**Federal State Budgetary Educational Institution of Higher Education**

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Department of Physiology

named after Prof. A.T. Pshonik

**METHODOLOGICAL GUIDELINES**

**FOR STUDENTS # 10**

**for extracurricular (independent) work**

**"Normal physiology"**

**for students in the specialty Specialty 31.05.01 – General medicine**

**FOR PRACTICAL CLASS № 10**

**03.11.2022 - 09.11.2022**

**Topic:**

**“Blood as a means of transport and the internal milieu. BLOOD CELLS, THEIR STORAGE AND FUNCTIONS»**

**LESSON 7**

**.Questions for self-preparation on the topic of practical training.**

1. The concept of the blood system, properties and functions of peripheral blood.

2. The composition of circulating blood, the main physiological constants of blood and the mechanism for their maintenance.

3. Electrolyte composition of blood plasma. Osmotic pressure of blood. Functional blood system that maintains the constancy of the osmotic pressure of the blood.

4. The concept of blood pH, acid-base balance. A functional system that ensures the constancy of acid-base balance.

5. Blood plasma proteins, their characteristics and functional significance. Oncotic blood pressure and its significance.

6. Structure, functions, number of red blood cells.

7. Hemoglobin, its structure, functions, types and compounds. Physiological significance of hemoglobin.

8. Structure, functions, number of leukocytes. regulation of leukopoiesis.

9. Physiological bases of immunity, T- and B-lymphocytes.

10. Structure, functions, platelet count.

11. Functional system for maintaining the constancy of the cellular composition of the blood.

**1. The list of practical skills on the topic.**

### LABORATORY WORK OF STUDENTS

### Practical work №1.

### MASTERING THE TECHNIQUE OF COLLECTING BLOOD FOR ANALYSIS.

Progress of work .Taking blood.

The accuracy and correctness of the results are influenced by the technique of taking blood, ­the instruments used (needles, scarifiers, etc.), the test tubes into which the blood is taken ­, and subsequently stored and transported.

Blood for a clinical blood analysis is taken from a patient from a finger, vein or earlobe, in newborns - from the heel, it is recommended to conduct a blood test in the morning on an empty stomach, before physical activity and various diagnostic procedures, taking medications ­, especially those administered parenterally. Taking the material should be done in rubber gloves, following the rules of asepsis. To take a sample of capillary blood, use ­sterile disposable scarifiers-spears or laser perforators.

Before the puncture, the skin of the patient's finger is treated with a sterile swab moistened with 70 ° alcohol. The skin at the puncture site should be dry, pink and warm, blood should flow freely from the wound. You can not put pressure on the finger, since in this case tissue fluid enters the bloodstream, which significantly distorts the results of the study. After taking blood, a new sterile swab moistened with 70 ° alcohol is applied to the wound surface.

Blood sampling for hematological studies can be carried out in 2 ways:

1. After a finger puncture, a few drops of blood (at least 3-4) are lowered onto an individual ­glass slide (watch) or a plastic tablet socket, mixed and used ­for work.

2. Blood is collected with an individual sterile capillary.

### Practical work №2.

### DETERMINATION OF THE HEMATOCRIT INDICATOR.

Progress of work and interpretation of the results : The determination is carried out in hematocrit, which is a glass capillary divided into 100 equal parts. Blood is collected in hematocrit up to the mark of 100. A capillary filled with blood is placed in a ­centrifuge for 1-2 minutes. Note what part of the ­graduated tube is occupied by erythrocytes, and express it as a percentage (hematocrit).

### Practical work №3.

### DETERMINATION OF THE RATE OF ERYTHROCYTE SEDIMENTATION (ESR).

Progress and interpretation of the results : The capillary from the Panchenkov device is washed in a 5% sodium citrate solution. Then citrate is collected up to the “P” mark of the capillary and blown onto a watch glass or into a crucible. In the same capillary, the test blood is collected twice up to the “K” mark. Both portions of blood are mixed ­on a watch glass or in a crucible with citrate. The mixture is drawn into a capillary up to the “O” mark and the capillary is placed ­in a stand. After 1 hour, measure the height of the column in the capillary in millimeters.

### LABORATORY WORK FOR STUDENTS

### Practical work number 4.

### DETERMINATION OF THE CONCENTRATION OF HEMOGLOBIN IN THE BLOOD USING A PHOTOELECTROCOLORIMER.

Progress of work . Determination of hemoglobin in the blood is traditionally based on the measurement of ­the stained iron porphyrin complex. In this case, different photometric ­methods are used: Drabkin's cyanmethemoglobin method, ammonia method, and others. The principle of these methods is to prepare bioassays from whole blood using transforming ­solutions with their subsequent photometry.

Definition progress . Add 20 ml of blood (Sali capillary, dilution 1:251) to a test tube with 5 ml of the transforming solution. ­The contents of the tube are thoroughly mixed and left for 10 minutes. Measurements are carried out on a spectrophotometer ­at a wavelength of 540 nm or on a photoelectric colorimeter at a wavelength of 520-560 nm (green light filter) in a cuvette with an optical path length of 10 mm against a blank sample (transforming solution.).

This method is implemented in ­the MiniGEM-523 hemoglobinometer, which has a narrow-band ­light filter with a transmission maximum at a wavelength of 523 nm. The methodological accuracy ­of hemoglobin determination on MiniGEM-523 hemoglobinometers (the maximum permissible value of the coefficient of ­total analytical variation) does ­not exceed 1.5% if the concentration of carboxyhemoglobin in the blood does not exceed 10%.

**Abstract** .

It is customary to call blood and lymph the internal environment of the body, since they surround all cells and tissues, ensuring their vital activity. With regard to its origin, blood, like other body fluids, can be considered as sea water that surrounded the simplest organisms, closed inwards and subsequently undergone certain changes and complications. Blood consists of plasma and the formed elements (blood cells) that are in suspension in it. In humans, the formed elements are 42.5+-5% for women and 47.5+-7% for men. This value is called the hematocrit. The blood circulating in the vessels, the organs in which the formation and destruction of its cells, as well as the systems of their regulation, are united by the concept of "blood system". The following main groups of blood functions can be distinguished: Transport functions. The number of transport functions includes such functions as: respiratory, which consists in the transport of oxygen from the lungs to tissues and carbon dioxide from tissues to the lungs; nutritional, which consists in the transfer of nutrients from the digestive organs to the tissues, as well as in their transfer from the depot and to the depot, depending on the need at the moment; excretory (excretory), which consists in the transfer of unnecessary metabolic products (metabolites), as well as excess salts, acid radicals and water to the places of their excretion from the body; regulatory, related to the fact that blood is the medium through which the chemical interaction of individual parts of the body with each other is carried out through hormones and other biologically active substances produced by tissues or organs. The protective functions of blood are related to the fact that blood cells protect the body from infectious-toxic aggression. The following protective functions can be distinguished: phagocytic - blood leukocytes are able to devour (phagocytize) foreign cells and foreign bodies that have entered the body; immune - blood is a place where various kinds of antibodies are located, which are formed in lymphocytes in response to the intake of microorganisms, viruses, toxins and provide acquired and innate immunity; hemostatic (hemostasis - stopping bleeding), which consists in the ability of blood to clot at the site of injury to a blood vessel and thereby prevent fatal bleeding. homeostatic functions. They consist in the participation of blood and the substances and cells in its composition in maintaining the relative constancy of a number of body constants. These include: pH maintenance; maintenance of osmotic pressure; maintaining the temperature of the internal environment. Plasma is a yellowish liquid, and is a very complex biological environment, which includes proteins, various salts, carbohydrates, lipids, metabolic intermediates, hormones, vitamins and dissolved gases. It includes both organic and inorganic substances (up to 9%) and water (91-92%). Blood plasma is in close connection with the tissue fluids of the body. A large amount of metabolic products enters the blood from tissues, but, due to the complex activity of various physiological systems of the body, there are no significant changes in the composition of plasma normally. The active reaction of the blood is determined by the concentration of hydrogen and hydroxide ions in it. Normally, the blood has a slightly alkaline reaction (pH 7.36-7.4). The specific weight of the blood depends mainly on the number of erythrocytes, the hemoglobin contained in them and the protein composition of the plasma. In men, it is 1.057, in women - 1.053, which is explained by the different content of red blood cells. Osmosis is the diffusion of solvent molecules into a solution through a semi-permeable membrane separating them, through which solutes do not pass. Osmosis also occurs if such membrane separates solutions with different concentrations. In this case, the solvent moves through the membrane towards the solution with a higher concentration until these concentrations are equal. The measure of osmotic forces is the osmotic pressure (OD) of 7.6 atm. Blood is a stable suspension of small cells in a liquid (plasma). The property of blood as a stable suspension is violated when the blood passes to a static state, which is accompanied by cell sedimentation and is most clearly manifested by erythrocytes. The noted phenomenon is used to assess the suspension stability of blood in determining the erythrocyte sedimentation rate (ESR). The ESR value depends on the composition of the plasma and increases in inflammatory diseases due to an increase in the amount of coarse blood proteins.

