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КАФЕДРА ПРОПЕДЕВТИКИ ВНУТРЕННИХ БОЛЕЗНЕЙ

МЕТОДЫ ИССЛЕДОВАНИЯ В КЛИНИКЕ ВНУТРЕННИХ БОЛЕЗНЕЙ

DIAGNOSTIC METHODS IN THE INTERNAL MEDICINE

Практикум для студентов стоматологического факультета

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CHAPTER 1
LABORATORY DIAGNOSTISTICS

In the modern world in the process of treatment, patients meet with a variety of diagnostic examinations, among which an important place is occupied by clinical laboratory tests.

Laboratory tests are performed using biological material that is taken from the patient. The most popular tests doctors use in therapeutic practice are as follows:

– Complete blood count (CBC);
– Urinalysis;
– Sputum tests;
– Biochemical blood analysis;
– Examination of pleural fluid and other biological fluids;
– Stool tests.

It should be noted that the "normal values" of laboratory parameters are the values found in a carefully examined group of people without objective signs of pathology. Since the term "normal values" is difficult to interpret, it was proposed to replace it with the concept of "reference values", that is, the values given for comparison. The reference interval usually includes the central 95 % of the values, i. e. 2.5 % of the minimum and maximum values are discarded. Currently, due to the significant diversification of laboratory research methods, it is impossible for all indicators to provide unified reference values. In each laboratory, the reference interval may differ slightly (and sometimes significantly). Therefore, when interpreting the results of laboratory studies, it is necessary to rely not on abstract "normal values", but on the reference values of the particular laboratory that performed the analysis.

Therefore, when we interpret the results of laboratory and instrumental examinations, especially if these are new or rarely used methods, we must know the characteristics of the method: sensitivity and specificity.

Sensitivity measures the proportion of truly positive results that correctly indicate an underlying disease (the proportion of those who do have a disease who are correctly identified by the method as suffering from that disease).

Specificity measures the proportion of truly negative outcomes (the proportion of those who do not have the disease who are correctly identified as not having the disease).

Thus, if the sensitivity of the test is 98 % and its specificity is 92 %, the false-negative rate is 2 %, and the false-positive rate is 8 %.

Complete Blood Count (CBC)

An important condition for ensuring the quality of laboratory blood tests is taking the material on an empty stomach in the morning. 12 hours before examination patient should exclude alcohol, smoking, eating, and should limit physical activity. Blood tests are taken before radiological, endoscopic examinations or physiotherapy (if they are performed in one day). Patients should postpone medication intake (if it's impossible to stop taking the medication, it's necessary to inform the laboratory about it).

Complete blood count (CBC) is one of the main tests in Internal Medicine, it is used for diagnosis of various hematological and non-hematological pathologies. The purpose of this blood test is a quantitative and qualitative analysis of blood cells (erythrocytes, leukocytes, platelets), determination of hemoglobin and erythrocyte sedimentation rate (ESR). Currently, most indicators are performed on automatic hematology analyzers, which are able to simultaneously determine from 5 to 24 parameters of blood. The main ones are the number of leukocytes (white blood cells), hemoglobin concentration, hematocrit, erythrocytes (red blood cell), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), mean corpuscular volume (MCV), platelets, mean platelet volume (MPV), etc.

ESR is determined by the Panchenkov's method (in the Panchenkov's capillary) or by the Westergren's method (in a test tube). ESR count in mm for 1 hour and it depends on the age. The normal rate of ESR for male is 2–10 mm/hour, for female 2–15 mm/hour. The Westergren's method is an international method for determining ESR. It differs from the Panchenkov's method by the characteristics of the tubes used and the calibration of the result scale. But the Westergren's method is more sensitive to increased ESR, and the results in the zone of elevated ESR values will be more accurate than the results obtained by the Panchenkov's method. In many diseases, the ESR is increased, especially for those that are accompanied by changes in the protein fractions of the blood. This is explained by the fact that the greatest influence on the ESR is caused by the violation of the ratio of different fractions of blood proteins. Albumins prevent erythrocyte sedimentation, and globulins, on the contrary, accelerate it. Especially great influence on the erythrocyte sedimentation has fibrinogen. The increase in ESR is observed in various inflammatory processes and infectious diseases, in case of rheumatic and oncological diseases, tuberculosis, myocardial infarction. ESR decreases in case of diseases accomplained by blood clots (polycythemia, food toxicoinfection, cholera).

Hemoglobin is the red blood cell pigment. It's a carrier of oxygen from the lungs to the tissues and carbon dioxide from the tissues to the lungs. Currently, hemoglobin is determined automatically using the photometric method. The amount of hemoglobin is significantly reduced with anemia, other blood diseases, malignant tumors.

Erythrocytes (red blood cells, RBC) are the most numerous blood cells that don't contain nuclei and are the most special cells in the body, the main function of RBC is oxygen transport from the lungs to the tissues and transfer carbon dioxide from the tissues to the lungs. This process is carried out with the help of hemoglobin. The red blood cells shape (a biconcave disc) gives the optimum ratio of volume to surface for the gases exchange, and provides RBC with the ability to deform during microcirculationThe red blood cells count underlies the assessment of erythropoiesis.

Erythrocytes are the subject of further tests to determine the hemoglobin concentration and hematocrit value (the ratio of the erythrocytes volume to the total blood volume).

Following erythrocyte indices characterize RBC quality: MCH — mean corpuscular hemoglobin, MCHC — mean corpuscular hemoglobin concentration, MCV — mean corpuscular volume. Low level of red blood cells indicates the presence of anemia. RBC number below than 1×10^{12}/l is a life-threatening condition. In patients with erythremia, the number of erythrocytes increased to $8–12\times10^{12}$/l.

Platelets (thrombocytes) come from giant bone marrow cells-megakaryocytes. Platelets are round or oval in shape. They take part in a blood clot formation. The number of platelets (thrombocytosis) increases in case of bleeding, surgery, cancer. Thrombocytopenia occurs with Verlgof's disease, leukemia, and infectious diseases.

Leukocytes (white blood cells, WBC) are divided into groups: granulocytes and agranulocytes. The name of granulocytes is associated with the presence of specific granules in the cytoplasm. Three types of granulocytes are identified, depending on their color in blood smear: neutrophils, eosinophils, and basophils. Agranulocytes consist of lymphocytes and monocytes, they don't contain specific cytoplasmic granules, their nucleus is non-segmented. In healthy individuals, the number of leukocytes is $4–9\times10^{9}$/l. When the number of leukocytes exceeds 9×10^{9}/l, we are talking about leukocytosis; the number of white blood cells below 4×10^{9}/l is called leukopenia. Leukocytosis is observed in many diseases of the blood system (leukemia, Hodgkin's disease), in purulent inflammation (abscess, appendicitis, cholangitis), pneumonia and myocardial infarction. Leukopenia presents in case of blood diseases, liver cirrhosis, drug poisoning, radiation sickness, as well as with some infectious diseases (viral hepatitis, brucellosis, influenza, typhoid fever). The leukocyte count is the ratio between the various forms of white blood cells. It is counted in blood smear.

Neutrophils amount is 50–70 % of leukocytes. Their cytoplasm is colored in light pink, granules are purple. Neutrophils are divided into band and segmented. Eosinophils have a characteristic bright red grain and a segmented core. Basophils are the smallest granulocytes. The nucleus of their irregular shape occupies almost the entire cell.

Lymphocytes are non-granular cells. The nucleus is located centrally, has a round or bean-shaped form, is painted in blue-violet color.

Monocytes are the largest blood cells. Their horseshoe-shaped or irregular shaped core are colored purple-red. Cytoplasm has a purple-blue color with a delicate reddish grain.

Neutrophils perform a protective function in the body. They fight against microbes and toxins. During infections, intoxication, their number increases significantly. At the same time, immature forms appear: the number of band is increased, young neutrophils appear, even myelocytes can occur in the smear. This neutrophilic rejuvenation is called left shift. Eosinophils are very active in allergic diseases and collagen diseases. Their number increases with parasitic diseases, scarlet fever, Hodgkin's disease. In some diseases their number, on the contrary, decreases (miliary tuberculosis, typhoid fever). Basophils are involved in immune response.

Basophil number increases with myeloid leukemia. An increase in the number of lymphocytes (lymphocytosis) is observed in tuberculosis, thyrotoxicosis, and especially in lymphocytic leukemia. Lymphopenia occurs in case of Hodgkin's disease, viral infections, autoimmune diseases. Monocytes are cells of the innate immune response, after entering the blood they are in the bloodstream for 1–2 days, then they settle down in the tissues. Monocytosis is observed in malaria, tuberculosis. Monocytopenia occurs in case of severe sepsis, typhoid fever.

Biochemical Blood Analysis

A biochemical blood analysis includes a long list of indicators. The number of these indicators depends on the capacity of the clinical laboratory. In the practice of the hospital, there is an order that defines the minimum number of biochemical tests. This minimum volume usually includes:

1. Renal function parameters (urea and creatinine).
2. Liver function parametres: total bilirubin, direct and indirect bilirubin, alanine transaminase (alanine aminotransferase, ALT), aspartate transaminase (aspartate aminotransferase, AST), total protein, albumin. The activity of gamma-glutamyltransferase (GGTP), alkaline phosphatase (ALP) is also evaluated.
3. Peripheral blood glucose level.
4. Electrolytes: sodium, potassium, chlorides, calcium.
5. C-reactive protein (CRP) level is used to assess inflammatory changes.
6. Cardiovascular system state is estimated by different groups of parameters as follows:

6.1. Lipid metabolism parameters: total cholesterol, high density lipoprotein cholesterol (HDL-C), low-density lipoprotein cholesterol (LDL-C), triglycerides.

6.2. Myocardial damage parameters: troponin, myoglobin, creatine kinase (creatine phosphokinase, CK) and its MB fraction (CK-MB).

When making a diagnosis, we have wide variety of parameters in bochemical blood analysis: for example, the pancreas disorders can be diagnosed by the high activity of amylase; in case of anemia, it is useful to determine serum iron level, transferrin, ferritin, etc.

Urinalysis

Urinalysis is an important diagnostic test not only for kidney and cardiovascular diseases, but also for diseases of other organs and systems. Various pathological processes affect the urine test. The results of urine tests allow us to assess the disease course and effectiveness of treatment.

For urinalysis, it's necessary to collect strictly morning urine collected immediately after awakening. Patient shouldn't take diuretics, alcohol, spicy and salty meal, products that change the color of urine (beets, carrots) on the day before of urine collection. Before urine collection, patient should do genital hygiene without antiseptics. Women are not recommended to take a urine test in menstruation. In case of urgency, urine is taken with the catheter. Urine is collected in a sterile disposable container. The container after

collecting is tightly closed, placed in a clean disposable bag and delivered to the laboratory. Nurse should fill direction for urinalysis, write patient's surname, name, patronymic, age, department, diagnosis.

For Urinalysis, the middle portion of morning urine is collected (at least 50 ml). Urinalysis includes determination of physical properties, chemical analysis and microscopic examination of the sediment.

Physical properties of urine. The color of urine is normally depending on its concentration and ranges from dark-yellow to slightly-yellow. Colorless urine is observed in case of polyuria (after taking diuretics, in case of diabetes). Dark-yellow urine color, like beer color, occurs in case of jaundice due to presence of bile pigments. The urine of the color of meat slop is observed in case of hematuria, for example in glomerulonephritis.

Normal urine is clear. Turbidity of the urine can be caused by the presence of salts, cells, mucus, fat, bacteria.

Smell: fresh urine of a healthy person has no smell. If the urine was in a warm room for a long time, it gets an ammonia smell. Acetone in the urine (in case of diabetes) provides fruity odor.

Reaction of urine: normal urine in case of mixed diet is acidic or neutral; in case of acidosis, it becomes more acidic, in case of alkalosis it becomes more alkaline. In case of diseases accompanied by the appearance of acidic metabolic products in the blood (uremia, diabetes, heart failure), urine becomes very acidic. The pH of urine is determined by titration, using a pH meter and litmus paper.

The density of urine ranges from 1001 to 1040. The density of the primary urine is 1010–1012, i. e. it is equal to the plasma density. The excretion of urine with a density of 1010–1012 is called isostenuria, the excretion of urine with a lower density of hyposthenuria. Pro-longed hypostenuria is a poor prognostic sign. The amount of urine depends on the amount of fluid intake. A healthy person produces 1000–2000 ml of urine per 24 hours. In case of diabetes, the amount of urine can be 8 liters or more per 24 hours. Normally, most urine is excreted during the day. Excretion of urine mainly at night (nicturia) is observed in chronic kidney failure and in chronic heart failure.

Chemical examination of urine. The presence of protein, urobilin, glucose, acetone, salts is determined in the urine. Concentration of enzymes, hormones, metabolites of drugs, alcohol can be found by a special test. Protein: urine of a healthy person contains a trace amount of protein (0.03 g/l). Urinary protein excretion is called proteinuria. Proteinuria can be renal and extrarenal. In renal proteinuria, protein enters the urine from the blood plasma through nephron in case of damage (glomerulonephritis, nephrotic syndrome) or increased permeability due to external stimulus (cold, physical stress). Extrarenal proteinuria can have prerenal causes (associated with an excessive concentration of protein in the blood plasma, for example, in multiple myeloma) and postrenal causes (associated with diseases of the urinary tract).

Glucose: urine of a healthy person doesn't contain glucose. Glucosuria occurs in case of diabetes, hypophysis and adrenal gland diseases. Ketone bodies include acetone,

acetoacetic acid and beta — oxybutyric acid. They appear in the urine in case of diabetic ketoacidosis, acute liver or kidney damage, intoxication.

Microscopic urine examination is done for estimation of the elements such as red blood cells, leukocytes, casts, epithelial cells. Red blood cells may be unchanged (isomorphic, contain hemoglobin), having a greenish-yellow color, and changed (dysmorphic, free from hemoglobin) — color-less. The presence of red blood cells in the urine is called hematuria. There is a macrohematuria, when the blood in the urine is so pronounced that the urine becomes the reddish color, and microhematuria, in which red blood cells are detected only in microscopy. Unchanged erythrocytes (isomorphic) indicate non-glomerular hematuria, they are found in kidney infarction, kidney stones, cancer, kidney tuberculosis, injuries, as well as in cystitis and urethritis. Dysmorphic (changed) erythrocytes indicate glomerular hematuria, they are detected when RBC enter the urine directly through the nephron (with glomerulonephritis). Leukocytes in the urine of healthy individuals are 3–5 cells per high-powered field (HPF) microscopy. If leukocytes cover the entire field of view, it called pyuria. It occurs in case of pyelonephritis, cystitis, and urinary tract infection.

Casts are protein structeres are formed mainly from blood plasma globulins in the renal tubules. The appearance of casts in the urine (cylindruria) indicates the damage of the tubular kidney epithelium.

Epithelial cells in urine can be squamous, transitional and renal cuboidal epithelium. Cells of the squamous epithelium have a round or polygonal shape with a small nucleus. They enter the urine from the external genitalia or urethra. The cells of the transitional epithelium cover the mucous membrane of the urinary tract. The presence of a large number of these cells in the urine indicates an inflammatory process in the pelvis or bladder. Renal cuboidal epithelial cells have an irregular shape, yellowish color. Their appearance is a sign of acute and chronic kidney damage. They are also found in infectious diseases and intoxications.

Sputum examination

Sputum is collected in the morning before meals and drugs, by coughing. Before sputum discharge, the patient should thoroughly rinse his mouth and throat with boiled water to prevent saliva collection. The patient needs to take two deep breaths, holding the breath for a few seconds after each inhalation and exhaling slowly. After the third breath, he should cough up well, collect the secreted sputum in a container and immediately close the lid.

A macroscopic examination determines the amount of sputum, smell, consistency, color, the presence of pathological substances. In bronchitis, bronchial asthma, lobar pneumonia, patients cough out sputum in a little portion. In the presence of bronchiectasis, the amount of sputum can be 0.5 liters or more per day.

The consistency of spupum can be liquid, viscous and thick sputum. With bronchitis and bronchopneumonia, sputum is liquid or moderately viscous, and with lobar pneumonia it's thick, poorly coughed out. By the sputum character it can be mucous, mucous-purulent in case of bronchitis and bronchial asthma. In case of pulmonary edema, sputum is serous; it is purulent in case of bronchiectasis, lung abscess.

Bloody sputum contains blood in various quantities. In case of pulmonary bleeding, it consists of almost one blood, in case of tuberculosis, abscess, lung cancer, spupum contains some blood portions. The color of sputum depends on the disease: in case of lung cancer the color is a crimson, in case of lobar pneumonia — broun. Purulent sputum usually has a yellowish color, asthma patients have "glassy" sputum. The smell of sputum is often absent. Offensive odor arises from the purulent destruction of lung tissue (lung gangrene, lung cancer), as well as protein decomposition during sputum retention in the cavities (bronchiectasis, lung abscess).

Sputum can include fibrin in case of lobar pneumonia, Kurschman spirals and Charcot–Leyden crystals in case of asthma.

Microscopic examination of sputum is carried out in both native (unstained) and stained smears. In the first case, a portion of sputum is applied to a glass slide, covered with a cover glass and then examined under a microscope under different magnifications.

In the native smears are detected epithelial cells, leukocytes, erythrocytes, actinomycetes, hematoidin crystals and fatty acids. Eosinophils are a rounded cells of light gray color. Charcot crystals are clistalls that are formed when eosinophils are destroyed. Spiral Kurshman represents the casts of transparent mucus, occurring in case of bronchial asthma. Elastic fibers are double-lumen shiny formations, they are formed in case of lung tissue breakdown and are found in tuberculosis and lung abscess. Hematoidin crystals have the rhomboid or star form, golden color and are found in case of hemorrhages in lung tissue. The cells of malignant tumors enter the sputum due to their disintegration. These cells are large, have a different shape, a large nucleus, and sometimes several nuclei. Actinomycetes consist of a central part, which is a plexus of mycelium, and a radiantly located flask-shaped formations surround-ing it.

Note!

The reference values given in the workbook are not universal and may vary at different laboratories.

