plateau phase</i>		
<i>Describe the repolarization phase</i>		
<i>How many mV is the potential amplitude?</i>		

TASK 2. Look at this figure and write an explanation about the syncytium of the heart.

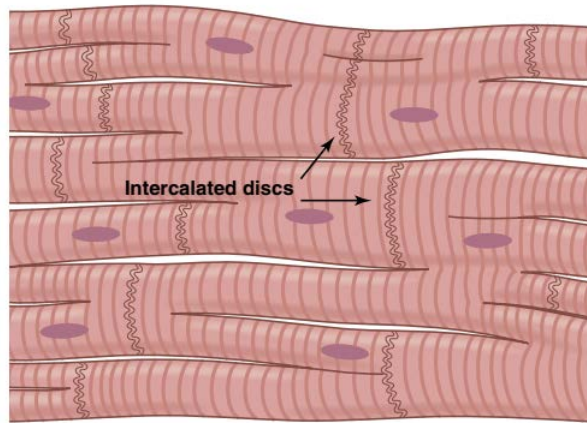


Figure 5. Source: Hall J. E., Hall M. E., Guyton A. C. Guyton and Hall Textbook of Medical Physiology: 14th ed. Philadelphia: Elsevier, 2021. P. 114

TASK 3. Look at this figure. What are the various waves, segments and intervals represented in normal ECG? What are their duration and amplitude? Put the results into the table.

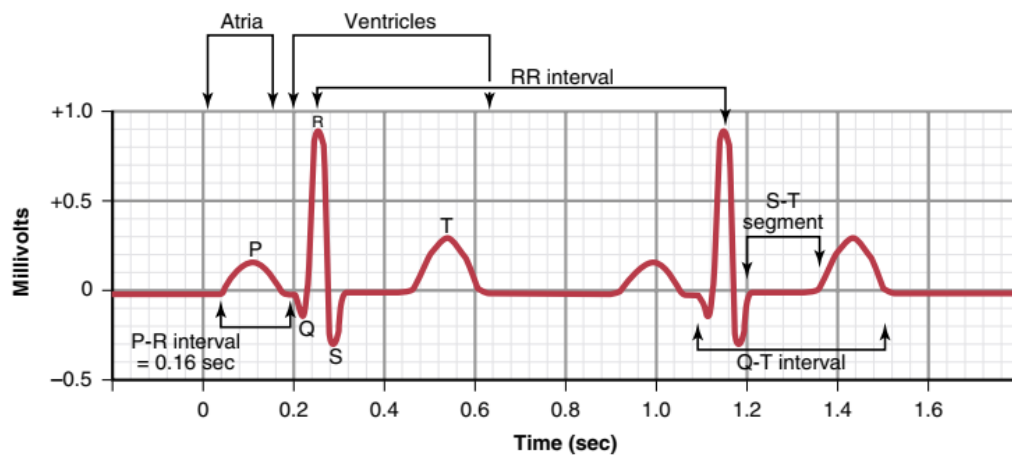


Figure 6. Source: Hall J. E., Hall M. E., Guyton A. C. Guyton and Hall Textbook of Medical Physiology: 14th ed. Philadelphia: Elsevier, 2021. P. 136

<i>ECG parameters</i>	<i>represent</i>	<i>duration</i>
P		
Q		
R		
S		

T		
RP		
QRS		
ST		
QT		

TASK4. What is ECG and what is its basis? Demonstration of ECG record. How can you determine the heart rate, waves and intervals from an ECG tracing?

ECG graph paper

Timed interpretation of an ECG was once incumbent to a stylus and paper speed. Computational analysis now allows considerable study of heart rate variability. A typical electrocardiograph runs at a paper speed of 25 mm/s, although faster paper speeds are occasionally used. Each small block of ECG paper is 1 mm². At a paper speed of 25 mm/s, one small block of ECG paper translates into 0.04 s (or 40 ms). Five small blocks make up 1 large block, which translates into 0.20 s (or 200 ms). Hence, there are 5 large blocks per second. A diagnostic quality 12 lead ECG is calibrated at 10 mm/mV, so 1 mm translates into 0.1 mV. A calibration signal should be included with every record. A standard signal of 1 mV must move the stylus vertically 1 cm that is two large squares on ECG paper.

Table of the heartbeat frequency per minute

R-R	Heart beat	R-R	Heart beat	R-R	Heart beat
1.50	40	1.02	58	0.70	86
1.48	41	1.01	60	0.69	87
1.46	41	1.00	60	0.68	88
1.44	42	0.99	60	0.67	90
1.40	43	0.98	61	0.66	91
1.38	43	0.97	62	0.65	92
1.36	44	0.96	62	0.64	94
1.34	44	0.95	63	0.63	95
1.32	45	0.94	64	0.62	97
1.30	46	0.93	64	0.61	98
1.28	47	0.92	65	0.59	102
1.26	48	0.91	66	0.58	103
1.24	48	0.90	66	0.57	105
1.22	49	0.89	67	0.56	107
1.20	50	0.88	68	0.55	109
1.19	50	0.87	69	0.54	111

1.18	51	0.86	70	0.53	113
1.17	51	0.85	70	0.52	116
1.16	52	0.84	71	0.51	118
1.15	52	0.83	72	0.50	120
1.14	53	0.82	73	0.49	122
1.13	53	0.81	74	0.48	125
1.12	54	0.80	75	0.47	128
1,11	54	0.79	76	0.46	130
1.10	54	0.78	77	0.45	133
1.09	55	0.77	78	0.44	136
1.08	55	0.76	79	0.43	139
1.07	56	0.75	80	0.42	142
1.06	56	0.74	81	0.41	146
1.05	57	0.73	82	0.40	150
1.04	57	0.72	83		
1.03	58	0.71	84		

You have to determine

- a) frequency of the heartbeat per minute by table;
- b) position of an electric axis of the heart:
 - Measure the R wave's amplitude in all 3 standard limb leads (mm)
 - Horizontal position of an electric axis of the heart – if $R_1 > R_2 > R_3$;
 - Intermediate position of an electric axis of the heart if $R_2 > R_1 > R_3$;
 - Vertical position of an electric axis of the heart if $R_3 > R_2 > R_1$;
- c) amplitude and duration of waves of the electrocardiogram;
- d) duration of intervals.

<i>ECG parameters</i>	<i>Normal ECG</i>		<i>Patient's ECG</i>	
	<i>amplitude</i>	<i>duration</i>	<i>amplitude</i>	<i>duration</i>
P				
Q				
R				
S				
T				
RP				
QRS				
ST				
QT				

Make conclusions about your results:

TASK 5. What is the clinical importance of ECG? Write an explanation.

THE CONTROL OF THE LEVEL OF KNOWLEDGE

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Content Sections #11. Blood circulation system

PRACTICAL LESSON 5

Theme: The heart as a pump. Regulation of the heart activity.

THE GOALS:

Study the Heart Sounds, the mechanism of Cardiac cycle, the mechanism of Heart pumping regulation

The initial level of knowledge

1. Anatomy and Histology of Heart

CONTROL OF THE INITIAL LEVEL OF KNOWLEDGE

CONTROL QUESTIONS:

1. Cardiac cycle.
2. Mechanical events of the Cardiac Cycle. Intra-atrial pressure, Intraventricular and Aortic pressure changes during Cardiac Cycle. Ventricular volume changes during Cardiac Cycle.
3. Length of Systole and Diastole in Cardiac cycle.
4. Cardiac output:
5. Heart Sounds. Phonocardiography.
6. Methods of study of heart sounds
7. Actions of the heart:
 - a. Chronotropic action;
 - b. Inotropic action;

- c. Dromotropic action;
 - d. Bathmotropic action.
8. Autoregulation of heart activity.
- a. Myogenic and theory of auto regulation of heart activity.
9. Neural control of the Cardiovascular System.
- a. medullary control of the cardiovascular system – cardiac center (vasoconstrictor area, vasodilator area, sensory area);
 - b. Innervation of the heart (motor (efferent) nerve fibers to heart, sensory (afferent) nerve fibers from heart).;
10. Receptors.
- a. role of Baroreceptors in short-term control of heart activity
 - b. impulses from chemoreceptors
11. Factors affecting vasomotor center – regulation of vagal tone
- c. impulses from higher centers
 - d. impulses from respiratory centers
 - e. impulses from baroreceptors
 - f. impulses from chemoreceptors
 - g. impulses from right atrium
 - h. impulses from other afferent nerves
 - i. Bezold-Jarisch reflex
12. Humoral regulation of heart activity.
- a. hormonal regulation of heart activity;
 - b. effect of changes in electrolyte concentration on heart (sodium ion, potassium ion concentration, calcium ion concentration).

PRACTICAL WORK

TASK 1. Look at these figures and write an explanation about the mechanism of cardiac cycle. Put the results into this table.

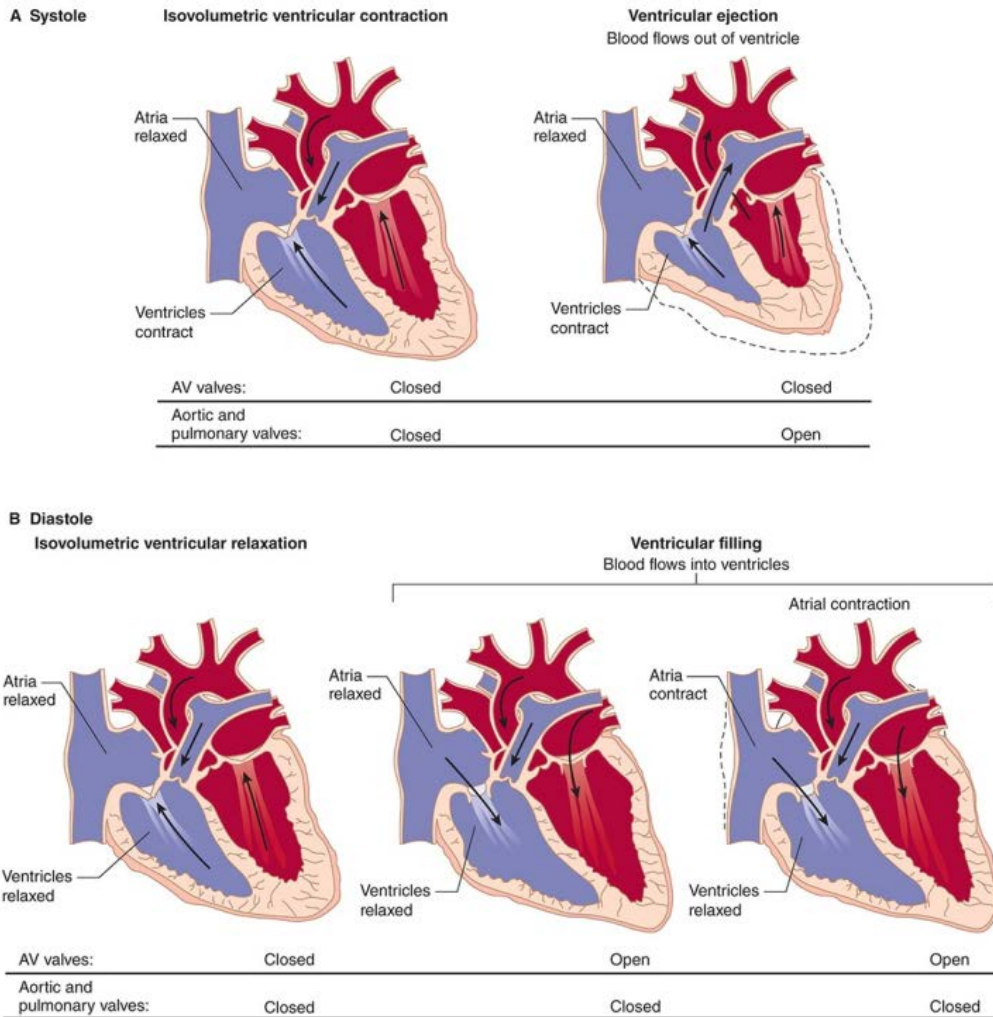


Figure 7. Source: Barrett K. E., Barman S. M., Yuan J. X.-J., Brooks H. Ganong's Review of Medical Physiology: 26th ed. New York: McGraw-Hill Education LLC, 2019. P. 1220

	mechanism	duration
Atrial systole		
Isometric contraction		
Ejection period		
Protodiastole		
Isometric		

relaxation period		
Rapid filling phase		

TASK 2. What do you know about the Frank-Starling law? Look at this figure and write an explanation.

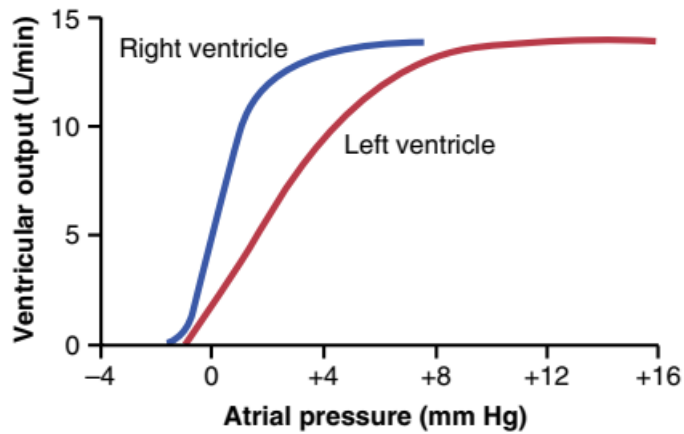


Figure 8. Source: Hall J. E., Hall M. E., Guyton A. C. Guyton and Hall Textbook of Medical Physiology: 14th ed. Philadelphia: Elsevier, 2021. P. 124

TASK 3. Look this figure and describe the origin of heart sounds. Put the information into this table.

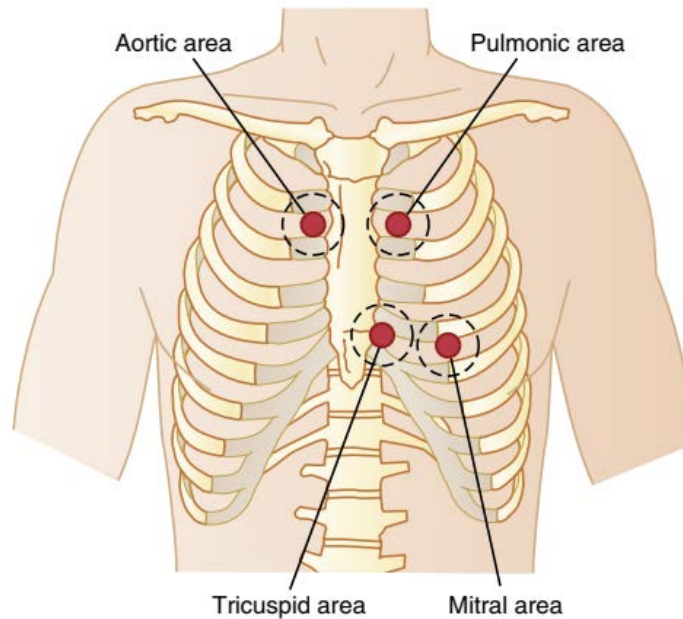


Figure 9. Source: Hall J. E., Hall M. E., Guyton A. C. Guyton and Hall Textbook of Medical Physiology: 14th ed. Philadelphia: Elsevier, 2021. P. 284

Heart Sounds	Mechanism	Duration
<i>The First Sound</i>		
<i>The Second Sound</i>		
<i>The Third Sound</i>		
<i>The Fourth Sound</i>		

TASK 4. Auscultation of the heart sounds with a stethoscope. Describe your results.

<u>Pulmonary valve</u> (to pulmonary trunk)	second <u>intercostal space</u>	left upper sternal border
<u>Aortic valve</u> (to aorta)	second intercostal space	right upper sternal border
<u>Mitral valve</u> (to left ventricle)	fifth intercostal space	lateral to left midclavicular line
<u>Tricuspid valve</u> (to right ventricle)	fourth intercostal space	lower left sternal border

TASK 5. Write an explanation about the effects of autonomic nerve system, potassium and calcium ions on the heart work. Put the information into this table.

Controlling factors	Action
---------------------	--------

<i>Sympathetic nerves</i>	
<i>Parasympathetic nerves</i>	
<i>Potassium ions</i>	
<i>Calcium ions</i>	

TASK 6. Examine the arterial pulse of the subject provided and comment on your findings.

The radial artery is palpated with the tips of three fingers compressing the vessel against the head of radius bone. The subject's forearm should be slightly pronated and the wrist slightly flexed. The index finger varies the pressure on the artery; the middle finger feels the pulse, while the distal finger prevents reflections of pulsations from the palmar arch of arteries. The following observations are made:

rate of pulse	rhythm	character and form	types of arterial pulse	volume	tension	condition of the vessel wall	delay

Explain your results.

TASK 7. What are physiological tachycardia and bradycardia and what are their causes? Put your explanations in this table.

N.B. An increase in heart rate above 100/min is called *tachycardia*.

A decrease in heart rate below 60/min is called *bradycardia*.

Factors	Physiological bradycardia is seen in	Physiological tachycardia is seen in
<i>Emotional excitement, nervousness, and apprehension</i>		
<i>Muscular exercise</i>		
<i>In the newborns</i>		
<i>Sex</i>		
<i>Diurnal variations</i>		
<i>Athletes</i>		
<i>Sleep and meditation</i>		

TASK 8. Look at this figure and write the explanation about the mechanism of baroreceptor reflex.

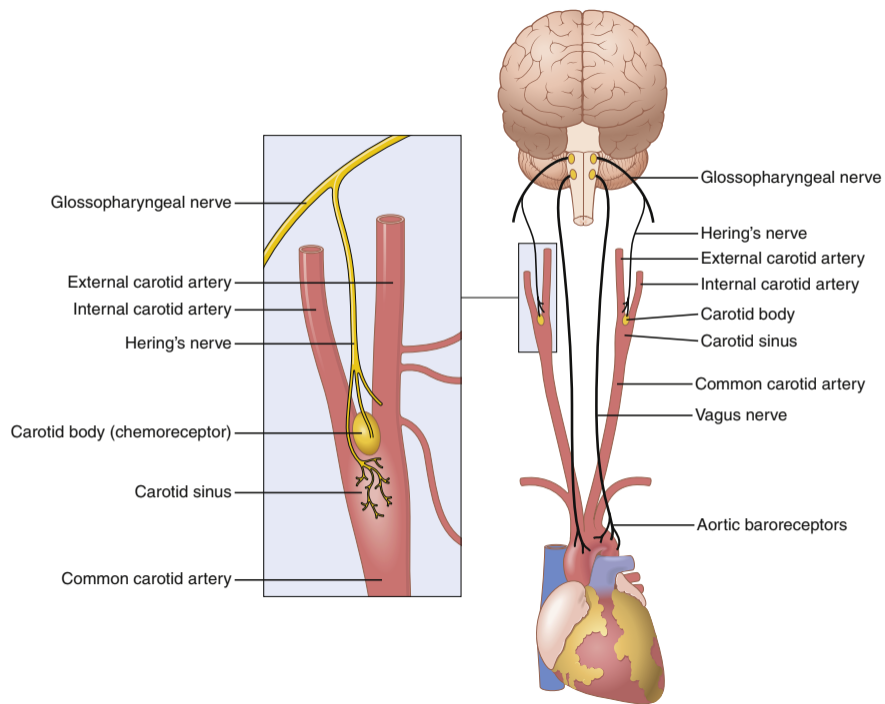


Figure 10. Source: Hall J. E., Hall M. E., Guyton A. C. *Guyton and Hall Textbook of Medical Physiology: 14th ed.* Philadelphia: Elsevier, 2021. P. 221

TASK 9. Cardiac efficiency tests (exercise tolerance tests). Put your results in the table and make a resume.

The response of the cardiovascular system to standardized exercise (*exercise tolerance test*, also called "*stress testing*") is the single and the best test for assessing the efficiency of the heart. During exercise, there is a progressive increase in the heart rate (HR) and blood pressure (BP). However, after the exercise is over, these values return to the pre-exercise levels during the next few minutes. The fact that, compared to a trained person, there is a **greater** increase in the heart rate and BP in an untrained individual during exercise, and that these values take a longer time to return to basal levels, forms the basis of exercise tolerance tests. The response to physical exercise depends on the cardiac reserve, (ie, efficiency of the heart), muscle power, training, motivation, and the state of nutrition. Therefore, the cardiac efficiency tests can also be used to test physical fitness in an individual.

I. Record the basal pulse rate, then ask the subject to hop 20 times on each foot, raising the shoulders 6 inches at each step.

If the heart is healthy, there should be little disturbance of breathing and the pulse rate should not increase by more than 10-20 beats per minute, and should return to pre-exercise level in about a minute.

Record these timings in your work book.

II. Harvard Step Test

Caution. This is a test for physical fitness and should not be used in patients.

Protocol. Record the basal pulse rate. Then ask the subject to alternately step up and down, lifting each foot about 20 inches (16 inches in females) off the ground, at a rate of 30 double steps per minute, for a period of 5 minutes. (Alternately, the subject may step

up and down a 50 cm bench (40 cm in females), at a frequency of 30 times/min for 5 minutes). Stop the test if the subject feels breathless and exhausted and is unable to continue the test.

Count the pulse rate 1 minute after the end of the exercise. The pulse rate is inversely proportional to the degree of cardiac efficiency. To obtain an approximate idea of the cardiac efficiency index, count the pulse rate at the following intervals:

- i. Between 1 and 1,5 minutes= /min (a)
- ii. Between 2 and 2,5 minutes= /min (b)
- iii. Between 3 and 3,5 minutes= /min (c)
- iv. Time after which the pulse rate returns to basal levels= minutes

$$\text{Cardiac efficiency index} = \frac{\text{Duration of exercise in seconds (300)}}{a+b+c} \times 100$$

	pulse rate	time
	Between 1 and 1,5minutes	per/min
	Between 2 and 2,5minutes	per/min
	Between 3 and 3,5minutes	per/min
	Time after which the pulse rate returns to basal levels	min
	Cardiac efficiency index	

In normal individuals, the cardiac efficiency index is nearly 100 percent, but is more in sportspersons.

Efficiency index: over 50% - efficiency is excellent; 81-90% - efficiency is good; 55-80% - efficiency is average; below 55% - efficiency is poor.

Resume:

THE CONTROL OF THE LEVEL OF KNOWLEDGE

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Content Sections #11. Blood circulation system

PRACTICAL LESSON 6

Theme: Dynamics of blood and lymph flow. Functions of the individual segments of the vascular system.

THE GOALS:

Study the mechanism of Blood and Lymph Flow. Study examination of the arterial pressure, arterial pulse, and results of sphygmography

Initial level of the knowledge

1. Anatomy of the Circulation system
2. Basic concepts and laws of hydrodynamics

CONTROL OF THE INITIAL LEVEL OF KNOWLEDGE

1. Overview of the circulation:
 - a. cross-sectional areas and velocities of blood flow;
 - c. pressure-flow relationship;
 - d. resistance against the flow;
 - e. viscosity.
2. General structure of the vascular tree.
3. Functions of the individual segments:
 - a. the windkessel vessels;
 - b. precapillary resistance vessels;
 - c. arterioles and the fall of arterial pressure;
 - d. precapillary sphincter;
 - e. exchange vessels, that is, the capillaries;
 - f. capacitance vessels.
4. Describe the physiological mechanism of arterial and arteriolar circulation:
 - a. velocity and blood flow;
 - b. arterial pressure;
 - c. effect of gravity;
 - d. methods of blood pressure measuring;
 - e. auscultatory method;
 - f. normal arterial blood pressure.
5. Arterial Pulse:
 - a. transmission of pulse;
 - b. methods of recording arterial pulse;
 - c. interpretation of arterial pulse tracing.
6. Describe the physiological mechanism of capillary circulation:
 - a. methods of study;
 - b. capillary pressure and flow;
 - c. active and inactive capillaries.
7. Lymphatic circulation and interstitial fluid volume:
 - a. lymphatic circulation and lymphatic system functions;
 - b. interstitial fluid volume.
8. Describe the venous circulation:
 - a. venous pressure and flow;
 - b. thoracic pump and effects of heartbeat;
 - c. muscle pump;
 - d. venous pressure in the head, air embolism;
 - e. measuring venous pressure.
9. Measurement of arterial blood pressure:
 - a. direct method;

b. indirect method.

PRACTICAL WORK

TASK 1. Look at this figure and write an explanation about changes in blood pressure, velocity, and the area of the arteries, capillaries, and veins of the circulatory system.

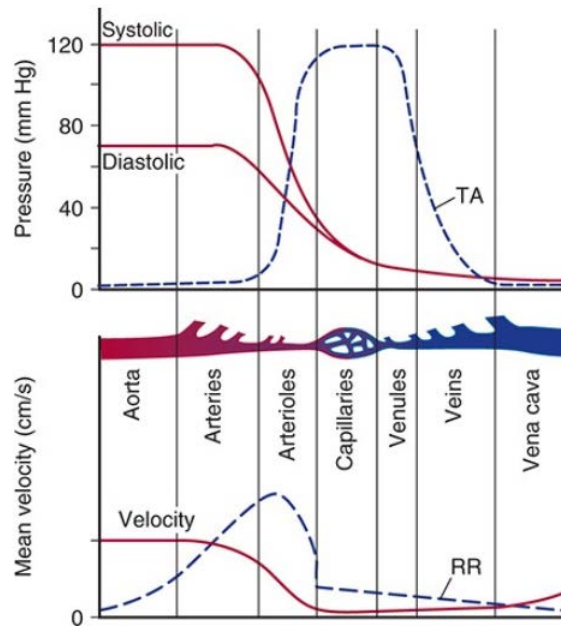


Figure 11. Source: Barrett K. E., Barman S. M., Yuan J. X.-J., Brooks H. Ganong's Review of Medical Physiology: 26th ed. New York: McGraw-Hill Education LLC, 2019. P. 1305

TASK 2. Recording of blood pressure.

The term "*blood pressure*", used unqualified, refers to the lateral pressure exerted by the moving column of blood on the walls of the systemic arteries. Its measurement is an important clinical procedure as it provides valuable information about the cardiovascular system under normal and abnormal conditions.

Auscultatory Method (Korotkoff)

Ordinarily, no sounds are heard when a stethoscope is applied over the brachial or any other artery. However, if the cuff **pressure** is raised above the expected systolic pressure level, and then gradually lowered, a series of sounds, called the Korotkoff sounds, are heard in the brachial artery below the cuff.

1. Locate the bifurcation of the brachial artery (it divides into radial and ulnar branches) in the cubital space, just medial to the tendon of the biceps muscle, and mark

this point with a felt-tip pen. Place the diaphragm of the stethoscope on this point and keep it in position with your fingers and thumb. (The diaphragm, when in use, should not rub against the cuff or the rubber tubes or on the skin because the disturbing noises will interfere with auscultation of the sounds).

2. Inflate the cuff slowly (some sounds will be heard as the cuff pressure rises) and raise the pressure to 40-50 mm Hg above the systolic level as determined by the palpatory method.

Lower the cuff pressure slowly until the Korotkoff sounds are heard. *Phase I* sounds are clear, sharp, and tapping and last for 10-12 mm Hg fall in mercury column. *The first of these sounds, a clear tap, indicates the systolic pressure.* As the pressure falls, the character of the sounds changes (one must listen carefully to the sounds); they first become murmurish (*Phase II*), then clear and banging (*Phase III*), until they suddenly become muffled (*Phase IV*), indistinct, dull and faint, as if coming from a distance) and disappear (*Phase V*; no sounds). The muffling of sounds and their disappearance occurs nearly at the same time, there being a difference of 4-5 mm Hg between them.

The pressure at which the sounds become muffled marks the diastolic pressure. Note the reading at muffling and at disappearance of sounds, after which deflate the cuff quickly.

3. Record the blood pressure first in the supine position. Then record the pressure in the standing position immediately after the subject assumes erect position from supine posture.

4. Disconnect the metal connection on the tube connecting the cuff and the mercury reservoir, then ask the subject to do muscular exercise (e.g., spot running) for 5-6 minutes. Record the pulse and blood pressure immediately after the end of exercise and then at 2-minute intervals till the pulse and BP return to resting levels.

5. Record the blood pressure with the arm raised above the head, and then with the arm hanging down below the level of the heart. Tabulate your results, showing the various readings.

Note The BP readings are seldom identical in the two arms. It has been suggested that both arms be used, preferably the right and then the left, and that the lowest reading be recorded.

Put your results in the table. Make a resume.

Position	Left arm	Right arm
sitting position		
supine position		
standing position		
arm raised above the head		
arm hanging down below the level of the heart		

after the end of exercise		
---------------------------	--	--

TASK 3. What does arterial pressure mean and what is its significance? Why does the blood exert a pressure on the arterial walls? Write an explanation.

TASK 4. What are the physiological variations in blood pressure? Put your explanation into the table.

Factors	Action
<i>Age</i>	
<i>Sex</i>	
<i>Muscular exercise</i>	
<i>Diurnal variations</i>	
<i>Digestion</i>	
<i>Emotional stress</i>	
<i>Posture</i>	

TASK 5. What is the pulse pressure and what is its significance? Write an explanation.

TASK 6. What are the 5 steps of blood flow to the heart? Write an explanation about the mechanism of them.

TASK 7. Demonstration of venous blood flow.

The flow of blood through the veins of the forearm and the presence of valves in these veins can be demonstrated by a simple experiment. William Harvey originally described it as one of the proofs for his theory of circulation, in his 68-page book

"Exercitatio anatomica de motu cordis et sanguinis in animalibus", published in Latin in 1828.