**4. Self-control on test tasks**

1. PARTICIPATION OF BLOOD IN HUMORAL REGULATION CONSISTS

1) in changing the functions of organs and systems under the influence of hormones and biologically active substances carried by the blood\*

2) in the synthesis of hormones

3) in the inactivation of hormones with their excess in the body

4) in the transmission of a nerve impulse

2. BLOOD COMPOSITION

1) 70-80% plasma, 30-20% formed elements

2) 55-60% plasma, 40-45% formed elements\*

3) 40-45% plasma, 55-60% formed elements

4) 60-70% plasma, 40-30% formed elements

5) 50% plasma, 50% formed elements

3. THE TOTAL AMOUNT OF BLOOD IN THE HUMAN BODY NORMALLY IS

1) 4-5% of body weight

2) 6-8% of body weight\*

3) 9-10% of body weight

4) 2-3% of body weight

5) 15% of body weight

4. NORMAL BLOOD PH IS

1) 7.36 - 7.40\*

2) 7.50 - 7.55

3) 7.55 - 7.60

4) 6.55 - 7.25

5) 7.0-7.8

5. EXTREME PH CHANGE LIMITS COMPATIBLE WITH LIFE ARE

1) 7.50 - 7.60

2) 7.35 - 7.40

3) 7.00 - 7.80\*

4) 6.00 - 7.00

5) 6.25-7.25

6. PLASMA ONCOTIC PRESSURE IS CREATED TO A GREAT EXTENT BY

1) albumin\*

2) globulins

3) fibrinogen

4) glucose

5) cholesterol

7. THE INTERNAL ENVIRONMENT OF THE ORGANISM IS CALLED

1) blood and lymph

2) blood, lymph, interstitial fluid\*

3) all body fluids

4) interstitial fluid

8. PLASMOLYSIS IS

1) destruction of erythrocytes in a hypertonic environment

2) shrinkage of cells in a hypertonic environment\*

3) increase in the number of blood cells

4) shift of blood pH to the acidic side

5) a decrease in the volume of erythrocytes in a hypotonic environment

9. NORMALLY BLOOD FREEZING TEMPERATURE IS

1) + 5.0 o C

2) - 6.0 o C

3) -0.56 о С \*

4) + 0.56 o C

5) -3.0 o C

10. BLOOD VISCOSITY EXCEEDS WATER VISCOSITY BY

1) 1.5 times

2) 1-2 times

3) 10 times

4) 3-5 times\*

5) 7-8 times

11. ANTIBODIES ARE BLOOD PLASMA PROTEINS

1) albumins

2) gamma globulins\*

3) fibrinogen

4) alpha - globulins

5) beta - globulins

12. THE VALUE OF THE ONCOTIC PRESSURE OF THE BLOOD PLASMA

1) 120mm Hg

2) 100mm Hg

3) 25 mm Hg\*

4) 4.3mm Hg

5) 50mm Hg

13. BLOOD pH, IF INTRAVENOUSLY INTRODUCED 1L 5% GLUCOSE SOLUTION

1) increase

2) decrease

3) will not change\*

4) first increase, then return to normal

5) first decrease, then return to normal

14. OSMOTIC AND ACID RESISTANCE OF ERYTHROCYTES, IF THE NUMBER OF RETICULOCYTES IN THE BLOOD IS DOUBLED

1) increase\*

2) decrease

3) will not change

4) first increase, then decrease

15. COMPENSATED ACIDOSIS IS

1) pH shift to the alkaline side

2) pH shift to the acid side

3) decrease in alkaline reserve without pH shift\*

4) increase in acidic foods in the blood

5) increase in alkaline reserves

16. DECOMPENSATED ALKALOSIS IS

1) real pH shift towards its increase\*

2) increase in alkaline reserves without pH shift

3) decrease in pH

4) decrease in alkaline reserves without pH shift

5) increase in acidic foods in the blood

17. TRANSPORT FUNCTIONS OF BLOOD ARE

1) respiratory, nutritional, excretory, regulatory\*

2) phagocytic, immune

3) homeostatic, hemostatic

4) respiratory, phagocytic

5) nutritional, immune, hemostatic

18. THE VALUE OF OSMOTIC PRESSURE OF BLOOD PLASMA IS EQUAL

1) 7.2 atm

2) 8.5 atm

3) 7.9 atm

4) 7.1 atm

5) 7.6 atm\*

19. THE MOST POWERFUL BLOOD BUFFER SYSTEM IS

1) hemoglobin \*

2) bicarbonate

3) phosphate

4) protein

5) immune

20. AT REST, THE TOTAL AMOUNT OF BLOOD IN THE BODY IS DISTRIBUTED AS FOLLOWS

1) 1/3 in the blood stream, 2/3 in the blood pool

2) 1/3 in the blood stream, 1/3 in the depot, 1/3 in the intercellular space

3) all in the blood stream

4) 1/3 in the blood poolt, 2/3 in the blood stream\*

5) 50% in the blood pool, 50% in the blood stream

21. TO CALCULATE VOLUME OF BLOOD CIRCULATION BY THE INDICATOR METHOD, DETERMINE

1) the concentration of the injected dye

2) hematocrit

3) hematocrit and dye concentration\*

4) leukocyte formula

22. PERCENTAGE COMPONENTS OF BLOOD PLASMA IS EQUAL

1) dry residue 8-10%, water 90-92%\*

2) dry residue 90-92%, water 8-10%

3) dry residue 18-20%, water 80-82%

4) dry residue 80-82%, water 18-20%

5) dry residue 50%, water 50%

23. ALL ORGANIC SUBSTANCES OF THE DRY RESIDUE OF BLOOD PLASMA ARE DIVIDED INTO

1) organic and inorganic

2) nitrogen-containing and nitrogen-free \*

3) proteins, fats and carbohydrates

4) organic and nitrogen-free

5) lipids and phospholipids

24. BY THEIR NATURE ALL NITROGEN-CONTAINING SUBSTANCES OF THE DRY BLOOD PLASMA RESIDUES ARE DIVIDED INTO

1) protein and non-protein\*

2) organic and inorganic

3) proteins, fats and carbohydrates

4) protein and inorganic

5) phospholipids

25. INORGANIC SUBSTANCES OF DRY RESIDUE OF BLOOD PLASMA ARE:

1) glucose, neutral fats, lipoids

2) uric acid, creatinine, urea

3) sodium, potassium, calcium salts, chlorides, carbonates\*

4) proteins, fats and carbohydrates

5) lipids, phospholipids

26. NITROGEN-FREE SUBSTANCES OF ORGANIC NATURE IN BLOOD PLASMA ARE

1) sodium, calcium, potassium salts

2) glucose, neutral fats, lipoids\*

3) polypeptides, amino acids

4) albumins, globulins, fibrinogen

5) urea, uric acid, creatinine

27. THE SIGNIFICANCE OF PROTEINS AS A BUFFER SYSTEM IS

THAT THEY

1) maintain osmotic pressure

2) prevent an increase in the concentration of hydrogen ions in the blood

3) participate in respiratory function

4) have amphoteric properties\*

5) provide hemostasis

28. IN THE BODY BLOOD PROVIDES

1) nervous regulation

2) humoral regulation\*

3) local regulation

4) reflex regulation

5) paracrine regulation

29. THE PROTECTIVE FUNCTION OF THE BLOOD IS DUE TO THE PRESENCE IN IT

1) antibodies and phagocytic activity of leukocytes\*

2) phospholipids

3) oxyhemoglobin

4) platelets

5) plasma

30. BLOOD PROVIDES ALL CELLS OF THE BODY WITH NUTRIENTS THANKS TO

1) respiratory function

2) trophic function\*

3) thermoregulatory function

4) excretory function

5) hemostatic function

31. BLOOD PLASMA PROTEINS CREATE ...... PRESSURE

1) osmotic

2) hydrostatic

3) hemodynamic

4) oncotic\*

5) filtration

32. OSMOTIC ACTIVITY IMPLIES THE ABILITY

1) hold a certain number of water molecules around \*

2) overcome lipophilic membranes

3) go into a gaseous state

4) destroy red blood cells

5) maintain a constant pH

33. HOMEOSTASIS IS

1) destruction of red blood cells

2) the constancy of the internal environment of the body \*

3) the totality of the body's defenses

4) a combination of blood coagulation factors

5) wrinkling of erythrocytes

34. BLOOD SYSTEM (ACCORDING TO LANG) INCLUDES

1) blood, lymph, blood depot, heart and blood vessels

2) bone marrow, lymphatic system, blood, liver, spleen

3) bone marrow, blood, liver, spleen, veins and arteries

4) peripheral blood, hematopoietic organs, hematopoietic organs, neurohumoral mechanisms of their regulation\*