COMPLETE BLOOD COUNT (CBC)

1. CBC				
Parameter	**Reference values**		**Unit**	**Note**
	male	**female**		
RBC	3,8–5,7	3,5–5,1	10^{12}/l	
Hemoglobin	130–160	120-150	g/l	
Hematocrit	40–52	36-42	%	
MCV	80–95		fl.	
MCH	27–33,3		pg	
MCHC	300–370		g/l	
Reticulocytes	0,2–1,5		%	
WBC	4–9		10^9/l	
Platelets	150–450		10^9/l	
ESR Panchenkov's method	2–10		mm/h	male
	2–15		mm/h	female
ESR Westergren's method	1–15		mm/h	before 50 y.o.
	1–20		mm/h	after 50 y.o.
Leukocyte count				
Parameter	**%**	**10^9/l**	**Note**	
Basophils	0,5–1	0,01–0,065		
Eosinophils	1–5	0,02–0,5	from 5 y.o.	
Neutrophils:				
band	1–6	0,04–0,57	from 14 y.o.	
segmented	47–72	1,8–6,5	from 5 y.o.	
Lymphocytes	19–39	1,5–4	from 5 y.o.	
Monocytes	2–11	0,05–0,8	from 14 y.o.	
Conclusion:				

2. **CBC**		
PATIENT'S NAME: IVANOV II		
AGE: 67 y.o.	Sex: man	
Parameter	Result	Note
RBC	$3{,}0 \times 10^{12}$/l	
Hemoglobin	98 g/l	
Hematocrit	40 %	
MCV	80 fl.	
MCH	27 pg	
MCHC	310 g/l	
Reticulocytes	1 %	
WBC	$6{,}8 \times 10^{9}$/l	
Platelets	357×10^{9}/l	
ESR	12 mm/h	
Leukocyte count		
Basophils	1 %	
Eosinophils	1 %	
Neutrophils: band	3 %	
segmented	52 %	
Lymphocytes	37 %	
Monocytes	6 %	
Conclusion:		

3. **CBC**		
PATIENT'S NAME: IVANOVA II		
AGE: 78 y.o.	Sex: female	
Parameter	Result	Note
RBC	$2{,}5 \times 10^{12}$/l	
Hemoglobin	77 g/l	
Hematocrit	37,5 %	
MCV	68 fl.	
MCH	25 pg	
MCHC	250 g/l	
Reticulocytes	0,5 %	
WBC	$4{,}7 \times 10^{9}$/l	
Platelets	345×10^{9}/l	
ESR Westergren's method	55 mm/h	
Leukocyte count		
Basophils	1 %	
Eosinophils	2 %	
Neutrophils: band	5 %	
segmented	49 %	
Lymphocytes	37 %	
Monocytes	6 %	
Morphology:	Poikilocytosis+ Microanisocytosis ++	
Conclusion:		

4.
CBC

PATIENT'S NAME: IVANOVA II		
AGE: 62 y.o.	Sex: female	
Parameter	Result	Note
RBC	$3{,}03 \times 10^{12}$/l	
Hemoglobin	43 g/l	
Hematocrit	18,2 %	
MCV	60,1 fl.	
MCH	14,2 pg	
MCHC	236 g/l	
Reticulocytes	0,9 %	
WBC	$5{,}8 \times 10^{9}$/l	
Platelets	369×10^{9}/l	
ESR	27 mm/h	
Leukocyte count		
Basophils	0 %	
Eosinophils	1 %	
Neutrophils: band	7 %	
segmented	59 %	
Lymphocytes	23 %	
Monocytes	10 %	
Morphology:	Pronounced anisocytosis (microcytes), poikilocytosis	
Conclusion:		

5.
CBC

PATIENT'S NAME: IVANOV II		
AGE: 37 y.o.	Sex: male	
Parameter	Result	Note
RBC	$1{,}3 \times 10^{12}$/l	
Hemoglobin	60 g/l	
Hematocrit	25,3 %	
MCV	108 fl.	
MCH	39 pg	
MCHC	390 g/l	
Reticulocytes	0,1 %	
WBC	$3{,}5 \times 10^{9}$/l	
Platelets	259×10^{9}/l	
ESR Westergren's method	45 mm/h	
Leukocyte count		
Basophils	0 %	
Eosinophils	0 %	
Neutrophils: band	6%	
segmented	46 %	
Lymphocytes	42 %	
Monocytes	6 %	
Morphology:	Anisocytosis++ (macrocytes)	
Conclusion:		

6.
CBC

PATIENT'S NAME: IVANOVA II		
AGE: 69 y.o.	Sex: female	
Parameter	Result	Note
RBC	$2{,}9 \times 10^{12}$/l	
Hemoglobin	70 g/l	
Hematocrit	23,6 %	
MCV	93 fl.	
MCH	33 pg	
MCHC	360 g/l	
Reticulocytes	10 %	
WBC	$12{,}0 \times 10^{9}$/l	
Platelets	480×10^{9}/l	
ESR	17 mm/h	
Leukocyte count		
Basophils	0 %	
Eosinophils	2 %	
Neutrophils: Myelocytes Metamyelocytes band segmented	 0% 6% 12% 60 %	
Lymphocytes	15 %	
Monocytes	6 %	
Normoblasts, polychromatophiles		
Conclusion:		

7.
CBC

PATIENT'S NAME: IVANOV II		
AGE: 35 y.o.	Sex: male	
Parameter	Result	Note
RBC	$6{,}0 \times 10^{12}$/l	
Hemoglobin	180 g/l	
Hematocrit	58,9 %	
MCV	90,6 fl.	
MCH	30,5 pg	
MCHC	336 g/l	
Reticulocytes	2,0 %	
WBC	$4{,}8 \times 10^{9}$/l	
Platelets	307×10^{9}/l	
ESR	8 mm/h	
Leukocyte count		
Basophils	0 %	
Eosinophils	2 %	
Neutrophils: band segmented	 1 % 68 %	
Lymphocytes	28 %	
Monocytes	1 %	
Conclusion:		

8. **CBC**		
PATIENT'S NAME: IVANOV II		
AGE: 20 y.o.	Sex: male	
Parameter	Result	Note
RBC	$4{,}6 \times 10^{12}$/l	
Hemoglobin	143 g/l	
Hematocrit	37 %	
MCV	85 fl.	
MCH	28 pg	
MCHC	300 g/l	
Reticulocytes	0,8 %	
WBC	$16{,}5 \times 10^{9}$/l	
Platelets	200×10^{9}/l	
ESR Westergren's method	40 mm/h	
Leukocyte count		
Basophils	1 %	
Eosinophils	2 %	
Neutrophils: band	12 %	
segmented	64 %	
Lymphocytes	20 %	
Monocytes	1 %	
Conclusion:		

9. **CBC**		
PATIENT'S NAME: IVANOV II		
AGE: 55 y.o.	Sex: male	
Parameter	Result	Note
RBC	$4{,}4 \times 10^{12}$/l	
Hemoglobin	136 g/l	
Hematocrit	39 %	
MCV	86 fl.	
MCH	28 pg	
MCHC	300 g/l	
Reticulocytes	0,6 %	
WBC	$5{,}8 \times 10^{9}$/l	
Platelets	322×10^{9}/l	
ESR	39 mm/h	
Leukocyte count		
Basophils	0 %	
Eosinophils	15 %	
Neutrophils: band	4 %	
segmented	49 %	
Lymphocytes	29 %	
Monocytes	3 %	
Conclusion:		

10. **CBC**		
PATIENT'S NAME: IVANOVA II		
AGE: 57 y.o.	Sex: female	
Parameter	Result	Note
RBC	$4{,}76 \times 10^{12}$/l	
Hemoglobin	125 g/l	
Hematocrit	41 %	
MCV	87 fl.	
MCH	31 pg	
MCHC	336 g/l	
Reticulocytes	0,9 %	
WBC	$2{,}2 \times 10^{9}$/l	
Platelets	290×10^{9}/l	
ESR	18 mm/h	
Leukocyte count		
Basophils	1 %	
Eosinophils	1 %	
Neutrophils: band segmented	 3 % 80 %	
Lymphocytes	10 %	
Monocytes	5 %	
Conclusion:		

11. **CBC**		
PATIENT'S NAME: IVANOVA II		
AGE: 28 y.o.	Sex: female	
Parameter	Result	Note
RBC	$3{,}6 \times 10^{12}$/l	
Hemoglobin	100 g/l	
Hematocrit	41 %	
MCV	89 fl.	
MCH	31 pg	
MCHC	330 g/l	
Reticulocytes	0,6 %	
WBC	$16{,}3 \times 10^{9}$/l	
Platelets	298×10^{9}/l	
ESR	37 mm/h	
Leukocyte count		
Basophils	1 %	
Eosinophils	2 %	
Neutrophils: band segmented	 12 % 43 %	
Lymphocytes	32 %	
Monocytes	10 %	
Morphology	Toxic granularity of neutrophils+	
Conclusion:		

12.
CBC

PATIENT'S NAME: IVANOV II		
AGE: 42 y.o.	Sex: male	
Parameter	Result	Note
RBC	$4{,}5 \times 10^{12}$/l	
Hemoglobin	146 g/l	
Hematocrit	42 %	
MCV	88 fl.	
MCH	30 pg	
MCHC	320 g/l	
Reticulocytes	0,7 %	
WBC	$6{,}8 \times 10^{9}$/l	
Platelets	355×10^{9}/l	
ESR	10 mm/h	
Leukocyte count		
Basophils	1 %	
Eosinophils	12 %	
Neutrophils: band	4 %	
segmented	35 %	
Lymphocytes	30 %	
Monocytes	8 %	
Conclusion:		

13.
CBC

PATIENT'S NAME: IVANOVA II		
AGE: 72 y.o.	Sex: female	
Parameter	Result	Note
RBC	$1{,}1 \times 10^{12}$/l	
Hemoglobin	30 g/l	
Hematocrit	16 %	
MCV	71 fl.	
MCH	22 pg	
MCHC	280 g/l	
Reticulocytes	0 %	
WBC	1×10^{9}/l	
Platelets	34×10^{9}/l	
ESR Westergren's method	72 mm/h	
Leukocyte count		
Basophils	0 %	
Eosinophils	1 %	
Neutrophils: band	7 %	
segmented	56 %	
Lymphocytes	32 %	
Monocytes	4 %	
Conclusion:		

14.
CBC

PATIENT'S NAME: IVANOV II		
AGE: 69 y.o.	Sex: male	
Parameter	Result	Note
RBC	$5{,}2 \times 10^{12}$/l	
Hemoglobin	148 g/l	
Hematocrit	41 %	
MCV	87 fl.	
MCH	29 pg	
MCHC	310 g/l	
Reticulocytes	0,7 %	
WBC	$4{,}8 \times 10^{9}$/l	
Platelets	75×10^{9}/l	
ESR Westergren's method	12 mm/h	
Leukocyte count		
Basophils	1 %	
Eosinophils	1 %	
Neutrophils:		
band	5 %	
segmented	45 %	
Lymphocytes	45 %	
Monocytes	3 %	
Conclusion:		

15.
CBC

PATIENT'S NAME: IVANOVA II		
AGE: 65 y.o.	Sex: female	
Parameter	Result	Note
RBC	$3{,}35 \times 10^{12}$/l	
Hemoglobin	105 g/l	
Hematocrit	33 %	
MCV	78 fl.	
MCH	25,7 pg	
MCHC	289 g/l	
Reticulocytes	0,5 %	
WBC	72×10^{9}/l	
Platelets	256×10^{9}/l	
ESR Westergren's method	48 mm/h	
Leukocyte count		
Basophils	0 %	
Eosinophils	1 %	
Neutrophils:		
band	1 %	
segmented	5 %	
Lymphocytes	93 %	
Monocytes	0 %	
Morphology	Shadow cells of Botkin–Gumprecht +	
Conclusion:		

16. **CBC**		
PATIENT'S NAME: IVANOV II		
AGE: 19 y.o.	Sex: male	
Parameter	Result	Note
RBC	$1{,}88 \times 10^{12}$/l	
Hemoglobin	69 g/l	
Hematocrit	36 %	
MCV	80 fl.	
MCH	25 pg	
MCHC	290 g/l	
Reticulocytes	1 %	
WBC	$2{,}0 \times 10^{9}$/l	
Platelets	80×10^{9}/l	
ESR	45 mm/h	
Leukocyte count		
Basophils	0 %	
Eosinophils	0 %	
Blasts	10 %	
Neutrophils: band	 2 %	
segmented	16 %	
Lymphocytes	72 %	
Monocytes	0 %	
Morphology	Pronounced anisocytosis, poikilocytosis	
Conclusion:		

17. **CBC**		
PATIENT'S NAME: IVANOVA II		
AGE: 68 y.o.	Sex: female	
Parameter	Result	Note
RBC	$3{,}3 \times 10^{12}$/l	
Hemoglobin	102 g/l	
Hematocrit	33 %	
MCV	78 fl.	
MCH	25,7 pg	
MCHC	289 g/l	
Reticulocytes	0,5 %	
WBC	133×10^{9}/l	
Platelets	145×10^{9}/l	
ESR	43 mm/h	
Leukocyte count		
Basophils	7 %	
Eosinophils	9 %	
Promyelocytes	3 %	
Myelocytes	4 %	
Young neutrophils	13 %	
Neutrophils: band	 15 %	
segmented	40 %	
Lymphocytes	3 %	
Monocytes	0 %	
Conclusion:		

FOR NOTES

Note!

The reference values given in the workbook are not universal and may vary at different laboratories.

URINALYSIS

18. URINALYSIS	
PATIENT'S NAME: I. II	
AGE: 50 y.o.	Sex:
Parameter	Reference values
Physical properties	
Amount	100 ml
Color	pale yellow to deep amber
Transparency	Transparent
Ph	Acidic
Relative density	1012–1025
Chemical properties	
Protein	less 0,033 g/l
Glucose	Absent
Ketone bodies	Absent
Bilirubin	Absent
Urobilin	Absent
Microscopic examination	
Epithelium:	
squamous	0–5 per high-powered field
transitional	Absent
renal	Absent
RBC	0–5 per high-powered field — female 0–2 per high-powered field — male
WBC	0–6 per high-powered field — female 0–3 per high-powered field — male
Casts (hyaline)	0–1 per high-powered field
Casts (other types)	Absent
Salts	Absent
Bacteria	Absent
Mucus	Absent

19. URINALYSIS		
PATIENT'S NAME: IVANOV II		
AGE: 30 y.o.	Sex: male	
Parameter	Result	Note
Physical properties		
Amount	150,0	
Color	Straw-yellow	
Transparency	Cloudy	
Ph	Acidic	
Relative density	1035	
Chemical properties		
Protein	Absent	
Glucose	++	
Ketone bodies	++	
Bilirubin	Absent	
Urobilin	Absent	
Microscopic examination		
Epithelium:		
squamous	1–2 per high-powered field	
transitional	Absent	
renal	Absent	
RBC	0–1 per high-powered field	
WBC	0–2 per high-powered field	
Casts	Absent	
Salts	Absent	
Bacteria	Absent	
Mucus	Absent	
Conclusion:		

20. URINALYSIS		
PATIENT'S NAME: IVANOV II		
AGE: 50 y.o.	Sex: male	
Parameter	Result	Note
Physical properties		
Amount	200,0	
Color	Straw-yellow	
Transparency	Cloudy	
Ph	Alkaline	
Relative density	1020	
Chemical properties		
Protein	0,033 g/l	
Glucose	Absent	
Ketone bodies	Absent	
Bilirubin	Absent	
Urobilin	Absent	
Microscopic examination		
Epithelium:		
squamous	Considerable amount	
transitional	–	
renal	–	
RBC	6–7 per high-powered field	
WBC	20–30 per high-powered field	
Casts	Absent	
Salts	Absent	
Bacteria	Absent	
Mucus	Absent	
Conclusion:		

21. URINALYSIS		
PATIENT'S NAME: IVANOVA II		
AGE: 36 y.o.	Sex: female	
Parameter	Result	Note
Physical properties		
Amount	170,0	
Color	Straw-yellow	
Transparency	Transparent	
Ph	Acidic	
Relative density	1018	
Chemical properties		
Protein	Absent	
Glucose	Absent	
Ketone bodies	+++	
Bilirubin	Absent	
Urobilin	Absent	
Microscopic examination		
Epithelium:		
squamous	8–10 per high-powered field	
transitional	Absent	
renal	Absent	
RBC	0–3 per high-powered field	
WBC	2–4 per high-powered field	
Casts	Absent	
Salts	Absent	
Bacteria	Absent	
Mucus	Absent	
Conclusion:		

22. URINALYSIS		
PATIENT'S NAME: IVANOVA II		
AGE: 24 y.o.	Sex: female	
Parameter	Result	Note
Physical properties		
Amount	200,0	
Color	Straw-yellow	
Transparency	cloudy	
Ph	Alkaline	
Relative density	1016	
Chemical properties		
Protein	0,066 g/l	
Glucose	Absent	
Ketone bodies	Absent	
Bilirubin	Absent	
Urobilin	Absent	
Microscopic examination		
Epithelium:		
squamous	2–3 per high-powered field	
transitional	Absent	
renal	Absent	
RBC	1–3 per high-powered field	
WBC	20–30 per high-powered field	
Casts	Absent	
Salts	Absent	
Bacteria	++	
Mucus	Considerable amount	
Conclusion:		

23.

URINALYSIS

PATIENT'S NAME: IVANOVA II		
AGE: 68 y.o.	Sex: female	
Parameter	Result	Note
Physical properties		
Amount	220,0	
Color	Straw-yellow	
Transparency	cloudy	
Ph	Alkaline	
Relative density	1017	
Chemical properties		
Protein	0,087 g/l	
Glucose	Absent	
Ketone bodies	Absent	
Bilirubin	Absent	
Urobilin	Absent	
Microscopic examination		
Epithelium:		
squamous	3–4 per high-powered field	
transitional	Absent	
renal	Absent	
RBC	0–3 per high-powered field	
WBC	30–40 per high-powered field, aggregation till 50	
Casts	hyaline 0–2 per high-powered field	
Bacteria	+++	
Mucus	Considerable amount	
Conclusion:		

24.