Procedures

1. Seat the subject on a stool with his arm resting on a table. Apply the BP cuff on his upper arm and inflate it to 30-40 mm Hg. The superficial veins of the forearm will become prominent.
2. Place the tip of your right index finger (call it "R") over one of the veins, and mark the position of the valve (call it "V") above it, with a felt pen.
3. Keeping the finger "R" in the same position, and using your left index finger, squeeze out the blood from this vein towards the elbow. Note that the segment of the vein between points "R" and "V" remains collapsed and that there is no backflow of blood. However, the vein above the valve "V" is distended and the valve becomes prominent.
4. Keeping the finger "R" in position, place the left index finger above the valve "V" and try to squeeze the blood downwards towards the finger "R". It will be noticed that the blood cannot be forced backwards across the valve "V" unless a pressure that would be enough to rupture the valve "V" is applied.

What are the functions of the valves in the veins? Write an explanation.

TASK 8. What is the pulse pressure and what is its significance? Use this formula. Write an explanation about your result.

$$1) P_p = P_s - P_d,$$

Where P_p - pulse pressure; P_s - systolic pressure; P_d - diastolic pressure.

TASK 9. What is meant by jugular venous pulse? How is the record of this event obtained? Name the various waves recorded in the JVP tracing. Write an explanation.

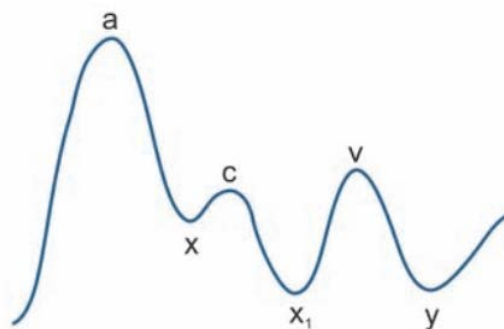


Figure 12. Source: K. Sembulingam, Prema Sembulingam Essentials of Medical Physiology: 6th ed. New Delhi: Jaypee Brothers Medical Publishers, 2012. P. 628

Normal jugular venous pulse: A, a positive wave due to contraction of the right atrium; C, a positive deflection due to bulging of the tricuspid valve toward the atria at the onset of ventricular contraction; X, a negative deflection due to atrial relaxation; V, a positive deflection due to filling of the right atrium against the closed tricuspid valve during ventricular contraction; Y, a negative deflection due to emptying of the right atrium upon ventricular relaxation.

THE CONTROL OF THE LEVEL OF KNOWLEDGE

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Content Sections #12. Blood circulation system

PRACTICAL LESSON 7

Theme: Mechanisms of vascular tone regulation. Regulation of blood pressure. Circulation through special regions.

THE GOALS:

Study the regulatory Central and Humoral mechanisms for Blood Circulation System

The initial level of knowledge

1. Physiological function of the Central Nervous system, Autonomic Nervous system, Endocrinology system.

CONTROL OF THE INITIAL LEVEL OF KNOWLEDGE

CONTROL QUESTIONS:

1. Local and Humoral Control of Tissue Blood Flow
 - a. Vascular tone.
2. Myogenic theory of auto regulation.
3. Metabolic theory of Autoregulation.
 - a. Vasodilator metabolites;
 - b. Vasoconstrictor metabolites;
 - c. Substances secreted by the endothelium.
4. Nervous mechanism or short-term regulatory mechanism involved in the regulation of arterial blood pressure:
 - a. Vasomotor center;
 - b. Vasoconstrictor fibers;

- c. Vasodilator fibers;
 - d. Mechanism of action of vasomotor center in the regulation of blood pressure.
5. Respiratory Centers:
- a. By regulation of extracellular fluid volume;
 - b. Through renin-angiotensin mechanism.
6. Hormonal mechanism for regulation of blood pressure:
- a. Hormones which increase blood pressure
 - b. Hormones which decrease blood pressure

PRACTICAL WORK

TASK 1. Write an explanation about the central regulation of circulation system. Draw the scheme.

TASK 2. Look at two-hour records of arterial pressure in a normal dog (above) and in the same dog (below) several weeks after the baroreceptors had been denervated. Write an explanation and make a resume.

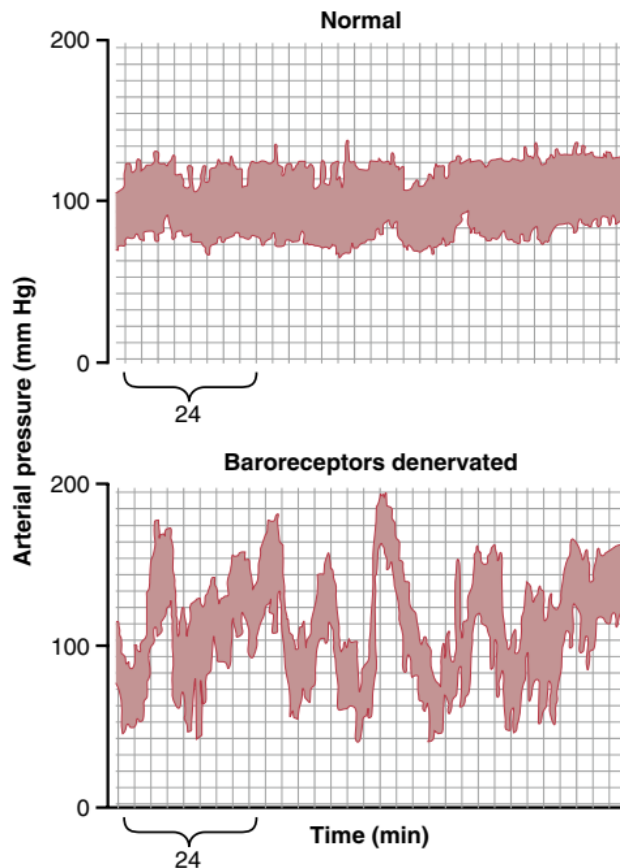


Figure 13. Source: Hall J. E., Hall M. E., Guyton A. C. Guyton and Hall Textbook of Medical Physiology: 14th ed. Philadelphia: Elsevier, 2021. P. 223

TASK 3. Which hormones are hypertonic or hypotonic for blood pressure? Put your results into the table and write an explanation.

<i>Hormones</i>	Mechanism for hypertonic effect	Mechanism for hypotonic effect
Adrenaline		
Bradykinin		
Prostaglandin		
Thyroxin		
Aldosterone		
Histamine		
Vasopressin		
Natriuretic peptide		
Angiotensin		
Serotonin		
Vasoactive intestinal polypeptide		

TASK 4. Demonstration of carotid sinus reflex. Write an explanation about the mechanism of carotid sinus reflex.

Stretch receptors in the walls of carotid sinus and aortic arch (and probably in other large arteries of thorax) continuously monitor or sense the blood pressure. Within physiological limits, a rise or fall of BP brings about appropriate reflex changes in cardiac activity and peripheral resistance to restore the BP toward the normal levels.

Procedure

1. Ask the subject to lie down supine on the examination couch. Loosen his collar and lay the neck bare. Locate the anterior edge of sternomastoid muscle and feel the pulsations of the common carotid artery which lies deeper and medial to it. Locate the upper border of the thyroid cartilage, and feel the pulsations in the carotid sinus which is a small dilation of the internal carotid artery just above the bifurcation of the main trunk (the sinus lies just below the angle of the jaw).

2. Palpate the radial artery with your left hand and, with the thumb of your right hand press the carotid sinus against the vertebral bodies *for 2 seconds only*. The pulse can be felt at this site as well as in the radial artery.

THE CONTROL OF THE LEVEL OF KNOWLEDGE

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PRACTICAL LESSON 8

Credit lesson: Physiology of visceral systems. Blood system. Circulatory system.

CONTROL QUESTIONS

1. Functions of Blood.
2. Composition of Blood.
3. Osmotic pressure and Oncotic pressure.
4. Red Blood Cells. Morphology of red blood cells
5. Hemoglobin and Iron Metabolism.
6. Erythrocyte Sedimentation Rate.
7. Functional characteristics of various types of leukocytes
 - a. Neutrophils and its physiological functions.
 - b. Eosinophils and its physiological functions.

- c. Basophils and its physiological functions.
 - d. Monocytes and its physiological functions.
 - e. The Lymphocytes and its physiological functions.
8. Innate Immunity or Non-Specific Immunity.
 9. Acquired Immunity or Specific Immunity.
 10. ABO blood groups. Rh Factor. Hemolytic Disease of the Newborn.
 11. Physical and Chemical characteristics and physiological functions of Platelets?
 12. Events in Hemostasis”. Stages of hemostasis.
 - a. Response to Injury: vascular contraction.
 - b. Formation of the Platelet Plug and its mechanism.
 - c. Blood Coagulation
 13. Fibrinolysis
 14. Anticlotting mechanism in the body (Chemical Factors – Natural Anticoagulants).
 15. Blood Coagulation Tests?
 - a. Bleeding Time;
 - b. Clotting Time;
 - c. Prothrombine Time.
 16. Physiological properties of Cardiac Muscle.
 17. Specialized excitatory and conductive system of the heart. Automatic electrical rhythmicity of the sinus fibers
 18. Describe the Origin of Electrocardiogram.
 19. Characteristics of the normal ECG.
 20. Mechanical events of the Cardiac Cycle. Intra-atrial pressure, Intraventricular and Aortic pressure changes during Cardiac Cycle. Ventricular volume changes during Cardiac Cycle.
 21. Cardiac output:
 22. Heart Sounds. Phonocardiography.
 23. Autoregulation of heart activity.
 24. Neural control of the Cardiovascular System.
 25. Role of Baroreceptors and chemoreceptors.
 26. Factors affecting vasomotor center – regulation of vagal tone
 27. Humoral regulation of heart activity.
 - a. hormonal regulation of heart activity;
 - b. effect of changes in electrolyte concentration on heart (effect of changes in sodium ion, potassium ion concentration, calcium ion concentration).
 28. Classification and functional characteristics of blood vessels
 29. Lymphatic circulation and interstitial fluid volume
 30. Mechanism of venous return to the heart
 31. Origin and methods of blood pressure measurement
 32. Local and Humoral Control of Tissue Blood
 33. Nervous mechanism regulation of arterial blood pressure.
 34. Hormonal mechanism for regulation of blood pressure

TESTS FROM THE STEP 1 DATABASE

1. As a result of increased permeability of the erythrocyte membrane in a patient with microspherocytic anemia (Minkowsky-Shauffard disease) cells receive sodium ions and water. Erythrocytes take form of spherocytes and can be easily broken down. What is the leading mechanism of erythrocyte damage in this case?
 - A. Protein
 - B. Nucleic acid
 - C. Electrolytic osmotic
 - D. Acidotic
 - E. Calcium
2. 38-year-old woman was admitted to the admission-diagnostic department with uterine bleeding. What are the most likely changes of blood?
 - A. Reduction of hematocrit rate
 - B. Increase of hematocrit rate
 - C. Leukopenia
 - D. Leukocytosis
 - E. Polycythemia
3. A 38-year-old patient with a uterine hemorrhage lasting for 2 days was delivered to the admission ward. Which of the following will be revealed in the patient's blood?
 - A. Decrease in the hematocrit index
 - B. Eosinophilia
 - C. Deceleration in ESR
 - D. Leukocytosis
 - E. Increase in the color index
4. A woman's blood test showed the increase of ESR. What is the reason for it?
 - A. Physical activity.
 - B. Pregnancy.
 - C. Loss of blood.
 - D. Stress.
 - E. Food intake.
5. During the last month of pregnancy the content of fibrinogen in blood plasma was twice as much as the norm. What values of ESR are expected?
 - A. 3-12 mm/h.
 - B. 0-5 mm/h.
 - C. 10-15 mm/h.
 - D. 5-10 mm/h.
 - E. 40-50 mm/h.

6. Examination of a pregnant woman revealed twice as much concentration of fibrinogen in blood plasma. What ESR can this woman have?
- A. 40-50 mm/h
 - B. 10-15 mm/h
 - C. 2-12 mm/h
 - D. 5-10 mm/h
 - E. 0-5 mm/h
7. Long-term starvation cure of a patient resulted in diminished ratio of albumins and globulins in plasma. What of the following will be result of these changes?
- A. Increase of ESR
 - B. Decrease of ESR
 - C. Increase of hematocrit
 - D. Decrease of hematocrit
 - E. Hypercoagulation
8. Examination of a person who worked hard at elevated temperature in the environment detected an abnormal amount of plasma proteins. What is this phenomenon?
- A. Relative hyperproteinemia
 - B. Absolute hyperproteinemia
 - C. Absolute hypoproteinemia
 - D. Dysproteinemia
 - E. Paraproteinemia
9. A man weighs 80 kg, after long physical activity his circulating blood volume is reduced down to 5.4 L, hematocrit makes up 50%, whole blood protein is 80 g/l. These blood characteristics are determined first of all by:
- A. Water loss with sweat
 - B. Increased number of erythrocytes
 - C. Increased protein concentration in plasma
 - D. Increased circulating blood volume
 - E. Increased diuresis
10. Toxic affection of liver results in dysfunction of protein synthesis. It is usually accompanied by the following kind of dysproteinemia:
- A. Absolute hypoproteinemia
 - B. Relative hypoproteinemia
 - C. Absolute hyperproteinemia
 - D. Relative hyperproteinemia
 - E. Paraproteinemia
11. A patient being treated for viral hepatitis type B got symptoms of hepatic insufficiency. What blood changes indicative of protein metabolism disorder will be observed in this case?

- A. Absolute hypoalbuminemia
 - B. Absolute hyperalbuminemia
 - C. Absolute hyperfibrinogenemia
 - D. Proteinic blood composition is unchanged
 - E. Absolute hyperglobulinemia
12. As a result of a chronic disease of the liver the protein synthesis function of a person is substantially defective. It will result in the decrease of some parameter of homeostasis. What parameter is it?
- A. Density of blood.
 - B. Osmotic pressure.
 - C. pH.
 - D. Oncotic pressure of blood plasma.
 - E. Hematocrit index.
13. As a result of long-term starvation the glomerular filtration of a man was accelerated by 20%. The most probable cause of filtration changes under such conditions is:
- A. Fall of oncotic pressure of blood plasma
 - B. Rise of systemic arterial pressure
 - C. Increased permeability of renal filter
 - D. Growth of filtration coefficient
 - E. Increase of renal plasma flow
14. As a result of continuous starvation the glomerular filtration rate has increased by 20%. The most probable cause of the glomerular filtration alteration under the mentioned conditions is:
- A. Decrease in the oncotic pressure of blood plasma
 - B. Increase in the systemic arterial pressure
 - C. Increase in the permeability of the renal filter
 - D. Increase of the filtration quotient
 - E. Increase of the renal blood flow
15. A patient has got sharp decrease of the content of albumins in blood plasma and oncotic pressure. What phenomenon will be the result of these changes?
- A. Decrease of ESR.
 - B. Decrease of diuresis.
 - C. Increase of blood volume.
 - D. Edemas.
 - E. Increase of blood density.
16. Trying to lose weight a woman limited the amount of products in her dietary intake. Three months later she had edemata, diuresis increased. The deficit of what components in food is the reason for it?
- A. Mineral substances.

- B. Fats.
- C. Carbohydrates.
- D. Vitamins.
- E. Proteins.

17. After a long-term starvation a patient got edemata of tissues. What is the reason for this phenomenon?

- A. Reduction of the oncotic pressure of blood plasma.
- B. Increase of the osmotic pressure of blood plasma.
- C. Reduction of the osmotic pressure of blood plasma.
- D. Reduction of hydrostatic blood pressure.
- E. Increase of oncotic blood pressure.

18. The concentration of albumins in human blood sample is lower than normal. This leads to edema of tissues. What blood function is damaged?

- A. Maintaining the oncotic blood pressure
- B. Maintaining the pH level
- C. Maintaining the body temperature
- D. Maintaining the blood sedimentation system
- E. All answers are correct

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

20. In a car accident a man got injured and lost a lot of blood. What changes in peripheral blood are most likely to occur on the 2nd day after the injury?

- A. Erythropenia
- B. Hypochromia
- C. Anisocytosis
- D. Microplania
- E. Significant reticulocytosis

21. A 42 year old patient complains of pain in the epigastral area, vomiting; vomit masses have the color of "coffee-grounds", the patient has also melena. Anamnesis records gastric ulcer. Blood formula: erythrocytes – $2.8 \cdot 10^{12}/L$, leukocytes – $8 \cdot 10^9/L$, Hb- 90 g/L. What complication is it?

- A. Haemorrhage
- B. Penetration

- C. Perforation
- D. Canceration
- E. Pyloric stenosis

22. A hypertensive glucose solution was introduced to a patient. It will intensify water movement:

- A. From the cells to the intercellular liquid
- B. From the intercellular liquid to the capillaries
- C. From the intercellular liquid to the cells
- D. From the capillaries to the intercellular liquid
- E. There will be no changes of water movement

23. Along with normal hemoglobin types there can be pathological ones in the organism of an adult. Name one of them:

- A. HbS
- B. HbF
- C. HbA₁
- D. HbA₂
- E. HbO₂

24. Human red blood cells contain no mitochondria. What is the main pathway for ATP production in these cells?

- A. Anaerobic glycolysis
- B. Aerobic glycolysis
- C. Oxidative phosphorylation
- D. Creatine kinase reaction
- E. Cyclase reaction

25. Blood count of an athlete is as follows: erythrocytes – $5.5 \times 10^{12}/L$, Hb - 180 g/L, leukocytes - $7 \times 10^9/L$, neutrophils - 64%, basophils – 0.5%, eosinophils – 0.5%, monocytes - 8%, lymphocytes - 27%. First of all, such results indicate the stimulation of:

- A. Erythropoiesis
- B. Leukopoiesis
- C. Lymphopoiesis
- D. Granulocytopoiesis
- E. Immunogenesis

26. When ascending to the top of Elbrus, a mountain climber experiences oxygen starvation, dyspnea, palpitations, and numbness of the extremities. What kind of hypoxia has developed in the mountain climber?

- A. Hypoxic
- B. Circulatory
- C. Hemic

- D. Tissue
- E. Cardiac

27. People who live in highlands have got the increased content of erythrocytes. It can be caused by the increase of the production of certain matter by kidneys. What matter is it?

- A. Renin.
- B. Erythropoietin.
- C. Urokinase.
- D. Prostaglandins.
- E. Vitamin D₃

28. During the examination in the state of rest a healthy person has the number of erythrocytes $5.65 \times 10^{12}/L$. The reason for this can be the fact that the examined person is:

- A. A miner.
- B. An inhabitant of highlands.
- C. A student.
- D. An expectant mother.
- E. A responsible ministry worker.

29. A man suffering from a kidneys disease has anemia. The most probable reason for anemia can be a disorder in the secretion of a certain matter. What matter is it?

- A. Antidiuretic hormone.
- B. Renin.
- C. Aldosterone.
- D. Atrial natriuretic factor.
- E. Erythropoietin.

30. As a result of a long stay in the mountains at 3,000 m above the sea level a person had an increase of the oxygen capacity of blood. The increased formation of what substances in the organism is the direct reason for it?

- A. Leukopoietins.
- B. Erythropoietins.
- C. Carbhemoglobin.
- D. Catecholamines.
- E. 2,3-diphosphoglycerate.

31. Blood test of a patient suffering from atrophic gastritis gave the following results: RBCs – $2.0 \times 10^{12}/L$, Hb- 87 g/L, color index – 1.3, WBCs – $4.0 \times 10^9/L$, thrombocytes - $180 \times 10^9/L$. Anemia might have been caused by the following substance deficiency:

- A. Vitamin B₁₂
- B. Vitamin A
- C. Vitamin K

- D. Iron
- E. Zinc

32. In 3 years after the surgery of stomach removal a 45-year-old man has the number of erythrocytes in blood $2.0 \cdot 10^{12}/L$, Hb – 85 g/L, color index - 1.27. The violation of the absorption of what vitamin caused the changes of erythropoiesis?

- A. C
- B. B₁₂
- C. A
- D. P
- E. B₁

33. A 40-year-old man with a removed kidney has got symptoms of anemia. What is the reason for such symptoms?

- A. Lack of iron.
- B. Intensive destruction of erythrocytes.
- C. Decline of synthesis of erythropoietins.
- D. Lack of vitamin B₁₂.
- E. Lack of folic acid.

34. A patient with chronic glomerulonephritis has disorders in the excretory function of the kidneys. The deficit of what blood cells is observed?

- A. Thrombocytes.
- B. Leukocytes.
- C. Erythrocytes.
- D. Leucocytes and thrombocytes.
- E. Erythrocytes and leukocytes.

35. In an experiment in two weeks after the narrowing of the kidney arteria of a rabbit the increase of erythrocytes number and hemoglobin is found in its blood as a result of the stimulation of erythropoiesis by erythropoietins. What increases the formation of erythropoietins?

- A. Hypercapnia.
- B. Hypoxemia.
- C. Hyperosmia.
- D. Hypoosmia.
- E. Hypovolemia.

36. As a result of poisoning with carbon monoxide a person has got a headache, short breath, vertigo. The decline of the content of what compound in blood resulted in this?

- A. Oxyhemoglobin.
- B. Carboxyhemoglobin.
- C. Carbhemoalbumin.
- D. Methemoglobin.

E. Deoxyhemoglobin.

37. What compound of hemoglobin will have the inhabitants of the house, where the flue was blocked untimely?

- A. Deoxyhemoglobin.
- B. Carbhemoalbumin.
- C. Carboxyhemoglobin.
- D. Methemoglobin.
- E. Oxyhemoglobin.

38. An emergency doctor stated the signs of poisoning by carbon monoxide. What compound became the reason for it?

- A. Carboxyhemoglobin.
- B. Carbhemoalbumin.
- C. Methemoglobin.
- D. Deoxyhemoglobin.
- E. Oxyhemoglobin.

39. Blood group of a 30-year-old man has been determined before a surgery. The blood was Rhesus-positive. Agglutination did not occur with standard O (I), A (II), and B (III) serums. The blood belongs to the following group:

- A. (I)
- B. A (II)
- C. B (III)
- D. AB (IV)

40. During determining the blood group according to the ABO system with salt solutions of monoclonal antibodies agglutination did not occur with any of the solutions. What blood group is it?

- A. (I)
- B. A (II)
- C. B (III)
- D. AB (IV)

41. Blood group of a 30 year old man was specified before an operation. His blood is Rh-positive. Reaction of erythrocyte agglutination was absent with standard sera of $O\alpha\beta$ (I), $A\beta$ (II), $B\alpha$ (III) groups. The blood under examination is of the following group:

- A. $O\alpha\beta$ (I)
- B. $A\beta$ (II)
- C. $B\alpha$ (III)
- D. AB (IV)

42. An expectant mother had her blood type defined. The reaction of agglutination of erythrocytes took place with standard serums of blood groups $O\alpha\beta$ (I), $B\alpha$ (III), and did

not appear with the serum of blood group A β (II). What group does the blood belong to?

- A. B α (III).
 - B. A β (II).
 - C. A β (I).
 - D. AB0 (IV).
 - E. Defining is impossible.
43. A pregnant woman had her blood group identified. Reaction of erythrocyte agglutination with standard serums of O $\alpha\beta$ (I), B α (III) groups didn't proceed with standard serum of A β (II) group. The blood group under examination is:
- A. A β (II)
 - B. O $\alpha\beta$ (I)
 - C. B α (III)
 - D. AB (IV)
44. When defining a blood type according to the ABO system the agglutination of erythrocytes of the explored blood was stimulated by standard serums of the I and II blood groups and wasn't stimulated by the standard serum of the III blood group. What agglutinogens are in these erythrocytes?
- A. A and B
 - B. A
 - C. B
 - D. C
 - E. D and C
45. It was established that agglutination of the recipient's blood erythrocytes had been caused by the standard sera from the I and II groups. Serum from the III group as well as anti-Rh serum hadn't provoke any agglutination. Which blood group and rhesus is allowed to be transfused this recipient?
- A. B, α (III) Rh-
 - B. A, β (II) Rh-
 - C. O, $\alpha\beta$, (I) Rh+
 - D. AB (IV), Rh+
 - E. AB (IV), Rh-
46. A pregnant woman underwent AB0 blood typing. Red blood cells were agglutinated with standard sera of the I and II blood groups, and were not agglutinated with the III group serum. What is the patient's blood group?
- A. B (III)
 - B. (I)
 - C. A (II)
 - D. AB (IV)

47. During a laboratory blood analysis of a 33-year-old patient the reaction of agglutination of erythrocytes is detected with standard serums of the I and II blood groups. The reactions of agglutination did not take place with the serum of the III blood group and with anti-rhesus serum. What type of blood can be transfused if it is necessary to take into consideration the CDE system?
- A. B (III) Rh-
 - B. (I) Rh+
 - C. A (II) Rh-
 - D. AB (IV) Rh+
 - E. AB (IV) Rh-
48. When defining a blood type according to ABO system with the help of standard serums such results were got: agglutination took place with the serums of the I and II blood groups and did not take place with the serum of the III blood group. What is the group of the examined blood?
- A. AB (IV).
 - B. A (II).
 - C. B (III).
 - D. (I).
 - E. It is impossible to define.
49. When defining a blood type according to the ABO system the agglutination of erythrocytes of the examined blood was caused by standard serums of the I and II blood groups and wasn't caused by the serum of the III blood group. What blood type is it?
- A. O
 - B. A β (I).
 - C. A β (II).
 - D. AB0 (IV).
 - E. B α (III).
 - F. It is impossible to define.
50. During a surgery there was a necessity of massive blood transfusion. A victim's blood type is B(III)Rh+. What must be the blood type of a donor?
- A. AB (IV) Rh-
 - B. (I) Rh $^-$.
 - C. A (II) Rh+.
 - D. B (III) Rh+.
 - E. B (III) Rh-
51. When defining a blood type according to ABO system with the help of standard serums such results were got: agglutination took place with the serums of the I, II, and III blood groups. What is the group of the examined blood?
- A. AB (IV).

- B. A (II).
 - C. B (III).
 - D. (I).
 - E. It is impossible to define.
52. A 25-year-old woman, pregnant for the third time, got into a clinic with a threat of miscarriage. What combination of her Rh-factor and the fetus' Rh- factor may be the reason for it?
- A. Rh- of the mother and Rh+ of the fetus.
 - B. Rh- of the mother and Rh- of the fetus.
 - C. Rh+ of the mother and Rh- of the fetus.
 - D. Rh+ of the mother and Rh+ of the fetus.
 - E. Defining is impossible.
53. A woman with the blood type AB (IV) Rh-, who has a 3-year-old child with the blood type AB (IV) Rh+, was taken to a hospital with posttraumatic bleeding. It is necessary to transfuse blood. Which of the following blood types is it possible to transfuse?
- A. AB (IV) Rh-.
 - B. (I) Rh-.
 - C. A (II) Rh+.
 - D. A (II) Rh-.
 - E. AB (IV) Rh+.
54. Determining a patient's blood group with monoclonal test-reagents revealed positive agglutination reaction to anti-A and anti- B reagents, and negative reaction to anti-D. What blood group does this patient have?
- A. AB (IV) Rh-
 - B. A (II) Rh+
 - C. B (III) Rh-
 - D. AB (IV) Rh+
 - E. (I) Rh+
55. A woman with B, Rh- blood group born a child with A blood group. The child is diagnosed with hemolytic disease of newborn as a result of rhesus incompatibility. What blood group is the child's father likely to have?
- A. A Rh+
 - B. O Rh+
 - C. B Rh+
 - D. AB Rh-
 - E. A Rh-
56. A woman with the B (III) Rh- blood group gave birth to a child with the A (II) blood group. The child is diagnosed with hemolytic disease of newborn caused by rhesus incompatibility. What blood group and Rh can the father have?

- A. A (II) Rh+
- B. O (I) Rh+
- C. B (III) Rh+
- D. O (I) Rh-
- E. A (II) Rh-

57. After transfusion of 200 ml of blood a patient presented with body temperature rise up to 37.9°C. Which of the following substances is the most likely cause of temperature rise?

- A. Interleukin-1
- B. Interleukin-2
- C. Tumor necrosis factor
- D. Interleukin-3
- E. Interleukin-4

58. Lymphocytes and other cells of our body synthesize universal antiviral agents as a response to viral invasion. Name these protein factors:

- A. Interferon
- B. Interleukin-2
- C. Cytokines
- D. Interleukin-4
- E. Tumor necrosis factor

59. A 16-year-old boy was performed an appendectomy. He has been hospitalized for right lower quadrant abdominal pain within 18 hours. The surgical specimen is edematous and erythematous. Infiltration by what of the following cells is the most typical for the process occurring here?

- A. Neutrophils
- B. Eosinophils
- C. Basophils
- D. Lymphocytes
- E. Monocytes

60. Two hours after an exam a student had a blood count done and it was revealed that he had leukocytosis without significant leukogram modifications. What is the most probable mechanism of leukocytosis development?

- A. Redistribution of leukocytes in the organism
- B. Leukopoiesis intensification
- C. Deceleration of leukocyte lysis
- D. Deceleration of leukocyte migration to the tissues
- E. Leukopoiesis intensification and deceleration of leukocyte lysis

61. A 26-year-old man is in the torpid shock phase as a result of a car accident. In blood: $3.2 \times 10^9/L$. What is the leading mechanism of leukopenia development?