5) red bone marrow, peripheral blood

35. ESR IN NORMAL IN MEN IS

1) 1-10 mmol/l

2) 1-10 mm/hour\*

3) 1-15mm/hour

4) 11-15mm/hour

5) 40%

36. ESR IN NORMAL IN WOMEN

1) 2-10 mmol/l

2) 1-10mm/hour

3) 2-15 mm /hour\*

4) 15-25mm/hour

5) 15%

37. ESR IN PREGNANT WOMEN IN NORMAL IS

1) 1 mmol/l

2) 60-80mm/hour

3) 2-15mm/hour

4) 40-60 mm/hour\*

5) 40-60%

38. THE MAIN REASON FOR INCREASING ESR

1) increase in blood viscosity

2) an increase in the content of globulins and fibrinogen \*

3) increase in albumin content

4) an increase in the number of red blood cells

5) increase in the number of platelets

39. RECEPTORS OF THE RESULT OF THE FUNCTIONAL SYSTEM OF REGULATION OF OSMOTIC PRESSURE ARE

1) osmoreceptors\*

2) water-salt center

3) kidney receptors

4) hypothalamus

5) Pacini bodies

40. CUMULATION OF OSMORECEPTORS IS LOCALIZED

1) in the walls of the aortic arch and carotid sinus\*

2) in the stomach and duodenum

3) in the skin and mucous membranes

4) in the cornea and iris

41. VIOLATIONS OF THE SUSPENSION PROPERTIES OF BLOOD DURING ITS STORAGE LEADS TO

1) hemolysis

2) plasmolysis

3) sedimentation of blood cells\*

4) pH change

5) change in osmotic pressure

42. BLOOD BUFFER SYSTEMS ARE MORE RESISTANT TO

1) alkalosis

2) acidosis\*

3) hyperthermia

4) hypothermia

43. GAS ACIDOSIS IS ACIDOSIS WHEN ACCUMULATED IN THE BODY

1) phosphoric acid

2) lactic acid

3) pyruvic acid

4) carbon dioxide\*

44. BUFFER SYSTEMS ACTIVATION DURING PH SHIFT OCCUR

1) instantly\*

2) after 2 hours

3) within minutes

4) in a day

45. PROTECTIVE FUNCTION AND PARTICIPATION IN BLOOD COAGULATION AS PLASMA FACTORS IS CHARACTERISTIC FOR

1) albumin

2) globulins\*

3) fibrinogen

4) glucose

46. BLOOD SERUM IS PLASMA WITHOUT

1) albumin

2) globulins

3) fibrinogen **\***

4) glucose

47. THE MOLECULAR WEIGHT OF HUMAN BLOOD PLASMA ALBUMIN IS EQUAL

1) 70 000 DA\*

2) 200 000 DA

3) 400 000 DA

4) 800 000 DA

48. THE MOLECULAR WEIGHT OF GLOBULINS OF HUMAN BLOOD PLASMA IS EQUAL

1) 70 000 DA

2) 200 000 DA

3) up to 450,000 DA\*

4) 800 000 DA

49. AVERAGE MOLECULAR WEIGHT OF HUMAN BLOOD PLASMA FIBRINOGEN IS EQUAL

1) 70 000 DA

2) 200 000 DA

3) 340,000 DA\*

4) 800 000 DA

50. ALBUMIN IS SYNTHESIZED

1) in the liver\*

2) in erythrocytes

3) in the red bone marrow

4) in leukocytes

51. GLOBULINS ARE SYNTHESIZED

1) in erythrocytes

2) in lymphoid and plasma cells\*

3) in the red bone marrow

4) in leukocytes

52. FIBRINOGEN SYNTHESIS IS GOING ON

1) in the liver\*

2) in lymphoid and plasma cells

3) in the red bone marrow

4) in leukocytes

53. BLOOD PLASMA PROTEINS GENERATE ONCOTIC PRESSURE, COMPOSING OF BLOOD OSMOTIC PRESSURE

1) 1/10

2) 1/20

3) 1/200\*

4) 1/2000

54. TO DETERMINE BLOOD OSMOTIC PRESSURE USE

1) cryoscopic method\*

2) microelectrode method

3) electrophoretic method

4) indicator method

55. CONTENT OF PROTEINS IN THE BLOOD PLASMA IN G/L IS

1. 60–80\*
2. 165–185
3. 200–250
4. 300 - 350
5. THE CONTENT OF SODIUM IN BLOOD SERUM IN MMOL/L IS
   1. 100-120
   2. 120-140
   3. 170-200
   4. 150-170
   5. 130-150\*

57. POTASSIUM CONTENT IN MMOL/L IN BLOOD SERUM IS

1) 3.3-5.5\*

2) 7.7-8.5

3) 2.1-3.0

4) 5.5-7.0

58. THE CONTENT OF TOTAL CALCIUM IN MMOL/L IN THE BLOOD SERUM ­IS

1) 1.0-2.1

1. 2.25-2.78\*
2. 2.78-3.78
3. 4.1-4.8

59. THE CONTENT OF ALBUMIN IN G/L IN THE BLOOD SERUM IS:

* 1. 10-20
  2. 20-30
  3. 35-50\*
  4. 50-60

60. THE CONTENT OF GLUCOSE IN MMOL/L IN THE BLOOD SERUM IS

* 1. 2-3
  2. 5.5-7.5
  3. 7.5-8.5
  4. 3.3-5.5\*

61. Hematocrit is the percentage of:

1. amount of hemoglobin to blood volume
2. the volume of formed elements (more precisely, erythrocytes) to the volume of blood \*
3. plasma volume to blood volume
4. percentage of blood cells
5. number of leukocytes to blood volume

62. In case of hypoproteinemia there will be observed:

1. tissue edema with accumulation of water in the intercellular space\*
2. cellular edema
3. both equally
4. proteinuria
5. increased blood pressure

63. IN CASE OF Hyperproteinemia will be observed:

1. tissue edema with accumulation of water in the intercellular space
2. cellular edema
3. both equally
4. increased blood volume (hypervolemia)\*
5. lowering blood pressure

**64.** Oncotic blood pressure plays a MAIN role:

1. in the transport of proteins between blood and tissues
2. in the transport of water between blood and tissues (maintenance of circulating blood volume) \*
3. in maintaining blood pH
4. in hydrostatic pressure change
5. in the transport of oxygen in the blood

65. Most of the osmotic pressure of blood plasma is created by ions OF:

1. sodium and chlorine\*
2. potassium and calcium
3. bicarbonate and phosphate
4. magnesium
5. hydrogen

**66.** When administered intravenously, WhICH solution will not change the osmotic pressure of blood plasma:

1. glucose 40%
2. sodium chloride 0.2%
3. calcium chloride 20%
4. sodium chloride 0.9%\*
5. calcium chloride 3%

**67.** Calcium ions are not involved as a leading factor in:

1. creation of osmotic blood pressure\*
2. blood clotting
3. regulation of neuromuscular excitation
4. bone formation
5. no correct answer

68. Isotonic blood solution of sodium chloride

1. 0.3%
2. 0.9%\*
3. 1.2%
4. 3%
5. 9%

69. The destruction of the erythrocyte membrane and the release of hemoglobin into the plasma under the influence of various factors is called:

1. plasmolysis
2. fibrinolysis
3. hemostasis
4. hemolysis\*
5. lysis

70. Two organs have the greatest importance in regulating the constancy of blood pH:

1. lungs and kidneys\*
2. heart and liver
3. stomach and intestines
4. bones and muscles
5. mucous membranes and skin

**7** 1 **.** Increase in blood viscosity:

1. reduces resistance to blood flow
2. increases resistance to blood flow\*
3. does not affect blood flow resistance
4. causes hydremia
5. lowers the concentration of proteins

**5. Self-control on situational problems on the topic with answers** .

**1.** 5 ml of a 5% solution of colloidal dye was injected into the animal's blood. After 5 minutes, blood was taken from a vein, the concentration of dye in the plasma of which was 0.02%.

1. What is the volume of circulating blood (CBV) in the body if the hematocrit is 45%?

2. What is the total amount of blood in the human body normally?

3. How is the total amount of blood distributed in the body at rest?

4. What is the blood system according to G. Lang?

5. What is the normal osmotic pressure of blood and what method is it determined by?

**Sample answers:**

1. The concentration of dye in the blood decreased by 250 times. Consequently, there was 250 times more plasma than the ink injected, i.e. 1250 ml. Since the hematocrit is 45%, this means that 1250 ml of plasma is 55% of the total circulating blood volume. From here it is easy to determine that the amount of blood in the body is 2270 ml.