URINALYSIS

PATIENT'S NAME: IVANOV II		
AGE: 42 y.o.	Sex: male	
Parameter	Result	Note
Physical properties		
Amount	230,0	
Color	Straw-yellow	
Transparency	cloudy	
Ph	Acidic	
Relative density	1007	
Chemical properties		
Protein	1,66 g/l	
Glucose	Absent	
Ketone bodies	Absent	
Bilirubin	Absent	
Urobilin	Absent	
Microscopic examination		
Epithelium:		
squamous	3–4 per high-powered field	
transitional		
renal	0–1 per high-powered field	
RBC	Changed 10–15 в per high-powered field	
WBC	2–3 per high-powered field	
Casts	Hyaline: 2–3 per high-powered field Granular: 2–3 per high-powered field	
Conclusion:		

25. URINALYSIS		
PATIENT'S NAME: IVANOVA II		
AGE: 20 y.o.	Sex: female	
Parameter	Result	Note
Physical properties		
Amount	150,0	
Color	yellow	
Transparency	Transparent	
Ph	Faintly acidic	
Relative density	1022	
Chemical properties		
Protein	Absent	
Glucose	Absent	
Ketone bodies	Absent	
Bilirubin	Absent	
Urobilin	+++	
Microscopic examination		
Epithelium:		
squamous	1–2 per high-powered field	
transitional	Absent	
renal	Absent	
RBC	0–1 per high-powered field	
WBC	0–2 per high-powered field	
Casts	Absent	
Salts	Absent	
Bacteria	Absent	
Mucus	Absent	
Conclusion:		

26. URINALYSIS		
PATIENT'S NAME: IVANOV II		
AGE: 46 y.o.	Sex: male	
Parameter	Result	Note
Physical properties		
Amount	150,0	
Color	Bloody	
Transparency	Transparent	
Ph	Acidic	
Relative density	1020	
Chemical properties		
Protein	0,056 g/l	
Glucose	Absent	
Ketone bodies	Absent	
Bilirubin	Absent	
Urobilin	Absent	
Microscopic examination		
Epithelium:		
squamous	10–15 per high-powered field	
transitional		
renal		
RBC	Considerable amount, fresh	
WBC	10–20 per high-powered field	
Casts		
Salts	Oxalates+++	
Bacteria	Absent	
Mucus	Absent	
Conclusion:		

27.

URINALYSIS

PATIENT'S NAME: IVANOV II		
AGE: 53 y.o.	Sex: male	
Parameter	Result	Note
Physical properties		
Amount	100,0	
Color	Bear color	
Transparency	Transparent	
Ph	Acidic	
Relative density	1018	
Chemical properties		
Protein	Absent	
Glucose	Absent	
Ketone bodies	Absent	
Bilirubin	+++	
Urobilin	absent	
Microscopic examination		
Epithelium:		
squamous	1–2 per high-powered field	
transitional	Absent	
renal	Absent	
RBC	0–1 per high-powered field	
WBC	0–2 per high-powered field	
Casts	Absent	
Salts	Absent	
Bacteria	Absent	
Mucus	Absent	
Conclusion:		

28.

URINALYSIS

PATIENT'S NAME: IVANOVA II		
AGE: 60 y.o.	Sex: female	
Parameter	Result	Note
Physical properties		
Amount	180,0	
Color	Bright yellow	
Transparency	Transparent	
Ph	Faintly acidic	
Relative density	1020	
Chemical properties		
Protein	Absent	
Glucose	Absent	
Ketone bodies	Absent	
Bilirubin	++	
Urobilin	++	
Microscopic examination		
Epithelium:		
squamous	1–2 per high-powered field	
transitional	Absent	
renal	Absent	
RBC	0–1 per high-powered field	
WBC	0–2 per high-powered field	
Casts	Absent	
Salts	Absent	
Conclusion:		

29. URINALYSIS		
PATIENT'S NAME: IVANOV II		
AGE: 63 y.o.	Sex: male	
Parameter	Result	Note
Physical properties		
Amount	180,0	
Color	Bloody	
Transparency	Cloudy	
Ph	Acidic	
Relative density	1020	
Chemical properties		
Protein	0,15 g/l	
Glucose	Absent	
Ketone bodies	Absent	
Bilirubin	Absent	
Urobilin	Absent	
Microscopic examination		
Epithelium:		
squamous	2–3 per high-powered field	
transitional	0–1 per high-powered field	
renal		
RBC	Considerable amount, fresh	
WBC	2–3 per high-powered field	
Casts	Absent	
Salts	Absent	
Mucus	Absent	
Conclusion:		

30. URINALYSIS		
PATIENT'S NAME: IVANOV II		
AGE: 25 y.o.	Sex: male	
Parameter	Result	Note
Physical properties		
Amount	190,0	
Color	Meat slops	
Transparency	Cloudy	
Ph	Acidic	
Relative density	1024	
Chemical properties		
Protein	2,3 g/l	
Glucose	Absent	
Ketone bodies	Absent	
Bilirubin	Absent	
Urobilin	Absent	
Microscopic examination		
Epithelium:		
squamous	2–3 per high-powered field	
transitional	Absent	
renal	Absent	
RBC	Considerable amount, changed	
WBC	5–10 per high-powered field	
Casts	Hyaline1–2 per high-powered field	
Salts	Absent	
Bacteria	Absent	
Conclusion:		

SPUTUM TEST

31. SPUTUM TEST	
PATIENT'S NAME: IVANOVA II	
Sex: female	Age: 36 y.o.
DEPARTMENT pulmonology	
Macroscopic examination	
Amount: 30 ml	Consistence: fluid
Odor: odorless	Color: grayish-yellow
Character: mucous	Admixture: absent
Microscopic examination	
Native preparation	
WBC	18–20 per high-powered field
RBC	absent
Epithelium squamous	0–1 per high-powered field
Epithelium cylindrical	1–2 per high-powered field
Alveovar macrophage	absent
Elastic fibers	absent
Spirals of Kurshman	absent
Crystals of Charcot–Leyden	absent
Special stain	
Neutrophils	90 %
Lymphocytes	10 %
Eosinophils	absent
Alveovar macrophage	absent
Fungi	absent
Acid Resistant Bacteria	absent
Conclusion:	

32. SPUTUM TEST	
PATIENT'S NAME: IVANOVA II	
Sex: female	Age: 79 y.o.
DEPARTMENT pulmonology	
Macroscopic examination	
Amount: 20 ml	Consistence: viscous
Odor: odorless	Color: grayish
Character: mucous	Admixture: absent
Microscopic examination	
Native preparation	
WBC	20–25 per high-powered field
RBC	absent
Epithelium squamous	2–3 per high-powered field
Epithelium cylindrical	3–4 per high-powered field
Alveovar macrophage	absent
Elastic fibers	absent
Spirals of Kurshman	absent
Crystals of Charcot–Leyden	absent
Special stain	
Neutrophils	20 %
Lymphocytes	80 %
Eosinophils	0–1 per high-powered field
Alveovar macrophage	absent
Fungi	absent
Acid Resistant Bacteria	absent
Conclusion:	

33. SPUTUM TEST	
PATIENT'S NAME: IVANOVA II	
Sex: female	Age: 58 y.o.
DEPARTMENTpulmonology	
Macroscopic examination	
Amount: 15 ml	Consistence: viscous
Odor: odorless	Color: rusty
Character: hemorrhagic	Admixture: absent
Microscopic examination	
Native preparation	
WBC	10–15 per high-powered field
RBC	20–30 per high-powered field
Epithelium squamous	0–1 per high-powered field
Epithelium cylindrical	0–1 per high-powered field
Alveovar macrophage	7–8 per high-powered field
Fibrous tissues	1–2 per high-powered field
Spirals of Kurshman	absent
Crystals of Charcot–Leyden	absent
Special stain	
Neutrophils	60 %
Lymphocytes	30 %
Eosinophils	single
Alveovar macrophage	7–10 per high-powered field
Fungi	absent
Acid Resistant Bacteria	absent
Conclusion:	

34. SPUTUM TEST	
PATIENT'S NAME: IVANOV II	
Sex: male	Age: 49 y.o.
DEPARTMENTpulmonology	
Macroscopic examination	
Amount: 315 ml	Consistence: viscous
Odor: stinking	Color: grayish-yellow-green
Character: serous-purulent	Admixture: 3 layers
Microscopic examination	
Native preparation	
WBC	cover all sight
RBC	absent
Epithelium squamous	0–1 per high-powered field
Epithelium cylindrical	5–8 per high-powered field
Alveovar macrophage	absent
Elastic fibers	considerable amount
Spirals of Kurshman	absent
Crystals of Charcot–Leyden	absent
Special stain	
Neutrophils	98 %
Lymphocytes	2 %
Eosinophils	absent
Alveovar macrophage	absent
Fungi	absent
Acid Resistant Bacteria	absent
Staphylococci	present
Conclusion:	

35. SPUTUM TEST	
PATIENT'S NAME: IVANOVA II	
Sex: male	Age: 85 y.o.
DEPARTMENTpulmonology	
Macroscopic examination	
Amount: 15 ml	Consistence: fluid
Odor: odorless	Color: pink
Character: mucous	Foammy,gummous
Microscopic examination	
WBC	1–2 per high-powered field
RBC	8–12 per high-powered field
Epithelium squamous	1–2 per high-powered field
Epithelium cylindrical	absent
Alveovar macrophage	absent
Elastic fibers	absent
Spirals of Kurshman	absent
Crystals of Charcot–Leyden	absent
Special stain	
Neutrophils	single
Lymphocytes	single
Eosinophils	absent
RBC	considerable amount
Alveovar macrophage	absent
Fungi	absent
Acid Resistant Bacteria	absent
Conclusion:	

36. SPUTUM TEST	
PATIENT'S NAME: IVANOV II	
Sex: male	Age: 34 y.o.
DEPARTMENTpulmonology	
Macroscopic examination	
Amount: 200 ml	Consistence: viscous
Odor: odorless	Color: grayish-yellow
Character: bloody	Admixture: absent
Microscopic examination	
WBC	5–6 per high-powered field
RBC	1–2 per high-powered field
Epithelium squamous	2–4 per high-powered field
Epithelium cylindrical	absent
Alveovar macrophage	absent
Elastic fibers	1–2 per high-powered field
Spirals of Kurshman	absent
Crystals of Charcot–Leyden	absent
Special stain	
Neutrophils	20 %
Lymphocytes	80 %
Eosinophils	absent
Alveovar macrophage	absent
Fungi	absent
Acid Resistant Bacteria	3–4 in 100 sights
Conclusion:	

37. SPUTUM TEST	
PATIENT'S NAME: IVANOV II	
Sex: male	Age: 74 y.o.
DEPARTMENTpulmonology	
Macroscopic examination	
Amount: 25 ml	Consistence: fluid
Odor: odorless	Color: reddish-yellow
Character: mucous-bloody	Admixture: absent
Microscopic examination	
WBC	20–30 per high-powered field
RBC	considerable amount
Epithelium squamous	0–1 per high-powered field
Epithelium cylindrical	absent
Alveovar macrophage	1–2 per high-powered field
Elastic fibers	absent
Spirals of Kurshman	absent
Crystals of Charcot–Leyden	absent
Crystals of hematoidin	considerable amount
Special stain	
Neutrophils	50 %
Lymphocytes	50 %
RBC	considerable amount
Alveovar macrophage	absent
Fungi	absent
Acid Resistant Bacteria	absent
Conclusion:	

38. SPUTUM TEST	
PATIENT'S NAME: IVANOV II	
Sex: male	Age: 43 y.o.
DEPARTMENTpulmonology	
Macroscopic examination	
Amount: 350 ml	Consistence: semifluid
Odor: stinking	Color: yellow-green
Character: purulent	Creamy
Microscopic examination	
WBC	40–50 per high-powered field
RBC	2–3 per high-powered field
Epithelium squamous	absent
Epithelium cylindrical	absent
Alveovar macrophage	absent
Elastic fibers	absent
Spirals of Kurshman	absent
Crystals of Charcot–Leyden	absent
Crystals of hematoidin	considerable amount
Special stain	
Neutrophils	99 %
Lymphocytes	1 %
RBC	2–3 per high-powered field
Alveovar macrophage	absent
Fungi	absent
Acid Resistant Bacteria	absent
Conclusion:	

39. SPUTUM TEST	
PATIENT'S NAME: IVANOVA II	
Sex: female	Age: 50 y.o.
DEPARTMENTpulmonology	
Macroscopic examination	
Amount: 20 ml	Consistence: viscous
Odor: odorless	Color: grayish-white
Character: mucous	Admixture: absent
Microscopic examination	
WBC	5–10 per high-powered field
RBC	absent
Epithelium squamous	0–1 per high-powered field
Epithelium cylindrical	0–1 per high-powered field
Alveovar macrophage	absent
Elastic fibers	absent
Spirals of Kurshman	0–1 per high-powered field
Crystals of Charcot–Leyden	2–3 per high-powered field
Special stain	
Neutrophils	absent
Lymphocytes	absent
Eosinophils	5–10 per high-powered field
Alveovar macrophage	absent
Fungi	absent
Acid Resistant Bacteria	absent
Conclusion:	

FOR NOTES

BIOCHEMICAL BLOOD ANALYSIS

40. BIOCHEMICAL BLOOD ANALYSIS		
Parameter	**Reference values**	**Units**
Urea	2,5–8,3	mmol/l
Creatinine	0,044–0,12	mmol/l
Total protein	60–87 (after 65 y.o.) 65–87 (3–65 y.o.)	g/l
Albumen	35–55	g/l
Glucose	3,9–6,4	mmol/l
Bilirubin total	5–21	mcmol/l
Bilirubin direct	0,5–5,1	mcmol/l
Bilirubin indirect	6,4–15,4	mcmol/l
ALT	5–45	u/l
AST	Less 45	u/l
GGTP	Female: 4–38 Male: 2–55	u/l
LDH	Less 248	u/l
Alkaline phosphatase	Female: less 240 Male: less270	u/l
Amylase	22–120	u/l
CRP	0–6	mg/l
Rheumatoid factor	Less 15	IU/ml
ASL-O	Less 200	IU/ml
Uric acid	Female: 0,24–0,36 Male: 0,3–0,42	mmol/l
Creatine kinase	20–174	u/l
Creatine kinase-MB	Less 24	u/l
Troponine	Less 0,05	ng/ml

Parameter	**Reference values**	**Units**
Total cholesterol	2,82–5,2	mmol/l
LDL	Less 3,36	mmol/l
HDL	0,78–1,63	mmol/l
Triglycerids	0,42–1,67	mmol/l
Atherogenic index	2–3	
Potassium	3–5,4	mmol/l
Calcium	2–2,75	mmol/l
Sodium	130–150	mmol/l
Chloride	95–110	mmol/l

41.

BIOCHEMICAL BLOOD ANALYSIS

PATIENT'S NAME: IVANOVA II			
Sex: female	Age: 37 y.o.		
Height 168 sm	Weight 72 kg		
Parameter	Result	Units	Note
Urea	16,4	mmol/l	
Creatinine	0,189	mmol/l	
Total protein	56	g/l	
Albumen	23	g/l	
Glucose	5,6	mmol/l	
Bilirubin total	10	mcmol/l	
ALT	13	u/l	
AST	16	u/l	
SRP	6	mg/l	
Potassium	5,7	mmol/l	
Calcium	2,25	mmol/l	
Sodium	131	mmol/l	
Chloride	100	mmol/l	
Conclusion:			

42.

BIOCHEMICAL BLOOD ANALYSIS

PATIENT'S NAME: IVANOV II			
Sex: male	Age: 45 y.o.		
Height 182 sm	Weight 94 kg		
Parameter	Result	Units	Note
Urea	4,2	mmol/l	
Creatinine	0,087	mmol/l	
Total protein	73	g/l	
Albumen	38	g/l	
Glucose	4,8	mmol/l	
Bilirubin total	20,5	mcmol/l	
Bilirubin direct	4,5	mcmol/l	
Bilirubin indirect	16	mcmol/l	
ALT	278	u/l	
AST	156	u/l	
LDH	460	u/	
GGTP	378	u/l	
Potassium	4,7	mmol/l	
Calcium	2,23	mmol/l	
Conclusion:			

43.

BIOCHEMICAL BLOOD ANALYSIS

PATIENT'S NAME: IVANOVA II			
Sex: female	Age: 48 y.o.		
Height 178 sm	Weight 75 kg		
Parameter	Result	Units	Note
Urea	6,5	mmol/l	
Creatinine	0,098	mmol/l	
Total protein	69	g/l	
Albumen	38	g/l	
Glucose	4,0	mmol/l	
Bilirubin total	48,5	mcmol/l	
Bilirubin direct	27,5	mcmol/l	
Bilirubin indirect	21	mcmol/l	
ALT	43	u/l	
AST	42	u/l	
GGTP	478	u/l	
Alkaline phosphatase	575	u/l	
Potassium	4,4	mmol/l	
Calcium	2,2	mmol/l	
Sodium	134	mmol/l	
Chloride	107	mmol/l	
Total cholesterol	8,2	mmol/l	
Conclusion:			

44.

BIOCHEMICAL BLOOD ANALYSIS

PATIENT'S NAME: IVANOV II			
Sex: male	Age: 69 y.o.		
Height 174 sm	Weight 88 kg		
Parameter	Result	Units	Note
Urea	3,9	mmol/l	
Creatinine	0,098	mmol/l	
Total protein	56	g/l	
Albumen	23	g/l	
Glucose	5,6	mmol/l	
Bilirubin total	28,6	mcmol/l	
Bilirubin direct	14	mcmol/l	
Bilirubin indirect	14,6	mcmol/l	
ALT	68	u/l	
AST	73	u/l	
LDH	315	u/l	
GGTP	278	u/l	
Alkaline phosphatase	297	u/l	
Potassium	4,4	mmol/l	
Calcium	2,26	mmol/l	
Sodium	130	mmol/l	
Chloride	103	mmol/l	
Total cholesterol	2,3	mmol/l	
Conclusion:			

45.

BIOCHEMICAL BLOOD ANALYSIS

PATIENT'S NAME: IVANOVA II			
Sex: female	Age: 72 y.o.		
Height 164 sm	Weight 78 kg		
Parameter	Result	Units	Note
Urea	7,6	mmol/l	
Creatinine	0,077	mmol/l	
Total protein	62	g/l	
Uric acid	0,655	mmol/l	
Glucose	7,5	mmol/l	
Bilirubin total	14,3	mcmol/l	
Bilirubin direct	3,3	mcmol/l	
Bilirubin indirect	11,0	mcmol/l	
ALT	12	u/l	
AST	20	u/l	
GGTP	48	u/l	
Alkaline phosphatase	148	u/l	
Potassium	4,2	mmol/l	
Calcium	2,2	mmol/l	
Sodium	140	mmol/l	
Chloride	102	mmol/l	
Total cholesterol	8,3	mmol/l	
LDL-cholesterol	5,78	mmol/l	
HDL-cholesterol	0,62	mmol/l	
Triglycerids	4,9	mmol/l	
Aterogenic index	12,4		
Conclusion:			

46.

BIOCHEMICAL BLOOD ANALYSIS

PATIENT'S NAME: IVANOV II			
Sex: male	Age: 54 y.o.		
Height 174 sm	Weight 109 kg		
Parameter	Result	Units	Note
Urea	5,4	mmol/l	
Creatinine	0,1	mmol/l	
Total protein	66	g/l	
Albumen	30	g/l	
Uric acid	0,59	mmol/l	
Glucose	6,8	mmol/l	
Bilirubin total	20,0	mcmol/l	
ALT	82	u/l	
AST	112	u/l	
LDH	448	u/l	
Potassium	4,8	mmol/l	
Calcium	2,15	mmol/l	
Sodium	142	mmol/l	
Chloride	104	mmol/l	
Troponin	1,25	нg/ml	
Creatine kinase	980	u/l	
Creatine kinase-MB	594	u/l	
Total cholesterol	5,9	mmol/l	
LDL-cholesterol	3,38	mmol/l	
HDL-cholesterol	1,1	mmol/l	
Triglycerids	2,5	mmol/l	
Conclusion:			

47.