- A. Redistribution of leukocytes in bloodstream
 - B. Leukopoiesis inhibition
 - C. Disturbed going out of mature leukocytes from the marrow into the blood
 - D. Lysis of leukocytes in the blood-forming organs
 - E. Intensified elimination of leukocytes from the organism
62. Examination of a patient 24 hours after appendectomy revealed neutrophilic leukocytosis with a regenerative shift. What is the most likely mechanism of leukocytosis development?
- A. Intensification of leukopoiesis
 - B. Redistribution of the leukocytes in the organism
 - C. Deceleration of leukocyte breakdown
 - D. Deceleration of leukocyte migration to the tissues
 - E. Intensification of leukopoiesis and deceleration of leukocyte migration to the tissues
63. Examination of a patient admitted to the surgical department with symptoms of acute appendicitis revealed the following changes in the white blood cells: the total count of leukocytes is $16 \times 10^9/L$. Leukocyte formula: basophils – 0%, eosinophils - 2%, juvenile forms - 2%, stabnuclear - 8%, segmentonuclear - 59%, lymphocytes - 25%, monocytes- 4%. The described changes can be classified as:
- A. Neutrophilia with regenerative left shift
 - B. Neutrophilia with right shift
 - C. Neutrophilia with degenerative left shift
 - D. Neutrophilic leukemoid reaction
 - E. Neutrophilia with hyperregenerative left shift
64. Blood sampling for the hematology is recommended to carry out on an empty stomach and in the morning. What changes in blood formula are possible if blood sampling was carried out after food intake?
- A. Increase of leukocyte number
 - B. Increase of erythrocyte number
 - C. Increase of plasm proteins
 - D. Decrease of thrombocyte number
 - E. Decrease of erythrocyte number
65. After an attack of bronchial asthma a patient had his peripheral blood tested. What changes can be expected?
- A. Eosinophilia
 - B. Leukopenia
 - C. Lymphocytosis
 - D. Thrombocytopenia
 - E. Erythrocytosis

66. A 3-year-old child had eaten some strawberries. Soon he developed a rash and itching. What was found in the child's leukogram?
- A. Eosinophilia
 - B. Hypolymphemia
 - C. Neutrophilic leukocytosis
 - D. Monocytosis
 - E. Lymphocytosis
67. A 5 year old child is ill with measles. Blood analysis revealed increase of total number of leukocytes up to $13 \times 10^9/L$. Leukogram: basophils – 0%, eosinophils – 1%, myelocytes – 0%, juvenile neutrophils – 0%, band neutrophils – 2%, segmented neutrophils – 41%, lymphocytes – 28%, monocytes – 28%. Name this phenomenon:
- A. Monocytosis
 - B. Agranulocytosis
 - C. Lymphocytosis
 - D. Eosinopenia
 - E. Neutropenia
68. A patient who suffers from pneumonia has high body temperature. What biologically active substance plays the leading part in origin of this phenomenon?
- A. Interleukin-I
 - B. Histamine
 - C. Bradykinin
 - D. Serotonin
 - E. Leukotrienes
69. A patient was ill with burn disease that was complicated by DIC syndrome. What stage of DIC syndrome can be suspected if it is known that the patient's blood coagulates in less than 3 minutes?
- A. Hypercoagulation
 - B. Transition phase
 - C. Hypocoagulation
 - D. Fibrinolysis
 - E. Terminal
70. After a disease a 16-year old boy is presenting with decreased function of protein synthesis in the liver as a result of vitamin K deficiency. This may cause disorder of:
- A. Blood coagulation
 - B. Osmotic blood pressure
 - C. Erythrocyte sedimentation rate
 - D. Anticoagulant production
 - E. Erythropoietin production

71. A patient underwent a surgery for excision of a cyst on pancreas. After this he developed hemorrhagic syndrome with apparent disorder of blood coagulation. Development of this complication can be explained by:
- A. Reduced number of thrombocytes
 - B. Activation of Christmas factor
 - C. Insufficient fibrin production
 - D. Activation of fibrinolytic system
 - E. Activation of anticoagulation system
72. A 70-yr-old patient suffers from atherosclerosis complicated by the lower limb thrombosis that has caused gangrene on his left toes. What is the most likely cause of the thrombin origin?
- A. Transformation of prothrombin into thrombin
 - B. Transformation of fibrinogen into fibrin
 - C. Impaired heparin synthesis
 - D. Thrombocyte adhesion
 - E. Prothrombinase activation
73. A patient suffers from the hemorrhagic syndrome that shows itself in frequent nasal bleedings, posttraumatic and spontaneous intracutaneous and intrarticular hemorrhages. After a laboratory study a patient was diagnosed with the type B hemophilia. This disease is provoked by the deficit of the following factor of blood coagulation:
- A. IX
 - B. VII
 - C. VIII
 - D. XI
 - E. V
74. Punctate hemorrhage was found out in the patient after application of a tourniquet. With dysfunction of what blood cells is it connected?
- A. Platelets
 - B. Eosinophiles
 - C. Monocytes
 - D. Lymphocytes
 - E. Neutrophiles
75. After a tourniquet application a patient was found to have petechial hemorrhages. The reason for it is the dysfunction of the following cells:
- A. Platelets
 - B. Eosinophils
 - C. Monocytes
 - D. Lymphocytes
 - E. Neutrophils

76. A 60-year-old man suffering from chronic hepatitis frequently observes nasal and gingival hemorrhages, spontaneous hemorrhagic rashes on the skin and mucosa. Such presentations result from:
- A. Decreased synthesis of prothrombin and fibrinogen
 - B. Increased blood content of aminotransferases
 - C. Decreased synthesis of serum albumins
 - D. Increased blood content of macroglobulins and cryoglobulins
 - E. Decreased blood content of cholinesterase
77. After implantation of a cardiac valve a young man constantly takes indirect anticoagulants. His state was complicated by hemorrhage. What substance content has decreased in blood?
- A. Prothrombin
 - B. Haptoglobin
 - C. Heparin
 - D. Creatin
 - E. Ceruloplasmin
78. A patient with tissue trauma was taken a blood sample for the determination of blood clotting parameters. Specify the right sequence of extrinsic pathway activation.
- A. III – VIIa – Xa
 - B. II – IV – Xa
 - C. IV – VIII: TF – Xa
 - D. IV – VIIa – Xa
 - E. III – VIII: TF – Xa
79. A 2-year-old child has got intestinal dysbacteriosis, which results in hemorrhagic syndrome. What is the most likely cause of hemorrhage of the child?
- A. Vitamin K insufficiency
 - B. Activation of tissue thromboplastin
 - C. PP hypovitaminosis
 - D. Fibrinogen deficiency
 - E. Hypocalcemia
80. There is an inhibited coagulation in the patients with bile ducts obstruction, bleeding due to the low level of absorption of a vitamin. What vitamin is in deficiency?
- A. K
 - B. A
 - C. D
 - D. E
 - E. Carotene

81. Patients with bile ducts obstruction suffer from inhibition of blood coagulation, bleedings as a result of low level of vitamin assimilation. What vitamin is in deficiency?
- A. K
 - B. A
 - C. D
 - D. E
 - E. Carotene
82. A clinic observes a 49 year old patient with significant prolongation of coagulation time, gastrointestinal hemorrhages, subcutaneous hematomas. These symptoms might be explained by the deficiency of the following vitamin:
- A. K
 - B. B₁
 - C. B₆
 - D. H
 - E. E
83. A 10-year-old girl has a history of repeated acute respiratory viral infection. After recovering she presents with multiple petechial hemorrhages on the sites of friction from clothing rubbing the skin. What kind of hypovitaminosis has this girl?
- A. C
 - B. B₆
 - C. B₁
 - D. A
 - E. B₂
84. A 3-year-old boy with pronounced hemorrhagic syndrome doesn't have antihemophilic globulin A (factor VIII) in the blood plasma. Hemostasis has been impaired at the following stage:
- A. Internal mechanism of prothrombinase activation
 - B. External mechanism of prothrombinase activation
 - C. Conversion of prothrombin to thrombin
 - D. Conversion of fibrinogen to fibrin
 - E. Blood clot retraction
85. A 46-year-old female is scheduled for a maxillofacial surgery. It is known that the patient is prone to high blood coagulation. What natural anticoagulant can be used to prevent blood clotting?
- A. Heparin
 - B. Hirudin
 - C. Sodium citrate
 - D. Fibrinolysin
 - E. None of the above-listed substances

86. 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. Thromboplastin formation
 - B. Thrombin formation
 - C. Fibrin formation
 - D. Clot retraction
87. A microspecimen of heart shows rectangular cells from 50 to 120 micrometers large with central position of nucleus and developed myofibrils. The cells are connected by intercalated discs. These cells are responsible for the following function:
- A. Function of heart contractions
 - B. Function of impulse conduction
 - C. Endocrine
 - D. Protective
 - E. Regeneratory
88. The process of heart transplantation determined the viability of myocardial cells. The determination of what myocardium parameter is the most important?
- A. Resting potential of cardiomyocytes
 - B. Heart temperature
 - C. Concentration of oxygen in heart vessels
 - D. Concentration of calcium-ions in myofibrils
 - E. Concentration of Ca-ions in heart vessels
89. It is necessary to estimate the level of the excitability of tissue in an experiment. What parameter is it necessary to define for this purpose?
- A. Threshold of depolarization.
 - B. Resting potential.
 - C. Duration of action potential.
 - D. Amplitude of action potential.
 - E. Critical level of depolarization.
90. During ventricular systole, the cardiac muscle does not respond to additional stimulation because it is in the phase of:
- A. Absolute refractoriness
 - B. Relational refractoriness
 - C. Hyperexcitability
 - D. Subnormal excitability
 - E. There is no correct answer
91. An isolated muscle fiber is under examination. It was established that the threshold of stimulation force became significantly lower. What is the cause of this phenomenon?

- A. Activation of sodium channels of membrane
 - B. Activation of potassium channels of membrane
 - C. Inactivation of sodium channels of membrane
 - D. Inactivation of potassium channels of membrane
 - E. Block of energy production in the cell
92. Examination of an isolated cardiomyocyte revealed that it didn't generate excitation impulses automatically. This cardiomyocyte was obtained from:
- A. Ventricles
 - B. Sinoatrial node
 - C. Atrioventricular node
 - D. His bundle
 - E. Purkinje fibers
93. An isolated cell of human heart automatically generates excitation impulses with frequency 60 times pro minute. What structure does this cell belong to?
- A. Sinoatrial node
 - B. Atrium
 - C. Ventricle
 - D. Atrioventricular node
 - E. His bundle
94. The frequency of heartbeats of a man is constantly at the level of 40 per min. What structure is the conductor of the rhythm?
- A. His bundle.
 - B. Sinoatrial node.
 - C. Atrioventricular node.
 - D. Crura of His bundle.
 - E. Purkinje fibers.
95. A cardiac electric stimulator was implanted to a 75 year old man with heart rate of 40 bpm. Thereafter the heart rate rose up to 70 bpm. The electric stimulator has undertaken the function of the following heart part:
- A. Sinoatrial node
 - B. Atrioventricular node
 - C. His bundle branches
 - D. His bundle fibers
 - E. Purkinje fibers
96. A person has steady HR not exceeding 40 bpm. What is the pacemaker of the heart rhythm in this person?
- A. Atrioventricular node
 - B. Sinoatrial node
 - C. His bundle

- D. Branches of His bundle
- E. Purkinje fibers

97. In a healthy adult speed of the excitement conduction through the atrioventricular node is 0.02-0.05 m/sec. Atrioventricular delay enables:

- A. Sequence of atrial and ventricular contractions
- B. Sufficient force of ventricular contractions
- C. Simultaneity of both atria contractions
- D. Sufficient force of atrial contractions
- E. Simultaneity of both ventricles contractions

98. The speed of the conduction of excitement through the atrioventricular node of a healthy grown-up is 0.02-0.05 m/s. What process does the atrioventricular delay provide?

- A. Sufficient force of auricles contraction.
- B. Simultaneity of the contraction of both atria.
- C. Simultaneity of the contraction of both ventricles.
- D. Sequence of the contraction of atria and ventricles.
- E. Sufficient force of the contraction of ventricles.

99. In an experiment on a mammal by the destruction of a certain heart structure the conduction of excitement from atriums to ventricles is stopped. What heart structure is destroyed?

- A. Branches of His bundle
- B. Sinoatrial node.
- C. His bundle.
- D. Atrioventricular node.
- E. Purkinje fibers.

100. In an experiment on an animal a cardiac cycle is examined. All valves of heart are closed. What phase does it correspond to?

- A. Isometric contraction.
- B. Asynchronous contraction.
- C. Protodiastolic period.
- D. Rapid filling.
- E. Slow filling.

101. While preparing a patient to the operation the heart chambers' pressure was measured. In one of them the pressure changed during one heart cycle from 0 to 120 mm Hg. What chamber of heart was it?

- A. Left ventricle
- B. Right ventricle
- C. Right atrium
- D. Left atrium

102. During preparation of a patient to a heart surgery it was necessary to measure pressure in heart chambers. In one of them pressure varied from 0 mm Hg up to 120 mm Hg within one cardiac cycle. What heart chamber is it?
- A. Left ventricle
 - B. Right ventricle
 - C. Right atrium
 - D. Left atrium
103. An animal experiment is aimed at studying the cardiac cycle. All the heart valves are closed. What phase of the cycle is characterized by this status?
- A. Isometric contraction
 - B. Asynchronous contraction
 - C. Protodiastolic period
 - D. Rapid filling
 - E. Reduced filling
104. Examination of a person revealed that minute volume of heart is 3500 ml, systolic volume is 50 ml. What is the frequency of cardiac contraction?
- A. 70 bpm
 - B. 60 bpm
 - C. 50 bpm
 - D. 80 bpm
 - E. 90 bpm
105. Blood minute volume of a 30 year old woman at rest is 5 L/min. What blood volume is pumped through the pulmonary vessels per minute?
- A. 1.5 L.
 - B. 3.75 L.
 - C. 2.5 L.
 - D. 2 L.
 - E. 5 L.
106. It is necessary to examine the state of the person's heart valves. Which of the instrumental methods of research is it better to use for this purpose?
- A. Sphygmography.
 - B. Electrocardiography.
 - C. Phonocardiography.
 - D. Phlebography.
 - E. Probing of vessels.
107. When analyzing an ECG it is necessary to define the pacemaker of the heart. On the basis of the measuring of what index is it possible to do?
- A. Duration of waves.

- B. Amplitude of waves.
- C. Direction of waves.
- D. Duration of RR interval.
- E. Duration of QRS complex.

108. The duration of the PQ interval exceeds the norm against the background of the normal duration of the P wave. The reason for it is the lowering of the speed of excitement conduction in a certain structure. What structure is it?

- A. Atrioventricular node.
- B. Sinoatrial node.
- C. His bundle.
- D. Crura of His bundle.
- E. Purkinje fibers.

109. Electrocardiogram analysis demonstrates that cardiac cycle of a human equals 1 second. It means that heart rate per minute equals:

- A. 60
- B. 50
- C. 70
- D. 80
- E. 100

110. A 49-yr-old patient consulted a doctor about increased fatigability and dyspnea provoked by physical activity. ECG results: heart rate-50/min, PQ interval is prolonged, QRS complex is unchanged, the number of P waves exceeds the number of QRS complexes. What type of arrhythmia is it?

- A. Atrioventricular block
- B. Sinoatrial block
- C. Ciliary arrhythmia
- D. Extrasystole
- E. Sinus bradycardia

111. Electrocardiogram of a 45-year-old man showed absence of P wave in all the leads. What part of the conducting system is blocked?

- A. Sinoatrial node
- B. Atrioventricular node
- C. Common branch of the bundle of His
- D. Branches of the bundle of His
- E. Purkinje fibers

112. ECG of a patient with hyperfunction of thyroid gland showed heart hurry. It is indicated by depression of the following ECG element:

- A. RR interval
- B. PQ segment

- C. PQ interval
- D. PT interval
- E. QRS complex

113. A patient has got a diminishing speed of conduction of excitement on an atrioventricular node. The increase of the duration of a certain index will be registered on the ECG. What index is it?

- A. RR interval.
- B. P wave.
- C. PQ interval.
- D. QRS complex.
- E. ST segment.

114. A patient has delayed conduction of excitement through the atrioventricular node. What changes of ECG will be observed?

- A. Prolongation of PQ interval
- B. Prolongation of QS interval
- C. Negative T wave
- D. ST-segment displacement
- E. Prolongation of QT interval

115. ECG of a patient shows prolongation of T wave. This is caused by deceleration in ventricles of:

- A. Repolarization
- B. Depolarization and repolarization
- C. Depolarization
- D. Contraction
- E. Relaxation

116. A 67 year old patient complains of periodic heart ache, dyspnea during light physical activities. ECG reveals extraordinary contractions of heart ventricles. Such arrhythmia is called:

- A. Extrasystole
- B. Bradycardia
- C. Tachycardia
- D. Flutter
- E. Fibrillation

117. Analysis of the ECG revealed the missing of several PQRST cycles. The remaining waves and complexes are not changed. Specify the type of arrhythmia:

- A. Sinoatrial block
- B. Atrial fibrillation
- C. Atrioventricular block
- D. Atrial premature beat

E. Intra-atrial block

118. ECG of a patient displays an abnormally long R wave (up to 0.18 s). This is caused by a decrease in the conduction velocity of the following heart structures:

- A. Ventricles
- B. Atria
- C. Atrioventricular node
- D. Right ventricle
- E. Left ventricle

119. The processes of the repolarization in the myocardium of the ventricles of an examined patient are defective. The violation of amplitude, configuration, and duration of what wave will it lead to?

- A. QT
- B. Q
- C. R
- D. T
- E. P

120. The ECG of a patient showed the increase of the duration of T wave. The increasing of this index was caused by the diminishing speed of certain processes in ventricles. What processes are these?

- A. Depolarization and repolarization.
- B. Repolarization.
- C. Depolarization.
- D. Contraction.
- E. Relaxation.

121. Analyzing the ECG it was stated that in the II standard lead from the extremities the T waves are positive, their amplitude and duration are normal. What process takes place in the ventricles of the heart normally?

- A. Excitation.
- B. Depolarization.
- C. Repolarization.
- D. Contraction.
- E. Relaxation.

122. ECG study showed that the T waves were positive in the standard extremity leads, their amplitude and duration was normal. The right conclusion would be that the following process runs normally in the heart ventricles:

- A. Repolarization
- B. Depolarization
- C. Excitement
- D. Contraction

E. Relaxation

123. The ECG of a patient showed the increase of the duration of the QT interval. The increasing of this index was caused by the diminishing speed of certain processes in the ventricles. What processes are these?
- A. Depolarization.
 - B. Depolarization and repolarization.
 - C. Repolarization.
 - D. Contraction.
 - E. Relaxation.
124. A patient complains of palpitations after stress. Pulse is 104/min, PQ = 0.12 seconds, there are no changes in QRS complex. What type of arrhythmia does the patient have?
- A. Sinus tachycardia
 - B. Sinus bradycardia
 - C. Sinus arrhythmia
 - D. Ciliary arrhythmia
 - E. Extrasystole
125. In an experiment on a dog a peripheral part of the vagus nerve on the neck is irritated. What changes of cardiac activity are observed here?
- A. Increase of the force of contractions.
 - B. Increase of the excitability of myocardium.
 - C. Increase of the conduction of excitation on myocardium.
 - D. Decrease of the frequency of contractions.
126. Immediately after the transition from horizontal position to vertical one the frequency of heart beats of a man increased by 15 per minute. What mechanisms of regulation mainly predetermine this change?
- A. Conditional sympathetic reflexes.
 - B. Unconditional sympathetic reflexes.
 - C. Conditional and unconditional sympathetic reflexes.
 - D. Catecholamines.
127. The change of body position from horizontal to vertical caused the decrease of venous return of blood to the heart, and as a result there is a decrease of the stroke volume of blood and system arterial pressure. Signals from what receptors, first of all, start compensatory mechanisms of the renewal of hemodynamics?
- A. Baroreceptors of pulmonary artery.
 - B. Chemoreceptors of sinocarotid zone.
 - C. Mechanoreceptors of right atriums.
 - D. Baroreceptors of the arch of aorta and carotid sinuses.
 - E. Volume receptors of the vena cava inferior.

128. What compensatory mechanisms arise when a healthy person passes from a lying position to a standing position?
- A. Decline of diastolic arteriotony.
 - B. Decrease of the frequency of heartbeats.
 - C. Increase of the frequency of heartbeats.
 - D. Decrease of the tone of vessels.
 - E. Decrease of common peripheral resistance.
129. In response to a change in body position from horizontal to vertical blood circulation system develops reflectory pressor reaction. Which of the following is its compulsory component?
- A. Systemic constriction of the venous vessels
 - B. Systemic dilation of the arterial resistive vessels
 - C. Decrease in the circulating blood volume
 - D. Increase in the heart rate
130. Working up atypical cardiomyocytes with a biologically active substance the increase of their membrane potential is registered due to the increased permeability of potassium ions. What substance influenced the cardiomyocytes?
- A. Thyroxin.
 - B. Adrenaline.
 - C. Noradrenaline.
 - D. Acetylcholine.
 - E. Atrial natriuretic factor.
131. During physical activity the minute volume of blood of a man with a transplanted heart increased. What mechanism of regulation provides these changes?
- A. Sympathetic conditional reflexes.
 - B. Sympathetic unconditional reflexes.
 - C. Parasympathetic unconditional reflexes.
 - D. Catecholamines.
 - E. Parasympathetic conditional reflexes.
132. The minute blood volume in a patient with transplanted heart has increased as a result of physical activity. What regulative mechanism is responsible for the changes?
- A. Sympathetic unconditioned reflexes
 - B. Sympathetic conditioned reflexes
 - C. Catecholamines
 - D. Parasympathetic conditioned reflexes
 - E. Parasympathetic unconditioned reflexes

133. During an experiment vagus branches that innervate heart are being stimulated. This has stopped conduction of excitement from the atria to the ventricles. The reasons for it are electrophysical changes in the following structures:
- A. Atria
 - B. Sinoatrial node
 - C. Ventricles
 - D. His bundles
 - E. Atrioventricular node
134. Vagus branches that innervate heart are being stimulated in course of an experiment. As a result of it the excitement conduction from atria to the ventricles was brought to a stop. It is caused by electrophysical changes in the following structures:
- A. Atrioventricular node
 - B. His bundle
 - C. Sinoatrial node
 - D. Ventricles
 - E. Atria
135. The calcium canals of cardiomyocytes have been blocked on an isolated rabbit's heart. What changes in the heart's activity can happen as a result?
- A. Decreased rate and force of heart beat
 - B. Decreased heart beat rate
 - C. Decreased force of the contraction
 - D. Heart stops in systole
 - E. Heart stops in diastole
136. After the trauma, the patient's right n.vagus was damaged. Which violation of the cardiac activity is possible in this case?
- A. Violation of the automatism of a sinoatrial node
 - B. Violation of the automatism of an atrioventricular node
 - C. Violation of conductivity in the right auricle
 - D. Block of conductivity in the atrioventricular node
 - E. Arrhythmia
137. Heart rate of a 30-year-old man under emotional stress reached 112 bpm. The reason for the heart rate increase is the altered condition of the following conducting system of heart:
- A. Sinoatrial node
 - B. Purkinje fibers
 - C. His bundle branches
 - D. Atrioventricular node
 - E. His bundle

138. Short-term physical activity resulted in reflex amplification of heart rate and raise of systemic arterial pressure. What receptors activation was the main cause of pressor reflex realization?
- A. Proprioceptors of active muscles
 - B. Vascular chemoreceptors
 - C. Vascular volume receptors
 - D. Vascular baroreceptors
 - E. Hypothalamus thermoreceptors
139. A man presents with increased heart rate, mydriatic pupils, dry mouth. This condition results from the activation of the following system of function regulation:
- A. Sympathetic
 - B. Parasympathetic
 - C. Metasympathetic
 - D. Vago-insular
 - E. Hypothalamo-pituitary-adrenal
140. Vagus branches that innervate heart are being stimulated during an experiment. This caused reduction of heart rate due to the intensification of the following process (through the cell membrane of cardiac pacemaker):
- A. Potassium ion yield
 - B. Potassium ion entry
 - C. Calcium ion entry
 - D. Calcium ion yield
 - E. Calcium and potassium ion yield
141. During fighting a man had a cardiac arrest as a result of a hard blow to the upper region of anterior abdominal wall. Which of the described mechanisms might have provoked the cardiac arrest?
- A. Parasympathetic unconditioned reflexes
 - B. Sympathetic unconditioned reflexes
 - C. Parasympathetic conditioned reflexes
 - D. Sympathetic conditioned reflexes
 - E. Peripheric reflexes
142. A patient who had been continuously taking drugs blocking the production of angiotensin II developed bradycardia and arrhythmia. A likely cause of these disorders is:
- A. Hyperkalemia
 - B. Hypokalemia
 - C. Hypernatremia
 - D. Hypocalcemia
 - E. Hypercalcemia

143. A patient who suffers from severe disorder of water-salt metabolism experienced cardiac arrest in diastole. What is the most probable mechanism of cardiac arrest in diastole?
- A. Hyperkalemia
 - B. Hypernatremia
 - C. Organism dehydration
 - D. Hypokalemia
 - E. Hyponatremia
144. On experiment on the dog the peripheral part of nervus vagus of the neck was irritated. What changes of the heart function would be observed?
- A. Decreased contraction rate
 - B. Increased contraction force
 - C. Increased atrioventricular conduction
 - D. Increased contraction force and rate
 - E. Increased myocardial excitability
145. During an experiment vagus branches that innervate heart are being stimulated. This has stopped conduction of excitement from the atria to the ventricles. The reasons for it are electrophysical changes in the following structures:
- A. Atrioventricular node
 - B. His bundle
 - C. Sinoatrial node
 - D. Ventricles
 - E. Atria
146. A sportsman spontaneously held breath for 40 seconds, which resulted in an increase in heart rate and systemic arterial pressure. Changes of these indicators are due to activation of the following regulatory mechanisms:
- A. Unconditioned sympathetic reflexes
 - B. Unconditioned parasympathetic reflexes
 - C. Conditioned sympathetic reflexes
 - D. Conditioned parasympathetic reflexes
147. A man of 40. The rise of arterial pressure was diagnosed after emotional excitement. What is the possible reason for this effect?
- A. Hyperpolarization of cardiomyocytes.
 - B. Dilatation of arterioles.
 - C. Decrease of frequency of heart beats.
 - D. Increase of tone of sympathetic part of the nervous system.
 - E. Increase of tone of parasympathetic part of the nervous system.
148. An aged man had raise of arterial pressure under a stress. It was caused by activation of:

- A. Sympathoadrenal system
- B. Parasympathetic nucleus of vagus
- C. Functions of thyroid gland
- D. Functions of adrenal cortex
- E. Hypophysis function

149. In an experiment on a dog a peripheral part of the vagus nerve on the neck is irritated. What changes of cardiac activity take place?

- A. Increase of excitability of myocardium.
- B. Increase of the force of contractions.
- C. Increase of atrioventricular conduction.
- D. Increase of the frequency and force of contractions.
- E. Decrease of the frequency of contraction.

150. A peripheral segment of vagus nerve on a dog's neck was being stimulated in course of an experiment. The following changes of cardiac activity could be meanwhile observed:

- A. Heart rate fall
- B. Heart hurry
- C. Enhancement of atrioventricular conduction
- D. Heart rate and heart force amplification
- E. Increased excitability of myocardium

151. Atria of an experimental animal were superdistended by blood that resulted in decreased reabsorption of Na^+ and water in renal tubules. This can be explained by the influence of the following factor upon kidneys:

- A. Natriuretic hormone
- B. Aldosterone
- C. Renin
- D. Angiotensin
- E. Vasopressin

152. A reflex cardiac arrest happened during a surgical operation on the organs of abdominal cavity. Where is the center of this reflex located?

- A. In the diencephalon.
- B. In the spinal cord.
- C. In the mesencephalon.
- D. In the medulla oblongata.
- E. In the cortex of large hemispheres.

153. Cardiac arrest occurred in a patient during a surgery of the small intestine. What regulatory mechanisms resulted in the cardiac arrest in this case?

- A. Unconditioned parasympathetic reflexes
- B. Unconditioned sympathetic reflexes

- C. Conditioned parasympathetic reflexes
- D. Conditioned sympathetic reflexes
- E. Metasympathetic reflexes

154. In an experiment on a dog it was necessary to reduce the excitability of myocardium. What solution is it advisable to introduce intravenously?

- A. Glucose.
- B. Calcium chloride.
- C. Sodium chloride.
- D. Sodium bicarbonate.
- E. Potassium chloride.

155. What changes of the function of the isolated heart will take place after the increase of the concentration of calcium chloride in the perfusion solution?

- A. Decrease of the frequency of contractions.
- B. Decrease of the force of contractions.
- C. Increase of the frequency and force of contractions.
- D. Cardiac arrest in diastole.
- E. Decrease of the frequency and force of contractions.

156. Calcium canals of cardiomyocytes were partly blocked on the isolated heart of a rabbit. What changes in cardiac activity will take place as a result of it?

- A. Decrease of the frequency of contractions.
- B. Decrease of the frequency and force of contractions.
- C. Decrease of the force of contractions.
- D. Cardiac arrest in diastole.
- E. Cardiac arrest in systole.