2. 6-8% of body weight

3. 1/3 in the depot, 2/3 in the bloodstream

4. The blood system includes hematopoietic organs, peripheral blood, blood-destroying organs and neurohumoral mechanisms of their regulation

5. Normally, the osmotic blood pressure is 7.6 atm, determined by the cryoscopic method.

**2** . Here in front of you is the composition of two solutions.

|  |  |  |
| --- | --- | --- |
|  | solution A | solution B |
| NaCl | 0.05% | 0.7% |
| KCl | 0.02% | 0.02% |
| CaCl2 | 0.02% | 0.02% |
| NaHCO3 | 0.1% | 0.2% |
| NaH2CO3 | 0.02 % | 0.005 % |
| MgCl 2 | 0.01% | 0.01% |
| Glucose | 0.1% | 0.1% |

1. Which of them can be used for intravenous administration to a person as a blood substitute and why?

2. What groups are all organic substances of blood plasma divided into?

3. How much protein is normal in a liter of blood?

4. What are the functions of blood plasma proteins?

5. How does the ESR change with an increase in the amount of globulins and fibrinogen in the blood plasma, when do these changes occur?

**Sample answers:**

1. Solution B, because it satisfies the requirements of isotonicity and isoionicity. Solution A is hypotonic.

2. Nitrogen-containing and nitrogen-free

3.60-80g/l

4. Transport and plastic (they are carriers of biologically active substances, hormones, metabolites, etc., provide the processes of repair, growth and development of various cells of the body) and protective function (homeostatic: they regulate blood pH, provide oncotic pressure; hemostatic: they are factors of coagulation and anticoagulation systems provide humoral immunity).

5. ESR increases - in inflammatory processes, oncological diseases.

1. When placed in a salt(NaCl) solution, erythrocytes acquired

spherical look.

1. What is the name of this process? What is the approximate concentration of salts in this solution?
2. What happens to red blood cells in 0.4% sodium chloride solution?
3. Under what conditions is erythrocyte shrinkage observed and what is it called?
4. What causes oncotic pressure, what is its value?
5. What phenomena will be accompanied by the loss of proteins in the urine in kidney disease?

**Sample answers:**

1. Spherulation of erythrocytes. The salt concentration is less than 0.9% but more than 0.5%.

2. Osmotic hemolysis.

3. In a hypertonic environment, plasmolysis.

4. Oncotic pressure is created by blood plasma proteins, its value is 25-30 mm Hg. Art.

5. Proteinuria, hypoproteinemia, visible edema.

**4. T**he dog was injected intravenously with 1 liter of 5% glucose solution.

1. How will blood pH change?

2. What are the extreme limits of pH change compatible with life?

3. What is compensated acidosis?

4. What buffer systems of the blood provide pH constancy?

5. What organs are the executors of the functional system that ensures the constancy of blood pH?

**Sample answers:**

1. In this case, the pH of the blood will not change, since the ratio of acidic and alkaline substances in the plasma remains the same.

2.7.0-7.8

3. Decreased alkaline reserve without pH shift

4. Hemoglobin, protein, bicarbonate, phosphate.

5. Kidneys, lungs, gastrointestinal tract, skin.

**5.** When analyzing the blood of two children aged 1.5 and 8 years, it was found that one of them had a protein content in the blood plasma of 74 g/l, and the other 60 g/l.

1. Which of the indicators belongs to the oldest child?

2. At what age is the blood viscosity of a child 10-15 units?

3. How much glucose is in the blood of newborns?

4. What is the total amount of blood in an infant?

5. At what age is the hematocrit lowest?

**Sample answers:**

1. Older is the child whose protein is 74 g / l. In children under 3-4 years of age, the total amount of plasma proteins is low.

2. In the first days of life.

3. 1.6-2.7 mmol/l

4. 9% - 13%

5. In children 3-4 months of age (35-37%)

1. **Self-control on test tasks of the topic "** Blood cells, their structure and functions **".**

1. THE NUMBER OF ERYTHROCYTES PER LITRE OF BLOOD IS:

1) 4.5 - 5.0 \* 10 12 / l in men; 4.0 – 4.5 \*10 12 /l in women\*

2) 5.0 - 6.5 \* 10 12 / l in men; 3.0 - 4.5 \* 10 12 / l in women

3) 4.0 - 4.5 \* 10 12 / l for men; 4.5 - 5.0 \* 10 12 / l in women

4) 3.5 - 4.5 \* 10 12 / l for men; 4.5 - 5.0 \* 10 12 / l in women

2. ABSOLUTE ERYTHROCYTOSIS IS OBSERVED

1) with thickening of the blood (burns, sweating, cholera, etc.)

2) with blood thinning

3) with increased destruction of red blood cells or after blood loss

4) among the inhabitants of the highlands \*

3. AN ADULTS HAVE HEMOGLOBIN IN ERYTHROCYTES

1) F

2) A\*

3) P

4) E

4. NORMAL COLOR INDICATOR IS EQUAL

1) 0.8 - 1.0\*

2) 0.6 - 0.8

3) 1.0 - 1.2

4) 1.2 -2.0

5. HEMOGLOBIN IS PRODUCED

1) in the liver

2) in the spleen

3) in the red bone marrow\*

4) in the lymph nodes

6. PATHOLOGICAL COMPOUND OF HEMOGLOBIN IS

1) oxyhemoglobin

2) deoxyhemoglobin

3) carboxyhemoglobin\*

4) carbhemoglobin

7. FUNCTIONS SIMILAR TO HEMOGLOBIN IN MUSCLES PERFORMED

1) myoglobin\*

2) oxyhemoglobin

3) deoxyhemoglobin

4) carbohemoglobin

5) methemoglobin

8. HEMOLYSIS IS CALLED

1) changing the shape of blood cells

2) destruction of the erythrocyte membrane, accompanied by the release of hemoglobin into the blood plasma \*

3) wrinkling of erythrocytes in a hypertonic environment

4) fibrin dissolution

5) increase in the number of red blood cells

9. OSMOTIC HEMOLYSIS OF ERYTHROCYTES IS OCCURRED

1) under the influence of substances that violate the protein-lipid membrane of erythrocytes (ether, chloroform, benzene, and other organic solvents)

2) under strong mechanical stress

3) with a decrease in the osmotic pressure of blood plasma \*

4) when freezing or thawing

5) under the influence of immune hemolysins

10. Leukopenia is:

1. decrease in the number of leukocytes below 4.0 x 10 9 / l \*
2. an increase in the number of leukocytes above 9.0 x 10 9 /l
3. the content of leukocytes in the range of 4.0 - 9.0 x 10 9 /l
4. absence of a nuclear shift to the left in the neutrophilic series
5. a pronounced increase in the blood of young forms of leukocytes

11. NORMAL LEUKOCITES IN A HUMAN PER LITRE OF BLOOD CONTAIN

1) 4.0 - 9.0 \*10 9 \*

2) 3.5 - 4.0 \*10 12

3) 1.5 - 3.0 \*10 9

4) 9.0 - 12.0 \* 10 9 l

12. IN THE RED BONE MARROW

1) erythrocytes

2) erythrocytes, leukocytes, platelets\*

3) Leukocytes

4) proteins

5) phospholipids

13. T-DEPENDENT LYMPHOCYTES

1) form humoral immunity

2) provide non-specific protection

3) carry out reactions of cellular immunity \*

4) provide chemotaxis

5) block non-specific defense mechanisms

14. B-DEPENDENT LYMPHOCYTES

1) form humoral immunity\*

2) provide non-specific protection

3) carry out reactions of cellular immunity

4) provide chemotaxis

5) block non-specific defense mechanisms

15. REACTIVE (TRUE) LEUKOCYTOSIS OCCURRS

1) after eating

2) after hard physical work

3) in inflammatory processes\*

4) with emotional stress

5) during pregnancy

16. IMMUNITY IS

1) a way to protect the body from germs

2) a way to protect the body from parasites and genetically alien cells

3) a way to protect the body from microbes, viruses, parasites and genetically alien cells and substances \*