BIOCHEMICAL BLOOD ANALYSIS

PATIENT'S NAME: IVANOVA II

Sex: female	Age: 25 y.o.		
Height 158 sm	Weight 69 kg		
Parameter	Result	Units	Note
Urea	6,6	mmol/l	
Creatinine	0,068	mmol/l	
Total protein	55	g/l	
Uric acid	0,34	mmol/l	
Glucose	5,9	mmol/l	
Bilirubin total	19,5	mcmol/l	
CRP	22,4	mg/l	
Rheumatoid factor	48	IU/ml	
ASL-O	350	IU/ml	
ALT	18	u/l	
AST	22	u/l	
GGTP	50	u/l	
Potassium	4,0	mmol/l	
Calcium	2,2	mmol/l	
Sodium	142	mmol/l	
Chloride	103	mmol/l	
Total cholesterol	4,6	mmol/l	
Triglycerids	2,8	mmol/l	

Conclusion:

48.

BIOCHEMICAL BLOOD ANALYSIS

PATIENT'S NAME: IVANOV II

Sex: male	Age: 50 y.o.		
Height 181 sm	Weight 134 kg		
Parameter	Result	Units	Note
Urea	18,2	mmol/l	
Creatinine	0,38	mmol/l	
Total protein	50	g/l	
Albumen	24	g/l	
Uric acid	0,49	mmol/l	
Glucose	14,9	mmol/l	
Bilirubin total	23,0	mcmol/l	
ALT	48	u/l	
AST	40	u/l	
Potassium	5,8	mmol/l	
Calcium	2,1	mmol/l	
Sodium	140	mmol/l	
Chloride	101	mmol/l	
Creatine kinase	172	u/l	
Creatine kinase-MB	12	u/l	
Total cholesterol	6,9	mmol/l	
Triglycerids	4,5	mmol/l	

Conclusion:

FOR NOTES

CHAPTER 2
ELECTROCARDIOGRAPHY

THE CARDIAC CONDUCTION SYSTEM

Write the elements of the cardiac conduction system

1 –

2 –

3 –

4 –

5 –

6 –

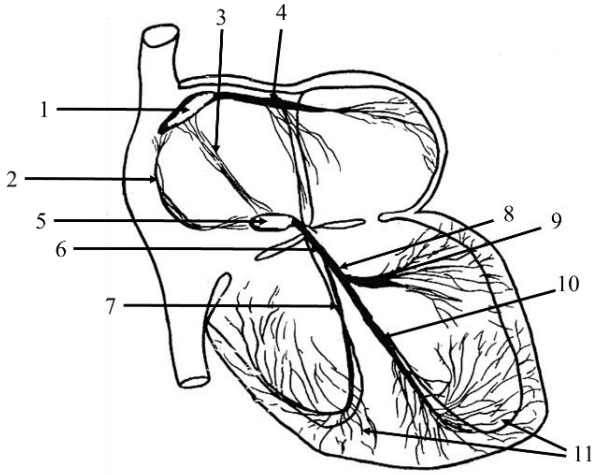
7 –

8 –

9 –

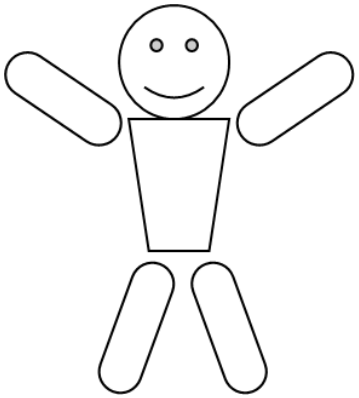
10 –

11 –



ECG ELECTRODE PLACEMENT

1. Color the electrodes applied to the limbs
2. Draw the standard leads by arrows



Limb Leads *(write)*

I — between _____ and _____

II — between _____ and _____

III — between _____ and _____

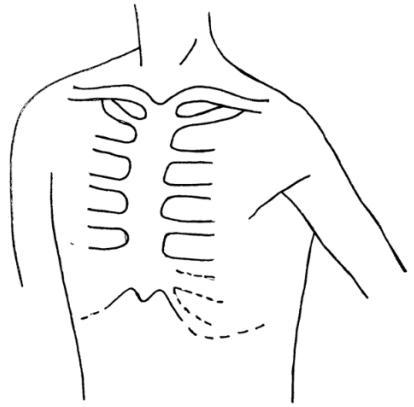
Augmented Limb Leads *(write)*

aVR — augmented lead from _____

aVL — augmented lead from _____

aVF — augmented lead from _____

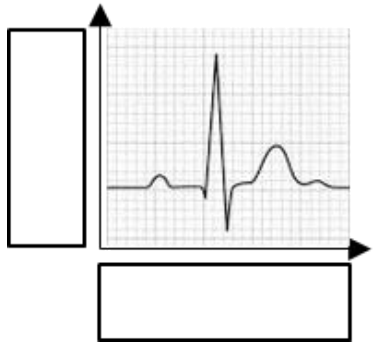
Draw the location of the chest electrodes



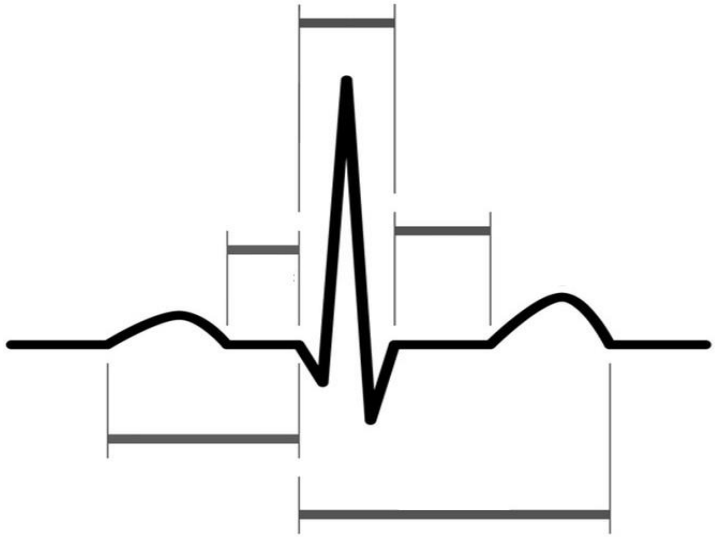
NORMAL ELECTROCARDIOGRAM

ECG elements		Duration, sec	Amplitude, mm
wave	P	0,08–0,1	0,05–2,5
wave	Q	0–0,03	$^1/_4$ R-wave at the same lead
wave	R	0,03–0,04	5–25
wave	S	0–0,03	0–6
wave	T	0,16–0,24	$^1/_2$–$^1/_3$ R-wave at the same lead
interval	P-Q	0,12–0,2	
interval	Q-T	0,35–0,42	
interval	R-R	0,75–1,0	
segment	S-T		Elevation or depression less than 1 mm from isoline
complex	QRS	0,06–0,1	

Indicate the amplitude and speed of the ECG recording



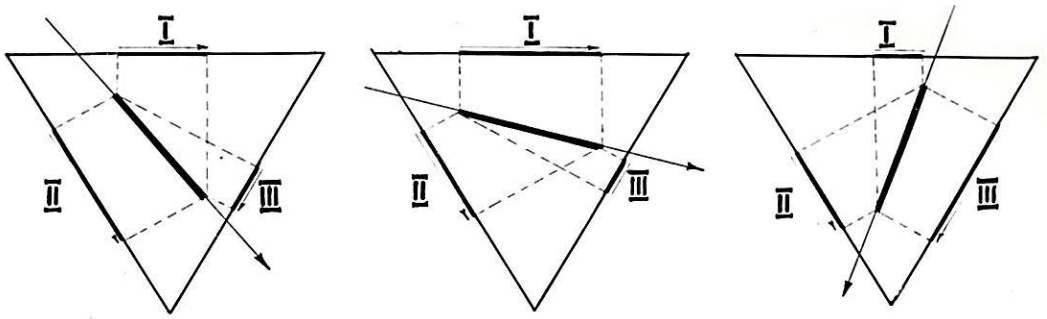
Indicate the elementss of a normal ECG



ECG analysis algorithm

1. Rhythm	Sinus rhythm	• wave P precedes every QRS complex, P is positive in standard lead II, the same in shape and direction in the same lead • RR intervals are equal, regular If the difference between RR intervals is more than 10 %, arrhythmia presents
	Heart rate	Heart rate = 60 / RR (sec), 60–90 beats per minute — normocardia, less than 60 — bradycardia, more than 90 — tachycardia
2. Voltage	Amplitude of waves RI + RII + RIII < 15 mm — low voltage	
3. Position of the electrical axis of the heart	RII > RI > RIII — normal position of the electrical heart axis RI > RII > RIII — left axis deviation RIII > RII > RI — right axis deviation	
4. Analysis of waves and intervals in standard lead II	Wave P: normal duration does not exceed 0.1 sec, amplitude — less than 2.5 mm Interval PQ: 0.02 sec × ... mm = ... (0.12–0.20 sec) Wave Q — normally does not exceed 0.03 sec in duration, amplitude — $^1/_4$ R wave (in III — not more than $^1/_2$ R). Transition zone (R = S) in V3 (or between V3 and V4) The amplitude of the R and T waves is maximum in V4. Interval QRS: 0.02 sec ×… mm = … (normally 0.06–0.1 sec); QRS > 0.1 sec, but less than < 0.12 sec — incomplete bundle brunch block; QRS ≥ 0.12 sec — complete bundle brunch block Segment ST: the position in relation to the isoline (on the isoline, higher by … mm, lower by … mm). Normally, segment ST is on the isoline. Wave T: positive, negative, isoelectric — in what leads Interval QT: 0.02 sec × ... mm = ... (less than 0.44 sec) Interval QT by Bazett formula = K × √ RR, with K (male) = 0.37 K (female) = 40	
5. Conclusion: *For example:* *Sinus rhythm, regular, with a heart rate of 66 per minute (normocardia), normal voltage, normal position of the electrical axis of the heart.*		

THE ELECTRICAL AXIS OF THE HEART



ECG SIGNS OF NORMAL SINUS RHYTHM

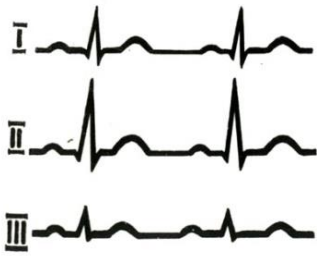
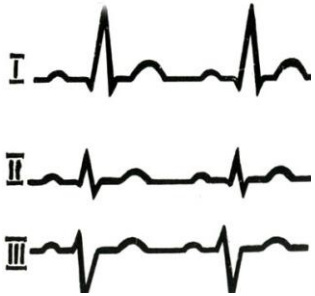
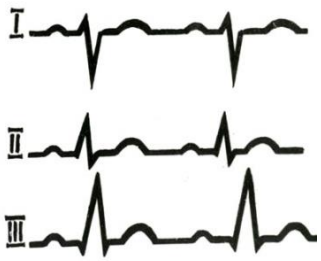
- The heart rate is between 60 and 90.
- Each QRS complex is preceded by a normal P wave.
- The RR intervals and PR intervals remain constant.
- The P waves are visible, positive at lead II and have the same shape and direction in the same lead.

Quick Heart Rate count:

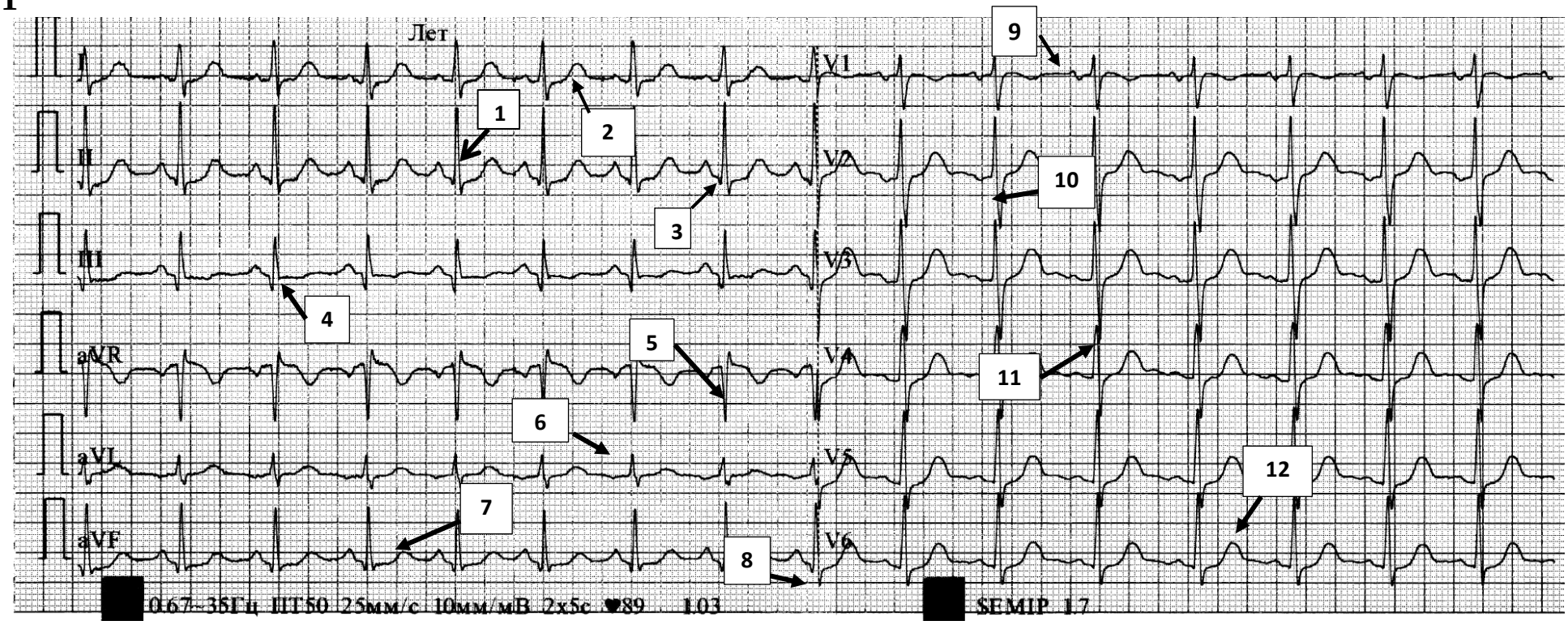
at a speed of 50 mm/s **Heart rate** $= \frac{600}{LB}$

at a speed of 25 mm/s **Heart rate** $= \frac{300}{LB}$

LB *— the number of large boxes (5 mm each) in the RR interval*

Normal axis	**Left axis deviation**	**Right axis deviation**	**ECG signs of Sinus Tachycardia** *(write)*	**ECG signs of Sinus Bradycardia** *(write)*
			• Heart rate is • Rhythm	• Heart rate is • Rhythm

1



Paper speed:

50 mm/sec 1 mm = 0,02 sec
25 mm/sec 1 mm = 0,04 sec

Rhythm (sinus or not)

Heart rate: interval RR

0,02 (or 0,04) sec × mm = sec
0,02 (or 0,04) sec × mm = sec
0,02 (or 0,04) sec × mm = sec

HR = 60 / RR interval (sec) =

Name the marked waves:

1 –
2 –
3 –
4 –
5 –
6 –
7 –
8 –
9 –
10 –
11 –
12 –

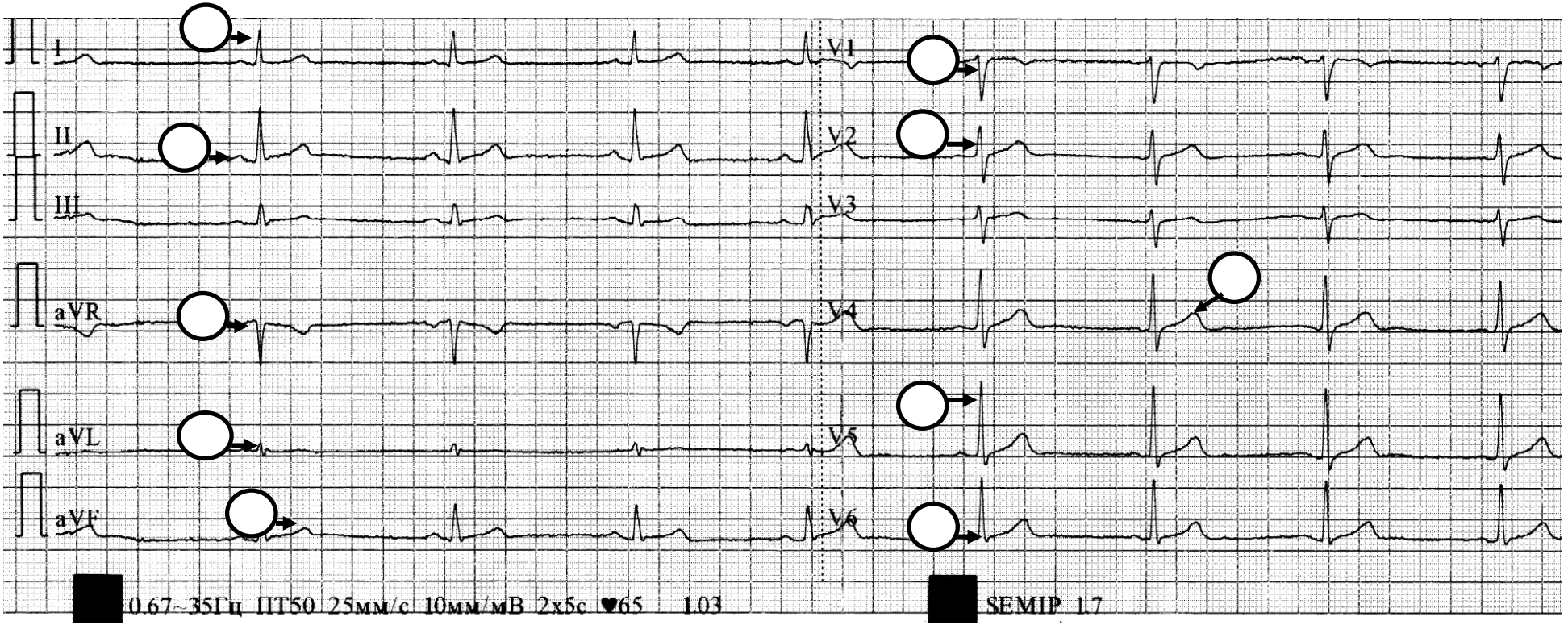
Position of the electrical axis of the heart
(underline the correct answer)

normal position

left axis deviation

right axis deviation

2



Paper speed:

50 mm/sec 1 mm = 0,02 sec
25 mm/sec 1 mm = 0,04 sec

Rhythm (sinus or not)

Heart rate: interval RR

0,02 (or 0,04) sec × mm = sec
0,02 (or 0,04) sec × mm = sec
0,02 (or 0,04) sec × mm = sec

HR = 60 / RR interval (sec) =

Name the marked waves:

I –

II –

III –

aVL –

V1 –

V2 –

V4 –

V5 –

V6 –

Position of the electrical axis of the heart
(underline the correct answer)

normal position

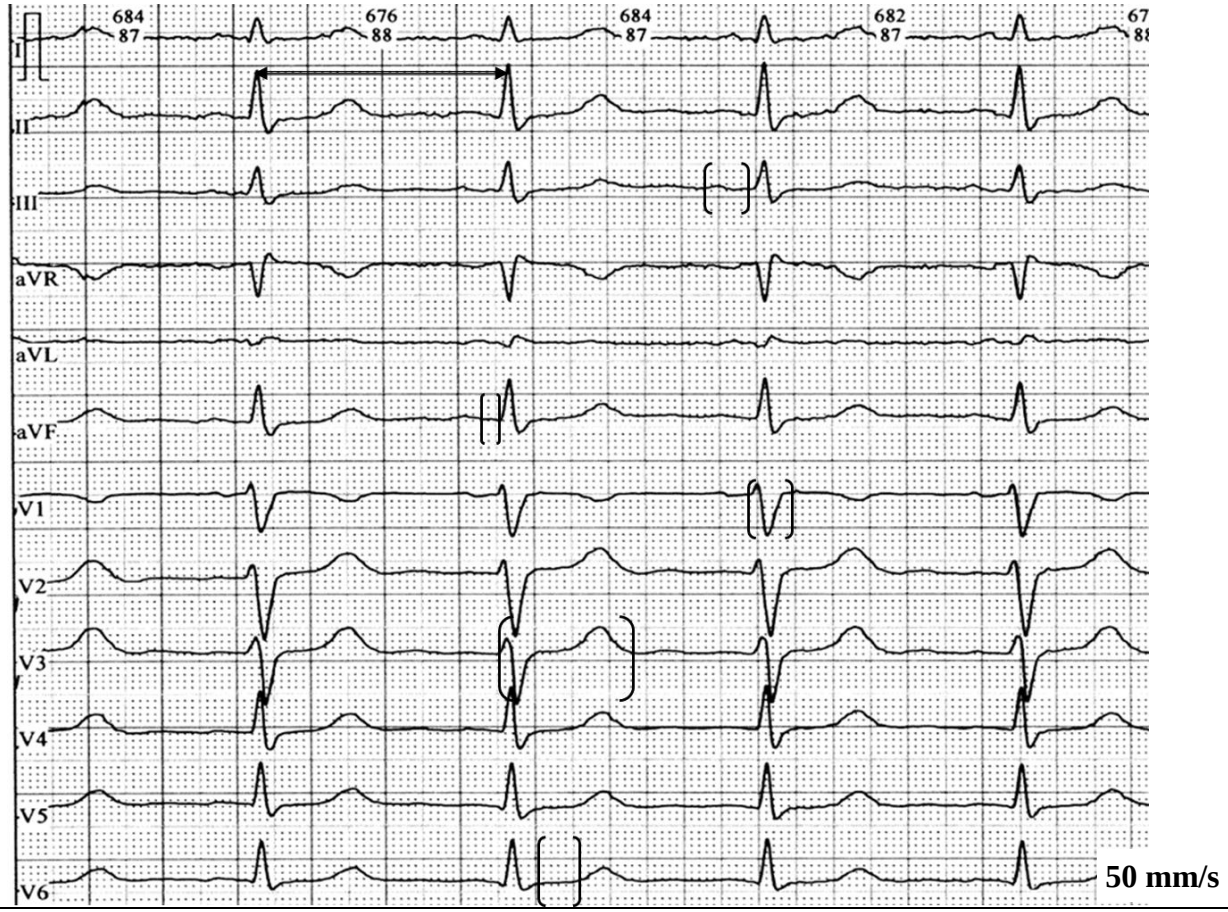
left axis deviation

right axis deviation

Write the ECG elements and appropriate components of the electrical sequence of the heart

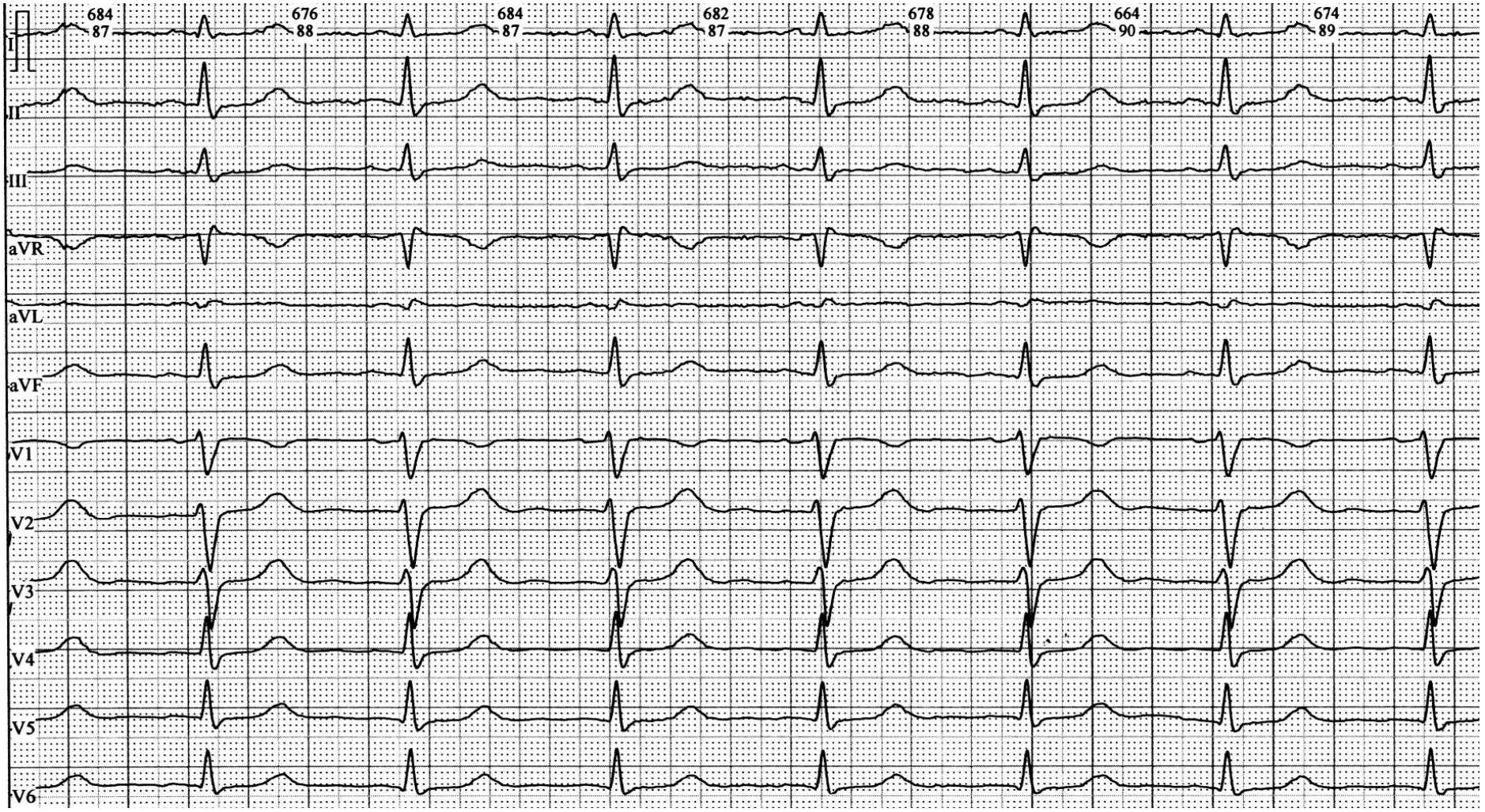
P		RR	
PQ		QT	
QRS		ST	
T		TP	

Write the segments and intervals (in brackets) and compare their duration with normal values



Lead	Segments or intervals	Duration, sec
II		
III		
aVF		
V1		
V3		
V6		

3


684
87
676
88
684
87
682
87
678
88
664
90
674
89
I
II
III
aVR
aVL
aVF
V1
V2
V3
V4
V5
V6

50 mm/s

3

Paper speed: 50 mm/s 1 mm = 0,02 sec
25 mm/s 1 mm = 0,04 sec

I. Rhythm (sinus or not)
Normal sinus rhythm: normal heart rate is between 60 and 90.
Each QRS complex is preceded by a normal P wave.
The RR intervals and PR intervals remains constant, the P waves are visible, positive at II lead and have the same morphology in each lead.
RR (the same).
The difference between RR intervals is more than 0.16 sec — arrhythmia.

0,02 (or 0,04) sec × mm = sec

0,02 (or 0,04) sec × mm = sec

0,02 (or 0,04) sec × mm = sec

Heart Rate = 60 / RR interval (sec)

II. Voltage RI + RII + RIII < 15 mm — low voltage

III. Axis

normal position

left axis deviation

right axis deviation

QT interval corresponds to _____ ventricles

What does Bazett formula calculate? _____

V. Conclusion

IV. Analysis of waves and intervals
P wave — duration < 0,1 sec amplitude < 2,5 mm

QRS — 0,02 (or 0,04) sec × mm = (less 0,1 sec)

0,11–0,12 sec — incomplete bundle branch block
> 0,12 sec — complete bundle branch block

PQ — 0,02 (or 0,04) sec × mm = (0,12–0,20 sec)

QT — 0,02 (or 0,04) sec × mm = (less 0,44 sec)

QT by Bazett formula $K \times \sqrt{RR/sec}$

Kmale = 0,37

Kfemale = 0,40

T wave — positive in leads…….

flat in leads …….

negative in leads …….

segment ST is characterized the position in relation to the isoline

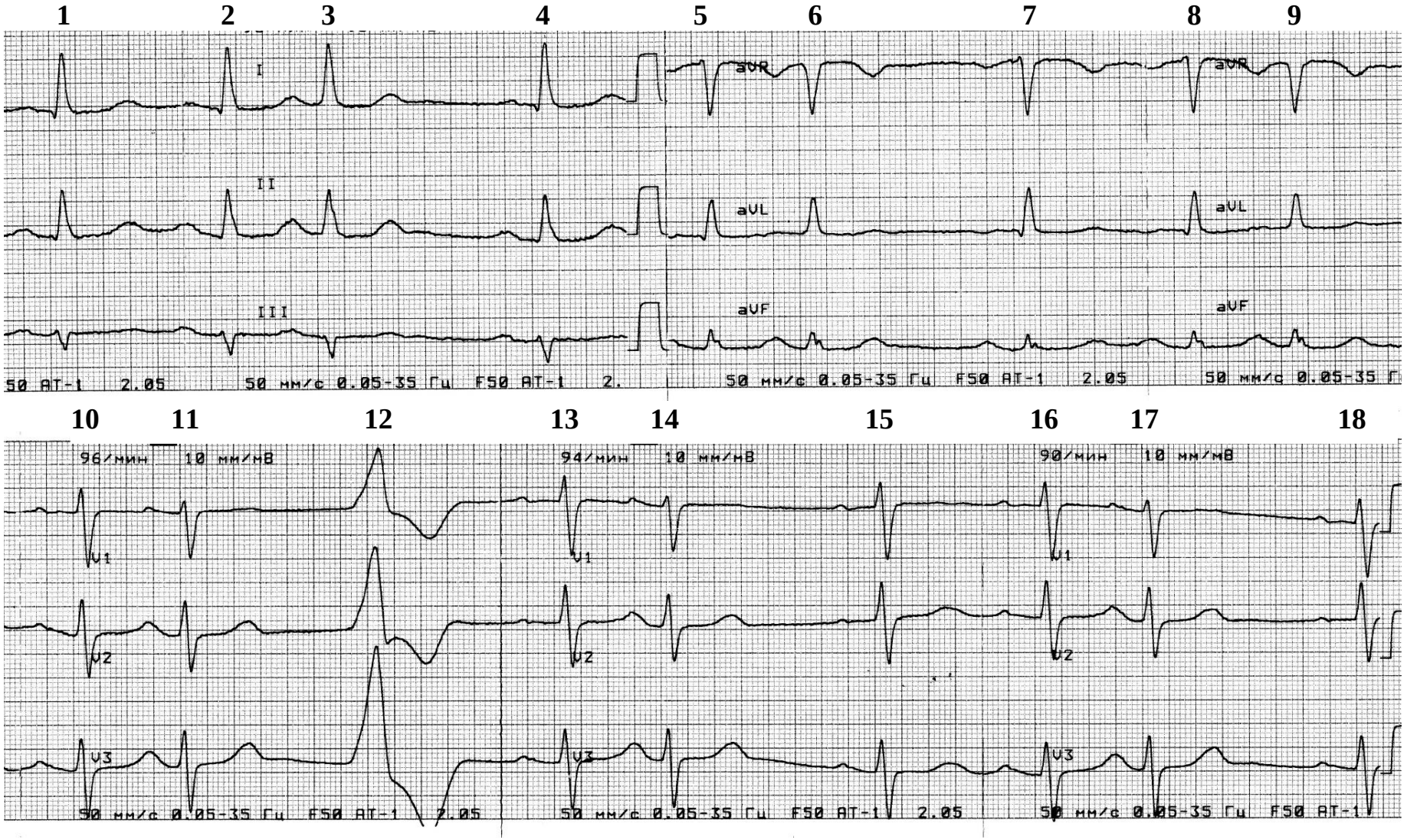
(on the isoline, higher by … mm, lower by … mm)

I	aVR	V1	V4
II	aVL	V2	V5
III	aVF	V3	V6

Q wave should be less than $^1/_4$ R wave in the same lead,
duration < 0,03 sec

Transition zone (R = S) in V3 (or between V3 and V4)
R increases from V1 to V4, then decreases

4


1
2
3
4
5
6
7
8
9
I
II
III
aVR
aVL
aVF
50 мм/с 0.05-35 Гц
10
11
12
13
14
15
16
17
18
96/мин
94/мин
90/мин
10 мм/мВ
V1
V2
V3

4

Paper speed: 50 mm/s 1 mm = 0,02 sec
25 mm/s 1 mm = 0,04 sec

I. Rhythm (sinus or not)
Normal sinus rhythm:
Each QRS complex is preceded by a normal P wave.
The RR intervals and PR intervals remains constant, the P waves are visible, positive at II lead and have the same morphology in each lead.
RR (the same).
The difference between RR intervals is more than 0.16 sec — arrhythmia.

RR (*minimum and maximum*)

0,02 (or 0,04) sec × mm = sec

0,02 (or 0,04) sec × mm = sec

0,02 (or 0,04) sec × mm = sec

Heart Rate = 60 / RR interval (sec) (*minimum and maximum)*

II. Voltage RI + RII + RIII **<** 15 mm — low voltage

III. Axis

normal position

left axis deviation

right axis deviation

V. Conclusion

IV. Analysis of waves and intervals

P wave — duration < 0,1 sec amplitude < 2,5 mm

QRS — 0,02 (or 0,04) sec × mm = (less 0,1 sec)

0,11–0,12 sec — incomplete bundle branch block
> 0,12 sec — complete bundle branch block

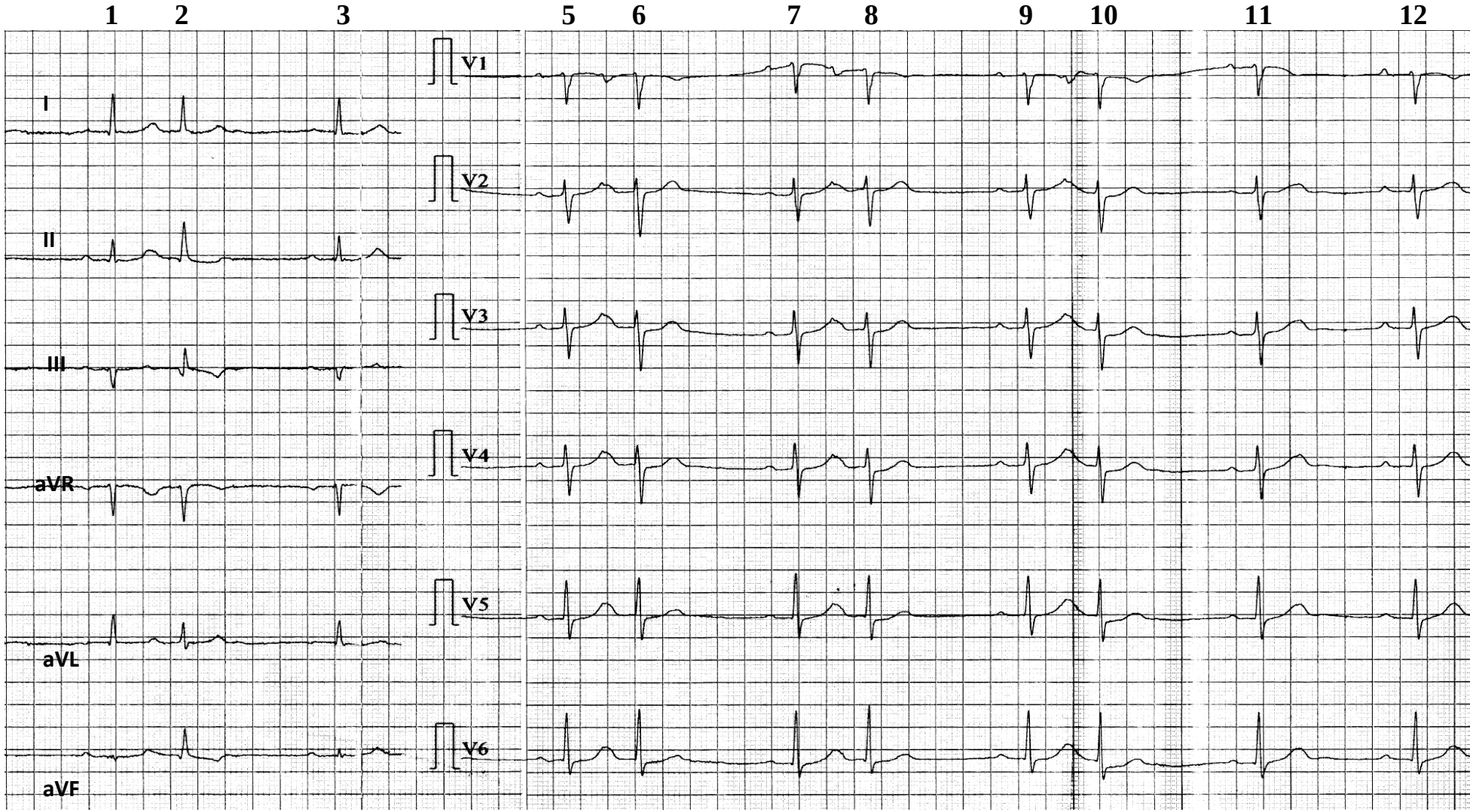
PQ — 0,02 (or 0,04) sec × mm = (0,12–0,20 sec)