157. Experimental stimulation of sympathetic nerve branches that innervate heart caused an increase in force of heart contractions because membrane of typical cardiomyocytes permitted an increase in:

- A. Calcium ion entry
- B. Calcium ion exit
- C. Potassium ion exit
- D. Potassium ion entry
- E. Calcium and potassium ion exit

158. A passenger of a fixed run taxi has a sudden and expressed attack of tachycardia. A doctor travelling by the same taxi has managed to slow down his heart rate by pressing upon the eyeballs and thus causing the following reflex:

- A. Dagnini-Aschner reflex
- B. Bainbridge reflex
- C. Holtz reflex
- D. Hering-Breuer reflex

E. Frank-Starling mechanism

159. Patient's systolic blood pressure is 90 mm Hg, diastolic - 70 mm Hg. Such blood pressure is caused by decrease of the following factor:

- A. Pumping ability of the left heart
- B. Pumping ability of the right heart
- C. Aortic compliance
- D. Total peripheral resistance
- E. Vascular tone

160. Systemic arterial pressure of an adult dropped from 120/70 to 90/50 mm Hg that led to reflexory vasoconstriction. The vasoconstriction will be maximal in the following organ:

- A. Bowels
- B. Heart
- C. Brain
- D. Kidneys
- E. Adrenals

161. A 56 year old patient suffering from cardiac insufficiency has edema of feet and shins, edematous skin is pale and cold. What is the leading mechanism of edema pathogenesis?

- A. Rise of hydrostatic pressure in venules
- B. Drop of oncotic pressure in capillaries
- C. Increase of capillary permeability
- D. Disorder of lymph outflow
- E. Positive water balance

162. An adult man presents with systemic arterial pressure drop from 120/70 to 90/50 mm Hg. This resulted in reflex vasoconstriction. Vasoconstriction will be minimal in the following organ:

- A. Heart
- B. Skin
- C. Bowels
- D. Skeletal muscles
- E. Liver

163. During the fight, a man had a cardiac arrest due to the strong blow to the upper region of the anterior abdominal wall. Which of the following mechanisms has led to the cardiac arrest?

- A. Parasympathetic unconditioned reflexes
- B. Sympathetic unconditioned reflexes
- C. Parasympathetic conditioned reflexes
- D. Sympathetic conditioned reflexes

E. Peripheral reflexes

164. Since a patient has had myocardial infarction, atria and ventricles contract independently from each other with a frequency of 60-70 and 35-40 per minute. Specify the type of heart block in this case:

- A. Complete atrioventricular
- B. Partial atrioventricular
- C. Sino-atrial
- D. Intra-atrial
- E. Intraventricular

165. During physical activity the activity of sympathetic part of the nervous system increases, which results in the increase of minute blood volume and narrowing of resistant vessels, but the vessels of working muscles dilate sharply. What is the reason for their dilatation?

- A. Strengthening of the impulsation from baroreceptors of the arch of aorta.
- B. Decrease of the sensitiveness of adrenoreceptors.
- C. Strengthening of the impulsation from arterial chemoreceptors.
- D. Strengthening of the impulsation from proprioceptors of muscles.
- E. Accumulation of the products of metabolism.

166. As a result of bleeding the volume of circulatory blood of a patient is reduced. How will it influence the value of arterial pressure?

- A. Diastolic pressure will decrease only.
- B. Systolic pressure will decrease only.
- C. Systolic and diastolic pressure will decrease.
- D. Systolic pressure will decrease at increasing of diastolic.
- E. Diastolic pressure will decrease at increasing of systolic.

167. A patient with hypertensive crisis has increased content of angiotensin II in blood. Angiotensin pressor effect is based on:

- A. Contraction of arteriole muscles
- B. Activation of biogenic amine synthesis
- C. Prostaglandin hyperproduction
- D. Vasopressin production stimulation
- E. Activation of kinin–kallikrein system

168. A student got tachycardia before an examination. What changes in the ECG will testify its presence?

- A. Lengthening of QRS complex.
- B. Lengthening of RR interval.
- C. Shortening of RR interval.
- D. Lengthening of PQ interval.
- E. Lengthening of QT segment.

169. A patient who lost about 500 ml blood was delivered to a hospital. During an examination it was determined that considerable decrease of the volume of circulatory blood was absent. The increased secretion of which of the following hormones is the reason for it?
- A. Thyroxin.
 - B. Adrenaline.
 - C. Noradrenaline.
 - D. Aldosterone.
 - E. Cortisol.
170. A month after surgical constriction of rabbit's renal artery the considerable increase of systematic arterial pressure was observed. What of the following regulation mechanisms caused the animal's pressure change?
- A. Angiotensin-II
 - B. Vasopressin
 - C. Adrenaline
 - D. Noradrenaline
 - E. Serotonin
171. A sportsman has the increase of arterial pressure and frequency of heartbeats before a competition. By the influence of what parts of the CNS is it possible to explain these changes?
- A. Cortex of large hemispheres.
 - B. Diencephalon.
 - C. Medulla oblongata.
 - D. Mesencephalon.
 - E. Hypothalamus.
172. In the course of an experiment on a rabbit a bandaging of the kidney artery was done. As a result of it the level of arterial pressure increased considerably. The increase of the secretion of what substance caused it?
- A. Atrial natriuretic factor.
 - B. Adrenaline.
 - C. Vasopressin.
 - D. Noradrenaline.
 - E. Renin.
173. A student, 18 years old. During physical activity redistribution of blood flow in organs is reographically registered. In the vessels of what organ did the blood flow increase most of all?
- A. Liver.
 - B. Skeletal muscles.
 - C. Cerebrum.

- D. Kidneys.
- E. Digestive tract.

174. Introduction of a big dose of histamine to an experimental animal caused abrupt drop of arterial pressure as a result of:

- A. Dilation of resistance vessels
- B. Constriction of resistance vessels
- C. Increase of heart rate
- D. Decrease of heart rate
- E. Decrease of heart rate and force

175. In an experiment during the study of the processes of the excitation of cardiomyocytes it was determined that in the phase of rapid depolarization sodium ions can move additionally. What channels can they additionally move through?

- A. Calcium.
- B. Potassium.
- C. Chloric.
- D. Magnesium.
- E. Lithium.

176. A student, 18 years old. During physical activity redistribution of blood flow in organs is reographically registered. In the vessels of what organ did the blood flow increase most of all?

- A. Liver
- B. Skeletal muscles
- C. Cerebrum
- D. Kidneys
- E. Digestive tract

177. In the course of an experiment on animals it was stated that arterial pressure depends on the size of vascular resistance. In what vessels is it the greatest?

- A. Aorta.
- B. Arteries.
- C. Arterioles.
- D. Veins.
- E. Capillaries.

178. In an experiment the linear speed of blood movement is measured. It is the least in a capillary. What is the reason for this phenomenon?

- A. Small diameter of the capillary.
- B. Small length of the capillary.
- C. The biggest total area of transversal section of capillaries.
- D. Small hydrostatic pressure in capillaries.
- E. Superfine wall of capillary.

179. During the research it was determined that normally the liquid outlet in interstitium exceeds its reverse inflow through a capillary wall. Where does the surplus of liquid get?
- A. Into arterial vessels.
 - B. Into venous vessels.
 - C. Into interpleural space.
 - D. Into abdominal cavity.
 - E. Into lymphatic vessels.
180. A 49 year old woman spent a lot of time standing. As a result of it she got leg edema. What is the most likely cause of the edema?
- A. Increase in hydrostatic pressure of blood in veins
 - B. Decrease in hydrostatic pressure of blood in veins
 - C. Decrease in hydrostatic pressure of blood in arteries
 - D. Increase in oncotic pressure of blood plasma
 - E. Increase in systemic arterial pressure
181. After several hours sitting in the forced position in a bus a passenger noticed an edema of his feet and ankles. What is the reason for such edema?
- A. Venous congestion.
 - B. Dilation of arterioles.
 - C. Increased permeability of capillaries.
 - D. Decline of proteins level in plasma.
 - E. High level of histamine.
182. It is necessary to examine the elasticity of a person's large arterial vessels. Which of the instrumental methods of research is it better to use for this purpose?
- A. Electrocardiography.
 - B. Sphygmography.
 - C. Phonocardiography.
 - D. Phlebography.
 - E. Vectorcardiography.
183. In an elderly person the change in heart force and vessels physical properties were detected; they can be clearly observed on graphic recording of carotid pulse waves. What method was applied?
- A. Sphygmography
 - B. Plethysmography
 - C. Rheography
 - D. Myography
 - E. Phlebography

184. Physical activity of a healthy man caused moderate decline of diastolic pressure. What is the reason for such phenomenon?
- A. Enhancement of heart work.
 - B. Decline of the tone of vessels in muscles.
 - C. Decrease of the elasticity of vessels.
 - D. Decrease of the volume of circulatory blood.
 - E. Increase of the resistance of vessels.
185. What effect will the electrostimulation of baroreceptors of carotid sinus lead to in an experiment on a dog?
- A. Expansion of vessels.
 - B. Vasoconstriction.
 - C. Increase of the frequency of heart beats.
 - D. Increase of the minute volume of blood.
 - E. Increase of systolic volume.
186. A patient has got an increasing tone of arterioles against the background of normal indexes of heart work. How will it influence the value of arterial pressure?
- A. Pressure will not change.
 - B. Systolic pressure will increase mainly.
 - C. Diastolic pressure will increase mainly.
 - D. Diastolic pressure will diminish mainly.
187. A driver who got a trauma in a road accident and is shocked has reduction of daily urinary output down to 300 ml. What is the main pathogenetic factor of such diuresis change?
- A. Drop of arterial pressure
 - B. Drop of oncotic blood pressure
 - C. Increased vascular permeability
 - D. Decreased number of functioning glomeruli
 - E. Secondary hyperaldosteronism
188. A 63-year-old patient with collapse presentations was delivered to the emergency hospital. A physician has chosen noradrenalin against hypotension. What is its mechanism of action?
- A. Activation of α_1 -adrenoreceptors
 - B. Activation of serotonin receptors
 - C. Activation of dopamine receptors
 - D. Block of M-cholinoreceptors
 - E. Activation of β -adrenoreceptors

Content Sections #13. Respiration system

PRACTICAL LESSON 9

Theme: Respiratory system. Research of external breath.

THE GOALS OF OCCUPATION:

Study the biomechanics of breath, parameters of external breath, and observation methods of the external breath.

The initial level of knowledge

1. Anatomic and histological structure of Respiration System.

CONTROL THE INITIAL LEVEL OF KNOWLEDGE

1. Respiration. Types of respiration. Phases of respiration.

2. Functional anatomy of the Lungs:

3. Structure of respiratory unit

4. Pulmonary circulation.

5. Functions of respiratory tract

6. Mechanics of Respiration

7. Muscles of respiration

a. Inspiratory Muscles;

b. Expiratory Muscles.

8. Movements of thoracic cage

9. Factors Causing Collapsing Tendency of Lungs

10. Factors Preventing Collapsing Tendency of Lungs

11. Respiratory pressures

a. Intrapleural pressure;

b. Intra-alveolar pressure.

12. Compliance

13. Describe the Mechanics of Respirations:

a. inspiration and expiration;

14. Pulmonary Function Tests

b. Lung volumes;

c. Lung capacities.

PRACTICAL WORK

TASK 1. Look at this figure and write an explanation about the differences between expansion and contraction of the thoracic cage during expiration and inspiration.

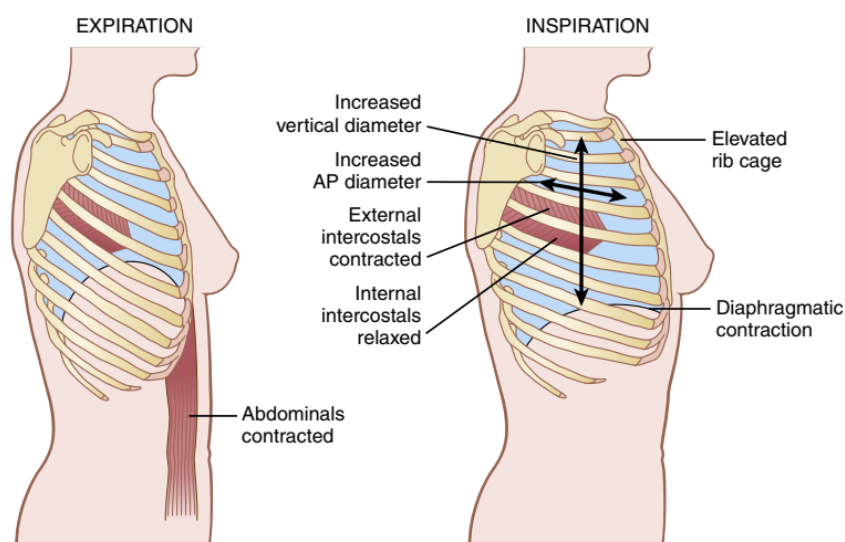


Figure 14. Source: Hall J. E., Hall M. E., Guyton A. C. Guyton and Hall Textbook of Medical Physiology: 14th ed. Philadelphia: Elsevier, 2021. P. 492

TASK 2. Determination of breath holding time (BHT).

Relevance. Breathing can be held for a variable period of time by different individuals depending upon the functional status of lungs, development of respiratory muscles, practice, age and sex. Breath holding time (BHT) is a simple test which can provide useful information in health and disease of the lungs.

PROCEDURES:

As the students work in batches of two, one becomes the subject and the other acts as the observer.

1. The subject should sit quietly for a few minutes, breathing normally, before the BHT exercises are started. The observer uses a stop watch and records the time for each determination.

2. Ask the subject to pinch his nostrils with the thumb and forefinger, and hold his breath after a normal inspiration. Note the time for which the breath can be held. Make 3 observations at intervals of 5 minutes.

Using the same procedure, record the BHT after (i) a normal expiration; (ii) a deep inspiration; (iii) a deep expiration; (iv) hyperventilation (deep and fast breathing) for 20 times; (v) rebreathing from a large polythene bag for 15-20 seconds, with a nose clip on. (Discontinue if there is discomfort).

Tabulate your results and record these in your work book.

BHT Time				
After a normal	After a deep	After a deep	After hyperventilation	After rebreathing from a large

	expiration	inspiration	expiration	(deep and fast breathing)	polythene bag for 15-20 seconds
BHT					

N.B. The normal BHT after a deep inspiration may vary from 40 seconds to over a minute.

TASK 3. What are the factors which increase or decrease the breath holding time? Put information in this table.

Factors, which increase BHT	Factors, which decrease BHT
N	N

TASK 4. Vital capacity and peak expiratory flow rate

Relevance. Estimation of vital capacity is an important determination for assessing the ventilatory functions of the lungs in health and disease. Vital capacity is also employed as a criterion of physical fitness.

Definition.

Vital capacity (VC), also called *forced vital capacity (FVC)*, or *forced expiratory volume (FEV)*, is the largest amount of air a person can expel from the lungs with maximum effort after first filling the lungs by a deepest possible inspiration. The subject inspires to total lung capacity (TLC) and then forcibly exhales to residual volume (RV).

A **simple spirometer** is generally available for student work.

1. Ask the subject to breathe normally for a few times. Then ask him to inspire as deeply and fully as possible and, while keeping the nostrils closed with his thumb and finger, to expire with a maximum effort into the mouthpiece which is held tightly between the lips. The pointer on the spirometer indicates the volume of expired air. The forced expiration should be deep and quick but without undue haste.

2. Record the vital capacity in the standing, sitting, and lying down positions in order to study the effect of posture.

Take 3 readings, at intervals of 5 minutes, for each determination. The purpose of taking three readings is not to get their average, but to familiarize the subject with the

procedure, the third reading being usually the maximum in most cases. The subject can also be motivated to improve his performance.

For report: Maximum value = Liters

3. Tabulate your results showing three readings in each of the standing, sitting, and supine postures, and indicate the maximum value in each case.

4. **Write the resume.**

	In the standing	In the sitting	In the supine postures
Vital capacity (VC)	L	L	L

5. Define the:

a) **TV (tidal volume)**. There is the volume of air inspired or expired with each normal breath; it amounts to about 500 milliliters in the average young adult.

b) **ExRV (expiratory reserve volume)**. There is the extra amount of air that can be expired by forceful expiration after the end of a normal tidal expiration; this normally amounts to about 1100 milliliters.

c) **InsRV (inspiratory reserve volume)**. There is the extra volume of air that can be inspired over and beyond the normal tidal volume; it is usually equal to approximately 3000 milliliters.

d) **RV (residual volume)**. There is the volume of air still remaining in the lungs after the most forceful expiration. This volume averages about 1200 milliliters.

e) **standard parameter by the formula:**

For the men: $VC = [27,63 - (0,112 \times \text{age in years}) \times \text{height in cm}]$

For the women: $VC = [21,73 - (0,101 \times \text{age in years}) \times \text{height in cm}]$

N.B. The normal VC ranges from 3,5 to 4,5 liters, the values being about 20% lower in the females. Since the VC depends on the age, sex, body build, occupation, etc. various formulae have been devised to predict VC in a given person.

6. Write the resume.

TASK 5. Look at this figure and write the explanation.

Changes in lung volume, alveolar pressure, pleural pressure, and transpulmonary pressure at the beginning of inspiration is approximately - 5 centimeters of water, which is the amount of suction that is required to hold the lungs open to their resting level. Then, during normal inspiration, the expansion of the chest cage pulls the surface of the lungs with still greater force and creates a still more negative pressure down to an average of

about - 7.5 centimeters of water. These relationships between pleural pressure and changing lung volume are illustrated in this figure.

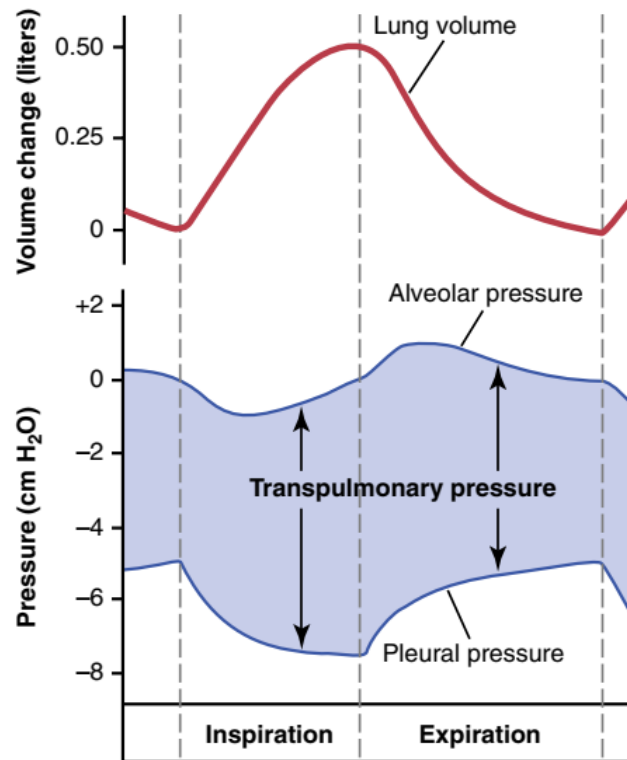


Figure 15. Source: Hall J. E., Hall M. E., Guyton A. C. Guyton and Hall Textbook of Medical Physiology: 14th ed. Philadelphia: Elsevier, 2021. P. 492

TASK 6. What functions does surfactant have? Put information into this table.

Surfactant	Functions

TASK 7. Demonstration of computer Spirography method. Look at this curve. Which volumes and capacities are not recorded on a spirometer? Write an explanation.

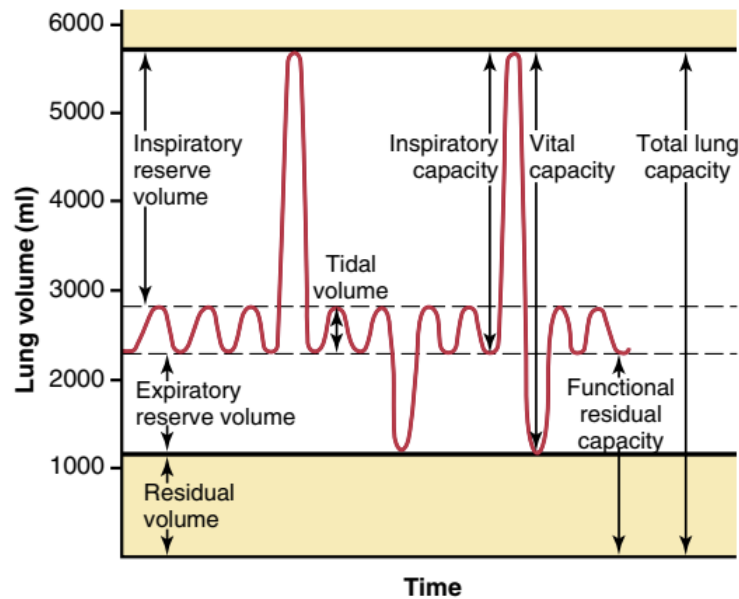


Figure 16. Source: Hall J. E., Hall M. E., Guyton A. C. Guyton and Hall Textbook of Medical Physiology: 14th ed. Philadelphia: Elsevier, 2021. P. 495

TASK 8. Find out the physiological dead space, expiratory reserve volume, residual volume, inspiratory reserve volume, and functional residual capacity from the given data. Make resume.

Data

- a). Tidal volume = 450ml
- b). Alveolar air PCO₂ = 40 mm Hg
- c). Expired air PCO₂ = 26 mm Hg
- d). Total lung capacity = 5200 ml
- e). Inspiratory capacity = 3000 ml
- f). Vital capacity = 4000 ml

Physiological dead space = $\frac{\text{Alveolar air PCO}_2 - \text{Expired air PCO}_2}{\text{Alveolar air PCO}_2} \times \text{Tidal volume}$;

Expiratory reserve volume = Vital capacity - Inspiratory capacity;

Residual volume = Total lung capacity - Vital capacity;

Inspiratory reserve volume = Inspiratory capacity - Tidal volume;

Functional residual capacity = Residual volume + Expiratory reserve volume

THE CONTROL OF THE LEVEL OF KNOWLEDGE

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Content Sections #13. Respiration system

PRACTICAL LESSON10

Theme: Gas exchange in the Lungs. Pulmonary circulation. Gas transport between the lungs and tissues. Regulation of Respiration. Respiratory Adjustments in health.

THE GOALS: Study the physiological mechanisms of the gas transport between the Lungs and tissues. Study the regulation mechanisms of respiration

Initial level of the knowledge

1. Anatomy of Pulmonary Blood vessels.
2. *Anatomy of Autonomic and Central nervous systems, physiology of Endocrine system.*

CONTROL OF THE INITIAL LEVEL OF KNOWLEDGE

CONTROL QUESTIONS:

1. Properties of Gases and Partial pressure.
2. Inspired Air, Alveolar Air and Expired Air
3. Ventilation and perfusion gases.
4. Diffusion of gases Through the Respiratory Membrane
5. Transport of Oxygen in Blood and Tissue Fluids. Oxygen-hemoglobin dissociation curve.
6. Transport of Carbon Dioxide in Blood and Tissue Fluids
7. Describe the Pulmonary circulation:
8. Regulation of Pulmonary flow.
9. Respiratory center
 - a. Medullary centers (Dorsal and Ventral Respiratory Group of Neurons)
 - b. Pontine centers (Apneustic Center, Pneumotaxic Center)
10. Connections of respiratory centers (Efferent Pathway and Afferent Pathway)
12. Integration of respiratory centers

13. Types of Chemoreceptors
 - a. Central chemoreceptors
 - b. Peripheral chemoreceptors.
14. Factors affecting respiratory centers
 - a. Impulses from Higher Centers
 - b. Impulses from Stretch Receptors of Lungs: Hering-Breuer Reflex
 - c. Impulses from 'J' Receptors of Lungs
 - d. Impulses from Irritant Receptors of Lungs
 - e. Impulses from Baroreceptors
 - f. Impulses from Proprioceptors
 - g. Impulses from Thermoreceptors
 - e. Impulses from Pain Receptors
19. Hormonal effects on respiration

PRACTICAL WORK

TASK 1. Look at this figure illustrating the effect of alveolar ventilation on alveolar PO_2 at two rates of oxygen absorption from the alveoli – 250 ml/min and 1000 ml/min. Write an explanation for it.

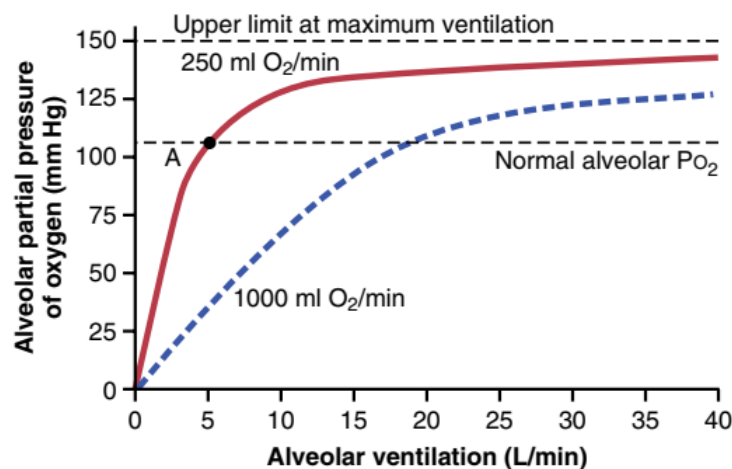


Figure 17. Source: Hall J. E., Hall M. E., Guyton A. C. Guyton and Hall Textbook of Medical Physiology: 14th ed. Philadelphia: Elsevier, 2021. P. 514

TASK 2. Look at this figure illustrating the effect of alveolar ventilation on the alveolar PCO_2 at two rates of carbon dioxide excretion from the blood – 800 ml/min and 200 ml/min. Write an explanation for it.

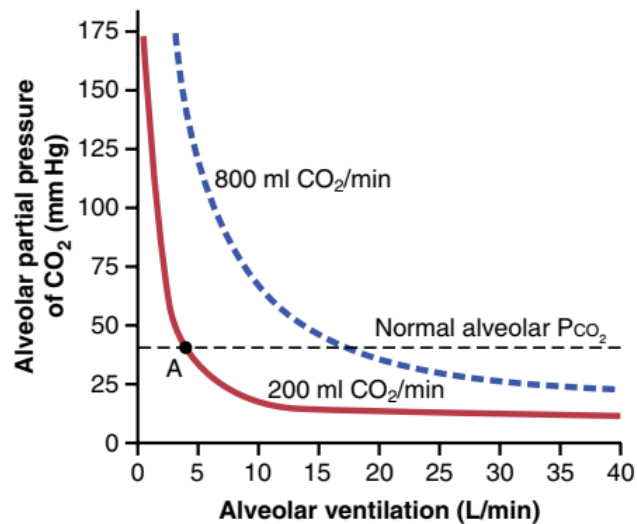


Figure 18. Source: Hall J. E., Hall M. E., Guyton A. C. Guyton and Hall Textbook of Medical Physiology: 14th ed. Philadelphia: Elsevier, 2021. P. 514

TASK 3. Look at this figure. Write an explanation for oxygen-hemoglobin dissociation curve.

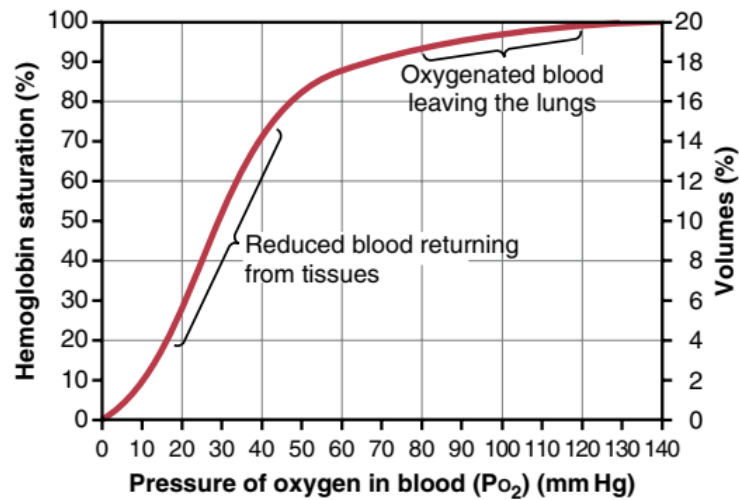


Figure 19. Source: Hall J. E., Hall M. E., Guyton A. C. Guyton and Hall Textbook of Medical Physiology: 14th ed. Philadelphia: Elsevier, 2021. P. 524

TASK 4. Determine the oxygen carrying capacity and oxygen content of arterial and venous blood samples from the data provided below:

Data

- a). Percentage saturation of arterial blood with oxygen=97%
- b). Percentage saturation of venous blood with oxygen=75%
- c). Hemoglobin concentration=14.5g /dl

.....

Oxygen carrying capacity of blood (ml/100ml)

$$= \text{Hg\%} \times 1.34 = \dots\dots\dots(\text{ml/dl})$$

Formula for oxygen content of blood= (Percentage saturation x capacity)/ 100

TASK 5. What is the normal alveolar ventilation? How is it regulated? Write an explanation.

TASK 6. Look this figure and write an explanation about the Central and Humoral mechanisms of breath regulation.