4) ensuring homeostasis

5) the ability of blood to clot

17. SPECIFIC DEFENSE MECHANISMS OF THE ORGANISM ARE

1) skin and mucous membranes

2) blood proteins: gamma globulins, interferon, lysozyme

3) phagocytosis

4) formation of antibodies or immunoglobulins\*

5) mechanisms of hemostasis

18. NON-SPECIFIC PROTECTION MECHANISMS ARE

1) mechanisms of hemostasis

2) antianemic factors and erythropoietins

3) phagocytosis\*

4) the formation of antibodies or immunoglobulins

19. IN THE ANALYSIS OF BLOOD CHANGES FOR THE CLINICIST

MORE IMPORTANT

1) an increase in the number of leukocytes

2) change in relationships in the leukocyte formula \*

3) decrease in the number of leukocytes

4) decrease in ESR

20. WHAT STIMULATES THE PRODUCTION OF RED BLOOD CELLS

1) leukopoetins

2) erythropoietins\*

3) lymphopoietins

4) thrombopoietins

21. WHAT STIMULATES THE PRODUCTION OF WHITE BLOOD CELLS

1) leukopoetin\*

2) erythropoietins

3) lymphopoietins

4) thromboetins

22. DIAMETER OF ERYTHROCYTES IN A HUMAN IS EQUAL

1) 50 microns

2) 20 microns

3) 9-10 microns\*

4) 7-8 microns

23. MONOCYTES IN THE LEUKOCYTE FORMULA NORMALLY CONTAIN

1) 30%

2) 10-15%

3) 50-60%

4) 2-4%

5) 4-8%\*

24. THE MAIN BLOOD PHAGOCYTES ARE

1) eosinophils

2) neutrophils\*

3) platelets

4) erythrocytes

5) lymphocytes

25. WHAT PRODUCES ANTIBODIES

1) eosinophils

2) neutrophils

3) monocytes

4) basophils

5) lymphocytes\*

26. The function of eosinophils is to

1. transport of carbon dioxide and oxygen
2. maintaining osmotic pressure
3. antibody production
4. detoxification for allergic reactions\*
5. phagocytosis and destruction of microbes and cell debris

27. WHAT PRODUCES HEPARIN

1) platelets

2) eosinophils

3) neutrophils

4) erythrocytes

5) basophils\*

28. NORMAL VOLUME OF PLATELETS PER LITRE OF BLOOD

1) 2-3 \*10 11 \*

2) 1-2 \*10 11

3) 3-5 \*10 11

4) 5 -6\*10 11

5) 3-5\* 109

29. NORMALLY, A LITTER OF BLOOD OF A HEALTHY MAN CONTAINS THIS VOLUME OF HEMOGLOBIN

1) 180 g

2) 130-160 g\*

3) 120-130g

4) 90 -100 g

30. THE LIFESPAN OF ERYTHROCYTES IN THE BLOOD IS

1) 50-80 days

2) 100-120 days\*

3) 130-150 days

4) 6-7 years old

5) 8-11 days

31.THE LIFESPAN OF GRANULAR LEUKOCYTES IN THE CIRCULATING BLOOD IS

1) 100-120 days

2) 50-100 days

3) 15-30 days

4) several years

5) several hours\*

32. THE LIFESPAN OF PLATELETS IN THE BLOOD IS

1) 1 day

2) 100-120 days

3) up to 5 days

4) 10-15 days

5) 8-11 days\*

33. WHAT VOLUME OF OXYGEN DOES ONE GRAM OF HEMOGLOBIN BIND?

1) 0.136 ml

2) 8.3-9.1 ml

3) 2.00 ml

4) 5.00 ml

5) 1.34-1.36 ml\*

34. WHAT DIRECTS DIFFERENTIATION OF BONE MARROW CELLS TOWARDS ERYTHROCYTES

1) vitamin B12

2) erythropoietin \*

3) gastromucoprotein

4) glucagon

35. Erythropoietin is formed mainly in two organs:

1. in red bone marrow and lymph nodes
2. in the juxtaglomerular apparatus of the kidneys and in the liver\*
3. in the spleen and intestines
4. in the stomach and pancreas
5. in the heart and blood vessels

36. INTERNAL FACTOR CASTLE (GASTROMUCOPROTEID) IS REQUIRED

1) for the absorption of vitamin B 12 in the intestines \*

2) to protect vitamin B 12 from destruction in the stomach HCL

3) for the absorption of proteins

4) for protein synthesis

5) for the absorption of iron

37. STAB NEUTROPHILS IN THE LEUKOCYTE FORMULA NORMALLY CONTAIN

1) 1-2%

2) 3-5%\*

3) 5-10%

4) 20 -25%

38. LEUKOCYTE FORMULA NORMALLY CONTAINS LYMPHOCYTES

1) 15-20%

2) 10-15%

3) 45 - 60%

4) 1 -2%

5) 20-40%\*

39. AFTER EATING THE LEUKOCYTE VOLUME IN THE BLOOD

1) increase\*

2) decrease

3) will not change

40. THE CONTENT OF NEUTROPHILS TO ALL LEUKOCYTES IN THE BLOOD OF A HEALTHY PERSON IS

1) 40 - 65%

2) 47 - 72%\*

3) 5 - 10%

4) 10 - 20%

5) 20-40%

41. THE CONTENT OF EOSINOPHILES TO ALL LEUKOCYTES IN THE BLOOD OF A HEALTHY PERSON IS

1) 10 - 12%

2) 25 - 30%

3) 40 - 45%

4) 60-65%

5) 1 - 5%\*

42. LEUKOCITES PERFORM THE FOLLOWING FUNCTIONS

1) transport of carbon dioxide and oxygen

2) maintenance of oncotic pressure of blood plasma

3) protective\*

4) hemostasis

5) ensure the constancy of blood pH

43. The main function of neutrophils is:

1. synthesis and secretion of heparin, histamine, serotonin
2. phagocytosis of microbes, toxins, production of cytokines\*
3. phagocytosis of mast cell granules, destruction of histamine by histaminase
4. participation in the regulation of the aggregate state of the blood
5. participation in the regulation of vascular tone