QT — 0,02 (or 0,04) sec × mm = (till 0,44 sec)

Name the impulse source for each QRS complex:

1 –
2 –
3 –
4 –
5 –
6 –
7 –
8 –
9 –
10 –
11 –
12 –
13 –
14 –
15 –
16 –
17 –
18 -

5



25 mm/s

5

Paper speed: 50 mm/s 1 mm = 0,02 sec
25 mm/s 1 mm = 0,04 sec

I. Rhythm (sinus or not)
Normal sinus rhythm:
Each QRS complex is preceded by a normal P wave
The RR intervals and PR intervals remains constant
P waves are visible, positive at II lead

RR *(minimum and maximum)*

0,02 (or 0,04) sec × mm = sec

0,02 (or 0,04) sec × mm = sec

Heart Rate = 60 / RR interval (sec) (*minimum and maximum)*

II. Voltage RI + RII + RIII < 15 mm — low voltage

III. Axis

normal position

left axis deviation

right axis deviation

V. Conclusion

IV. Analysis of waves and intervals

P wave — duration < 0,1 sec amplitude < 2,5 mm

QRS — 0,02 (or 0,04) sec × mm = (less 0,1 sec)

PQ — 0,02 (or 0,04) sec × mm = (0,12–0,20 sec)

QT — 0,02 (or 0,04) sec × mm = (till 0,44 sec)

Name the impulse source for each QRS complex:

1 – 7 –

2 – 8 –

3 – 9 –

4 – 10 –

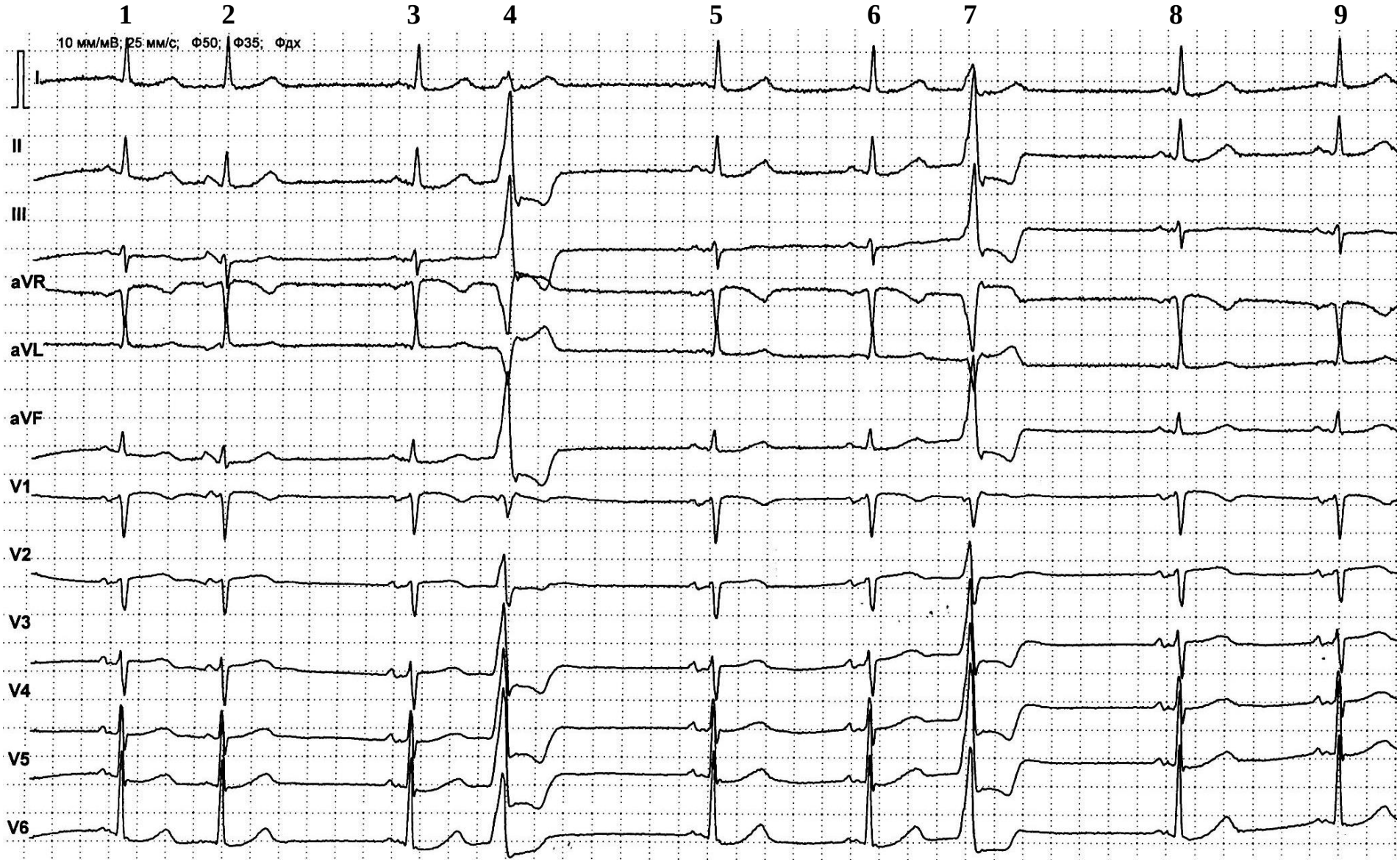
5 – 11 –

6 – 12 –

What is the arrhythmia type when after each sinus contraction a premature contraction follows?

_____

6


1
2
3
4
5
6
7
8
9
10 мм/мВ; 25 мм/с; Ф50; Ф35; Фдх
I
II
III
aVR
aVL
aVF
V1
V2
V3
V4
V5
V6

6

Paper speed: 50 mm/s 1 mm = 0,02 sec
25 mm/s 1 mm = 0,04 sec

I. Rhythm (sinus or not)
Normal sinus rhythm:
Each QRS complex is preceded by a normal P wave
The RR intervals and PR intervals remains constant
P waves are visible, positive at II lead

RR *(minimum and maximum)*

0,02 (or 0,04) sec × mm = sec

0,02 (or 0,04) sec × mm = sec

Heart Rate = 60 / RR interval (sec) (*minimum and maximum*)

II. Voltage RI + RII + RIII < 15 mm — low voltage

III. Axis

normal position

left axis deviation

right axis deviation

V. Conclusion

IV. Analysis of waves and intervals

P wave — duration < 0,1 sec, amplitude < 2,5 mm

QRS — 0,02 (or 0,04) sec × mm = (less 0,1 sec)

Measure all QRS complexes in lead II

1) QRS — 0,02 (or 0,04) sec × mm = (less 0,1 sec)
2) QRS=
3) QRS=
4) QRS=
5) QRS=
6) QRS=
7) QRS=
8) QRS=
9) QRS=

Name the impulse source for each QRS complex

1 –
2 –
3 –
4 –
5 –
6 –
7 –
8 –
9 –

- *Sign all P waves in lead V2*
- *Indicate a compensatory pause in lead III*

ECG SIGNS OF RHYTHM AND CONDUCTION DISORDERS

Write the signs

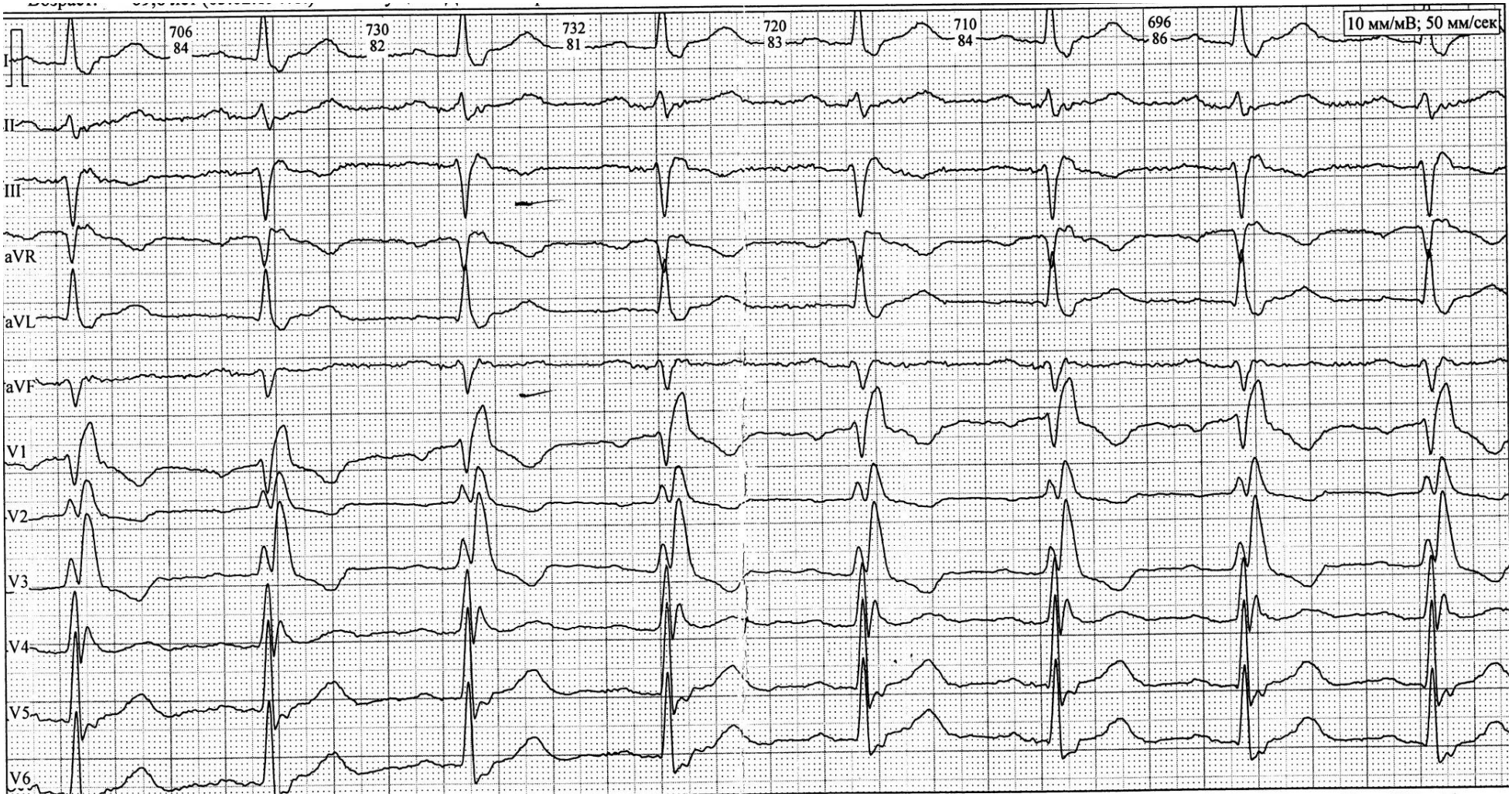
Give a definition Extrasystole is	**Types of extrasystoles by origin**	**General ECG signs of extrasystole**

ECG SIGNS OF BUNDLE BRANCH BLOCK

Write

Right bundle branch block		**Left bundle branch block**
incomplete QRS =	**complete** QRS =	**complete** QRS =

7


706
84
730
82
732
81
720
83
710
84
696
86
10 мм/мВ; 50 мм/сек
I
II
III
aVR
aVL
aVF
V1
V2
V3
V4
V5
V6

7

Paper speed: 50 mm/s 1 mm = 0,02 sec
25 mm/s 1 mm = 0,04 sec

I. Rhythm (sinus or not)
Normal sinus rhythm:
Each QRS complex is preceded by a normal P wave
The RR intervals and PR intervals remains constant
P waves are visible, positive at II lead

RR

0,02 (or 0,04) sec × mm = sec

0,02 (or 0,04) sec × mm = sec

Heart Rate = 60 / RR interval (sec)

II. Voltage *(underline)*

Sufficient or low

III. Axis

normal position

left axis deviation

right axis deviation

V. Conclusion

IV. Analysis of waves and intervals

P duration _____ sec

P amplitude _____ sec

QRS — 0,02 (or 0,04) sec × mm = (less 0,1 sec)

Mark the r and R waves in lead V1, V2, V3 and V4

Note the QRS duration in leads I, III, V1 and V2

I QRS 0,02 (or 0,04) sec × mm = sec

III QRS 0,02 (or 0,04) sec × mm = sec

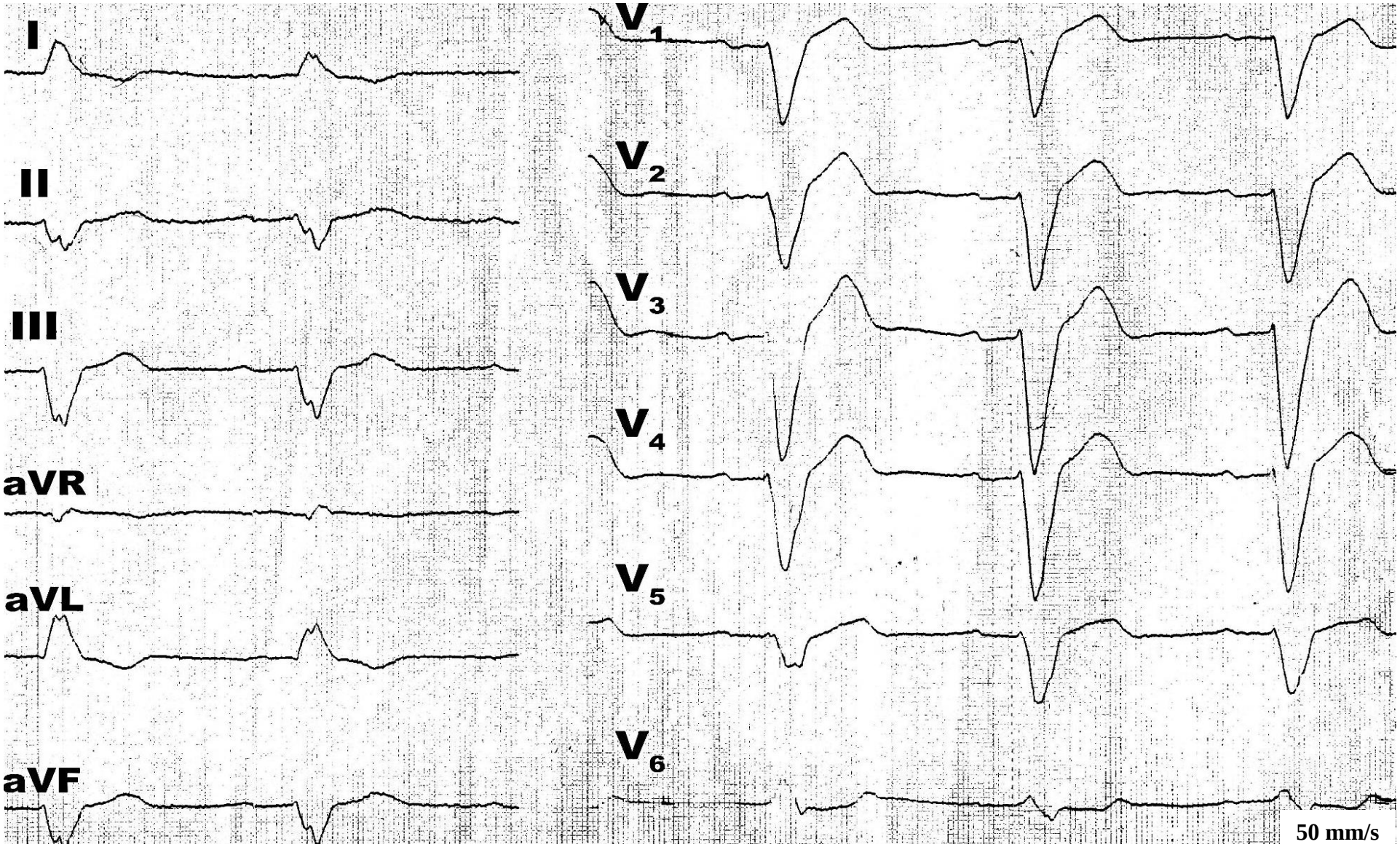
V1 QRS 0,02 (or 0,04) sec × mm = sec

V2 QRS 0,02 (or 0,04) sec × mm = sec

QRS

0,11–0,12 sec — incomplete bundle branch block
> 0,12 sec — complete bundle branch block

8



8

Paper speed: 50 mm/s 1 mm = 0,02 sec
25 mm/s 1 mm = 0,04 sec

I. Rhythm (sinus or not)

Normal sinus rhythm:
Each QRS complex is preceded by a normal P wave
The RR intervals and PR intervals remains constant
P waves are visible, positive at II lead

RR

0,02 (or 0,04) sec × mm = sec

0,02 (or 0,04) sec × mm = sec

Heart Rate = 60 / RR interval (sec)

II. Voltage *(underline)*

Sufficient or low

III. Axis

normal position

left axis deviation

right axis deviation

V. Conclusion

IV. Analysis of waves and intervals

P duration _____ sec

P amplitude _____ sec

PQ — 0,02 (or 0,04) sec × mm = (0,12–0,20 sec)

QRS — 0,02 (or 0,04) sec × mm = (less 0,1 sec)

Note the QRS duration in leads I, III, V1 and V6

I QRS 0,02 (or 0,04) sec × mm = sec

III QRS 0,02 (or 0,04) sec × mm = sec

V1 QRS 0,02 (or 0,04) sec × mm = sec

V6 QRS 0,02 (or 0,04) sec × mm = sec

Find the Transition zone (chest lead where R = S)