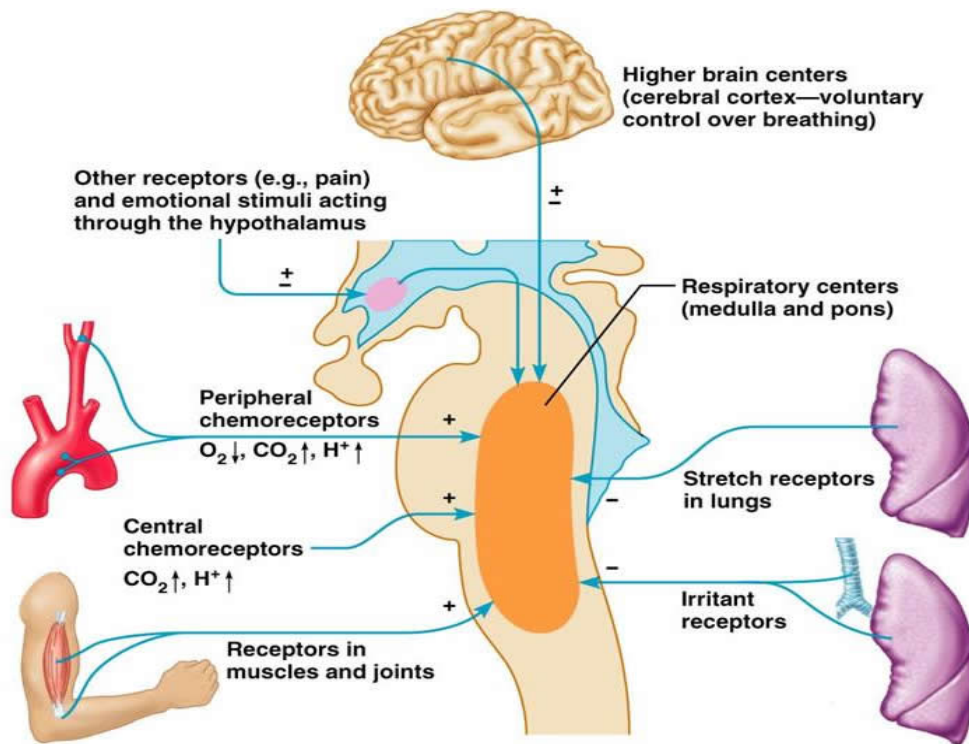


Figure 20. Source: <https://onlinesciencenotes.com/mechanism-of-breathing-and-its-neural-regulation/>

TASK 7. Look at this figure and write the explanation about it.

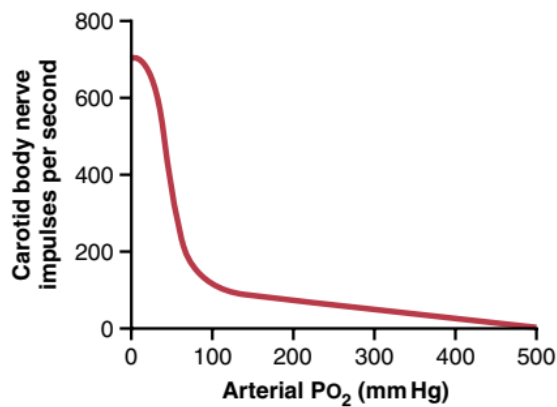


Figure 21. Source: Hall J. E., Hall M. E., Guyton A. C. Guyton and Hall Textbook of Medical Physiology: 14th ed. Philadelphia: Elsevier, 2021. P. 535

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Content Sections #14. Digestion system

PRACTICAL LESSON 11

Theme: Gastrointestinal function. Research of digestion in the oral cavity and in the stomach, mechanisms of its regulation.

THE GOALS OF OCCUPATION:

To study the digestion and absorptium of Carbogydrates, Proteins, Lipids, absorptium of Water and Electrolites, Vitamins and Minerals.

Initial level of the knoveledge

1. Anatomy of Alimentary tract.

THE CONTROL OF THE INITIAL LEVEL OF KNOWLEDGE

CONTROL QUESTIONS:

1. Functional anatomy of digestive system.
 - a. Characteristics of the gastrointestinal wall;
 - b. the gastrointestinal smooth muscle;
 - c. Gastrointestinal circulation;
 - d. the Enteric nervous system, Extrinsic innervation;
 - e. peristalsis, basic electrical activity and regulation of Motility;
 - f. migrating motor complex.
2. Nerve supply to gastrointestinal tract.
 - a. Intrinsic nerve supply – enteric nervous system;
 - b. Extrinsic nerve supply.
3. Gastrointestinal Hormones and their function.
4. Digestion into the mouth:
 - a. Functions of mouth;
 - b. Composition of saliva;
 - c. Regulation of salivary secretion.
5. Digestion into the Stomach.
 - a. Functional anatomy of stomach;
 - b. Properties and composition of Gastric juice.
 - c Functions of Gastric juice: digestive, hemopoetic and protective functions.
 - d. Pepsinogen and Hydrochloric acid secretion.
 - e. Gastric motility and emptying. Hunger contractions
 - f. Regulation of the Gastric Secretion. Cephalic, Gastric and Intestinal influences.

INDEPENDENT PRACTICAL WORK

TASK 1. Look at this figure and note the parts of GIT. Describe their functions.

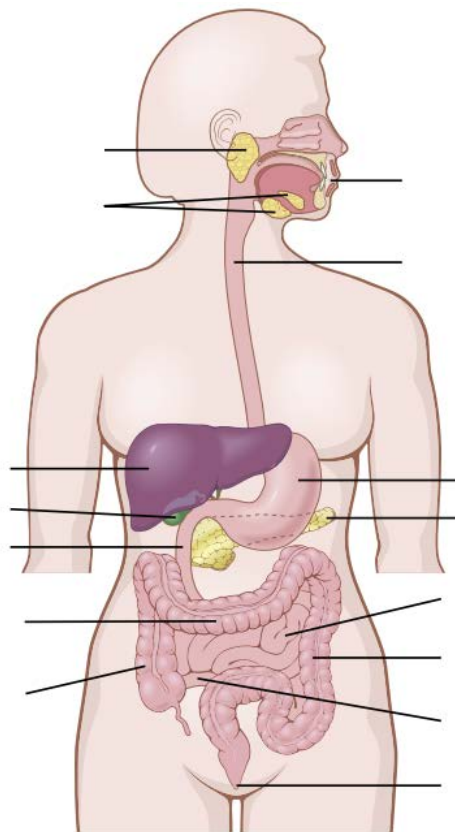


Figure 22. Source: Hall J. E., Hall M. E., Guyton A. C. Guyton and Hall Textbook of Medical Physiology: 14th ed. Philadelphia: Elsevier, 2021. P. 788

TASK 2. Studying of reaction on mucin.

During 1-2 minutes rinse a mouth of distilled water of 20 ml. Repeat manipulation 3 times. Filter the collected saliva through a filtering paper. Add to 2 ml of a saliva some drops of an acetic acid. After that mucin drops out as a white sediment. And the saliva loses viscosity.

RESEARCH PROBLEMS

1. Describe this research and write a conclusion on value of saliva's mucin.

TASK 3. Studying of saliva's pH

Eat one sweet before performance of work. Then, collect 2 ml of a saliva in a test tube. Place a strip of a display paper in a test tube with the help of a tweezers. Take out a strip and immediately compare the received coloring to a scale.

RESEARCH PROBLEMS

1. Describe this research and write a conclusion by the received results

TASK 4. Look at this figure and write an explanation about the formation and secretion of saliva by a salivary gland.

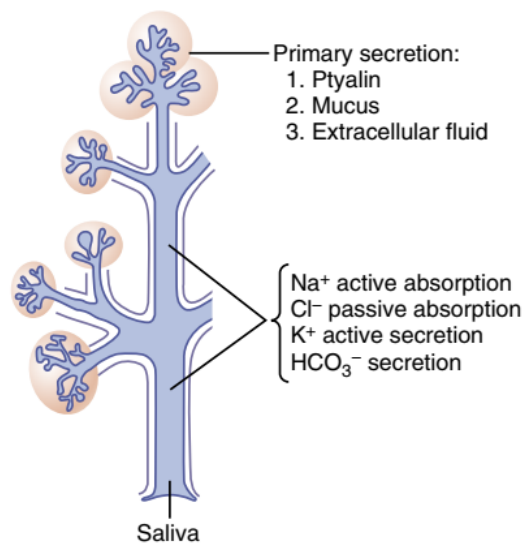


Figure 23. Source: Hall J. E., Hall M. E., Guyton A. C. Guyton and Hall Textbook of Medical Physiology: 14th ed. Philadelphia: Elsevier, 2021. P. 808

TASK 5. Put information about the Stomach functions in this table.

#	<i>Stomach functions</i>	<i>your explanation</i>
1.	Storage function	
2.	Mechanical function	
3.	Digestive function	

4.	Protective function	
5.	Hemopoetic function	
6.	Excretory function	

TASK 6. Put information about the Gastric enzymes role for digestive in this table.

	<i>Food types</i>	<i>Final products of digestion</i>
Gastric amylase		
Gastric gelatinase		
Pepsin		
Gastric lipase		
Rennin		

TASK 7. Analysis Basal Acid Output (BAO) AND Maximal Acid Output (MAO) in Gastric juice.

The specimen is collected over a 2½ hour period. The first 60 minutes, collected in 15-minute intervals is called the Basal Acid Output (BAO). The amount of gastric juice collected from a normal patient will range from 30 mLs to 80 mLs. After chemical stimulation with pentagastrin, histalog, or histamine, the following continuous 60 minutes of 15-minute interval collections is called the Maximal Acid Output (MAO). These four consecutives 15-minute samples are used for the MAO value. Normal values for basal and maximal acid output are as follows:

	BAO mMol/hr	MAO	Typical ratio of
--	--------------------	------------	-------------------------

		mMol/hr	BAO to MAO
man	0-10	7-48	~20%
women	0-6	5-30	~20%
Gastric ulcer	>2	1-20	20%-40%
Gastric cancer	>2	0-20	~20%
Pernicious anemia	0	0	0

There were about three parenteral introductions of substances and Vagal stimulation for an animal. How can BAO and MAO change after experiment? Put information in this table.

substances	BAO mMol/hr	MAO mMol/hr	Typical ratio of BAO to MAO
Gastrin			
Histamine			
Enterogastrone			
Vagal stimulation			

TASK 8. Definition the debit of hydrochloric acid in gastric juice by a nomogram.

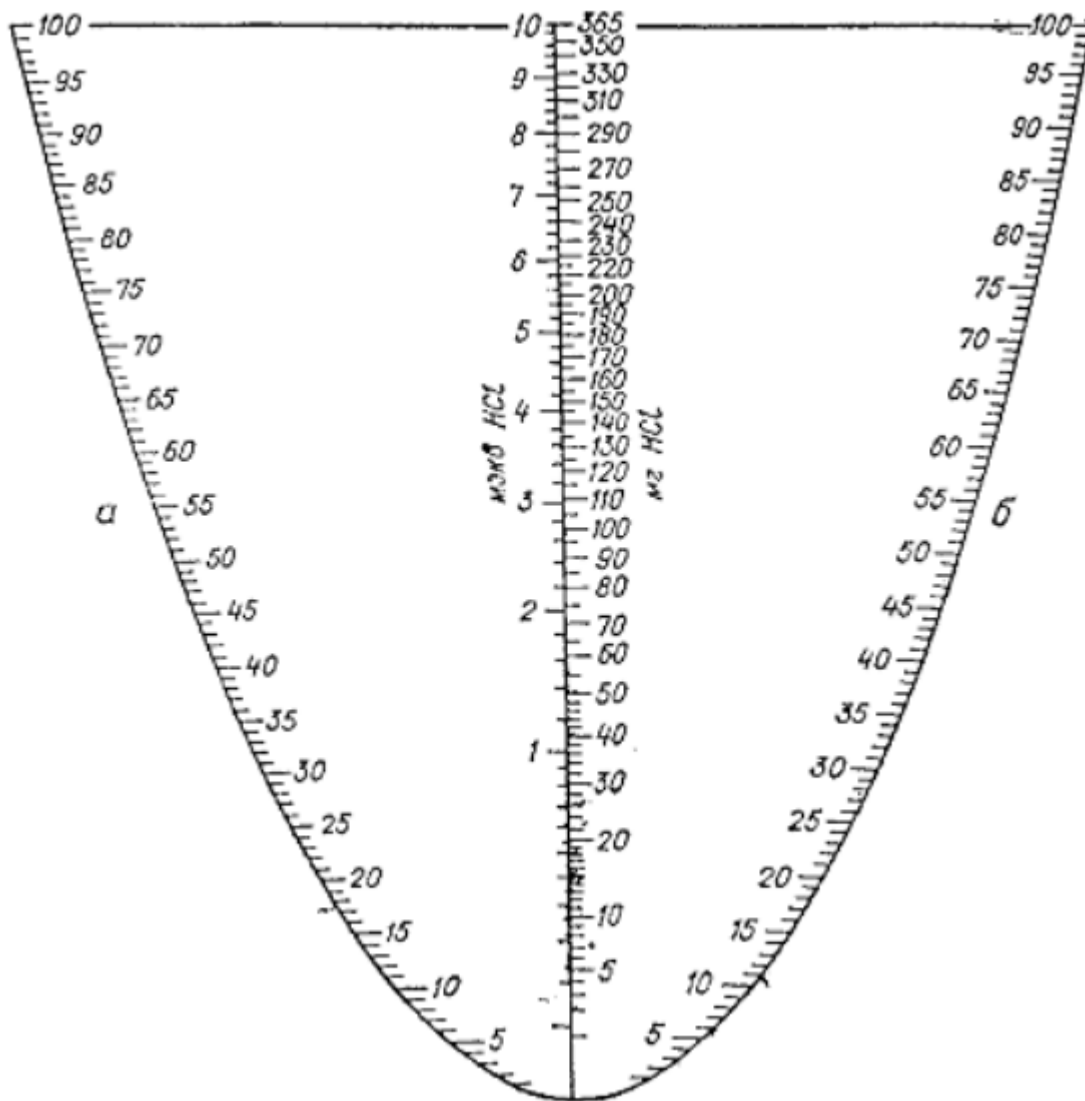


Figure 24. Source: Прохоров Є.В. та ін. Гастроентерологія дитячого віку / За загальною редакцією проф. Є.В. Прохорова, проф. О.П. Волосовця. Тернопіль: Укрмедкнига, 2004. С. 20

Mark volume of gastric juice (ml) in the right branch of this curve. Then mark acidity of this one (T/unit) in the left branch. Connect these two points by a ruler. The point of intersection between the ruler and vertical line of Nomogram is quantity of hydrochloric acid (ml).

The amount of hydrochloric acid in gastric juice collected from a normal patient will range from 40 to 150 mg (during the first 60 minutes of gastric secretion) and from 40 to 220 mg (during the second 60 minutes of one).

The patient's second portion of gastric juice (90ml) contains about 60 T/unit of acidity. How many mg of hydrochloric acid is there in his specimen? Explain your result and write an explanation.

THE CONTROL OF THE LEVEL OF KNOWLEDGE

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Content Sections #14. Digestion system

PRACTICAL LESSON12

Theme: Digestive functions of pancreas and liver. Digestive functions of small intestine and colon.

THE GOALS:

Study the digestion function of Stomach and Pancreas

Initial level of the knowledge

1. Anatomy of Esophagus, Stomach and Pancreas

CONTROL OF THE INITIAL LEVEL OF KNOWLEDGE

CONTROL QUESTIONS:

1. Functional anatomy and nerve supply of pancreas.
2. Properties and composition of pancreatic juice.
3. Functions of pancreatic juice.
4. Mechanism of pancreatic secretion.
 - a. Secretion of pancreatic enzymes;
 - b. Secretion of bicarbonate ions;
5. Regulation of pancreatic secretion.
 - a. Stages of pancreatic secretion.
 - b. Cephalic phase.
 - c. Gastric phase.
 - d. Intestinal phase.
6. Functional anatomy of liver and biliary system.
7. Properties and composition of bile. Bile salts; Bile pigments
8. Secretion of bile.
9. Functions of bile.
10. Gallbladder.
11. Regulation of bile secretion.
12. Properties and composition of succus entericus.
13. Functions of succus entericus.
14. Functions of small intestine.
15. Regulation of secretion of succus entericus.
16. Functions of large intestinal juice.
17. Functions of large intestine.

INDEPENDENT PRACTICAL WORK

TASK 1. Put information about the functions of Liver in this table.

#	<i>Liver functions</i>	<i>your explanation</i>
1.	Metabolic function.	
2.	Storage function	
3.	Synthetic function	
4.	Secretion of Bile	
5.	Excretory function	
6.	Heat production	
7.	Hemopoetic function	
8.	Hemolytic function	
9.	Inactivation of Hormones and Drugs	
10.	Defensive and detoxification functions	

TASK 2. Put information about the Bile functions in this table.

#	<i>Bile functions</i>	<i>your explanation</i>
1.	Digestive function.	

2.	Absorptive function	
3.	Excretory function	
4.	Laxative action	
5.	Antiseptic action	
6.	Choleretic action	
7.	Maintenance of pH in gastrointestinal tract	
8.	Prevention of Gallstone formation	
9.	Lubrication function	
10.	Cholagogue action	

TASK 3. Study the bile action to fat filtration. Take two test tubes with funnels. Put filters paper into the funnels. Moisten the first filter with bile but the second one with water. Pour about 2 ml of oil into each of two test tubes. Oil is faster to filter off through the bile layer than through moist paper. Why? **Describe this experiment. Write an explanation.**

TASK 4. Look at this figure. Write an explanation about the regulation of liver secretion and gallbladder emptying.

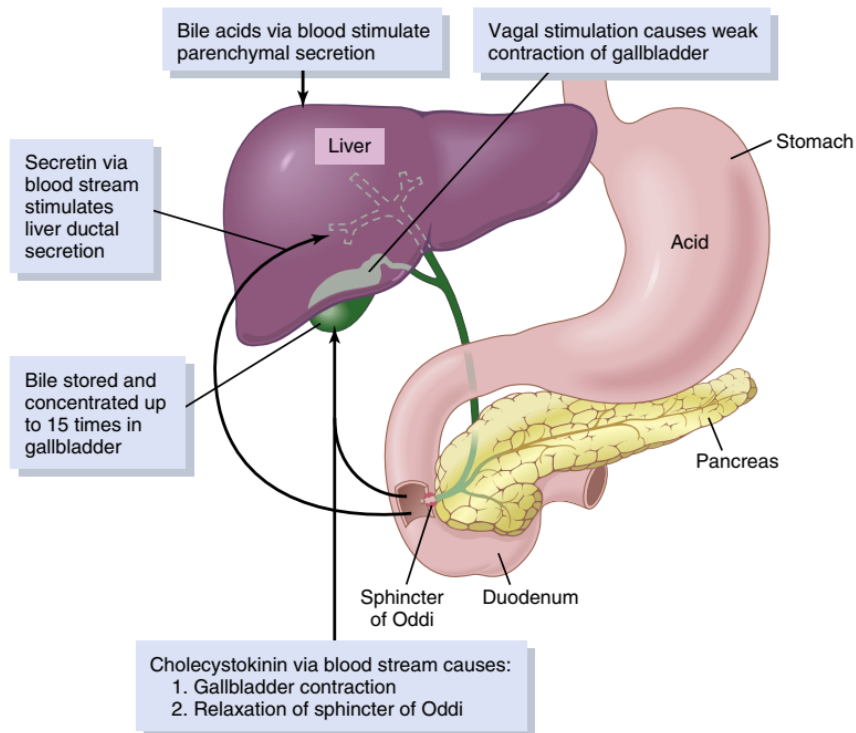


Figure 25. Source: Hall J. E., Hall M. E., Guyton A. C. Guyton and Hall Textbook of Medical Physiology: 14th ed. Philadelphia: Elsevier, 2021. P. 818

TASK 5. Two years ago, Den developed Gallstone and a doctor removed his gallbladder. What happened with digestion function after that? Write an explanation.

TASK 6. Look at this figure and write your explanation for this clinical situation. The person's secretin level was increased. How can it change the pancreatic juice pH?

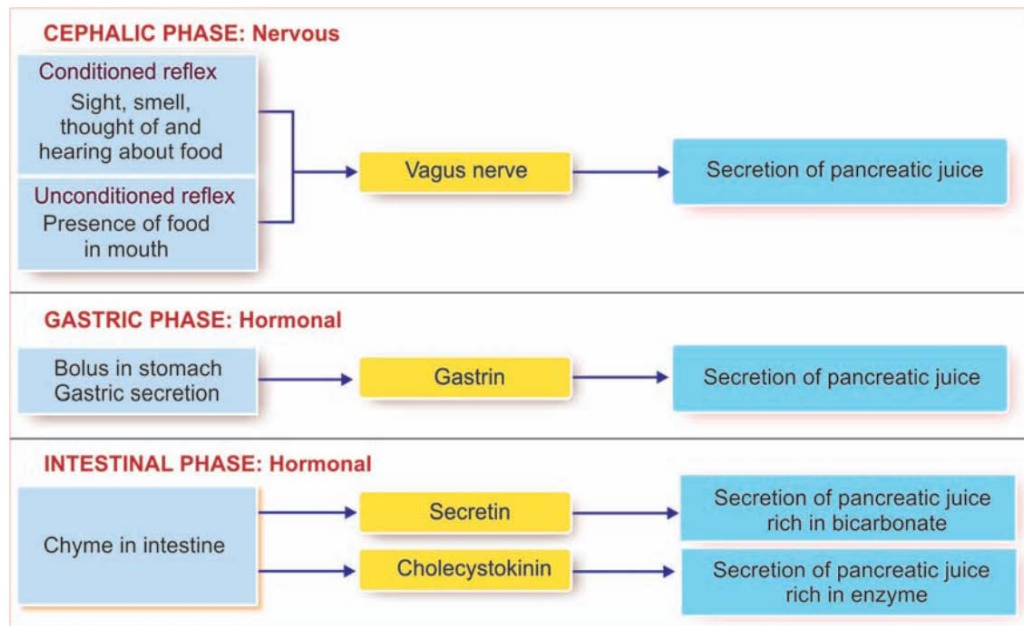


Figure 26. Source: K. Sembulingam, Prema Sembulingam Essentials of Medical Physiology: 6th ed. New Delhi: Jaypee Brothers Medical Publishers, 2012. P. 246

THE CONTROL OF THE LEVEL OF KNOWLEDGE

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Content Sections #14. Digestion system

PRACTICAL LESSON 13

Theme: Movements of gastrointestinal tract. Absorptive function of the digestive system.

THE GOALS:

Study the digestion function of Liver, Small Intestine and Colon

Initial level of the knowledge

1. Anatomy of Liver, Small Intestine and Colon

CONTROL OF THE INITIAL LEVEL OF KNOWLEDGE

CONTROL QUESTIONS:

1. Mastication:
 - a. Muscles and the movements of mastication;
 - b. Control of mastication.
2. Deglutition:
 - a. Oral stage or first stage;
 - b. Pharyngeal stage or second stage;
 - c. Esophageal stage or third stage;
 - d. Deglutition reflex.
3. Movements of stomach:
 - a. Hunger contractions;
 - b. Receptive relaxation;
 - c. Peristalsis;
4. Filling and emptying of stomach.
5. Vomiting.
6. Movements of small intestine.
7. Movements of large intestine.
8. Defecation.
9. Absorptive function.
 - a. Absorption of ions;
 - b. Absorption of nutrients;
10. Formation of feces.
11. Excretory function.
12. Secretory function.

INDEPENDENT PRACTICAL WORK

TASK 1. Put information about the Intestine enzymes' role for digestive in this table.

<i>Enzymes type</i>	<i>Food types</i>	<i>Final products of digestion</i>
<i>Proteolytic enzymes:</i> such as aminopeptidase, dipeptidase and tripeptidase		
<i>Amylolytic enzymes:</i> such as lactase, sucrase, maltase, dextrinase and trehalase		
<i>Lipolytic enzymes:</i> such as intestinal lipase		

TASK 2. Put information about the regulation of succus entericus secretion in this table.

	type of regulation	mechanism	effect
1.	Nervous regulation :		
a).	Stimulation of parasympathetic nerves		
b).	Stimulation of sympathetic nerves		
c).	The local nervous reflexes		
2.	Hormonal regulation:		
a).	cholecysto-kinin		
b).	secretin		
c).	enterocrinin		

TASK 3. Study the parietal digestion in rat's Intestine.

Put about a ml of physiological solution and 0,5 ml of starch slurry in two test tubes. Add a piece of rat's crushed intestine into the first of the two. Put these test tubes in a thermostat (at 37 ° C) for 20 minutes. Then add about a drop of iodine solution in both ones. Estimate the Amylase activity by color change. **Describe this experiment. Write an explanation.**

TASK 4. The person's Secretin level was decrease. How can it change the succus entericus secretion?

TASK 5. Put information about the Colon functions in this table.

<i>Large intestine functions</i>	<i>your explanation</i>
Digestive function.	

Absorptive function	
Formation of feces	
Excretory function	
Secretory function	
Synthetic functions	

TASK 6. Look at this figure. Write an explanation about the afferent and efferent pathways of the parasympathetic mechanism for the defecation reflex.

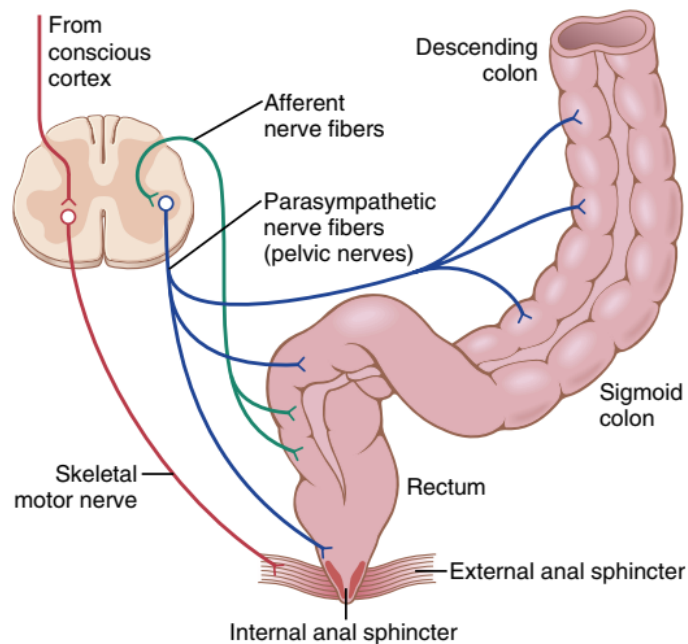


Figure 27. Source: Hall J. E., Hall M. E., Guyton A. C. Guyton and Hall Textbook of Medical Physiology: 14th ed. Philadelphia: Elsevier, 2021. P. 805

THE CONTROL OF THE LEVEL OF KNOWLEDGE

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Content Sections #15. Energy metabolism.

PRACTICAL LESSON 14

Theme: Regulation of the energy metabolism. Physiology of thermoregulation.

THE GOALS:

Study the mechanisms of energy exchange, methods of computation of basic exchange.

Initial level of the knowledge

1. Aerobic and anaerobic oxidization of matters.
2. Final products of oxidation: proteins, oils and carbohydrates.

CONTROL OF THE INITIAL LEVEL OF KNOWLEDGE

CONTROL QUESTIONS:

1. Release of Energy from foods and the concept of “free energy”.
2. Biological oxidation.
3. Regulation of food intake and energy storage
4. Metabolic rate.
5. Methods of determination of metabolic rate (energy expenditure)
6. Respiratory quotient
7. Factors affecting the metabolic rate
8. Normal body temperature.
9. Body temperature is controlled by balancing heat production and heat loss
10. Basic physics of how heat is lost from the skin surface.
11. Sweating and its regulation by the autonomic nervous system.
12. Regulation of body temperature—role of the hypothalamus.
13. Temperature-decreasing mechanisms when the body is too hot.
14. Temperature-increasing mechanisms when the body is too cold.
15. Skin temperature can alter the set point for core temperature control.
16. Behavioral control of body temperature.

INDEPENDENT PRACTICAL WORK

TASK 1. Look at this scheme. What kind of factors can increase or decrease the proteins metabolism in a human? Put information in this table.

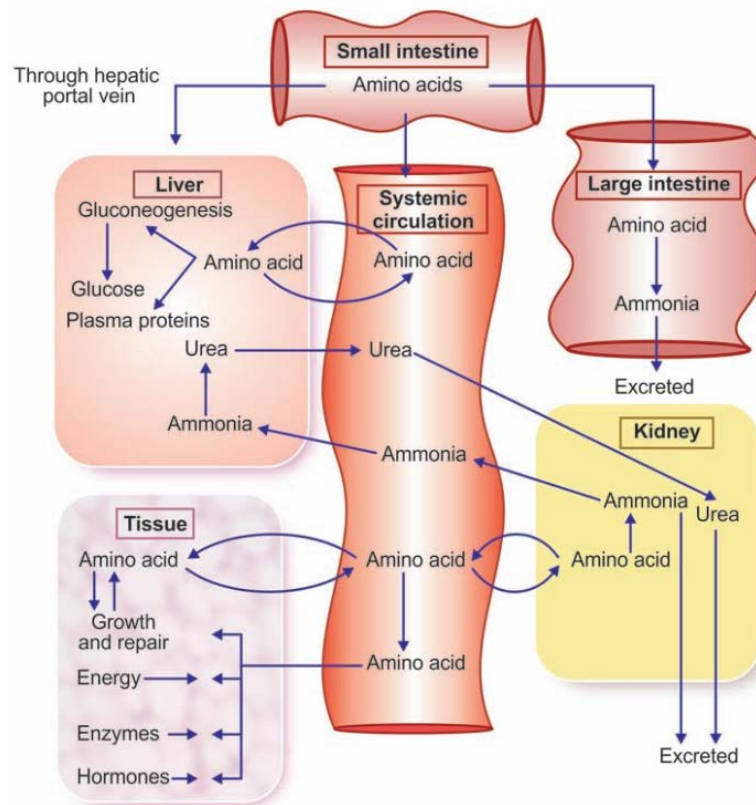


Figure 28. Source: K. Sembulingam, Prema Sembulingam Essentials of Medical Physiology: 6th ed. New Delhi: Jaypee Brothers Medical Publishers, 2012. P. 291

The factors	High proteins metabolism	Low proteins metabolism	Physiology mechanism
hungry			
nutrition			
exercise			

TASK 2. Look at this scheme. What central and humoral mechanisms can alter the carbohydrates metabolism? Put information in this table.