44. THE FUNCTION OF LYMPHOCYTES INCLUDES IN

1) phagocytosis and ensuring the reparative stage of the inflammatory process

2) bactericidal action

3) participation in maintaining the pH

4) recognition of antigens and production of immunoglobulins \*

45. THE PERCENTAGE RATIO OF INDIVIDUAL FORMS OF LEUKOCYTES IS CALLED

1) color indicator

2) leukocyte formula\*

3) hematocrit

4) the formula for determining the number of leukocytes

5) leukocyte profile

46. INCREASED CONTENT OF LEUKOCITES IN PERIPHERAL BLOOD IS CALLED

1) leukopoiesis

2) leukopenia

3) leukocytosis\*

4) thrombocytosis

5) leukocyte formula

47. LYMPHOCYTES PLAY AN IMPORTANT ROLE IN PROCESSES

1) blood clotting

2) hemolysis

3) fibrinolysis

4) immunity\*

5) leukopoiesis

48. AGRANULAR LEUKOCITES CAPABLE OF AMEBOID MOVEMENT AND PHAGOCYTOSIS ARE CALLED

1) eosinophils

2) monocytes\*

3) platelets

4) lymphocytes

5) basophils

49. GRANULAR LEUKOCITES THAT HAVE PHAGOCYTIC ACTIVITY AND THE PROPERTY TO BIND TOXINS ARE CALLED

1) neutrophils\*

2) monocytes

3) lymphocytes

4) erythrocytes

5) platelets

50. FOR COUNTING ERYTHROCYTES IN GORIAEV'S COUNTING CHAMBER, BLOOD IS DILUTED WITH

1) 0.1 N hydrochloric acid solution

2) distilled water

3) 5% solution of acetic acid with methylene blue

4) 3% sodium chloride solution\*

5) 5% hemoglobincyanide solution

51. FOR COUNTING LEUCOCYTES IN GORIAEV'S COUNTING CHAMBER, BLOOD IS DILUTED WITH

1) 5% acetic acid solution with methylene blue\*

2) 0.9% sodium chloride solution

3) 0.1 N hydrochloric acid solution

4) distilled water

5) 5% hemoglobincyanide solution

52. TO DETERMINE ESR USE

1) saline

2) 5% hemoglobincyanide solution

3) 5% glucose solution

4) 0.1 N hydrochloric acid

5) 5% sodium citrate solution\*

53. OXYHEMOGLOBIN IS

1) connection of red blood cells with oxygen

2) restored hemoglobin

3) connection of hemoglobin with oxygen \*

4) hemoglobin, oxidized carbonic acid oh

5) fetal hemoglobin

54. CARBHEMOGLOBIN IS

1) connection of hemoglobin with hydrochloric acid

2) connection of hemoglobin with carbon dioxide \*

3) connection of hemoglobin with oxygen

4) connection of hemoglobin with carbon monoxide

5) the combination of hemoglobin with atomic oxygen

55. CARBOXYHEMOGLOBIN IS

1) the combination of hemoglobin with carbon dioxide

2) connection of hemoglobin with carbon dioxide \*

3) connection of hemoglobin with oxygen

4) connection of hemoglobin with carbon monoxide

5) the combination of hemoglobin with atomic oxygen

56. METHEMOGLOBIN IS

1) the combination of hemoglobin with carbon dioxide

2) the combination of hemoglobin with carbon dioxide

3) oxidized hemoglobin, in which iron is trivalent \*

4) connection of hemoglobin with methionine

57. COLOR INDICATOR THIS

1) the ratio of the number of red blood cells to hemoglobin

2) percentage of saturation of hemoglobin with oxygen

3) the ratio of young and mature neutrophils

4) relative saturation of erythrocytes with hemoglobin \*

58. ANEMIA IS:

1) reduced content of red blood cells

2) reduced content of erythrocytes and hemoglobin \*

3) low platelet count

4) decrease in the volume of circulating blood

5) increase in the number of red blood cells and hemoglobin

60. MACROPHAGES ARE

1) eosinophils

2) neutrophils

3) lymphocytes

4) basophils

5) monocytes\*

61. MICROPHAGES IS

1) neutrophils\*

2) lymphocytes

3) platelets

4) monocytes

5) erythrocytes

62. NEUTROPHIL LIFESPAN

1) 8-11 days

2) from several hours to several days\*

3) 120 days

4) 2-3 months

5) more than 20 years

63. LIFESPAN OF LYMPHOCYTES

1) 5-11 days

2) several hours

3) more than 20 years\*

4) 2-3 months

5) 120 days

64. ERYTHROCYTE HAS A SHAPE OF

1) spherical

2) biconvex disc

3) biconcave disc\*

4) ellipsoid

65. NORMAL FORM ERYTHROCYTE IS CALLED

1) spherocyte

2) discocyte\*

3) agranulocyte

4) ovalocyte

66. PATIENT STUDY REVEALED THAT THE AVERAGE DIAMETER OF ERYTHROCYTES

IS 5.3 MKM. THIS IS

1) microcytosis\*

2) normocytosis

3) macrocytosis

4) ovalocytosis

67. DEPENDING ON THE DAILY CYCLE, THE CONTENT OF ERYTHROCYTES IN THE BLOOD IS

1) does not change

2) more at night than during the day

3) more during the day than at night \*

4) sharply decreases after eating

68. VALENCE OF IRON IN METHEMOGLOBIN IS

1) 1

2) 2

3) 3\*

4) 4

69. NORMAL CONTAINS IN PERIPHERAL BLOOD

1) reticulocytes and erythrocytes\*

2) only erythrocytes

3) only reticulocytes

4) ovalocytes

70. PERIPHERAL BLOOD OF ADULT PERSONS NORMALLY CONTAINS \_\_\_\_ OF RETICULOCITES:

1) 1 - 4%

2) 0-1%\*

3) 5-15%

4) 1-5%

71. RHYTHROCYTES ARE DESTROYED PREDOMINATELY BY

1) intravascular hemolysis

2) hemolysis in the cells of the reticuloendothelial system\*

3) fragmentosis

4) plasmolysis

72. DESTRUCTION OF RHYTHROCYTES HAPPENS

1) in the liver, spleen\*

2) in the myocardium, thymus

3) in the red bone marrow

4) in the submucosa of the small intestine

73. PROTEIN COMPONENT OF HEMOGLOBIN, APPEARING DURING ERYTHRODIERESIS,

1) hydrolyzed to amino acids for energy and plastic purposes\*

2) hydrolyzed to oligomers and excreted in the urine

3) reused for erythropoiesis

4) is excreted in the urine unchanged

74. BILIRUBIN CONJUGATES IN THE LUMEN OF THE INTESTINE

1) 100% absorbed

2) 100% output

3) excreted with feces and partially absorbed \*

4) are cleaved by lipase

75. T-LYMPHOCYTES DIFFERENTIATE

1) in the thymus\*

2) in accumulations of lymphoid tissue

3) in the liver

4) in the red bone marrow

76. B - LYMPHOCYTES DIFFERENTIATE

1) in the thymus

2) in accumulations of lymphoid tissue\*

3) in the liver

4) in the red bone marrow

77. INCREASE IN THE PERCENTAGE OF YOUNG FORMS OF LEUKOCYTES IS CALLED

1) shift of the leukocyte formula to the left \*

2) leukopenia

3) agranulocytosis

4) shift of the leukocyte formula to the right

5) leukocytosis

78. IN THE HUMAN BODY, HOW MANY ERYTHROCYTES ARE DESTROYED IN 1 SECOND ON AVERAGE

1) units

2) hundreds

3) thousands

4) tens of thousands

5) hundreds of thousands\*

79. RECEIVING RECEPTORS OF THE FUNCTIONAL SYSTEM PROVIDING CONSTANT BLOOD ERYTHROCYTES ARE LOCATED

1) in the aortic arch and carotid sinus zone\*

2) in the pulmonary alveoli

3) in the mucous membrane of the airways

4) in skeletal muscles

80. THE RECEIVING LINK OF THE FUNCTIONAL SYSTEM OF MAINTAINING A CONSTANT NUMBER OF BLOOD ERYTHROCYTES IS PRESENTED

1) specific chemoreceptors\*

2) thermoreceptors

3) mechanoreceptors

4) osmoreceptors

5) nociceptors

81. NERVE CENTERS REGULATED HEMATOPOISES ARE LOCATED

1) in the medulla oblongata

2) in the hypothalamus\*

3) in the spinal cord

4) in the basal ganglia

5) in the cerebellum

82. The main function of hemoglobin is to

1. transport of oxygen from lungs to tissues\*
2. creation of oncotic blood pressure
3. providing blood viscosity
4. transport of carbon dioxide from tissues to lungs
5. maintaining osmotic pressure

**83.** The greatest affinity for oxygen has

1. fetal hemoglobin (HbF)\*
2. adult hemoglobin (HbA)
3. carboxyhemoglobin
4. carbhemoglobin

84. Iron in erythropoiesis is necessary for

1. heme synthesis\*
2. globin synthesis
3. folic acid activation
4. absorption of vitamin B 12
5. absorption of vitamin C

**85.** The daily need for iron is mostly replenished

1. absorption of iron in the intestine
2. use of iron from decayed red blood cells\*
3. equally by both processes
4. mobilization of iron from the liver

**86.** Iron in the body is deposited mainly

1. in the liver, spleen, bone marrow, intestinal mucosa\*
2. in the brain, heart, kidneys
3. in the bones
4. in the muscles
5. in the skin

87. The main specific mediator through which nervous and endocrine influences on erythropoiesis are carried out is

1. intrinsic hematopoietic factor (gastromucoprotein)
2. vitamin B 12
3. erythropoietin\*
4. folic acid
5. a nicotinic acid

**88.** Hormones that inhibit erythropoiesis are

1. estrogen\*
2. androgens
3. thyroxine
4. glucocorticoids
5. mineralocorticoids

**89.** Hormones that stimulate erythropoiesis are

1. thyroxine, androgens, glucocorticoids, adrenaline\*
2. female sex hormones
3. antidiuretic hormone
4. glucocorticoids
5. LG

90. *Not* typical for eosinophils

1. antiparasitic action
2. formation of immunoglobulins\*
3. inactivation of heparin, leukotrienes, anaphylaxis factor
4. accumulation in tissues in contact with the external environment
5. inhibition of basophil function

**91.** Granular leukocytes with antiparasitic and antiallergic activity are called

1. neutrophils
2. monocytes
3. lymphocytes
4. eosinophils\*
5. agranulocytes

**92.** The main functions of basophilic leukocytES are

1. phagocytosis of microbes
2. neutralization and destruction of protein toxins, inhibition of mast cell degranulation, destruction of histamine by histaminase
3. production of heparin, histamine, thromboxane, leukotrienes\*
4. implementation of immune responses
5. destruction of microbes and cellular debris

93. Plasma B cells that form immunoglobulins are converted into

1. T-lymphocytes
2. B-lymphocytes\*
3. neutrophils
4. basophils
5. monocytes

94. main immunological function of monocytes

1. phagocytosis of microbes
2. capture, processing and presentation of antigens on its surface to other immunocompetent cells, the formation of interleukin-1, which stimulates T- and B-lymphocytes \*
3. direct formation of immunoglobulins
4. inhibition of basophil function

95. Leukopoiesis *is not* stimulated BY

1. leukopoetins
2. ionizing radiation in high doses\*
3. breakdown products of tissues and leukocytes
4. interleukins
5. colony stimulating factors