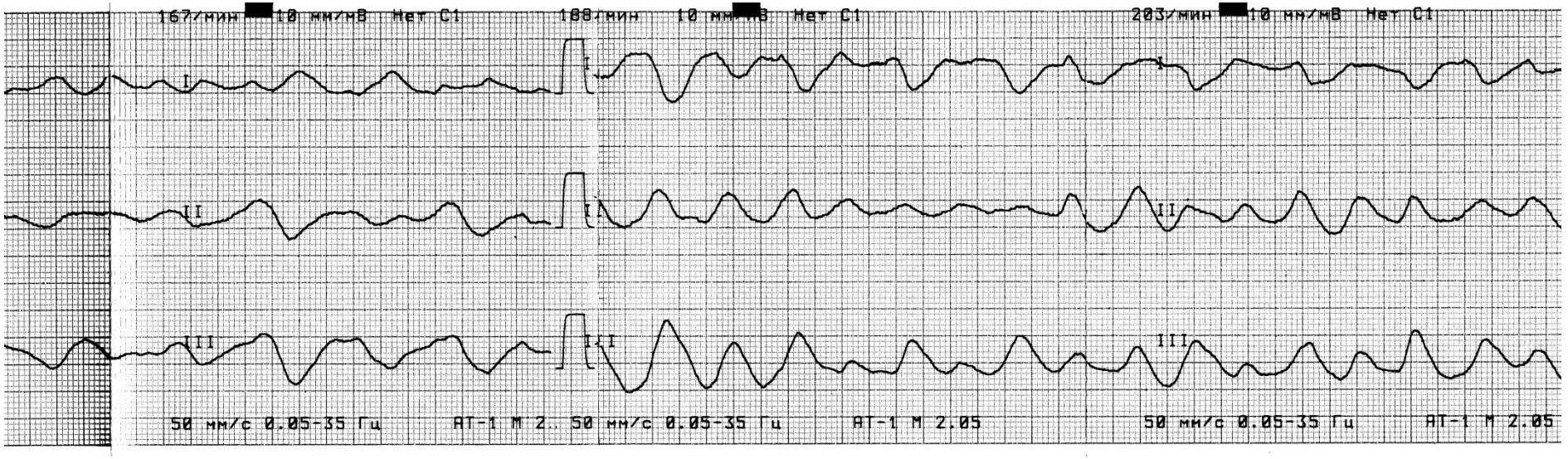
Normally, Transition zone is in the lead _____

ECG SIGNS OF ATRIAL FIBRILLATION AND FLATTER, VENTRICULAR FIBRILLATION

Write

Atrial fibrillation	Atrial flutter	Ventricular fibrillation

9



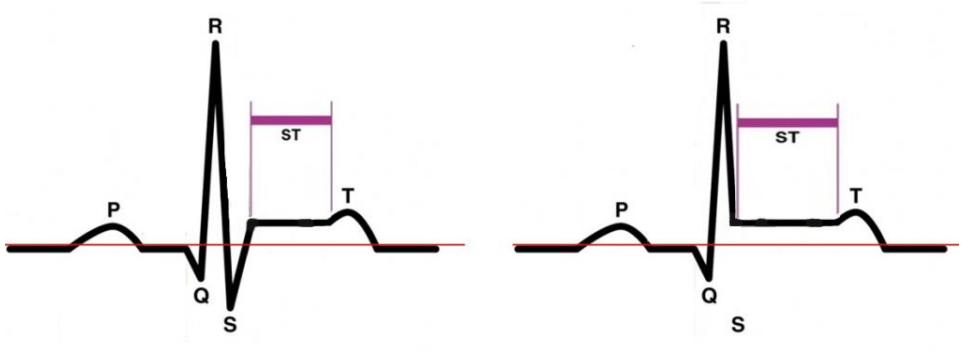
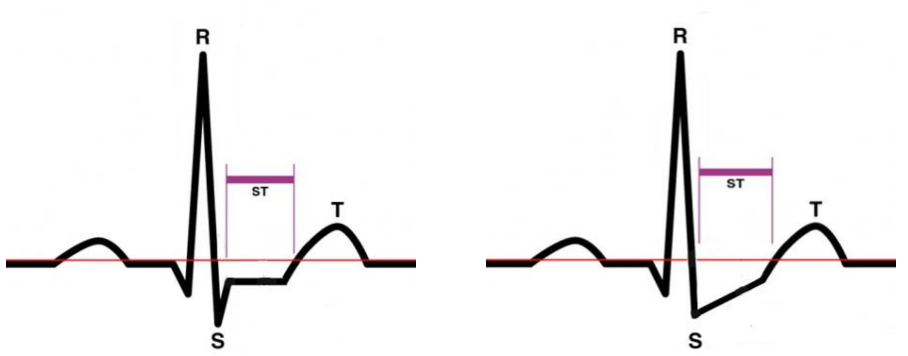
Conclusion:

ECG SIGNS OF MYOCARDIAL ISCHEMIA

Write the appropriate anatomical relations of the leads in a standart 12 leads ECG

Leads	Localization
I	
II	
III	
aVL	
aVF	
V_1, V_2	
V_3	
V_4	
V_5, V_6	

ST segment elevation and depression options

ST segment elevation	ST segment depression
	

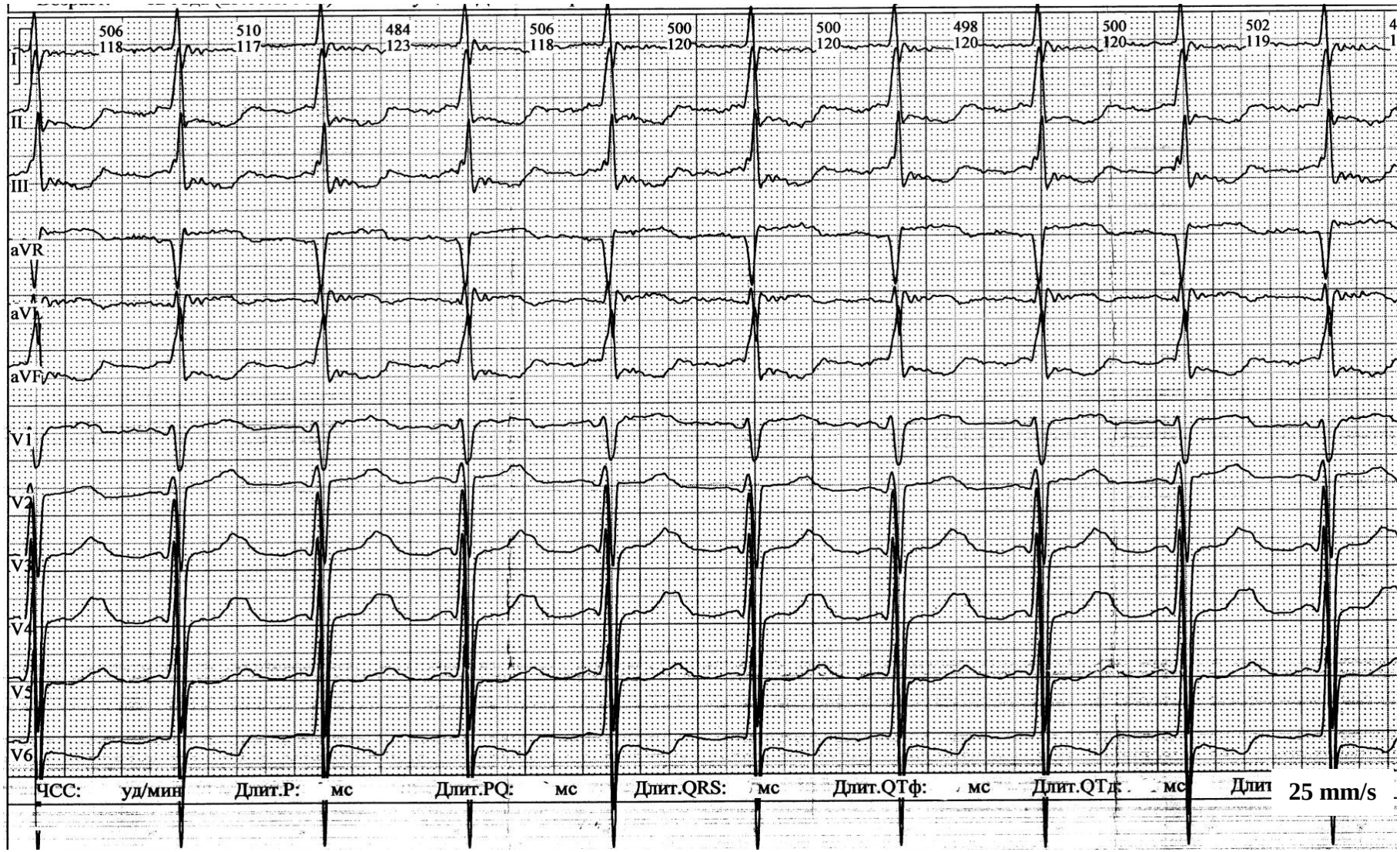
What deviation of the ST segment from the isoline is considered significant:

In the standart leads? _____ In the chest leads? _____

Signs of ST-elevation Acute Myocardial Infarction (STEMI)

		Signs	ECG
Normal ECG		• Q wave is less than $^1/_4$ R wave, duration < 0,03 sec • ST segment is at the isoline • T-wave is positive • ST elevation (single monophasic deflection)	
Evolution of STEMI	The most acute period (first hours)	• ST elevation (single monophasic deflection)	
	Acute period (till 7–10 days)	• Pathological Q wave • Segment ST gradually decreases, but remains above the isoline • Formation of a negative T wave	
	Subacute period (till 28th day)	• Pathological Q wave (QS) • Segment ST on isoline • Wave T negative	
	Infarct scar period (after 29th day)	• Pathological Q wave (QS) • Segment ST on isoline • Wave T positive, negative or flat	

10


506 510 484 506 500 500 498 500 502
118 117 123 118 120 120 120 120 119
I
II
III
aVR
aVL
aVF
V1
V2
V3
V4
V5
V6
ЧСС: уд/мин Длит.P: мс Длит.PQ: мс Длит.QRS: мс Длит.QTф: мс Длит.QTд: мс
25 mm/s

10

Paper speed: 50 mm/s 1 mm = 0,02 sec
25 mm/s 1 mm = 0,04 sec

I. Rhythm (sinus or not)

RR

0,02 (or 0,04) sec × mm = sec

0,02 (or 0,04) sec × mm = sec

0,02 (or 0,04) sec × mm = sec

HR = 60 / RR interval (sec)

II. Voltage *(underline)*

Sufficient or low

III. Axis

normal position

left axis deviation

right axis deviation

V. Conclusion

IV. Analysis of waves and intervals

QRS — 0,02 (or 0,04) sec × mm =

PQ — 0,02 (or 0,04) sec × mm =

Draw an isoline in all leads

Wave T — positive in leads…….

flat in leads……

negative in leads……

Segment ST is on the isoline in leads……..…….……

elevation by …… mm in leads…….

depression by …… mm in leads ……..

Wave Q in leads……

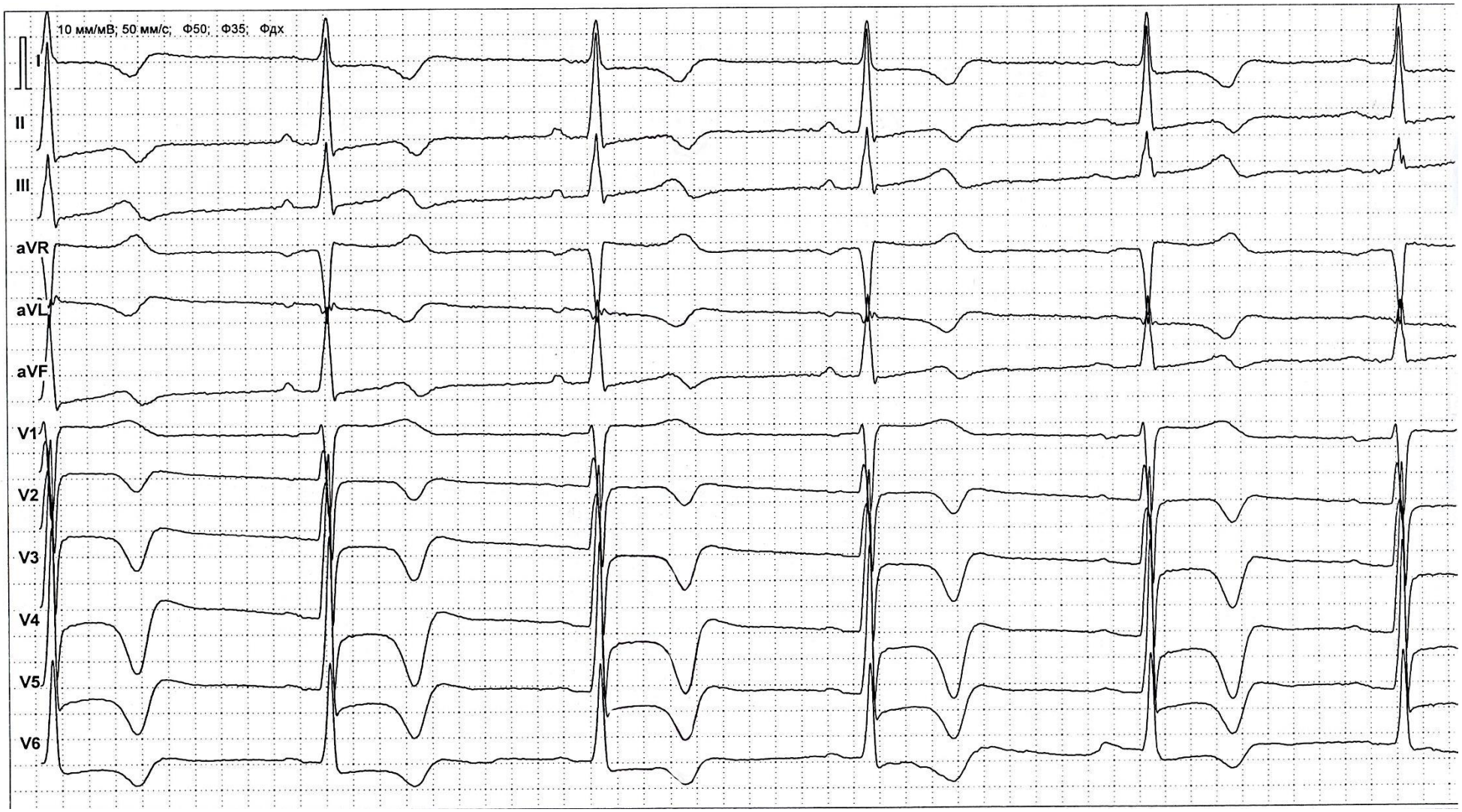
Duration …… sec

Amplitude *(what part)* ……. of R wave

Localization of the ischemia _____

_____

11



11

Paper speed: 50 mm/s 1 mm = 0,02 sec
25 mm/s 1 mm = 0,04 sec

I. Rhythm (sinus or not)

RR = 0,02 (or 0,04) sec × mm = sec

HR = 60 / RR interval (sec)

II. Voltage *(underline)*
Sufficient or low

III. Axis

normal position

left axis deviation

right axis deviation

Ischemia — *(write in the definition)*

_____

_____

V. Conclusion

IV. Analysis of waves and intervals

QRS — 0,02 (or 0,04) sec × mm =

PQ — 0,02 (or 0,04) sec × mm =

Draw an isoline in all leads

Wave T — positive in leads……

flat in leads……...

negative in leads……...

Segment ST is on the isoline in leads……..…….……

elevation by …… mm in leads…….

depression by …… mm in leads……...

Wave Q in leads……

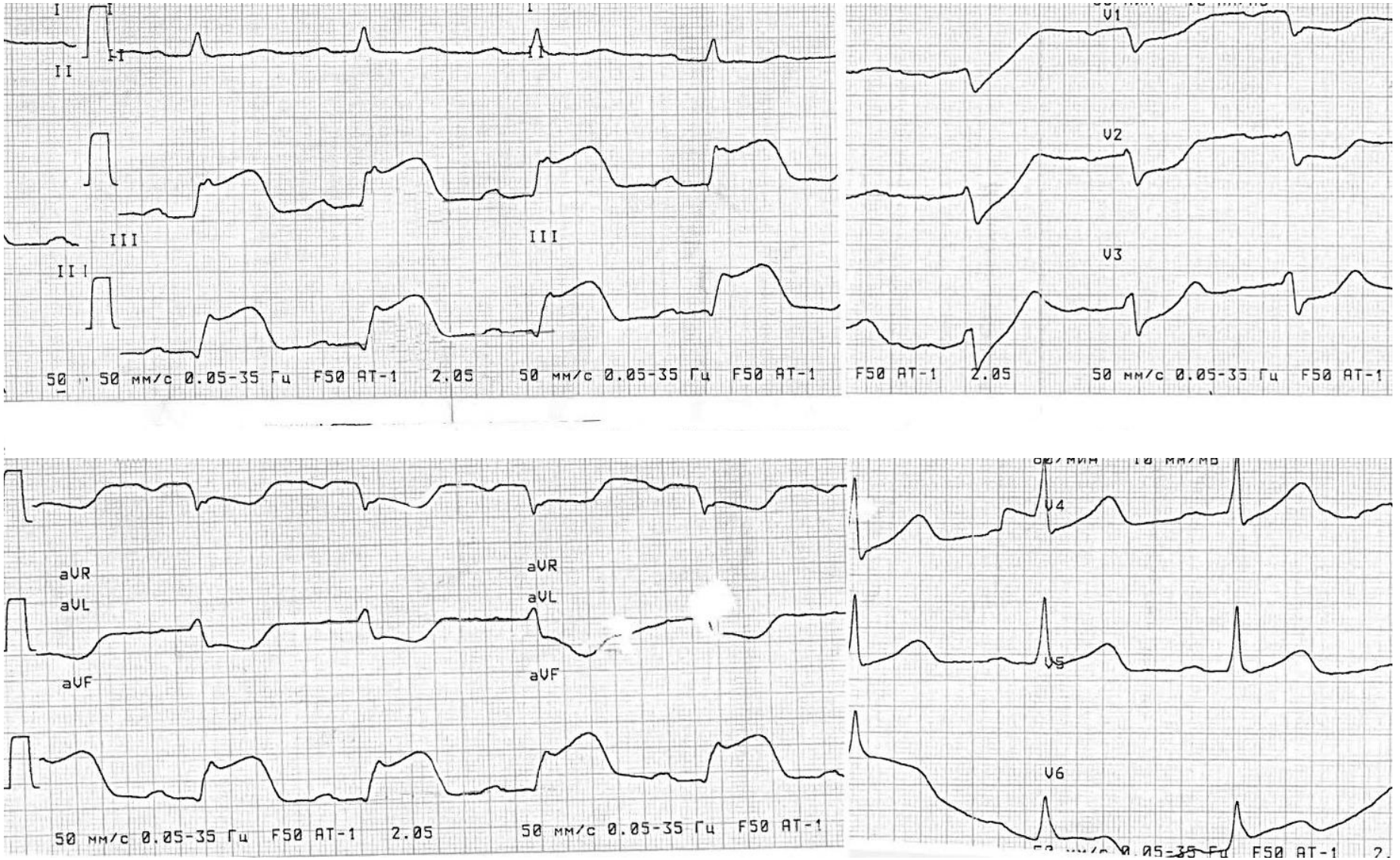
Duration ……. sec

Amplitude *(what part)* ……. from R wave

Localization of the ischemia _____

_____

12


I
II
III
aVR
aVL
aVF
V1
V2
V3
V4
V5
V6
50 мм/с 0.05-35 Гц F50 AT-1 2.05
50 мм/с 0.05-35 Гц F50 AT-1
F50 AT-1 2.05
50 мм/с 0.05-35 Гц F50 AT-1

12

Paper speed: 50 mm/s 1 mm = 0,02 sec
25 mm/s 1 mm = 0,04 sec

I. Rhythm (sinus or not)

RR = 0,02 (or 0,04) sec × mm = sec

HR = 60 / RR interval (sec)

II. Voltage *(underline)*

Sufficient or low

III. Axis

normal position

left axis deviation

right axis deviation

Ischemia — *(write in the definition)*

_____

_____

V. Conclusion

IV. Analysis of waves and intervals

P duration _____ sec

P amplitude _____ sec

QRS — 0,02 (or 0,04) sec × mm = (less 0,1 sec)

PQ — 0,02 (or 0,04) sec × mm = (0,12–0,20 sec)

QT — 0,02 (or 0,04) sec × mm = (less 0,44 sec)

Draw an isoline in all leads

Wave T — positive in leads…….

flat in leads ……...

negative in leads ……...