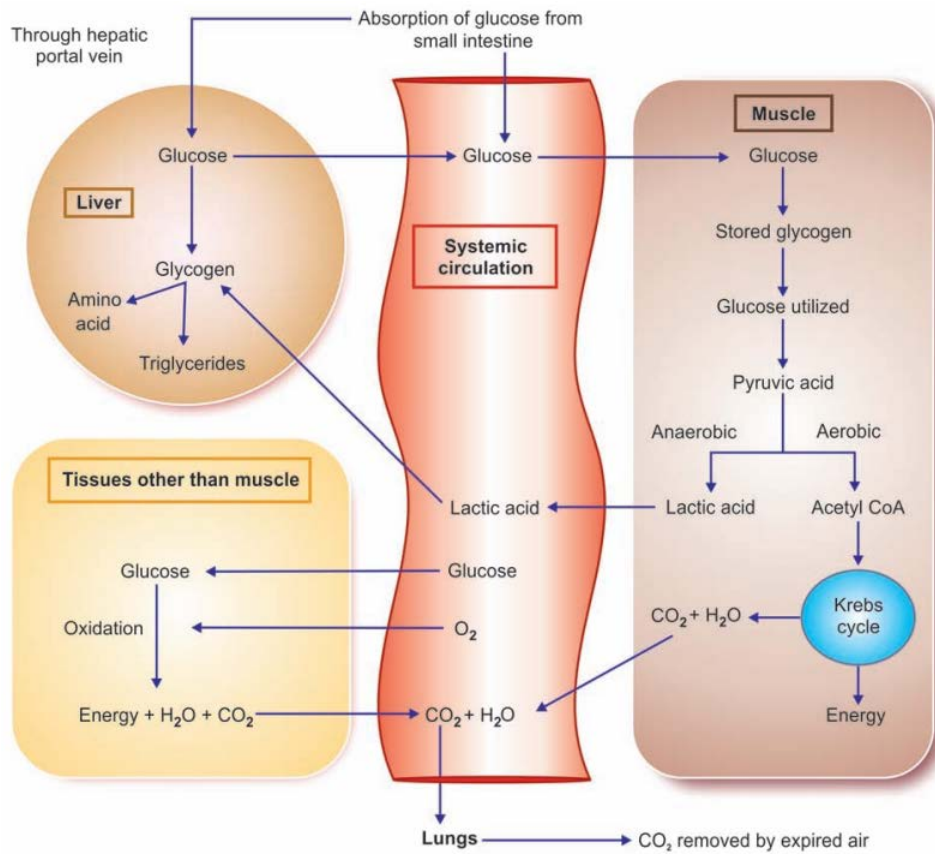


Figure 29. Source: K. Sembulingam, Prema Sembulingam Essentials of Medical Physiology: 6th ed. New Delhi: Jaypee Brothers Medical Publishers, 2012. P. 289

the factors	High carbohydrates metabolism	Low carbohydrates metabolism	Physiology mechanism

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TASK 3. Look at this scheme. What kind of factors can increase or decrease the lipid metabolism in a human? Put information in this table.

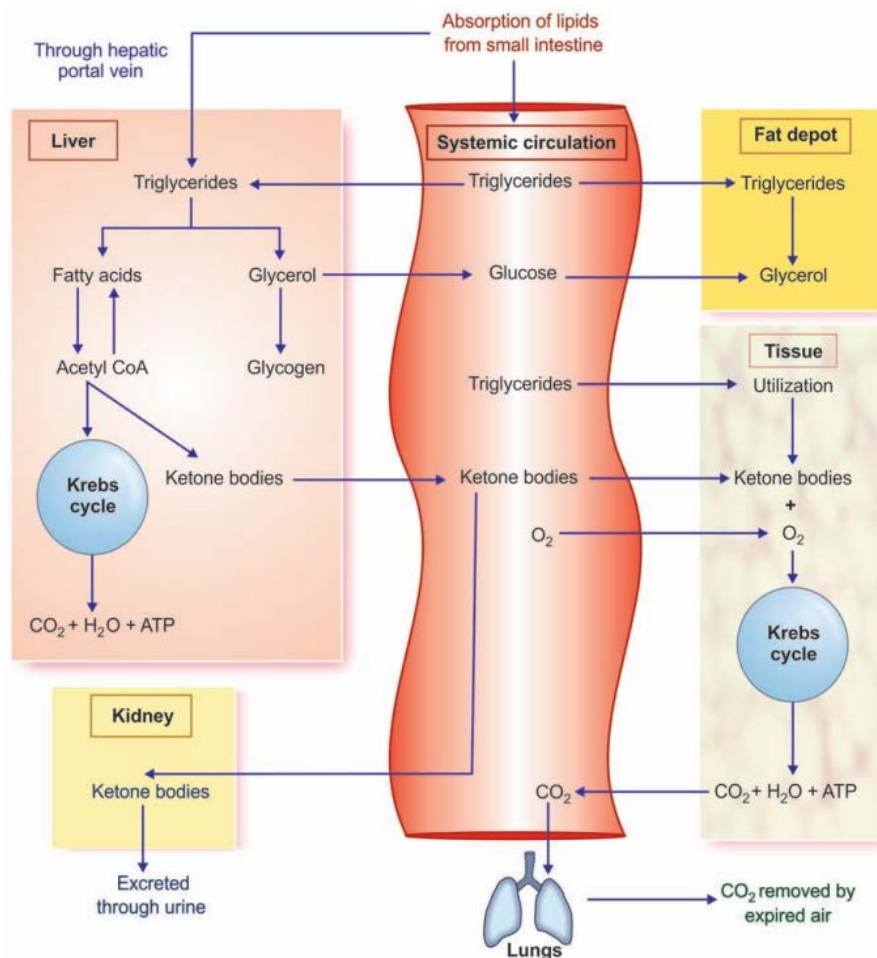


Figure 30. Source: K. Sembulingam, Prema Sembulingam Essentials of Medical Physiology: 6th ed. New Delhi: Jaypee Brothers Medical Publishers, 2012. P. 296

The factors	High lipid metabolism	Low lipid metabolism	Physiology mechanism
Hungry			
dietary fat intake			

alcohol intake			
smoking			
Exercise physical activity			

TASK 4. Calculation of Total Caloric Requirements

1. Body surface area (BSA) is determined from the height and weight of the person from a chart (nomogram) provided for the purpose, (see appendix)

2. Basal metabolic rate (BMR) is determined from the age, sex, and the BSA of the individual from a chart provided for this purpose.

3. Since $BMR = \text{Calories expended per hour per m}^2 \text{ BSA}$,

- $\text{Calories expended per hour} = BMR \times BSA$

4. A person is awake for 16 hours in a day,

- $\text{Calories expended during waking hours} = BMR \times BSA \times 16$ (a)

5. A person sleeps for 8 hours during which the caloric requirement is 90% of BMR

- $\text{Calories consumed during sleep} = BMR \times BSA \times 8 \times 90/100$ (b)

6. Work allowance: the calories consumed during the working period are dependent upon the type of work, as shown below:

Type of work	Calories/hr/kg body weight
--------------	----------------------------

Light	1.7
-------	-----

Moderate	2.5
----------	-----

Heavy	5.0
-------	-----

A person normally works for 8 hours a day; therefore, work allowance is calculated as under for a person doing moderate type of work-

$\text{Work allowance} = 8 \times 2.5 \times \text{Body weight in kg}$ (c)

7. Non-working allowance for the energy requirements of daily activities such as taking a bath, donning clothes, talking or other movements which a person performs while awake.

This allowance is taken as 400 kcal per day.(d)

8. Total calories required per day:

This is calculated as follows: $a + b + c + d$ (as mentioned above) (e)

9. Specific dynamic, or calorogenic, action of food (SDA):

Depending on the types of foodstuffs burnt in the body, 10-15% of the total caloric needs is added.(f)

10. Climate: A correction for ambient temperature during the day is required after calculating the figure (f) above. If the environmental temperature is about 25° C, no correction is required. If it is higher by 5-10° C, the caloric requirement is reduced by 5%. If the temperature is lower by 5-10° C, the caloric requirement is increased by 3%.(g)

11. Extra calories are required during pregnancy (250-350 Calories/day) and during lactation (550-600 Calories/day).

TASK 5. Find out the basal metabolic rate (BMR) of the subject from the data given below. Write a conclusion.

Date

- a). Oxygen consumption in 6 minutes = 1470 ml
b). Body surface area (BSA) of the subject = 1.6 m²
c). Standard BMR for the age and sex of the subject = 40 Cal/m²BSA/hour

Oxygen consumption in 1 hour = 14.70 liters

When 1 liter of oxygen is consumed, 4.8 Calories are released.

Calories released from consumption of 14.7 liter of oxygen = ?

BMR = Calories consumed per hr / BSA ; BMR = ?

Standard BMR for the subject = 40 cal/m²BSA/hour; Calculated BMR is in excess or decrease by n calories/m²BSA/hour

Percentage excess or decrease = $n / 40 * 100\% = \dots\%$

Normal range = ±15%

TASK 6. Look at this figure. Write an explanation about the role of blood vessels in regulation of body temperature.

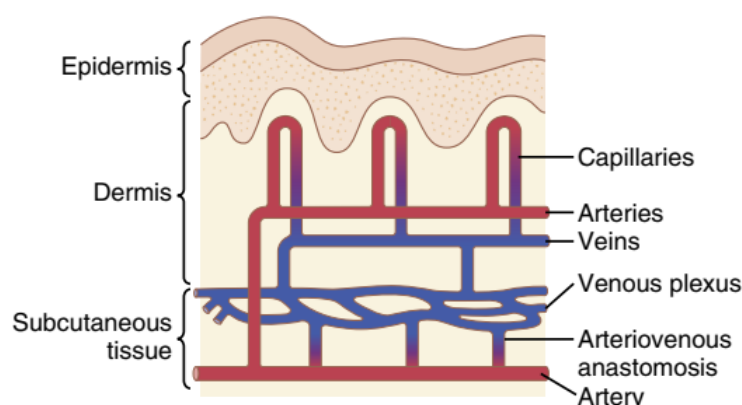


Figure 31. Source: Hall J. E., Hall M. E., Guyton A. C. Guyton and Hall Textbook of Medical Physiology: 14th ed. Philadelphia: Elsevier, 2021. P. 902

TASK 7. What do you know about the control of Heat conduction to the skin by the Sympathetic nervous system? Write explanation.

TASK 8. Look at this figure and describe the mechanisms of heat loss from the body. Use this table.

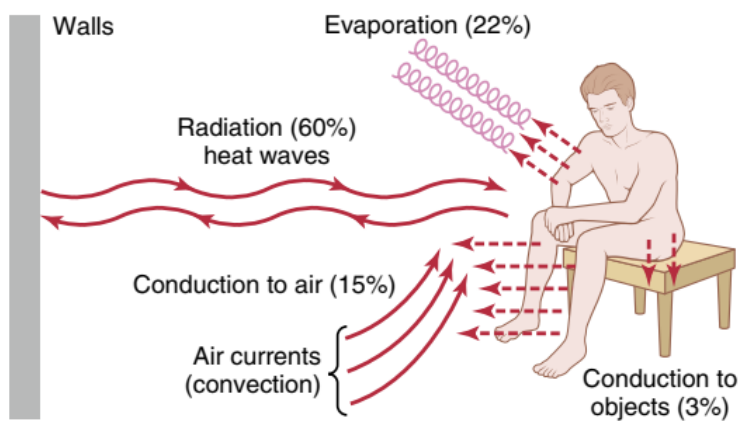


Figure 32. Source: Hall J. E., Hall M. E., Guyton A. C. Guyton and Hall Textbook of Medical Physiology: 14th ed. Philadelphia: Elsevier, 2021. P. 903

factor	mechanism
radiation	
conduction	
convection	

evaporation	

TASK 9. What do you know about the role of Aldosterone for acclimatization of the sweating mechanism to Heat? Write an explanation.

TASK 10. What do you know about the role of the Hypothalamus in regulation of body temperature? Write an explanation .Use this table.

Structure of the brain	function
<i>Anterior Hypothalamic-Preoptic area</i>	
<i>Posterior Hypothalamus</i>	
<i>receptors</i>	

THE CONTROL OF THE LEVEL OF KNOWLEDGE

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Content Sections #17. Kidney system. Physiology of the main periods of human evolution.

PRACTICAL LESSON 15

Theme: Role of kidneys in urine formation. Glomerular filtration and its regulation.

THE GOALS:

Study the mechanism of urine formation and its regulation.

Initial level of knowledge

1. Anatomy of kidneys; innervation of kidneys.
2. Renal blood vessels.
3. Osmotic and oncotic pressure.

CONTROL OF THE INITIAL LEVEL OF KNOWLEDGE

CONTROL QUESTIONS:

1. Physiology of excretory system, its composition and function.
2. Kidney functions.
3. What do you know about the functional anatomy of
 - a. Nephron;
 - b. Juxtaglomerular apparatus;
 - c. Renal circulation?
4. Describe the mechanism of urine formation (glomerular filtration, tubular reabsorption, tubular secretion)
5. What do you know about the glomerular filtration?
 - a. Glomerular filtration rate;
 - b. Filtration fraction;
 - c. Pressures determining filtration;
 - d. Filtration coefficient.
6. Plasma clearance.

INDEPENDENT PRACTICAL WORK

TASK 1. Put information about functions of kidneys in this table.

#	Functions	...about this function
1.	Role in homeostasis:	
a).	Excretion of Waste products	
b).	Maintenance of water balance	
c).	Maintenance of electrolyte balance	
d).	Maintenance of acid base balance	
2.	Hemopoetic function	

3.	Endocrine function	
4.	Regulation of blood pressure	
5.	Regulation of blood calcium level	

TASK 2. Look at the picture and write an explanation about the structure and functions of the nephron.

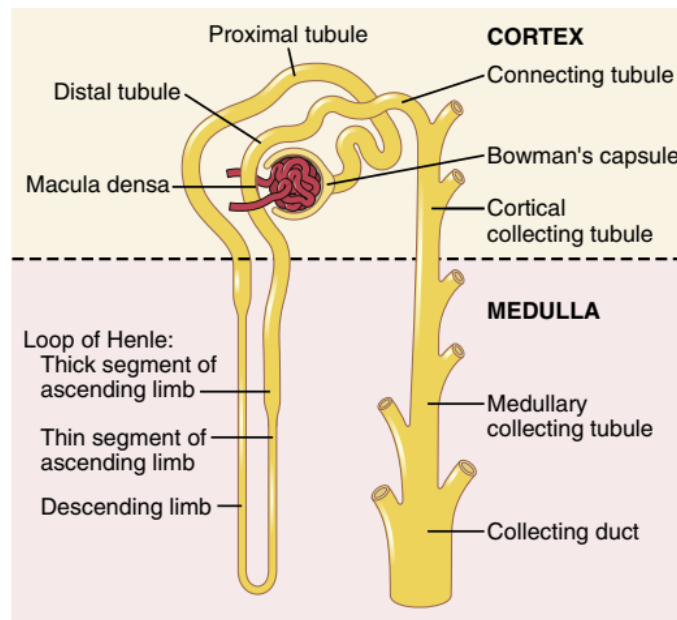


Figure 33. Source: Hall J. E., Hall M. E., Guyton A. C. Guyton and Hall Textbook of Medical Physiology: 14th ed. Philadelphia: Elsevier, 2021. P. 324

TASK 3. What do you know about the factors regulating Glomerular filtration rate? Put information about ones in this table.

#	Factors	...about this factor
1.	Tubuloglomerular feedback mechanism	

2.	Glomerular capillary pressure	
3.	Colloidal osmotic pressure	
4.	Hydrostatic pressure in Bowman's capsule	
5.	Renal blood flow	
6.	Constriction of afferent arteriole	
7.	Constriction of efferent arteriole	
8.	Systemic arterial pressure	
9.	Sympathetic stimulation	
10.	Surface area of capillary membrane	
11.	Permeability of capillary membrane	

TASK 4. What is it effective filtration pressure? Write an explanation. Calculate the effective filtration pressure from the data given below.

Data

a). Glomerular capillary hydrostatic pressure = 55mmHg

- b). Glomerular capillary blood osmotic pressure = 30mmHg
 - c). Bowman's capsular fluid pressure = 15mmHg
 - d). Bowman's capsular fluid osmotic pressure = 0mmHg
- Effective filtration pressure = a - (b+c)**

TASK 5. What is it Glomerular filtration (GFR) rate? Write an explanation. Calculate the Glomerular filtration rate from the data provided below.

Data

- a). Concentration of inulin in plasma (P) = 0,24 mg/ml
 - b). Concentration of inulin in urine (U) = 34 mg/ml
 - c). Rate of urine formation (V) = 0,9ml/min
- GFR (ml/min) = U * V / P**

TASK 6. Write an explanation for these clinical tasks

1. The osmotic blood pressure increases. How will the urine formation change?

2. Substance V normally cannot be found in the urine. Does it mean that it cannot be filtrated and cannot be secreted?

THE CONTROL OF THE LEVEL OF KNOWLEDGE

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Content Sections #17. Kidney system. Physiology of the main periods of human evolution.

Theme: Role of kidneys in urine formation. Physiology of tubular reabsorption and secretion.

THE GOALS:

Study the main mechanism of urine formation and its regulation.

Initial level of the knowledge

4. Classification and mechanisms of transport through cell membrane.
5. Features of kidneys blood circulation.

CONTROL OF THE INITIAL LEVEL OF KNOWLEDGE

CONTROL QUESTIONS:

1. Tubular reabsorption:
 - a. Selective reabsorption;
 - b. the mechanisms of reabsorption;
 - c. the mechanisms of reabsorption Na^+ , glucose, amino acids, proteins, water.
2. Tubular reabsorption and secretion:
 - a. reabsorption and secretion urea;
 - b. reabsorption and secretion K^+ ;
 - c. Secretion H^+ ;
 - d. ammonia secretion.
3. Concentration of urine.
4. Determination the tubular reabsorption.
5. Regulation of reabsorption processes.
6. Incretory function of kidneys
7. Process of urine excretion and its regulation
8. Kidneys and hemopoiesis
9. Physiology of micturition

INDEPENDENT PRACTICAL WORK

TASK 1. Calculate the urea clearance from the given data. Write an explanation for your results.

Data

Concentration of urea in urine (U) = 20 mg/ml
Concentration of urea in blood (B) = 38 mg/100ml
Rate of urine flow (V) = 1,5ml/min

Since the urine flow is less than 2.0ml/min, the formula of “standard” urea clearance is

Clearance of X = (Urine Concentration of X) * (Urine Flow Rate) / (Plasma Concentration of X) or Clearance = $(U_x * V_x) / B_x$.

$$\text{Clearance} = \frac{U \times V}{P}$$

Since the urine flow is more than 2.0 ml/min, the formula of “maximum” urea clearance is

$$\frac{U \times V}{P} \quad \text{where P is concentration of inulin in plasma}$$

Data

- Concentration of urea in urine (U) = 40 mg/ml
- Concentration of inulin in plasma (P) = 0,24 mg/ml
- Rate of urine flow (V) = 3ml/min

NB: The value for maximum clearance is 65-100 ml/min; while the normal value for standard clearance is 40-65ml/min

TASK 2. Write an explanation for clinical tasks

1. The oncotic blood pressure increases. How will the urine formation change?

2. The patient suffers from primary aldosteronism. It means that secretion of aldosterone is increased. It usually caused by the tumor of adrenal cortex. How will the concentration of renin in plasma change?

**TASK 3. The analysis of kidney function by test of Zimnitskiy:
The urine of the patient was taken during the day**

Daytime diuresis

test	time	Amount of the urine	Specific gravity
1.	6-9 a.m	270 ml	1012
2.	9-12 a.m	220 ml	1014
3.	12-15 p.m	210 ml	1016
4.	15-18 p.m	200 ml	1013
General amount of urine:			

Nighttime diuresis

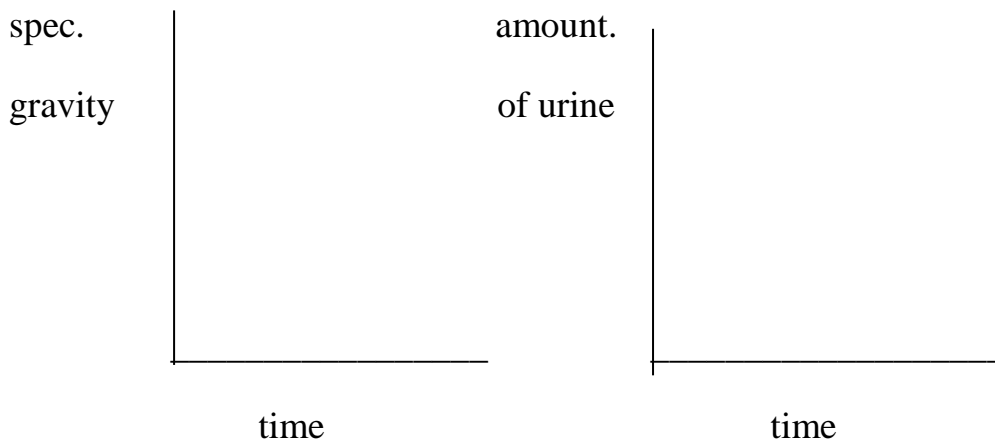
test	time	Amount of the urine	Specific gravity
5.	18-21 p.m	180 ml	1017

6.	21-24 p.m	120 ml	1027
7.	24-3 a.m	180 ml	1014
8.	3-6 a.m	120 ml	1024
General amount of urine:			

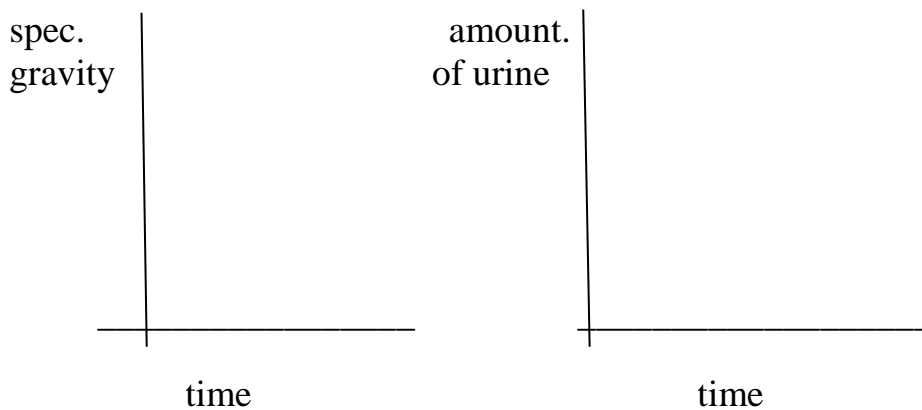
NB: The daily diuresis is bigger than nightly in healthy person.

Draw graphs (diagrams) of change in specific gravity, amount of the urine during day. Write an explanation for these diagrams.

Daily diuresis



Nightly diuresis



TASK 4. Put information about mechanism of kidney reabsorption in this table.

#	Substances	Site of reabsorption and about mechanism
1.	Sodium	
2.	Water	
3.	Glucose	

4.	Amino acids	
5.	Bicarbonates	

TASK 5. Put information about functions of nerves supplying urinary bladder and sphincters in this table.

nerve	On detrusor muscle	On internal sphincter	On external sphincter
Sympathetic nerve			
Parasympathetic nerve			
Somatic nerve			

TASK 6. Draw the scheme of Micturition reflex.

CONTROL OF THE LEVEL OF KNOWLEDGE

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PRACTICAL LESSON 17

Credit lesson: Physiology of visceral systems. Respiratory system. Digestive system. Energy metabolism. Thermoregulation. Excretory system. Physiological processes of adaptation.

1. Respiration. Types of respiration. Phases of respiration.
2. Functional anatomy of the respiratory tract and Lungs.
3. Pulmonary circulation.
4. Mechanics of Respiration, muscles of respiration, Respiratory pressures
5. Factors Causing and Preventing Collapsing Tendency of Lungs
6. Pulmonary Function Tests
 - b. Lung volumes;
 - c. Lung capacities.
7. Inspired Air, Alveolar Air and Expired Air.
8. Diffusion of gases through the Respiratory Membrane
9. Transport of Oxygen in Blood and Tissue Fluids
10. Transport of Carbon Dioxide in Blood and Tissue Fluids
11. Respiratory center. (Efferent Pathway, Afferent Pathway)
12. Types of Chemoreceptors and baroreceptors
13. Functional anatomy of digestive system.
14. Nerve supply to gastrointestinal tract.
15. Gastrointestinal Hormones and their function.
16. Digestion into the mouth. Composition and Regulation of salivary secretion
17. Digestion into the Stomach
 - a. Composition and functions of gastric juice;
 - b. Functions of gastric juice
 - c. Gastric motility and emptying
 - d. Regulation of the Gastric Secretion.
18. Functional anatomy and nerve supply of pancreas.
19. Properties and composition of pancreatic juice.
20. Mechanism of pancreatic secretion
21. Regulation of pancreatic secretion.
22. Functional anatomy of liver and biliary system.
23. Composition and functions of bile
24. Regulation of bile secretion
25. Composition and functions of succus entericus.
26. Regulation of secretion of succus entericus.
27. Functions of large intestinal juice.
28. Mastication mechanism and its control.

29. Swallowing stages and their regulation.
30. Movements and emptying of stomach.
31. Vomiting.
32. Movements of small and large intestine.
33. Defecation.
34. Absorptive function of intestine: ions, water, acids, nutrients.
35. Metabolism and Metabolic rate
36. Regulation of food intake and energy storage
37. Methods of determination of metabolic rate (Respiratory quotient)
38. Factors affecting the metabolic rate
39. Proteins, fat and carbohydrate metabolism
40. Normal body temperature.
41. Heat production and heat loss
42. Mechanism of Thermoregulation
43. Physiology of excretory system, its composition and function.
44. Functional anatomy of Kidney
45. Renal circulation.
46. The mechanism of Urine formation (Glomerular filtration, tubular reabsorption, tubular secretion)
47. Plasma clearance.
48. Concentration of urine.
49. Regulation of reabsorption processes.
50. Excretory function of kidneys

TESTS FROM THE STEP 1 DATABASE

1. A lung of a premature infant is presented on electronic photomicrography of biopsy material. Collapse of the alveolar wall caused by the deficiency of surfactant was revealed. Dysfunction of what cells of the alveolar wall caused it?
 - A. Alveolocytes type II
 - B. Alveolocytes type I
 - C. Alveolar macrophages
 - D. Secretory cells
 - E. Fibroblasts

2. Alveolar space of the acinus was invaded by some bacteria which interacted with the surfactant. This led to the activation of the cells that are localized in the alveolar walls and on the surface. What cells are these?
 - A. Alveolar macrophages
 - B. Alveolocytes type I
 - C. Endothelial cells
 - D. Clara cells
 - E. Alveolocytes type II

3. Work in a mine is known to cause inhalation of large amounts of coal dust. Inhaled coal dust can be detected in the following pulmonary cells:
- A. Alveolar macrophages
 - B. Respiratory epithelial cells
 - C. Secretory epithelial cells
 - D. Capillary endothelial cells
 - E. Pericapillary cells
4. Part of alveoli of a preterm infant didn't spread because of enhanced elastic recoil of lungs. How can this recoil be reduced?
- A. By surfactant introduction
 - B. By pure oxygen inhalation
 - C. By artificial pulmonary ventilation
 - D. By fluid suction from the respiratory tracts
 - E. By glyucose introduction
5. Lungs of a preterm infant have areas of atelectasis (pulmonary collapse). The main cause is:
- A. Surfactant deficiency
 - B. Increased viscous resistance
 - C. Underdeveloped inspiration muscles
 - D. Diminished force of surface tension of lungs
 - E. Surfactant excess
6. A patient demonstrates sharp decrease of pulmonary surfactant activity. This condition can result in:
- A. Alveolar tendency to recede
 - B. Decreased airways resistance
 - C. Decreased work of expiratory muscles
 - D. Increased pulmonary ventilation
 - E. Hyperoxemia
7. A doctor asked a patient to breathe out fully after taking a normal breath. What muscles contract during such exhalation?
- A. External intercostal muscles
 - B. Diaphragm
 - C. Trapezius muscles
 - D. Pectoral muscles
8. In the state of rest a person has considerably increased work of inspiration muscles. Which of the following can be the reason for it?
- A. Infrequent respiration.
 - B. Hypopnea.