**Questions for self-control:**

1. What is leukocytosis?

2. What leukocytes are granulocytes?

3. Write the formula for counting leukocytes in the Goryaev chamber.

4. How does the lack of oxygen in the body affect erythropoiesis?

5. What is microcytosis?

6. What is a leukocyte formula?

7. What are the functions of eosinophils?

8. List the phases of the erythrocyte life cycle..

9. What is the valency of iron in methemoglobin?

10. What hemoglobin compounds do you know?

11. What leukocytes are called macrophages?

12. What is leukopenia?

13. What is hyperchromia? In what cases is it observed?

14. What types of hemoglobin do you know?

15. What is called the internal factor of hematopoiesis?

16. What is the main function of neutrophils?

17. How many basophils are normally found in peripheral blood?

18. What is the normal number of red blood cells in men?

19. What are the normal size of an erythrocyte? What is this erythrocyte called?

20. What erythrocytes are called macrocytes?

21. What groups are lymphocytes divided into?

22. In what cases do true leukocytosis develop?

23. What is a color index?

24. What is the average hemoglobin content in women?

25. What leukocytes are called microphages?

26. What functions do basophils perform?

27. What forms of T-lymphocytes do you know?

28. How do erythrocyte decay products affect erythropoiesis?

29. What changes are observed in the blood system during inflammatory processes?

30. Why do men have more red blood cells and hemoglobin than women?

31. What methods determine the concentration of hemoglobin in peripheral blood?

32. What is called an external factor of hematopoiesis?

33. In what ways is the destruction of erythrocytes?

34. The main function of leukocytes.

35. How many lymphocytes are there in the blood?

36. What erythrocytes are called normochromic?

37. What is erythrocytosis?

38. What bile pigment does hemoglobin turn into when erythrocytes are destroyed and after what process?

39. What types of physiological leukocytosis do you know?

40. What is the shift of the leukocyte formula to the left?

41. Under what influence on the blood is methemoglobin formed?

42. What is the function of lymphocytes?

43. List the characteristic signs of redistributive leukocytosis?

44. In what medium do monocytes show maximum phagocytic activity?

45. What is erythropenia?

46. What groups are lymphocytes divided into?

47. In what cases is absolute erythropenia observed?

48. Write the permissible fluctuations in the amount of hemoglobin in men.

49. What is erythrocytosis?

50. What method can be used to differentiate hemoglobin compounds?

51. Why are young erythrocytes called reticulocytes?

52. The main function of monocytes.

53. What is relative erythrocytosis? In what cases is it observed?

54. What specific erythropoiesis stimulators do you know?

55. How long does an erythrocyte live?

56. Where does erythropoiesis occur and what cells are immature forms?

57. How many eosinophils are there in peripheral blood (by leukocyte formula)?

58. Under what conditions of the body does the number of zosinophils increase in the peripheral blood?

59. How many bacteria can one neutrophil phagocytose?

60. How many leukocytes are normally found in peripheral blood?

61. What is erythrodiarrhesis?

**Answers to questions for self-control:**

1. An increase in the number of leukocytes.
2. Neutrophils, basophils, eosinophils.
3. X= Ax4000x20

400

1. Stimulates.
2. Reducing the diameter of erythrocytes (<7 microns).
3. The percentage of individual forms of leukocytes.
4. Neutralization and destruction of toxins of protein origin, antigen-antibody complexes, carry out phagocytosis, produce histaminase, participate in the process of fibrinolysis.
5. Erythropoiesis, circulation in the vascular bed, erythrodieresis.
6. 3
7. Oxyhemoglobin, methemoglobin, carboxyhemoglobin, carboxyhemoglobin, reduced hemoglobin.
8. Monocytes.
9. Reducing the number of leukocytes.
10. An increase in the color index, with a lack of vitamin B 12 .
11. HbP (primitive), HbF (fetal), HbA (adult).
12. Gastromucoprotein produced by the glands of the pyloric part of the stomach.
13. Phagocytosis.
14. 0-1%
15. 4.5 - 5.5x10 12 / l of erythrocytes per liter.
16. 7-8 microns. Normocyte.
17. Monocytes.
18. T-lymphocytes, B-lymphocytes, null.
19. In inflammatory processes and infectious diseases.
20. An indicator of the degree of saturation of erythrocytes with hemoglobin.
21. 7.0-7.4 mmol/l (125-130 g/l).
22. Neutrophils.
23. Protective (phagocytosis and production of biologically active substances of a protective nature), transport, production of heparin and histamine.
24. T-helpers, suppressors, killers, immune memory cells and amplifier cells.
25. Stimulates.
26. Increased ESR and leukocytosis.
27. Male sex hormones stimulate erythropoiesis.
28. Saly method, electrophotocalorimetric method.
29. Vitamin B 12 .
30. Fragmentosis, phagocytosis, hemolysis.
31. Phagocytosis.
32. 20-40%
33. Erythrocytes having a color index of 0.8-1.
34. An increase in the number of red blood cells.
35. In bilirubin, after heme cleavage.
36. Digestive, myogenic, emotional, with pain effects.
37. Percentage increase in young granulocytes, up to the appearance of myelocytes.
38. Under the action of strong oxidizing agents (KMnO 4 , Bertolet salt).
39. Production of immune bodies, transport.
40. A slight increase in the number of leukocytes, no changes in the leukocyte formula. Short duration.
41. in an acidic environment.
42. Decrease in the number of red blood cells in the peripheral blood.
43. T-lymphocytes, B-lymphocytes, null.
44. Due to reduced formation, increased destruction of red blood cells or after blood loss.
45. 130-160 g/l.
46. An increase in the number of red blood cells.
47. Spectral analysis method.
48. They contain the remains of a nuclear substance, which, when specially dyed, has the appearance of a mesh.
49. Phagocytosis.
50. An increase in the number of erythrocytes per unit volume of blood without an increase in their total number in the body is observed with thickening of the blood (with profuse sweating, burns, cholera, desentery) and heavy muscle work (due to the release of erythrocytes from the splenic blood depot).
51. Erythropoietins.
52. 120 days.
53. In the red bone marrow, reticulocytes.
54. 3-5%.
55. In allergic conditions, helminthic invasion and antibiotic therapy.
56. 20-30.
57. 4-8x10 9 / l of leukocytes per liter.
58. **Self-control on situational tasks on the topic "** Blood cells, their structure and functions **" with response standards** .

**1.** In inflammatory conditions, changes in blood counts are observed.

1. What are these changes?

2. Why do these changes occur?

3. What is the name of the increase in the number of leukocytes?

4. What is the leukocyte formula.

5. What changes occur in the leukocyte formula during inflammatory processes?

Sample response:

1. In inflammatory conditions in the peripheral blood, the number of globulins increases, the ESR increases, the number of leukocytes increases, and the percentage of young forms of neutrophils increases.
2. ESR increases due to an increase in the number of globulins (dysproteinemia). Leukocytes are involved in the protective reactions of the body, during inflammatory processes, the formation of leukocytes is stimulated.
3. Lecocytosis
4. The percentage of different forms of leukocytes
5. Shift of the leukocyte formula to the left, i.e. increase in young forms of neutrophils

**2.** A student who took phenacetin during the examination session to improve his ability to work developed all the signs of oxygen deficiency. However, a clinical blood test showed that the number of erythrocytes and Hb are within the normal range, the heart is working normally, and the amount of oxygen in the air is sufficient.

1. What reason can be thought of if it is known that phenacetin is a strong oxidizing agent?

2. What kind of blood test can help in establishing the cause of these symptoms

3. What is the valency of iron in methemoglobin?

4. How much normal hemoglobin is contained in a liter of blood in men and women?

5. What changes in the blood system are observed during chronic hypoxia?

Sample response:

1. Taking phenacetin, which is a strong oxidizing agent, can cause the formation of a stable compound in the blood - methemoglobin, which leads to oxygen starvation ­.

2.Spectral analysis of blood. Methemoglobin has an additional ­absorption band in the red part of the spectrum.

3. 3

4. 130-160 g/l in men and 120-130 g/l in women

5. Stimulation of erythropoiesis is observed

1. **3.**

**4.** The examined color index is 0.6.

1. Is this a sign of a decrease in the amount of hemoglobin in the blood?

2. What is the color index normally equal to?

3. What is the name of the decrease in the color index?

4. In what case is a decrease in the color index observed?

5. What is vitamin B12 called and what is needed for its absorption in the intestines?

Sample response:

1. No, since the color index only indicates the degree of saturation of each erythrocyte with hemoglobin.

2.0.8 -1.0

3. hypochromia

4. with a lack of iron in the body

5. Vitamin B12 is an external anti-anemic factor (external hematopoietic factor), its absorption requires an internal hematopoietic factor (gastromucoprotein)

**5.** A person whose weight is 70 kg, Hb concentration 150 g/l, the total amount of blood in the body is 7% of body weight.

1. What is the oxygen capacity of this patient's blood?

2. What blood cells are called reticulocytes?

3. What does an increase in the number of reticulocytes in the peripheral blood indicate?

4. What stages does the life cycle of erythrocytes consist of?

5. What is the name and where is the specific erythropoiesis stimulator produced?

Sample response:

1. The amount of blood in a given person is 4.9 liters, the amount of hemoglobin in it is 4.9 l x 150 g/l = **735 g.**

Considering that 1 g of Hb can bind 1.34 ml of O 2 , the total oxygen capacity of the blood = 134 ml of O 2 x 735 g of Hb = **948.9** ml of O 2

2. Reticulocytes are young erythrocytes (with remnants of a nuclear substance stained with special dyes in the form of a mesh).