Segment ST is on the isoline in leads……..…….……

elevation by …… mm in leads…….

depression by …… mm in leads ……..

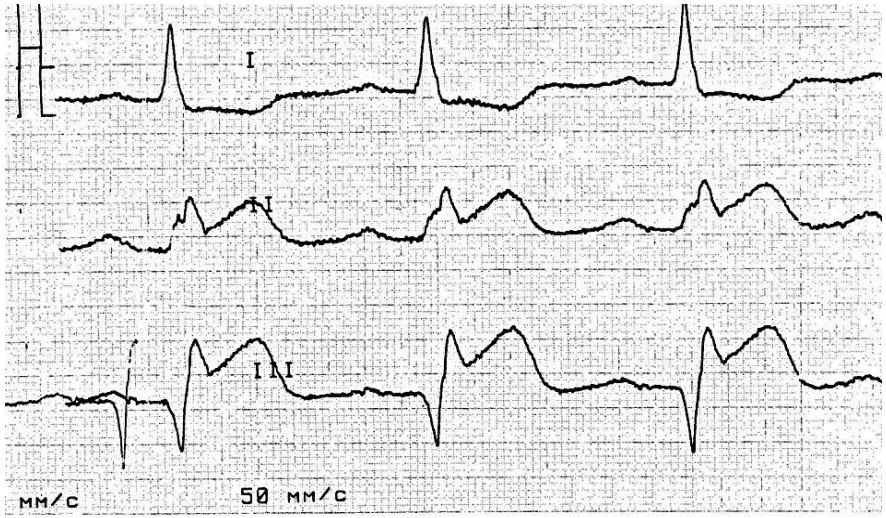
Wave Q is pathological in leads……...
Duration …… sec
Amplitude *(what part)* ……. of R wave

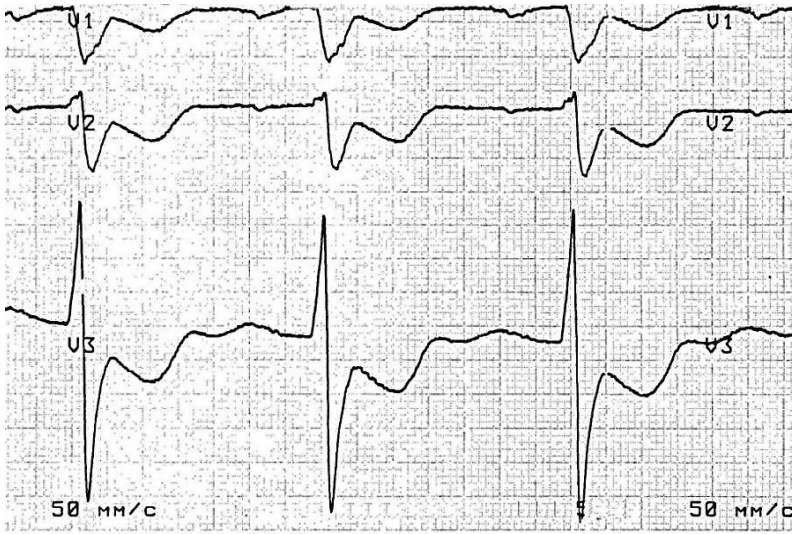
Localization of the ischemia

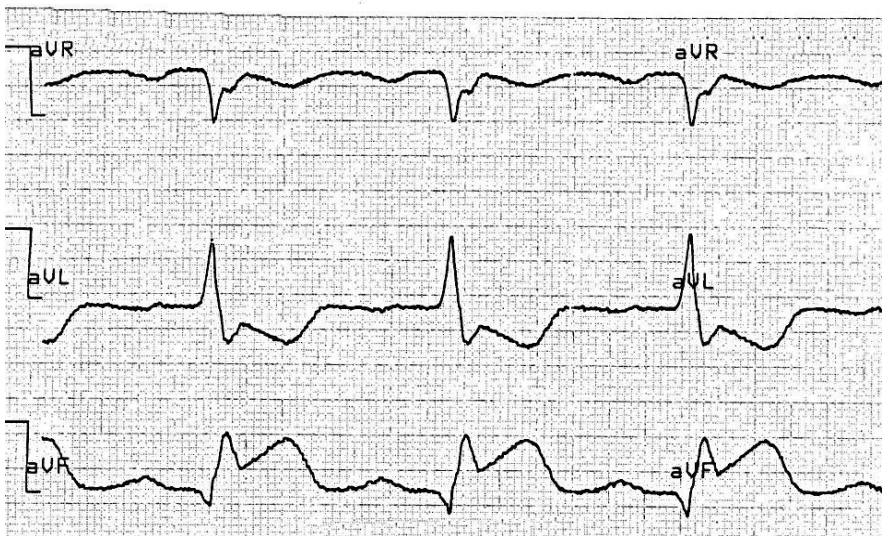
_____

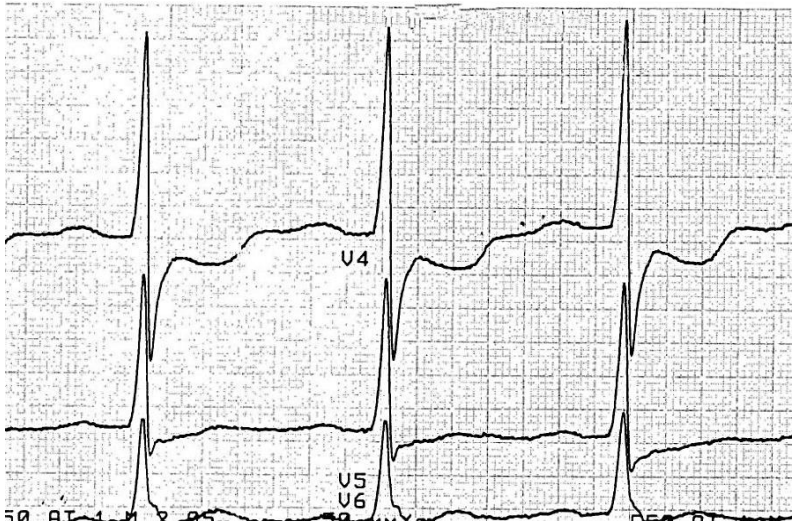
_____

13









13

Paper speed: 50 mm/s 1 mm = 0,02 sec
25 mm/s 1 mm = 0,04 sec

I. Rhythm (sinus or not)

RR = 0,02 (or 0,04) sec × mm = sec

HR = 60 / RR interval (sec)

II. Voltage *(underline)*

Sufficient or low

III. Axis

normal position

left axis deviation

right axis deviation

Reciprocal changes on ECG — *(write in the definition)*

_____

_____

V. Conclusion

IV. Analysis of waves and intervals

P duration _____ sec

P amplitude _____ sec

QRS — 0,02 (or 0,04) sec × mm = (less 0,1 sec)

PQ — 0,02 (or 0,04) sec × mm = (0,12–0,20 sec)

QT — 0,02 (or 0,04) sec × mm = (less 0,44 sec)

Draw an isoline in all leads

Wave T — positive in leads……

flat in leads……..

negative in leads……..

Segment ST is on the isoline in leads……..…….……..

elevation by …… mm in leads……

depression by …… mm in leads…….

Wave Q is pathological in leads……..

Duration …… sec

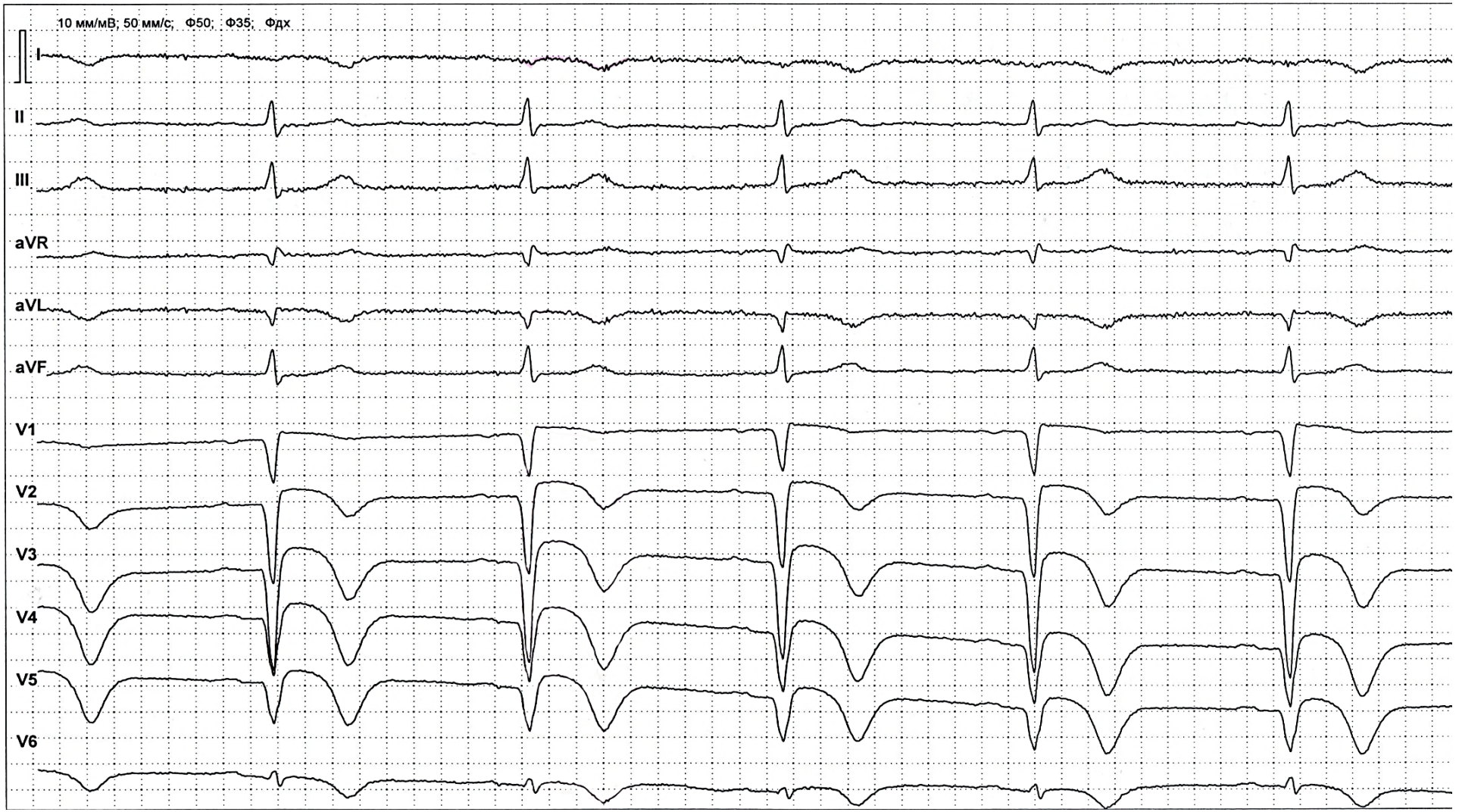
Amplitude *(what part)* ……. of R wave

Localization of the ischemia

_____

_____

14



14

Paper speed: 50 mm/s 1 mm = 0,02 sec
25 mm/s 1 mm = 0,04 sec

I. Rhythm (sinus or not)

RR = 0,02 (or 0,04) sec × mm = sec

HR = 60 / RR interval (sec)

II. Voltage *(underline)*

Sufficient or low

III. Axis

normal position

left axis deviation

right axis deviation

Biochemical markers of myocardial damage are
(*write down the names of indicators that increase in myocardial necrosis*)

_____

_____

V. Conclusion

IV. Analysis of waves and intervals

P duration _____ sec

P amplitude _____ sec

QRS — 0,02 (or 0,04) sec × mm = (less 0,1 sec)

PQ — 0,02 (or 0,04) sec × mm = (0,12–0,20 sec)

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Segment ST is on the isoline in leads……..…….……

elevation by …… mm in leads……..

depression by …… mm in leads……..

Wave Q is pathological in leads……...

Duration …… sec

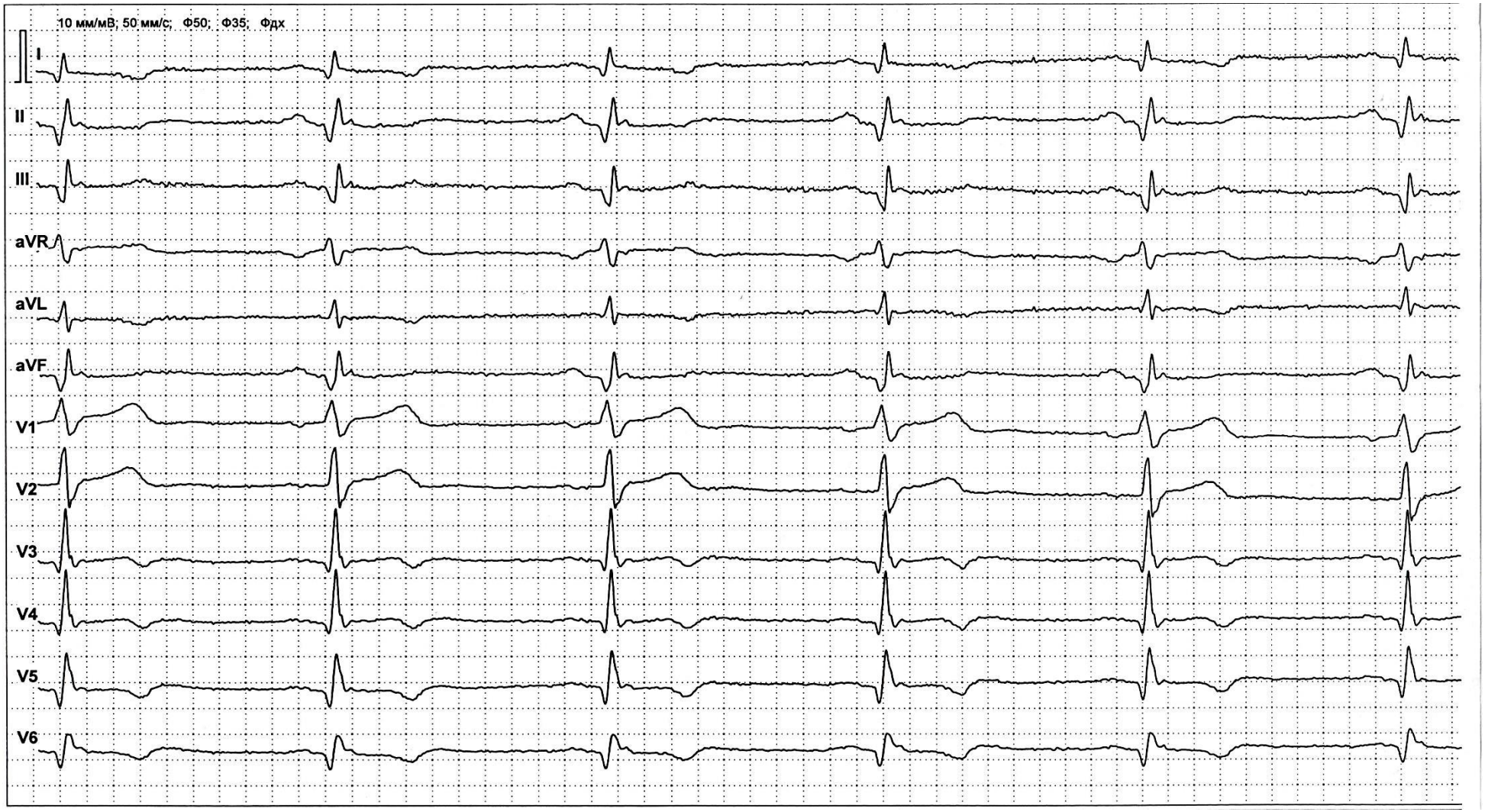
Amplitude *(what part)* ……. of R wave

Localization of the ischemia

_____

_____

15



15

Paper speed: 50 mm/s 1 mm = 0,02 sec
25 mm/s 1 mm = 0,04 sec

I. Rhythm (sinus or not)

RR = 0,02 (or 0,04) sec × mm = sec

HR = 60 / RR interval (sec)

II. Voltage *(underline)*

Sufficient or low

III. Axis

normal position

left axis deviation

right axis deviation

Pathological Q wave on the ECG corresponds to
(*write what changes in the myocardium*)

_____

_____

V. Conclusion

IV. Analysis of waves and intervals

P duration _____ sec

P amplitude _____ sec

QRS — 0,02 (or 0,04) sec × mm = (less 0,1 sec)

PQ — 0,02 (or 0,04) sec × mm = (0,12–0,20 sec)

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Wave Q is pathological in leads……...

Duration …… sec

Amplitude *(what part)* ……. of R wave

Localization of the ischemia

_____

_____

TABLE OF CONTENTS

Учебное издание

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Захарова Анна Геннадьевна и др.

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DIAGNOSTIC METHODS IN THE INTERNAL MEDICINE

Практикум для студентов стоматологического факультета

На английском языке

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