- C. Constriction of respiratory tracts.
 - D. Negative intrapleural pressure.
 - E. Decrease of minute respiratory volume.
9. As a result of physical activity a person has got hyperventilation. Which of the following indexes of his breathing are considerably higher than in the state of rest?
- A. Tidal volume
 - B. Vital capacity of lungs
 - C. Inspiratory reserve volume
 - D. Expiratory reserve volume
 - E. Total lung capacity.
10. A person took a maximum deep breath. What is the air volume contained in his lungs called?
- A. Total lung capacity
 - B. Vital capacity of lungs
 - C. Inspiratory capacity
 - D. Functional residual capacity
 - E. Tidal volume
11. Analysis of the experimental spirogram of a 55-year-old person revealed a decrease in tidal volume and respiratory amplitude compared to the situation of ten years ago. The change in these indicators is caused by:
- A. Decreased force of respiratory muscle contraction
 - B. Gas composition of the air
 - C. Physical build of a person
 - D. Height of a person
 - E. Body mass of a person
12. A patient has a trauma of sternocleidomastoid muscle. This caused a decrease in value of the following indicator of external respiration:
- A. Inspiratory reserve volume
 - B. Expiratory reserve volume
 - C. Respiratory capacity
 - D. Residual volume
 - E. Functional residual lung capacity
13. A person made a maximum deep expiration. What is the air volume contained in his lungs called?
- A. Functional residual capacity
 - B. Residual volume
 - C. Inspiratory capacity
 - D. Expiratory reserve volume
 - E. Tidal volume

14. Lung ventilation in a person is increased as a result of physical activity. Which of the following indices of the external respiration is much higher than in a state of rest?
- A. Respiratory reserve volume
 - B. Inspiratory reserve volume
 - C. Total lung capacity
 - D. Expiratory reserve volume
 - E. Vital capacity of lungs
15. To assess the effectiveness of breathing in patients, the indicator of functional residual capacity is used. It includes the following volumes:
- A. Expiratory reserve volume and residual volume
 - B. Inspiratory reserve volume and residual volume
 - C. Inspiratory reserve volume, tidal volume, residual volume
 - D. Expiratory reserve volume and tidal volume
 - E. Inspiratory reserve volume and tidal volume
16. A man took a quiet expiration. Name an air volume that is meanwhile contained in his lungs:
- A. Functional residual capacity
 - B. Residual volume
 - C. Expiratory reserve volume
 - D. Respiratory volume
 - E. Vital lung capacity
17. During recording of a spirogram a patient calmly exhaled. How do we call the volume of air remaining in the lungs?
- A. Functional residual capacity
 - B. Pulmonary residual volume
 - C. Expiratory reserve volume
 - D. Tidal volume
 - E. Vital capacity of lungs
18. A person made a quiet expiration. What is the air volume contained in his lungs called?
- A. Vital capacity of lungs
 - B. Residual volume
 - C. Expiratory reserve volume
 - D. Tidal volume
 - E. Functional residual capacity.
19. A man's intrapleural pressure is being measured. In what phase did the man hold his breath, if his pressure is 7.5 mm Hg?
- A. Quiet inspiration
 - B. Quiet expiration

- C. Forced inspiration
 - D. Forced expiration
20. Intrapleural pressure is being measured in a person. In what phase does a person hold his breath if the pressure is $-25 \text{ cm H}_2\text{O}$?
- A. Forced inspiration
 - B. Quiet expiration
 - C. Quiet inspiration
 - D. Forced expiration
21. Intrapleural pressure of a person is taken. In what phase did the person hold his breath if the pressure is 30 cm of water?
- A. Quiet expiration
 - B. Forced expiration
 - C. Forced inspiration
 - D. Quiet inspiration
 - E. Pause between inspiration and expiration
22. The pressure in the lung's alveoli of a healthy person is taken. In what phase of breathing is the pressure 0 mm Hg?
- A. Quiet expiration
 - B. Quiet inspiration
 - C. Pause between inspiration and expiration
 - D. Forced inspiration
 - E. Forced expiration
23. When analyzing a patient's spirogram the decrease of the frequency and depth of breathing is determined. The decrease of what index will it cause?
- A. Expiratory reserve volume
 - B. Vital capacity of the lungs
 - C. Inspiratory reserve volume
 - D. Minute volume of respiration
 - E. Residual volume
24. An examined person's tidal volume makes 500 ml, respiratory rate — 15 per 1 min, volume of dead space — 100 ml. How much air will pass through his alveoli in 1 minute?
- A. 9000 ml.
 - B. 7500 ml.
 - C. 1500 ml.
 - D. 6000 ml.
 - E. 7400 ml.

25. Tidal volume is 450 ml and breathing frequency is 20 per min. What will alveolar ventilation per minute be?
- A. 5000 ml.
 - B. 3000 ml.
 - C. 4000 ml.
 - D. 6000 ml.
 - E. 8000 ml.
26. The alveolar ventilation of the patient is 5 L/min, the breath frequency is 10 per min, and the tidal volume is 700 ml. What is the patient's dead space ventilation?
- A. 2 L/min
 - B. 0.7 L/min
 - C. 5 L/min
 - D. 7 L/min
 - E. 0.5 L/min
27. Anatomical dead space is the portion of the air that is left in the airways after expiration. The reduction of the anatomical dead space is typical for the following situation:
- A. Tracheostomy
 - B. Forward flexion of head
 - C. Turning the lying patient on his left side
 - D. Turning the lying patient on his right side
 - E. Breathing through the mouth
28. During an examination it is necessary to determine what part of the alveolar air is renewed at every person's breath. Which of the following indexes must be calculated for this purpose?
- A. Vital capacity of lungs.
 - B. Minute respiratory volume.
 - C. Alveolar ventilation per minute.
 - D. Coefficient of pulmonary ventilation.
 - E. Functional residual capacity.
29. A patient has increased thickness of alveolar-capillary membrane caused by a pathologic process. The direct consequence will be reduction of the following value:
- A. Diffusing lung capacity
 - B. Oxygen capacity of blood
 - C. Respiratory minute volume
 - D. Alveolar ventilation of lungs
 - E. Expiratory reserve volume
30. A patient after pathological process has a thickened alveolar membrane. The direct consequence of the process will be the reduction of:

- A. Diffusing lung capacity
- B. Oxygen capacity of blood
- C. Minute respiratory capacity
- D. Alveolar lung ventilation
- E. Reserve expiratory capacity

31. As a result of some pathological process a person has got an increased thickness of alveolocapillary membrane. The decrease of what indexes will be the direct result of it?

- A. Oxygen capacity of blood.
- B. Diffusing capacity of lungs.
- C. Minute respiratory volume.
- D. Alveolar ventilation of lungs per minute.
- E. Expiratory reserve volume.

32. The curve of the dissociation of oxyhemoglobin is shifted to the right. What changes in a person's organism can be the reason for it?

- A. Increase of the concentration of 2,3-diphosphoglycerate in erythrocytes.
- B. Hyperthermia.
- C. Alkalosis.
- D. Hypocapnia.
- E. Hypoxemia.

33. A person lost consciousness in a car salon, where he had been waiting for a friend with a turned on engine for a long time. What compound of hemoglobin was found in his blood?

- A. Methemoglobin.
- B. Deoxyhemoglobin.
- C. Carbhemoglobin.
- D. Carboxyhemoglobin.
- E. Oxyhemoglobin.

34. What type of hemoglobin provides greater oxygen capacity of fetus's blood than that of mother's?

- A. Hb F
- B. Hb A
- C. Hb H
- D. Hb S
- E. Hb P

35. Electrical activity of neurons is being measured. They fire prior to and at the beginning of inhalation. Where are these neurons situated?

- A. Medulla oblongata
- B. Diencephalon
- C. Mesencephalon

- D. Spinal cord
- E. Cerebral cortex

36. After a craniocerebral trauma a patient's breathing became infrequent and deep. What structure of cerebrum is damaged?

- A. Medulla oblongata
- B. Hypothalamus
- C. Metencephalon
- D. Cortex of large hemispheres
- E. Cerebellum

37. During the registration of the electric activity of neurons it was determined that they become excited before inspiration and at its beginning. Where are these neurons situated?

- A. In medulla oblongata.
- B. In diencephalon
- C. In mesencephalon
- D. In the spinal cord
- E. In cerebral cortex

38. The transection of the brainstem between pons and medulla oblongata caused the lengthening of inspiration phase. It caused the violation of connection between medulla oblongata and a certain structure of cerebrum. What structure is it?

- A. Cerebellum
- B. Reticular formation
- C. Pneumotaxic center
- D. Cortex of large hemispheres
- E. Red nuclei

39. A 23-year-old patient has been admitted to a hospital with a craniocerebral injury. The patient is in a grave condition. Respiration is characterized by prolonged convulsive inspiration followed by a short expiration. What kind of respiration is it typical for?

- A. Apneustic
- B. Gaspig breath
- C. Kussmaul
- D. Cheyne-Stokes
- E. Biot's

40. A 62-year-old patient was admitted to the neurological department due to cerebral hemorrhage. His condition is grave. There is evident progression of deep and frequent breath that turns into reduction to apnea and the cycle repeats. What respiration type has developed in the patient?

- A. Cheyne-Stokes respiration
- B. Kussmaul respiration

- C. Biot's respiration
- D. Gasping respiration
- E. Apneustic respiration

41. A patient has got a trauma of the spinal cord above the 5th neck segment. How will the breathing character change?

- A. Will become superficial and more frequent.
- B. Will become superficial and more seldom.
- C. Will become deep and more frequent.
- D. Will stop.
- E. Will become deep and more seldom.

42. A patient has a transverse disruption of spinal cord below the IV thoracic segment. What changes of respiration will it cause?

- A. Respiration will stay unchanged
- B. Respiration will stop
- C. Respiration will become less frequent
- D. Respiration will become deeper
- E. Respiration will become more frequent

43. A 35 year old man got an injury that caused complete disruption of spinal cord at the level of the first cervical segment. What respiration changes will be observed?

- A. No changes will be observed
- B. Diaphragmal respiration will be maintained, thoracic respiration will disappear
- C. Thoracic respiration will be maintained, diaphragmal respiration will disappear
- D. It will become infrequent and deep
- E. Respiration will become more frequent

44. Vagus nerve of an experimental animal have been cut on the both sides. What respiratory changes will result from this?

- A. There will be no respiratory changes
- B. Respiration will become deep and infrequent
- C. Respiration will become shallow and infrequent
- D. Respiration will become shallow and frequent
- E. Respiration will become deep and frequent

45. Vagi of an experimental animal were cut on both sides. What respiration changes will be observed?

- A. It will become deep and infrequent
- B. It will become shallow and frequent
- C. It will become deep and frequent
- D. It will become shallow and infrequent
- E. No changes will be observed

46. A group of mountain climbers went through the blood analysis at the height of 3000 m. It revealed decrease of HCO_3^- to 15 micromole/l (standard is 22- 26 micromole/l). What is the mechanism of HCO_3^- decrease?
- A. Hyperventilation
 - B. Intensification of acidogenesis
 - C. Hypoventilation
 - D. Decrease of ammoniogenesis
 - E. Decrease of bicarbonate reabsorption in kidneys
47. Examination of a miner revealed pulmonary fibrosis accompanied by disturbance of alveolar ventilation. What is the main mechanism of this disturbance?
- A. Limitation of respiratory surface of lungs
 - B. Constriction of superior respiratory tracts
 - C. Disturbance of neural respiration control
 - D. Limitation of breast mobility
 - E. Bronchospasm
48. A 30-year-old man has sustained an injury to his thorax in a traffic incident, which caused disruption of his external respiration. What type of ventilatory difficulty can be observed in the given case?
- A. Restrictive extrapulmonary ventilatory impairment
 - B. Restrictive pulmonary ventilatory impairment
 - C. Obstructive ventilatory impairment
 - D. Impaired ventilation regulation dysfunction
 - E. Cardiovascular collapse
49. When studying the signs of pulmonary ventilation, reduction of forced expiratory volume has been detected. What is the likely cause of this phenomenon?
- A. Obstructive pulmonary disease
 - B. Increase of respiratory volume
 - C. Increase of inspiratory reserve volume
 - D. Increase of pulmonary residual volume
 - E. Increase of functional residual lung capacity
50. A patient with bronchial asthma has developed acute respiratory failure. What kind of respiratory failure occurs in this case?
- A. Obstructive disturbance of alveolar ventilation
 - B. Restrictive ventilatory defect
 - C. Perfusion
 - D. Diffusion
 - E. Dysregulation of alveolar ventilation

51. A patient was admitted to the hospital with an asphyxia attack provoked by a spasm of smooth muscles of the respiratory tracts. This attack was mainly caused by alterations in the following parts of the airways:
- A. Terminal bronchioles
 - B. Small bronchi
 - C. Respiratory part
 - D. Large bronchi
 - E. Median bronchi
52. There is an increased content of carbon dioxide in an apartment. How will the breathing of a person entering the apartment change?
- A. Depth and frequency will increase
 - B. Depth will decrease
 - C. Depth will increase
 - D. Frequency will decrease
 - E. Frequency will increase
53. There are many people in a cramped enclosed space. What changes in the air will cause hyperventilation of the people?
- A. Increase of water vapor content.
 - B. Decrease of oxygen content.
 - C. Increase of carbon dioxide content.
 - D. Rise of temperature.
 - E. Temperature reduction.
54. Voluntary breath-holding caused increase of respiration depth and frequency. The main factor stimulating these changes of external respiration is:
- A. Increased tension of CO_2 in blood
 - B. Increased tension of O_2 in blood
 - C. Decreased tension of O_2 in blood
 - D. Decreased tension of CO_2 in blood
 - E. Decreased concentration of H^+ in blood
55. After hyperventilation a sportsman has a short stop of breathing. What changes in blood are the reasons for it?
- A. Decrease of pH.
 - B. Decrease of the tension of CO_2
 - C. Increase of the tension of CO_2
 - D. Decrease of the tension of O_2
 - E. Increase of the tension of CO_2 and O_2
56. Carotid bodies of an animal were ablated on both sides. The influence of which of the following factors will not cause hyperventilation?
- A. Increase of the temperature of the body.

- B. Physical activity.
- C. Hypercapnia.
- D. Acidosis.
- E. Hypoxemia.

57. There is a severe time restriction for people's staying at a height of over 8000 m above the sea level without oxygen bombs. What is the life limiting factor in this case?

- A. Partial oxygen pressure
- B. Ultraviolet intensity
- C. Moisture level
- D. Temperature
- E. Earth gravity

58. After inhalation of dust a man had a cough. By the excitation of what receptors is it caused?

- A. Irritant
- B. Juxtacapillary
- C. Chemoreceptors of lungs
- D. Thermoreceptors of lungs
- E. Pain

59. While smoking a man often has a cough. Irritation of what receptors starts this reflex?

- A. Chemoreceptors of carotid sinuses
- B. Central chemoreceptors
- C. Chemoreceptors of the arch of aorta
- D. Irritant
- E. Mechanoreceptors of lungs

60. A man who went out from a warm apartment into cold air often had a cough. The irritation of what receptors started the coughing reflex?

- A. Mechanoreceptors of lungs
- B. Central chemoreceptors
- C. Chemoreceptors of the arch of aorta
- D. Chemoreceptors of carotid sinuses
- E. Irritant

61. A young woman who entered a production department where it strongly smelt of paints and varnishes had a bronchospasm. This reflex was caused by irritation of the following receptors:

- A. Irritant
- B. Juxtaglomerular
- C. Pleura receptors
- D. Central chemoreceptors
- E. Peripheral chemoreceptors

62. Measurements of the arterial $p\text{CO}_2$ and $p\text{O}_2$ during an attack of bronchial asthma revealed hypercapnia and hypoxemia respectively. What kind of hypoxia occurred in this case?
- A. Respiratory
 - B. Hemic
 - C. Circulatory
 - D. Tissue
 - E. Histotoxic
63. A 12-year-old child has a viral infection complicated by obstructive bronchitis. Bronchospasm can be eliminated by inhalations of a drug from the following pharmacological group:
- A. β_2 -agonists
 - B. M-anticholinergics
 - C. N-cholinomimetics
 - D. β_2 -adrenergic blockers
 - E. Analeptics
64. A patient has got a spasm of smooth muscles of bronchi. Activators of what membrane cytoceptors are physiologically reasoned to stop an attack?
- A. β -adrenoreceptors
 - B. α -adrenoreceptors
 - C. α - and β -adrenoreceptors
 - D. N-cholinoreceptors
 - E. M-cholinoreceptors
65. If a man has an attack of bronchospasm it is necessary to reduce the effect of vagus on smooth muscles of bronchi. What membrane cytoceptors should be blocked for this purpose?
- A. M-cholinoreceptors
 - B. N-cholinoreceptors
 - C. α -adrenoreceptors
 - D. β -adrenoreceptors
 - E. α - and β -adrenoreceptors
66. Spasm of smooth muscle of bronchi developed in the patient. Usage of activators of what membrane cytoceptors is physiologically valid to decrease attack?
- A. β -adrenoreceptors
 - B. α -adrenoreceptors
 - C. α - and β -adrenoreceptors
 - D. N-cholinoreceptors
 - E. M-cholinoreceptors

67. When water affects mucous membrane of the inferior nasal meatuses, this causes "diver reflex" that provokes:
- A. Reflectory apnea
 - B. Reflectory dyspnea
 - C. Reflectory hyperpnea
 - D. Cough
 - E. Bronchospasm
68. In a pressure chamber the pressure was reduced to 400 mm Hg. How will the breathing of a person change in this pressure chamber?
- A. Respiration depth will decrease and respiration frequency will increase.
 - B. Respiration depth and frequency will decrease.
 - C. Respiration depth and frequency will increase.
 - D. Respiration depth will increase, and respiration frequency will decrease.
 - E. Will remain without changes.
69. In the prestart condition it is necessary for a runner to increase the content of oxygen in his muscles. In what way can the runner do it?
- A. To breathe with low frequency.
 - B. To breathe in the mode of hypoventilation.
 - C. To take a rapid inspiration and slow expiration.
 - D. To breathe in the mode of hyperventilation.
70. Which of the following processes of a hungry man who sees tasty food will be activated first of all?
- A. Secretion of gastric juice.
 - B. Secretion of intestinal juice.
 - C. Colon motility.
 - D. Contraction of Oddi's sphincter.
 - E. Small intestine motor activity.
71. With the violation of cerebral circulation a patient has got a broken act of swallowing. What part of the brain has suffered?
- A. Prosencephalon.
 - B. Cervical part of the spinal cord.
 - C. Brainstem.
 - D. Diencephalon.
 - E. Mesencephalon.
72. In an experiment cerebral structures are electrostimulated. As a result of it polyphagia (excessive yearning for food) appeared. What department of cerebrum are electrodes put in?
- A. Adenohypophysis.
 - B. Ventromedial nuclei of hypothalamus.

- C. Supraoptical nuclei of hypothalamus.
- D. Lateral nuclei of hypothalamus.
- E. Red nucleus.

73. In an experiment cerebral neurons of an animal are electrostimulated. As a result of it hypophagy (refusal to meal) appeared. What department of cerebrum are electrodes put in?

- A. Ventromedial nuclei of hypothalamus.
- B. Lateral nuclei of hypothalamus.
- C. Neurohypophysis.
- D. Adenohypophysis.
- E. Red nucleus.

74. The patient with pneumonia was treated with antibiotics for a long period. After treatment patient complains of frequent and watery stool, abdominal pain. What is the reason of intestine function disorder?

- A. Intestinal dysbacteriosis development
- B. Antibiotics toxic influence on the GIT
- C. Autoimmune reaction development
- D. Bacteria toxins influence
- E. Hereditary enzyme defect

75. A 60-year-old patient presents with weakened peristaltic activity of the bowels. Which of the following foodstuffs would stimulate peristalsis most of all?

- A. Brown bread
- B. White bread
- C. Meat
- D. Lard
- E. Tea

76. A part of a patient's pancreas was ablated. What products is it necessary for him to limit in his food ration?

- A. Fruit.
- B. Boiled vegetables.
- C. Dairy produce.
- D. Vegetables rich in proteins (beans, soy).
- E. Fat meat, beef tea.

77. A patient with disturbed cerebral circulation has problems with deglutition. What part of brain was damaged?

- A. Brainstem
- B. Cervical part of spinal cord
- C. Forebrain
- D. Interbrain

E. Midbrain

78. During an examination a student's mouth is dry. The increased realization of what reflexes is the mechanism causing the development of this state?
- A. Unconditional sympathetic.
 - B. Unconditional parasympathetic.
 - C. Conditional parasympathetic.
 - D. Conditional sympathetic.
 - E. Unconditional metasympathetic.
79. In Ancient India a person suspected of committing a crime was offered to swallow a handful of dry rice. Criminals could not swallow the rice because of decreased salivation. What process is the reason for such state?
- A. Inhibition of the sympathoadrenal system.
 - B. Activation of the parasympathetic nucleus of the facial nerve.
 - C. Decrease of blood circulation salivary glands.
 - D. Activation of the parasympathetic nucleus of the glossopharyngeal nerve.
 - E. Activation of the sympathoadrenal system.
80. A patient has got a chronic neuritis of the trigeminus. Which of the digestive processes is considerably broken?
- A. Mastication.
 - B. Salivation.
 - C. Formation of taste feeling.
 - D. Swallowing.
 - E. Formation of saliva.
81. A peripheral part of sympathetic fibers which innervate the sublingual salivary gland of an experimental animal is irritated. How does it influence the secretion of the sublingual salivary gland?
- A. Much viscid saliva secreted.
 - B. Little liquid saliva secreted.
 - C. Saliva is not secreted.
 - D. Much liquid saliva secreted.
 - E. Little viscid saliva secreted.
82. A person has got little viscid saliva, its enzyme activity is reduced, content of mucus is increased. The function violation of what glands is the most possible reason for this state?
- A. Parotid.
 - B. Own glands of tunica mucosa of oral cavity.
 - C. Sublingual.
 - D. Submandibular.
 - E. Own lingual glands.

83. When investigating human saliva it is necessary to assess its hydrolytic properties. What substance should be used as a substrate in the process?
- A. Starch
 - B. Proteins
 - C. Fats
 - D. Fiber
 - E. Amino acids
84. A 60 year old patient was found to have a dysfunction of main digestive enzyme of saliva. This causes the disturbance of primary hydrolysis of:
- A. Carbohydrates
 - B. Fats
 - C. Proteins
 - D. Cellulose
 - E. Lactose
85. During a patient's examination the decrease of the motor and evacuatory functions of the stomach was determined. The deficit of which of the following substances can it be connected with?
- A. Secretin.
 - B. Gastrin.
 - C. Adenosine.
 - D. Somatostatin.
 - E. Gastric-inhibiting peptide.
86. A lean solution of hydrochloric acid was introduced into an experimental dog's duodenum through a probe. The secretion increase of what hormone will it cause?
- A. Gastrin.
 - B. Secretin.
 - C. Histamine.
 - D. Cholecystokinin.
 - E. Neurotensin.
87. Lean solution of hydrochloric acid was introduced into the duodenum of an animal through a probe. The content of what hormone will be increased as a result of it?
- A. Gastrin.
 - B. Cholecystokinin pancreozymin.
 - C. Secretin.
 - D. Glucagon.
 - E. Neurotensin.
88. A patient's duodenum is ablated. The decrease of the secretion of what hormone will it cause?

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

89. A newborn child suffers from milk curdling in stomach, this means that soluble milk proteins (caseins) transform to insoluble proteins (paracaseins) by means of calcium ions and a certain enzyme. What enzyme takes part in this process?

- A. Rennin
- B. Pepsin
- C. Gastrin
- D. Secretin
- E. Lipase

90. A patient is diagnosed with chronic atrophic gastritis attended by deficiency of Castle's intrinsic factor. What type of anemia does the patient have?

- A. B₁₂-deficiency anemia
- B. Iron-refractory anemia
- C. Hemolytic anemia
- D. Iron-deficiency anemia
- E. Protein-deficiency anemia

91. Surgical removal of a part of stomach resulted in disturbed absorption of vitamin B₁₂, it is excreted with feces. The patient was diagnosed with anemia. What factor is necessary for absorption of this vitamin?

- A. Gastromucoprotein
- B. Gastrin
- C. Hydrochloric acid
- D. Pepsin
- E. Folic acid

92. Blood test of a patient suffering from atrophic gastritis gave the following results: RBCs – $2.0 * 10^{12}/L$, Hb- 87 g/L, color index – 1.3, WBCs – $4.0 * 10^9/L$, thrombocytes - $180 * 10^9/L$. Anemia might have been caused by the following substance deficiency:

- A. Vitamin B₁₂
- B. Vitamin A
- C. Vitamin K
- D. Iron
- E. Zinc

93. A 35-year-old man with peptic ulcer disease has undergone antrectomy. After the surgery secretion of the following gastro- intestinal hormone will be disrupted the most:

- A. Gastrin
- B. Histamine
- C. Secretin
- D. Cholecystokinin
- E. Neurotensin

94. When the pH level of the stomach lumen decreases to less than 3, the antrum of the stomach releases peptide that acts in paracrine fashion to inhibit gastrin release. This peptide is:

- A. GIF
- B. Acetylcholine
- C. Gastrin-releasing peptide (GRP)
- D. Somatostatin
- E. Vasoactive intestinal peptide (VIP)

95. Patient with hypersecretion of the gastric juices was recommended to exclude from the diet concentrated bouillons and vegetable decoctions because of their stimulation of gastric secretion. What is dominating mechanism of stimulation of secretion in this case?

- A. Stimulation of gastrin production by G-cells
- B. Irritation of taste receptors
- C. Irritation of mechanoreceptors of the oral cavity
- D. Irritation of mechanoreceptors of the stomach
- E. Stimulation of excretion of secretin in the duodenum

96. Examination of a 35 year old patient revealed high acidity of gastric juice. What receptors should be blocked in order to reduce it?

- A. Histamine
- B. α_1 -adrenoreceptors
- C. α_2 -adrenoreceptors
- D. β_1 -adrenoreceptors
- E. β_2 -adrenoreceptors

97. A person has got considerable violation in digestion of proteins, fats and carbohydrates. Reduced secretion of what digestive juice is the result of it?

- A. Saliva.
- B. Pancreatic juice.
- C. Gastric juice.
- D. Bile.
- E. Intestinal juice.

98. In the process of aging of a human being there is a decrease of the synthesis and secretion of the pancreatic juice, a decrease of trypsin content in it. To the violation of the splitting of what substances does it lead first of all?

- A. Polysaccharides.
- B. Phospholipids.
- C. Proteins.
- D. Nucleic acids.
- E. Lipids.

99. A patient consumed a lot of rich in proteins food that caused increase of rate of proteolytic enzymes of pancreatic juice. It is also accompanied by increase of rate of the following enzyme:

- A. Trypsin
- B. Pepsin
- C. Enterokinase
- D. Gastricsin
- E. Rennin

100. A 30 year old woman has subnormal concentration of enzymes in the pancreatic juice. This might be caused by the hyposecretion of the following gastrointestinal hormone:

- A. Cholecystokinin-pancreozymin
- B. Somatostatin
- C. Secretin
- D. Gastro-inhibiting peptide
- E. Vaso-intestinal peptide

101. A 30-year-old male patient with acute pancreatitis has been found to have a disorder of cavity protein digestion. The reason for such condition can be the hyposynthesis and hyposecretion of the following enzyme:

- A. Trypsin
- B. Pepsin
- C. Lipase
- D. Dipeptidase
- E. Amylase

102. A patient consumed a lot of rich in proteins food that caused increase of rate of proteolytic enzymes of pancreatic juice. It is also accompanied by increase of rate of the following enzyme:

- A. Trypsin
- B. Pepsin
- C. Enterokinase
- D. Gastricsin
- E. Rennin

103. A 30-year-old woman was diagnosed with insufficiency of exocrine function of pancreas. Hydrolysis of what nutrients will be disturbed?

- A. Proteins, fats, carbohydrates
- B. Proteins, fats
- C. Proteins, carbohydrates
- D. Fats, carbohydrates
- E. Proteins

104. A patient has a critical impairment of protein, fat and hydrocarbon digestion. Most likely it has been caused by low secretion of the following digestive juice:

- A. Pancreatic juice
- B. Saliva
- C. Gastric juice
- D. Bile
- E. Intestinal juice

105. Deficit of what enzyme is the most often the reason for incomplete digestion of fats in the digestive tract and the increase of the neutral fat quantity in excrements?

- A. Hepatic lipase.
- B. Gastric lipase.
- C. Pancreatic lipase.
- D. Intestinal lipase.
- E. Enterokinase.

106. A patient takes cholagogues. What other process besides biliary excretion will be stimulated?

- A. Intestinal motility
- B. Gastric juice secretion
- C. Pancreatic juice secretion
- D. Gastric motor activity
- E. Water absorption

107. Examination of a patient suffering from chronic hepatitis revealed a significant decrease in the synthesis and secretion of bile acids. What process will be mainly disturbed in the patient's bowels?

- A. Fat emulsification
- B. Protein digestion
- C. Carbohydrate digestion
- D. Glycerin absorption
- E. Amino acid absorption

108. A patient complains of frequent diarrheas, especially after consumption of rich food, weight loss. Laboratory examination revealed steatorrhea; his feces were hypocholic. What might have caused such condition?