3. About the stimulation of erythropoiesis.

4. Erythropoiesis, circulation in the blood stream, erythrodieresis.

5. Erythropoietin. It is produced mainly in the juxtaglomerular apparatus of the kidneys.

1. **List and standards of practical skills.**
2. Erythrocyte count in Goryaev's chamber.
3. Leukocyte count in Goryaev's chamber.
4. Determination of hemoglobin concentration using "MINIGEM"
5. PREPARATION OF THE ASSESSMENT REPORT ON THE STATE OF THE BLOOD SYSTEM.

A complete blood count includes an analysis of the content ­of formed elements (erythrocytes, leukocytes, platelets ­), total hemoglobin, color index, erythrocyte sedimentation rate (ESR), the ratio of formed elements and ­blood plasma (hematocrit), and the percentage of ­various forms leukocytes (leukocyte formula).

Normal scores. When evaluating the results of a patient's blood test, the obtained indicators are compared ­with the norm.

|  |  |
| --- | --- |
| Erythrocytes, cells/l | in men 4.0-5.0 \* 10 12  in women 4.0-4.5\* 10 12 |
| Leukocytes, cells/l | in men 4.0-6.0 \* 10 9  in women 6.0-8.0 \* 10 9 |
| Platelets, cells/l | 200-400\*10 9 |
| Hemoglobin, g/l | in men 130-160  in women 120-140 |
| ESR, mm/h | in men 1 - 10  in women 2-15 |
| Hematocrit, % | 40-45 |
| Leukocyte formula, %  basophils  eosinophils  young neutrophils  stab  segmented  lymphocytes  monocytes | 0.1  1-5  0-1  1-5  45-70  20-40  2-10 |

**Sample conclusion on a general blood test**

Erythrocytosis (erythropenia, anemia), hypo-, normo- or hyperchromia (when combined with erythropenia - hypo- or hyperchromic anemia), an increase (decrease or norm ­) in ESR, reticulocytosis (reticulopenia), leukocytosis (leukopenia) with a shift of the leukocyte formula to the left or to the right (if no ­shift this part is not indicated), relative basophilia (basophilopenia), eosinophilia (eosinopenia), neutrophilia (neutropenia), lymphocytosis (lymphopenia), absolute ­(relative) monocytosis (monocytopenia), thrombocytosis (thrombocytopenia).

Normal indicators of the blood system, as a rule, are reflected in the conclusion with the phrase: "blood indicators are normal."

### STUDENTS’ LABORATORY WORK

### Practical work №1.

### DETERMINATION OF THE CONCENTRATION OF HEMOGLOBIN IN THE BLOOD USING A PHOTOELECTROCOLORIMER.

Process of work . Determination of hemoglobin in the blood is traditionally based on the measurement of ­the stained iron porphyrin complex. In this case, different photometric ­methods are used: Drabkin's cyanmethemoglobin method, ammonia method, and others. The principle of these methods is to prepare bioassays from whole blood using transforming ­solutions with their subsequent photometry.

Hemiglobincyanide method (Drabkin method). In this method, Fe 2+ hemoglobin is oxidized to Fe 3+ methemoglobin, which is then converted to stable cyanmethemoglobin (CNmetHb). The absorbance of CNmetHb is measured at 540 nm, at which there is an absorption maximum.

Definition progress . Add 20 μl of blood (Sali capillary, dilution 1:251) to a test tube with 5 ml of the transforming solution. ­The contents of the tube are thoroughly mixed and left for 10 minutes. Measurements are carried out on a spectrophotometer ­at a wavelength of 540 nm or on a photoelectric colorimeter at a wavelength of 520-560 nm (green light filter) in a cuvette with an optical path length of 10 mm against a blank sample (transforming solution.).

This method is implemented in ­the MiniGEM-523 hemoglobinometer, which has a narrow-band ­light filter with a transmission maximum at a wavelength of 523 nm. The methodological accuracy ­of hemoglobin determination on MiniGEM-523 hemoglobinometers (the maximum permissible value of the coefficient of ­total analytical variation) does ­not exceed 1.5% if the concentration of carboxyhemoglobin in the blood does not exceed 10%.

### Practical work number 2.

### COUNTING OF THE NUMBER OF LEUKOCYTES IN THE GORIAEV'S CAMERA.

Process of work and interpretation of results .Blood dilution. Blood from a finger is drawn into a Saly capillary in an amount of 0.02 ml and injected into a test tube into which 0.2 or 0.4 ml of an acetic acid solution with methylene blue is poured (10 or 20 times dilution).

Leukocyte count. In acetic acid, the shell of erythrocytes and leukocytes is destroyed, and methylene blue stains the nuclei of leukocytes.

The cover glass is rubbed in advance to the side platforms of the Goryaev counting chamber until rainbow rings appear. Fill the chamber with the solution using a Saly capillary. Leukocytes are counted in 25 large squares at low magnification.

The number of leukocytes in 1 mm 3 of blood is calculated by the formula:

L \u003d [A x 4000 x 20 (10)] / 400

where A is the number of cells in 400 small squares; 1/4000 - the volume of the chamber under the small square; 20 (or 10) - the degree of blood dilution.

### Practical work No. 3.

### COUNTING THE NUMBER OF ERYTHROCYTES IN THE GORIAEV'S CAMERA.

Work progress and interpretation of results . Blood dilution. Blood from a finger is drawn into the Sali capillary in an amount of 0.02 ml and injected into a test tube into which 2 or 4 ml are poured

3% NaCl solution (100 or 200 times dilution).

Erythrocytes are counted under a high magnification microscope in the small squares of the Goryaev chamber according to the Egorov rule. It is necessary to calculate 5 large (i.e. 80 small) squares of the grid diagonally. The formula for counting red blood cells in 1 mm 3 of blood:

E \u003d [ A x 4000 x 100 (200)] / 80,

where a is the number of erythrocytes in 80 small squares, 1/4000 is the volume of the chamber above the small square; 100 (or 200) - the degree of blood dilution.

When expressing the number of formed elements in the SI system, the result obtained must be multiplied by 10 6. In this case, the result will be expressed as follows: E \* 10 12 erythrocytes / l of blood; L \* 10 9 leukocytes / l of blood.

**Practical work No. 4**

**DETERMINATION OF COLOR INDICATOR OF BLOOD.**

To assess the saturation of erythrocytes with hemoglobin, the so-called. color (color) index. It is equal to the ratio of two quantities:

Hb of the patient Erythrocytes of the patient

\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ = Color index

Hb norm Erythrocytes are normal

Or: \_\_\_\_\_ hemoglobin \_\_\_\_\_\_\_\_\_\_

Number of red blood cells (3 digits) x 3

Normally, the color index should be equal to 1 (normochromia). If the CPU is less than 0.8 - hypochromia, more than 1.1 - hyperchromia. Color index is used to assess the type of anemia (anemia).

**INDEPENDENT EXTRACURRICULAR WORK OF STUDENTS**

Using the **Virtual Physiology** program, perform the following experiments on the physiology of the blood system and record their results in a protocol notebook:

*Work number 3. Determination of hemoglobin concentration*

1. **Approximate topics of research work on the topic.**
2. Erythrocytosis and erythropenia.
3. Leukocytosis and leukopenia.
4. Protective systems of the body. nonspecific protection. Immune protection.

**LIST OF LITERATURE ON THE TOPIC OF THE LESSON:**

**Mandatory**

LITERATURE ON THE TOPIC OF THE LESSON

1. Dunn, R. B. USMLE Step 1. Lecture Notes. Physiology / R. B. Dunn ; ed. D. E. Fitzovich. - [S. l.] : Kaplan, 2006. - 576 p.

2. Hall, J. E. Guyton and Hall Textbook of Medical Physiology / J. E. Hall. - 13th ed., Int. ed. - Philadelphia : Elsevier, 2016. - 1145 p.

3. Sherwood, L. Fundamentals of Human Physiology / L. Sherwood. – 4th ed. – Belmont, CA, USA: Brooks/Cole, 2012. – 764 p.

4. Silbernagl, S. Color Atlas of Phisiology / S. Silbernagl, A. Despopoulos. - 7th ed. - Stuttgart : Thieme, 2015. - 458 p.

5. Wilson, L.B. USMLE Step 1. Lecture Notes. Physiology / L.B. Wilson. - Kaplan, 2013. - 423 p.

**Additional**

1. Practicum on normal physiology: guidelines for students in special dentistry / ed. Yu.I.Savchenkova. 2009
2. Savchenkov Yu.I. Methods for the study of physiological functions: textbook.
3. Smirnov V.M. Normal physiology: textbook.
4. Test tasks in normal physiology: in 2 volumes / ed. Yu.I.Savchenkov.
5. Savchenkov Yu.I., Pats Yu.S. Dental physiology: textbook. Phoenix, 2007

**Electronic resources on the University website:**

1. Atlas of multimedia lectures
2. Atlas of normal physiology. Korobkov and others. Electronic version
3. Electronic versions of all lectures of teaching aids in physiology