- A. Obturation of biliary tracts
- B. Inflammation of mucous membrane of small intestine

- C. Lack of pancreatic lipase
- D. Lack of pancreatic phospholipase
- E. Unbalanced diet

109. During the coprological research it is determined that excrements are discolored, neutral fat drops are found in them. The violation of what process is the most probable reason for such results?

- A. Processes of an intestine.
- B. Acidity of gastric juice.
- C. Secretion of pancreatic juice.
- D. Secretion of intestinal juice.
- E. Permeation of bile into the intestine.

110. A stone in the common bile duct stopped bile coming into the bowels. Violation of what process is observed here?

- A. Absorption of proteins.
- B. Digestion of carbohydrates.
- C. Absorption of carbohydrates.
- D. Digestion of fats.
- E. Digestion of proteins.

111. A 46 year old woman suffering from cholelithiasis developed jaundice. Her urine became dark-yellow and feces became colorless. Blood serum will have the highest concentration of the following substance:

- A. Conjugated bilirubin
- B. Unconjugated bilirubin
- C. Biliverdin
- D. Mesobilirubin
- E. Urobilinogen

112. After intake of rich food a patient feels nausea and sluggishness; with time there appeared signs of steatorrhea. Blood cholesterol concentration is 9,2 micromole/l. This condition was caused by lack of:

- A. Bile acids
- B. Triglycerides
- C. Fatty acids
- D. Phospholipids
- E. Chylomicrons

113. A patient has a disturbed absorption of fat hydrolysates. It might have been caused by a deficit in the small intestine cavity:

- A. Of bile acids
- B. Of bile pigments
- C. Of lipolytic enzymes

D. Of sodium ions

114. After consumption of rich food a patient has nausea and heartburn, steatorrhea. This condition might be caused by:

- A. Bile acid deficiency
- B. Increased lipase secretion
- C. Disturbed trypsin synthesis
- D. Amylase deficiency
- E. Disturbed phospholipase synthesis

115. A patient underwent an operation on account of gall bladder excision that resulted in obstruction of Ca absorption through the bowels wall. What vitamin will stimulate this process?

- A. D₃
- B. PP
- C. C
- D. B₁₂
- E. K

116. A patient has normally colored feces including a large amount of free fatty acids. The reason for this is a disturbance of the following process:

- A. Fat absorption
- B. Fat hydrolysis
- C. Biliary excretion
- D. Choleresis
- E. Lipase secretion

117. A peripheral part of chorda tympani of an experimental animal is irritated. How does it influence the secretion of parotid salivary gland?

- A. Much liquid saliva secreted.
- B. Little liquid saliva secreted.
- C. Saliva is not secreted.
- D. Little viscid saliva secreted.
- E. Much viscid saliva secreted.

118. During physical activity a young man's oxygen consumption and carbon dioxide elimination per minute make 1000 ml. What substances are oxidized in the cells of his organism?

- A. Carbohydrates
- B. Proteins
- C. Fats
- D. Carbohydrates and fats
- E. Carbohydrates and proteins

119. By the method of indirect calorimetry it was determined that the basic exchange of an examined person is 40% lower than it should be. The violation of the activity of what endocrine gland is the reason for such state?
- A. Pancreas
 - B. Thymus
 - C. Thyroid
 - D. Epiphysis
 - E. Adrenal glands
120. A teenager of 14 has got positive nitrogen balance. Which of the following can be the reason for it?
- A. Starvation
 - B. Growth of organism
 - C. Reduction of protein content in food
 - D. Considerable physical activity
 - E. Emotional tension
121. Measuring the energy wastes of a human organism by the method of indirect calorimetry it was determined that the oxygen consumption per minute is 1000 ml and carbon dioxide elimination per minute is 800 ml. What respiratory coefficient does the examined person have?
- A. 1.0
 - B. 1.25
 - C. 0.9
 - D. 0.8
 - E. 0.7
122. Measuring the energy wastes of a human organism it was determined that the respiratory coefficient is 1.0. What substances are mainly oxidized in the person's cells?
- A. Carbohydrates
 - B. Proteins
 - C. Fats
 - D. Proteins and carbohydrates
 - E. Carbohydrates and fats
123. Measuring the energy wastes of a human organism it was determined that the respiratory coefficient is 0.7. What substances are mainly oxidized in the person's cells?
- A. Carbohydrates
 - B. Proteins
 - C. Fats
 - D. Proteins and carbohydrates
 - E. Carbohydrates and fats

124. During the examination of a 35-year-old woman there was the increase of the indexes of basic exchange. The surplus of which of the following hormones probably caused this state?
- A. Triiodothyronine
 - B. Somatotropin
 - C. Insulin
 - D. Cortisol
 - E. Glucagon
125. The workers of hot workshops of metallurgical enterprises lose a lot of water with sweat. What drink is it necessary to take for optimum compensation for this state?
- A. Water with some salt added
 - B. Soda water
 - C. Milk
 - D. Natural juices
 - E. Tea
126. By the method of indirect calorimetry the decrease of indexes of basal metabolism of a 30-year-old man by 30% was determined. The decrease concentration of what hormones in blood plasma can be the reason for it?
- A. Triiodothyronine, tetraiodothyronine
 - B. Thyrocalcitonin, parathormone
 - C. Glucocorticoids
 - D. Catecholamine
 - E. Somatoliberin, somatostatin
127. In a young man during exercise, the minute oxygen uptake and carbon dioxide emission equaled to 1000 ml. What substrates are oxidized in the cells of his body?
- A. Carbohydrates
 - B. Proteins
 - C. Fats
 - D. Carbohydrates and fats
 - E. Carbohydrates and proteins
128. Respiratory coefficient was studied in the patient who strictly kept certain diet for 10 days. It was determined that it is 1. What diet does the patient follow?
- A. With domination of carbohydrates
 - B. With domination of proteins and fat
 - C. With domination of fat and carbohydrates
 - D. Mixed
 - E. With domination of proteins and carbohydrates

129. During an examination of a 45-year-old person who had been keeping to a vegetable diet for a long time negative nitrogen balance was determined. What peculiarity of the ration became the reason for such state?
- A. Excessive peculiarity of carbohydrates.
 - B. Excessive peculiarity of water.
 - C. Insufficient peculiarity of proteins.
 - D. Insufficient peculiarity of fats.
 - E. Insufficient peculiarity of fats and proteins.
130. Energy wastes of a 40-year-old miner is more than 5000 kcal per day. What component in his food ration is it necessary to increase for the renewal of such energy wastes?
- A. Vitamins
 - B. Liquid
 - C. Proteins
 - D. Carbohydrates
 - E. Fats
131. The energy inputs of a healthy man have been measured. In what position was the patient if his energy inputs were less than the main exchange?
- A. Sleep
 - B. Rest
 - C. Easy work
 - D. Nervous exertion
 - E. Calmness
132. Power inputs of a boy increased from 500 to 2000 kJ per hour. What can be the cause of it?
- A. Physical exercise
 - B. Raise of outer temperature
 - C. Mental activity
 - D. Food intake
 - E. Transition from sleep to wakefulness
133. A patient has pellagra. Interrogation revealed that he had lived mostly on maize for a long time and eaten little meat. This disease had been caused by the deficit of the following substance in the maize:
- A. Tryptophan
 - B. Tyrosine
 - C. Proline
 - D. Alanine
 - E. Histidine

134. Power inputs of a man were measured. In what state was this man if his power inputs were lower than basal metabolism?
- A. Sleep
 - B. Relaxation
 - C. Simple work
 - D. Nervous tension
 - E. Rest
135. When measuring power inputs of a man by the method of indirect calorimetry the following results were obtained: 1000 ml oxygen consumption and 800 ml carbon dioxide liberation per minute. The man under examination has the following respiratory coefficient:
- A. 0.8
 - B. 1.25
 - C. 0.9
 - D. 0.84
 - E. 1.0
136. While determining power inputs of a patient's organism it was established that the respiratory coefficient equaled 1.0. This means that in the cells of the patient the following substances are mainly oxidized:
- A. Carbohydrates
 - B. Proteins
 - C. Fats
 - D. Proteins and carbohydrates
 - E. Carbohydrates and fats
137. A part of a patient's pancreas was ablated. What products is it necessary for him to limit in his food ration?
- A. Fruit
 - B. Boiled vegetables
 - C. Dairy produce
 - D. Vegetables rich in proteins (beans, soy)
 - E. Fat meat, beef tea
138. The air temperature is 38°C, relative humidity of the air — 80%, wind speed — 0 m/sec. Due to what mechanism will there be heat emission under these conditions?
- A. Convection
 - B. Radiation
 - C. Evaporation of sweat
 - D. Heat conduction
 - E. Radiation and convection.

139. A man dressed in light clothes is standing in a room where air temperature is 14°C . Windows and doors are closed. In what way does the man give the biggest quantity of heat?
- A. By convection
 - B. By heat conduction
 - C. By heat radiation
 - D. By evaporation
 - E. By perspiration
140. What mechanism of heat emission is the most effective if a person is in the conditions of 80% air humidity and the temperature of the environment is 35°C ?
- A. Sweat secretion
 - B. Radiation
 - C. Heat conduction
 - D. Convection
 - E. Conduction
141. Air temperature in production premises is 36°C , relative air humidity is 80%. In what way does a human organism give its warm under such conditions?
- A. By evaporation of sweat
 - B. By heat conduction
 - C. By radiation
 - D. By convection
 - E. By conduction
142. The inhabitants of territories with cold climate have an increased content of a hormone in blood, which has an adaptive thermoregulatory meaning. What hormone is it?
- A. Thyroxin
 - B. Insulin
 - C. Glucagon
 - D. Somatotropin
 - E. Cortisol
143. In a laboratory experiment rats were adapted to living in the conditions of cold at a temperature of 5°C . The increasing secretion of what hormone caused the development of this adaptation?
- A. Thyroxin
 - B. Glucagon
 - C. Somatotropin
 - D. Testosterone
 - E. Adrenaline

144. People adapted to the action of high external temperature do not lose with sweat a large quantity of sodium chloride with hidrosis. The action of what hormone on sweat glands causes such effect?
- A. Atrial natriuretic factor
 - B. Vasopressin
 - C. Cortisol
 - D. Thyroxin
 - E. Aldosterone
145. The processes of heat emission of an undressed man at a room temperature are researched. In what way is the maximum quantity of heat emitted under such conditions?
- A. Convection
 - B. Heat conduction
 - C. Heat radiation
 - D. Evaporation
 - E. Conduction
146. During the examination of a 35-year-old woman there was the increase of the indexes of basal metabolic rate. The surplus of which of the following hormones probably caused this state?
- A. Triiodothyronine
 - B. Somatotropin
 - C. Insulin
 - D. Cortisol
 - E. Glucagon
147. A man went out from an apartment with air conditioning into the street where the air temperature was 40°C, air humidity was 60%. In what way will the heat be emitted from the organism in the street?
- A. By the evaporation of sweat
 - B. By convection
 - C. By radiation
 - D. By conduction
148. During the thermometry it was determined that the temperature of the open parts of skin is by 1-1.5°C lower than the temperature of the parts covered with clothes of natural fabrics. In what way do clothes reduce heat emission?
- A. By radiation
 - B. By convection
 - C. By conduction
 - D. By evaporation

149. In cold weather with wind people freeze quicker than without any wind. In what way does the wind increase heat emission?
- A. By evaporation
 - B. By radiation
 - C. By heat conduction
 - D. By convection
 - E. By conduction
150. The temperature of the ambient environment is 38°C and relative air humidity is 50%. What ways of heat emission provide maintaining a constant temperature of the human body?
- A. Convection
 - B. Radiation
 - C. Evaporation
 - D. Convection and conduction
 - E. Heat conduction
151. Cooling of the human body in water is much faster than in the air. What way of heat emission in water is much more effective?
- A. Sweat evaporation
 - B. Heat conduction
 - C. Heat radiation
 - D. Convection
152. A lightly dressed man is standing in a room, air temperature is $+14^{\circ}\text{C}$, windows and doors are closed. In what way does he emit heat the most actively?
- A. Heat radiation
 - B. Heat conduction
 - C. Convection
 - D. Evaporation
 - E. Perspiration
153. A human body cools in water much faster than in the air. What way of heat emission in water is much more efficient?
- A. Heat conduction
 - B. Convection
 - C. Heat radiation
 - D. Sweat evaporation
154. Workers of a hothouse farm work under conditions of unfavorable microclimate: air temperature is $+37^{\circ}\text{C}$, relative humidity is 90%, air speed is 0.2 m/s. The way of heat emission under these conditions will be:
- A. Evaporation
 - B. Heat conduction

- C. Convection
- D. Radiation
- E. All the ways

155. A 25 year old man has spent a long time in the sun under high air humidity. As a result of it his body temperature rose up to 39°C. What pathological process is it?

- A. Hyperthermia
- B. Infectious fever
- C. Hypothermia
- D. Noninfectious fever
- E. Burn disease

156. Which way of heat emission by the bodies of greenhouse workers is the most effective at the temperature of 36°C degrees and relative humidity of 70%?

- A. Liquid evaporation
- B. Thermal conduction
- C. Heat radiation
- D. Convection

157. Thermometry revealed that the temperature of the exposed skin is by 1-1,5° lower than the temperature of the adjacent areas covered with clothing from natural fabrics. The reason for this is that the clothes reduce the heat loss through:

- A. Convection
- B. Radiation
- C. Evaporation
- D. Conduction

158. The processes of heat transfer in a naked person at room temperature have been studied. It was revealed that under these conditions the greatest amount of heat is transferred by:

- A. Heat radiation
- B. Heat conduction
- C. Convection
- D. Evaporation

159. For people adapted to high external temperatures profuse sweating is not accompanied by loss of large volumes of sodium chloride. This is caused by the effect the following hormone has on perspiratory glands:

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

160. A transplanted kidney reacts to pain stimulations by the stop of urinary excretion. What is the reason for this reaction?
- A. Increase of the secretion of antidiuretic hormone.
 - B. Decrease of the secretion of anti-diuretic hormone.
 - C. Influence of the parasympathetic part of the nervous system.
 - D. Influence of the sympathetic part of the nervous system.
 - E. Decrease of the secretion of corticotropin.
161. A person has a decreased diuresis, hypernatremia, and hypokalemia in blood plasma. Hypersecretion of what hormone can be the reason for such changes?
- A. Aldosterone.
 - B. Vasopressin.
 - C. Atrial natriuretic factor.
 - D. Adrenaline.
 - E. Parathormone.
162. During the laboratory research the presence of glucose was detected in the urine of an 18-year-old patient, while its concentration in blood plasma was normal. Violation of what process is the most possible reason for this state?
- A. Secretion of insulin.
 - B. Glomerular filtration.
 - C. Tubular secretion.
 - D. Tubular reabsorption.
 - E. Secretion of glucocorticoids.
163. During an experiment the processes of energy formation in the epithelium of renal tubules were blocked. As a result of it diuresis increased by a factor of four. The decrease of what index is the most possible reason for polyuria?
- A. Glomerular filtration rate.
 - B. Reabsorption of sodium ions.
 - C. Secretion of potassium ions.
 - D. Renal blood flow.
 - E. Secretion of urea.
164. During a laboratory examination of a 54-year-old man it was determined that inulin clearance is 120 ml per min. What index of this man meets the norm?
- A. Glomerular filtration rate.
 - B. Tubular reabsorption.
 - C. Tubular secretion.
 - D. Renal blood flow.
 - E. Renal plasma current.

165. A man of 35 had had the flu complicated by the affection of the CNS. His daily amount of urine considerably increased after the disease. Which of the cerebral departments was the most probably affected?
- A. Spinal cord.
 - B. Mesencephalon.
 - C. Prosencephalon.
 - D. Metencephalon.
 - E. Diencephalon.
166. During an experiment a rabbit was intravenously injected 300 ml of isotonic solution of sodium chloride, which resulted in the considerable increase of circulatory blood volume. Concentration of what substance will be increased in the rabbit's blood these conditions provided?
- A. Atrial natriuretic factor.
 - B. Renin.
 - C. Aldosterone.
 - D. Angiotensin II.
 - E. Adrenaline.
167. In an experiment on an animal by overstretching of atriums by blood the decrease of the reabsorption of sodium ions and water in renal tubules was caused. The influence of what hormones on kidneys can it be explained by?
- A. Renin.
 - B. Aldosterone.
 - C. Atrial natriuretic factor.
 - D. Angiotensin.
 - E. Vasopressin.
168. During the research of a new low-molecular preparation X it was determined that its clearance was higher than the clearance of inulin. What is the mechanism of the excretion of the preparation by kidneys?
- A. Secretion.
 - B. Filtration.
 - C. Filtration and secretion.
 - D. Filtration and reabsorption.
 - E. Secretion and reabsorption.
169. A great number of protein and erythrocytes were detected in urine. The increase of what index can be the reason for it?
- A. Permeability of renal filter.
 - B. Net filtration pressure.
 - C. Hydrostatic blood pressure in glomerular capillaries.
 - D. Hydrostatic pressure of primary urine in the capsule.
 - E. Oncotic pressure of blood plasma.

170. The substance, which was introduced to a dog during an experiment, resulted in the damage of the renal filter. Which of the following substances can be detected in the animal's urine as a result of it?
- A. Ions of sodium.
 - B. Glucose.
 - C. Amino acids.
 - D. Proteins.
 - E. Ions of calcium.
171. In the kidneys of a patient the reabsorption of calcium ions is increased, and that of phosphate ions is reduced. The influence of what hormone was the reason for such changes?
- A. Parathormone.
 - B. Thyrocalcitonin.
 - C. Hormonal form of vitamin D₃.
 - D. Aldosterone.
 - E. Vasopressin.
172. The level of glucose in a person's blood is 15 millimoles/l (threshold of reabsorption is 10 mmol/l). What process will become the result of the glucose level increase?
- A. Decrease of vasopressin secretion.
 - B. Decrease of diuresis.
 - C. Decrease of glucose reabsorption.
 - D. Glucosuria.
 - E. Decrease of aldosterone secretion.
173. A man's glomerular filtration rate is 180 ml per min (norm — 125 ± 25 ml per min). The reduction of what index can be the reason for it?
- A. Oncotic pressure of blood plasma.
 - B. Net filtration pressure.
 - C. Hydrostatic blood pressure in glomerular capillaries.
 - D. Renal blood flow.
 - E. Permeability of renal filter.
174. As a result of continuous starvation the glomerular filtration rate has increased by 20%. The most probable cause of the glomerular filtration alteration under the mentioned condition is:
- A. Increase in the systemic arterial pressure
 - B. Increase in the permeability of the renal filter
 - C. Increase of the renal blood flow
 - D. Decrease in the oncotic pressure of blood plasma
 - E. Increase of filtration quotient

175. A 16 year-old patient got numerous traumas in automobile accident. Now the patient is having a shock. AP - 80/60 mm Hg. daily urine volume 60-80 ml. What pathogenic mechanism leads to kidneys function violation?
- A. Decreased hydrostatic pressure in glomerular capillaries
 - B. Increased osmotic pressure in glomerular capillaries
 - C. Increased pressure in Bowman's capsule
 - D. Increased vasopressin blood concentration
 - E. Trauma of the urinary bladder
176. The low specific gravity of the secondary urine (1002) was found out in the sick person. What is the most distant part of nephron where concentration of secondary urine takes place?
- A. In the collecting duct
 - B. In the nephron's glomerulus
 - C. In proximal tubule of nephron
 - D. In ascending part of loop of Henle
 - E. In distal tubule of nephron
177. Glomerular filtration rate (GFR) increased by 20% due to prolonged starvation of the person. The most evident cause of filtration changes under these conditions is:
- A. Decrease of oncotic pressure of blood plasma
 - B. Increase of systemic blood pressure
 - C. Increase of penetration of the renal filter
 - D. Increase of filtration coefficient
 - E. Increase of renal plasma stream
178. Chronic glomerulonephritis was diagnosed in a 34-year-old patient 3 years ago. Edema has developed within the last 6 months. What caused the edema?
- A. Proteinuria
 - B. Hyperproduction of vasopressin
 - C. Liver disfunction of protein formation
 - D. Hyperosmolarity of plasma
 - E. Hyperaldosteronism
179. A 58-year-old patient with acute cardiac insufficiency has decreased volume of daily urine - oliguria. What is the mechanism of this phenomenon?
- A. Decreased glomerular filtration
 - B. Decreased number of functioning glomeruli
 - C. Drop of oncotic blood pressure
 - D. Rise of hydrostatic blood pressure in capillaries
 - E. Reduced permeability of renal filter

180. A 4 y.o. child with signs of durative proteinic starvation was admitted to the hospital. The signs were as follows: growth inhibition, anemia, edema, mental deficiency. Choose a cause of edema development:
- A. Reduced synthesis of albumins
 - B. Reduced synthesis of globulins
 - C. Reduced synthesis of hemoglobin
 - D. Reduced synthesis of lipoproteins
 - E. Reduced synthesis of glycoproteins
181. As a result of a trauma a person lost 500 ml blood which resulted in the decrease of diuresis. The influence on the kidneys of what hormone caused this adaptive change?
- A. Cortisol.
 - B. Atrial natriuretic factor.
 - C. Aldosterone.
 - D. Vasopressin.
 - E. Renin.
182. As a result of a long stay in heat a person gets thirsty. Signaling from what receptors caused its development?
- A. Glucoreceptors of the hypothalamus.
 - B. Sodium receptors of the hypothalamus.
 - C. Osmoreceptors of the liver.
 - D. Osmoreceptors of the hypothalamus.
 - E. Baroreceptors of the arch of aorta.
183. Osmotic pressure of a man's blood plasma is 350 mosmole/l (standard pressure is 300 mosmole/l). First of all it will result in high secretion of the following hormone:
- A. Vasopressin
 - B. Aldosteron
 - C. Cortisol
 - D. Adrenocorticotropin
 - E. Natriuretic
184. A patient, who had been working hard under conditions of elevated temperature of the environment, has now a changed quantity of blood plasma proteins. What phenomenon is the case?
- A. Relative hyperproteinemia
 - B. Absolute hyperproteinemia
 - C. Absolute hypoproteinemia
 - D. Disproteinemia
 - E. Paraproteinemia
185. A patient has a decreased vasopressin synthesis that causes polyuria and as a result of it evident organism dehydration. What is the mechanism of polyuria development?

- A. Reduced tubular reabsorption of water
- B. Reduced tubular reabsorption of Na ions
- C. Reduced tubular reabsorption of protein
- D. Reduced glucose reabsorption
- E. Acceleration of glomerular filtration

186. A patient with nephrotic syndrome has massive edemata of his face and limbs. What is the leading pathogenetic mechanism of edemata development?

- A. Drop of oncotic blood pressure
- B. Increase of vascular permeability
- C. Rise of hydrodynamic blood pressure
- D. Lymphostasis
- E. Increase of lymph outflow

187. A patient is 44 years old. Laboratory examination of his blood revealed that content of proteins in plasma was 40 g/L. What influence will be exerted on the transcapillary water exchange?

- A. Filtration will be increased, reabsorption - decreased
- B. Both filtration and reabsorption will be increased
- C. Both filtration and reabsorption will be decreased
- D. Filtration will be decreased, reabsorption - increased
- E. Exchange will stay unchanged

188. As a result of a road accident a driver has gotten a trauma. Now he is in shock condition and presents with a decrease in daily diuresis down to 300 ml. What is the main pathogenetic factor of such alteration in the diuresis?

- A. Arterial pressure drop
- B. Oncotic blood pressure drop
- C. Increase in vascular permeability
- D. Decrease in number of the functioning glomeruli
- E. Secondary hyperaldosteronism

189. A man weighs 80 kg, after long physical activity his circulating blood volume is reduced down to 5.4 L, hematocrit makes up 50%, whole blood protein is 80 g/L. These blood characteristics are determined first of all by:

- A. Water loss with sweat
- B. Increased number of erythrocytes
- C. Increased protein concentration in plasm
- D. Increased circulating blood volume
- E. Increased diuresis

190. A histological specimen of kidney shows a structure consisting of a glomerulus of fenestrated capillaries and a bilayer epithelial capsule. Specify this structure:

- A. Renal corpuscle

- B. Proximal tubule
- C. Distal tubule
- D. Henle's loop
- E. Receiving tube

191. A man has a considerable decrease in diuresis as a result of 1.5 L blood loss. The primary cause of such diuresis disorder is the hypersecretion of the following hormone:

- A. Vasopressin
- B. Corticotropin
- C. Natriuretic
- D. Cortisol
- E. Parathormone

192. A person has got a considerable reduction of urine quantity after salt food intake. The influence of what hormone can it be explained by?

- A. Somatostatin.
- B. Adrenaline.
- C. Antidiuretic.
- D. Oxytocin.
- E. Corticotropin.

193. A person has a decreased diuresis as a result of increased secretion of vasopressin. The increase of what index stimulates the secretion of vasopressin?

- A. Osmotic pressure of plasma.
- B. Concentration of sodium.
- C. Volume of circulatory blood.
- D. Oncotic pressure of plasma.
- E. Concentration of potassium.

194. At dinner a person ate salt herring and potato with a pickled cucumber. Sometime later he felt thirsty. Excitation of what receptors caused this feeling?

- A. Baroreceptors of the arch of aorta.
- B. Volume receptors of vena cava and atria.
- C. Baroreceptors of carotid sinuses.
- D. Volumoreceptors of the hypothalamus.

195. During an experiment a dog under anesthetic was injected with vasopressin. As a result of that the quantity of urine decreased. What influence of vasopressin caused it?

- A. Decrease of the reabsorption of water.
- B. Increase of the reabsorption of sodium.
- C. Increase of the reabsorption of water.
- D. Decrease of the reabsorption of calcium.
- E. Increase of the reabsorption of calcium.

196. Long-lasting vomiting of a 32-year-old patient resulted in fluid loss. The increased secretion of what hormone promotes water preservation in the organism?
- A. Thyroxin.
 - B. Calcitonin.
 - C. Vasopressin.
 - D. Somatostatin.
 - E. Aldosterone.
197. A boy of 10 drank 1.5 L of water at once. The change in secretion of which of the following hormones will result in the increase of the volume of circulatory blood?
- A. Aldosterone.
 - B. Atrial natriuretic factor.
 - C. Vasopressin.
 - D. Corticotropin.
 - E. Renin.
198. The decline of synthesis of vasopressin of a patient was determined, that caused polyuria, the result of which was evident fluid loss. What is the mechanism of polyuria development?
- A. Increase of glomerular filtration.
 - B. Reduction of tubular reabsorption of sodium ions.
 - C. Reduction of the tubular reabsorption of protein.
 - D. Reduction of the reabsorption of glucose.
 - E. Reduction of tubular reabsorption of water.
199. Examination of a 43 y.o. anephric patient revealed anemia symptoms. What is the cause of these symptoms?
- A. Reduced synthesis of erythropoietins
 - B. Enhanced destruction of erythrocytes
 - C. Iron deficit
 - D. Vitamin B₁₂ deficit
 - E. Folic acid deficit
200. Urine analysis has shown high levels of protein and erythrocytes in urine. This can be caused by the following:
- A. Renal filter permeability
 - B. Effective filter pressure
 - C. Hydrostatic blood pressure in glomerular capillaries
 - D. Hydrostatic primary urine pressure in capsule
 - E. Oncotic pressure of blood plasma
201. Due to the use of poor-quality measles vaccine for preventive vaccination, a 1-year-old child has developed an autoimmune renal injury. The urine was found to contain macromolecular proteins. What process of urine formation has been disturbed?

- A. Filtration
- B. Reabsorption
- C. Secretion
- D. Reabsorption and secretion
- E. Secretion and filtration

202. According to the results of glucose tolerance test a patient has no disorder of carbohydrate tolerance. Despite that glucose is detected in the patient's urine (5 mmol/L). The patient has been diagnosed with renal diabetes. What renal changes cause glucosuria in this case?

- A. Decreased activity of glucose reabsorption enzymes
- B. Increased activity of glucose reabsorption enzymes
- C. Exceeded glucose reabsorption threshold
- D. Increased glucose secretion
- E. Increased glucose filtration

203. A patient has insufficient blood supply to the kidneys, which caused the development of pressor effect due to the constriction of arterial resistance vessels. This is the result of the vessels being greatly affected by the following substance:

- A. Angiotensin II
- B. Angiotensinogen
- C. Renin
- D. Catecholamines
- E. Norepinephrine

204. A month after surgical constriction of rabbit's renal artery the considerable increase of systematic arterial pressure was observed. What of the following regulation mechanisms caused the animal's pressure change?

- A. Angiotensin-II
- B. Vasopressin
- C. Adrenaline
- D. Noradrenaline
- E. Serotonin

205. In an experiment on a rabbit the narrowing of kidney arteria resulted in the increase of system arterial pressure. The increase of concentration of what biologically active substance in blood plasma caused hypertension?

- A. Medullin.
- B. Erythropoietin.
- C. Prostaglandins.
- D. Vasopressin.
- E. Rennin.

206. An increase of arteriotony, especially diastolic, of a person suffering from a kidney disease was diagnosed. The concentration of what biologically active substance was increased in the patient's blood?

- A. Noradrenaline.
- B. Adrenaline.
- C. Renin.
- D. Vasopressin.
- E. Catecholamines.

207. After giving blood as a donor, a student felt thirsty. The increased secretion of what biologically active substance stimulated it?

- A. Angiotensin II.
- B. Aldosterone.
- C. Erythropoietin.
- D. Adrenaline.
- E. Noradrenaline.

14. RECOMMENDED LITERATURE

Basic:

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