SEMIFINAL EXAM QUESTIONS

EPh_2-3

(2020/2021)

1. PHYSIOLOGY OF THE CARDIOVASCULAR SYSTEM
    1.1. Control of the internal environment; negative feed back, positive feed back and feed-forward control.
    1.2. Composition and volume of body fluid compartments. Plasma proteins and their physiological roles. Rheology of blood.
    1.3. Functional organization of the circulatory system. Hemodynamic functions of different vessels. Measurement and regulation of cardiac output.
    1.4. Factors influencing arterial blood pressure. Measurement of pressure and flow.
    1.5. Flow, pressure and resistance in the various segments of the circulatory system. Total peripheral resistance.
    1.6. The functional organization of the microcirculation. Blood pressure and flow in the microcirculation. Regulation of capillary circulation. Transcapillary exchange mechanisms.
    1.7. Volume and composition of interstitial fluid. Control of lymphatic flow and interstitial fluid volume. Mechanisms of edema formation.
    1.8. Venous circulation, physiological functions of veins. Factors determining venous pressure and flow. Venous capacity, central venous pressure, vascular function curve. Varicosity.
    1.9. Generation of rhythmic potentials in the sinoatrial node. Factors influencing impulse propagation through the conductive tissue and the myocardium.
    1.10. Electric responses of myocardial and nodal tissues. Adrenergic and cholinergic control.
    1.11. Mechanism and control of excitation-contraction in the myocardial tissue.
    1.12. The electrocardiogram.
    1.13. Cardiac cycle. Changes in pressure and volume during the cardiac cycle. Heart sounds.
    1.14. Definition of myocardial contractility. Factors affecting contractility. Relationship between active tension and myocardial fiber length, ventricular function curves.
    1.15. Local cardio-vascular control mechanisms: biomechanical, humoral-hormonal, metabolic and nervous components. Physiology of endothelial functions.
    1.16. Systemic cardio-vascular control – efferent pathways: neural and hormonal factors affecting vessel function.
    1.17. Reflex control of the circulation: baroreflexes and chemoreflexes.
    1.18. Coronary circulation. Mechanisms involved in the control of myocardial flow.
    1.19. Cerebral blood flow (CBF) and cerebrospinal fluid. Brain metabolism, oxygen requirements. Regulation of cerebral circulation. The blood-brain barrier.
    1.20. Splanchnic circulation. Skin circulation and its role in thermoregulation.
    1.21. Pulmonary circulation: general characteristics, function. Pressure, flow, resistances. Physiological control mechanisms of pulmonary circulation.
    1.22. Circulation through skeletal muscles, its physiological control. Adaptation of the cardiovascular system to physical exercise.
    1.23. Physiological aspects of hemorrhagic shock.

2. RESPIRATION. FORMATION & EXCRETION OF URINE.

2.1. Functional anatomy of upper and lower airways. Static and dynamic lung volumes and their measurement. Definition and measurement of respiratory dead space.
2.2. Mechanical properties of breathing. Respiratory cycle. Surface tension in the alveoli. Distensibility of the lungs and chest wall.
2.3. Dynamics of respiration. Definition, measurement and factors influencing airway resistance.
2.4. Gas exchange in the lungs. Alveolar ventilation, measurement. Determination of alveolar gas composition and alveolar-capillary gas exchange. Diffusion capacity.
2.5. Oxygen and CO_2 transport in the blood. Role of hemoglobin in oxygen transport.
2.6. Types of hypoxia.
2.7. Control of respiration. Organization and function of breathing centers. Respiratory patterns. Chemical control of respiration.
2.8. Renal circulation, measurement and control.
2.9. Glomerular filtration, measurement, mechanism and its regulation.
2.10. Tubular reabsorption and secretion along the different segments of the nephron.
2.11. Water and solute processes in the diluting and concentrating kidney. Osmolarity of the tubular fluid along the nephron. Osmoregulation.
2.12. Homeostatic control of the composition and volume of the extracellular fluid by the kidneys. The renin-angiotensin-aldosterone system.
2.13. Function of the urinary bladder. Control of micturition.

4. PHYSIOLOGY OF NERVE & MUSCLE CELLS.

4.1. Structure, permeability and transport function of the cell membrane. Osmosis. Main types and function of adhesive molecules between cells.
4.2. Function of ion channels and ionotropic membrane receptors.
4.3. Main types of G-protein coupled membrane receptors and their intracellular signal transduction pathways.
4.4. Main types of enzyme-linked and enzyme associated membrane receptors and their intracellular signaling pathways. Types and function of intracellular receptors.
4.5. Resting membrane potential and ionic equilibria. Nernst and Goldman-Hodgkin-Katz equations.
4.6. Electrotonic phenomena. Action potential.
4.7. General features and control of synaptic function. Synaptic plasticity.
4.8. Neuromuscular synapse and the EPP.
4.9. Ionic mechanisms of the EPSP and IPSP. Presynaptic inhibition.
4.10. Major classes and functions of transmitter substances.
4.11. Cross-bridge cycle in the skeletal muscle. Energy use and supply in skeletal muscle. Slow and fast skeletal muscle fiber types. Oxygen dept.
4.12. Contractile mechanism of skeletal muscle. Isotonic and isometric contraction. Length-force and velocity-load relationships in the skeletal muscle.
4.13. Excitation-contraction coupling in skeletal muscle.
4.14. Contractile function in smooth muscle. Regulation of cross-bridge cycle in smooth muscle.
4.15. Regulation of myoplasmic calcium concentration in smooth muscle.
4.16. Structure and general functional characteristics of the autonomic nervous system. Vegetative transmitters.

STANDARD PARAMETERS IN PHYSIOLOGY

(The range of values for the parameters listed below is required to be known at the exam. The values themselves should be taken from the appropriate chapters of the textbook.)

Total body water content.
The size of the individual fluid compartments.
Circulating blood volume. Hematocrit.
Osmolal concentration of blood plasma.
Plasma electrolyte concentrations: Na^+, K^+, Mg^{2+}, Cl^-, $HCO3^-$, Ca^{2+} (total, ionized and anion-complexed).
Plasma oncotic pressure.
Red blood cell size.
Red blood cell count.
Life time of red blood cells.
Blood hemoglobin content.
Daily iron intake.
White blood cell count of different white blood cell types.
Thrombocyte count. Clotting time of blood.
Mean pressure in various parts of the systemic circulation.
Resting pressure in the pulmonary circulation: in the right ventricle, pulmonary artery, pulmonary capillaries, pulmonary veins and left atrium.
Blood flow velocity in aorta, capillaries and vena cava.
Systolic, diastolic, mean and pulse pressure values.
Various pressures (Starling forces) determining the fluid equilibrium across the capillary wall.
Cardiac output and oxygen consumption; their fractionalization among the heart, skeletal muscle, kidneys, liver, skin and brain.
Pacemaker frequency of the sinoatrial (SA) node, atrioventricular (AV) node, and Purkinje fibers.
Normal ECG curce. Duration and amplitude of the different ECG waves.
Left and right ventricular and atrial pressures.
Resting cardiac output, maximal cardiac output, ventricular stroke volume.
Intrapulmonary and intrapleural pressures during inspiration and expiration.
Lung volumes: tidal volume, inspiratory and expiratory reserve volumes, residual volume, respiratory dead space, vital capacity, respiratory minute volume, timed vital capacity, maximal voluntary ventilation.
Partial pressure of O_2, CO_2, N_2 and H_2O in alveolar air, arterial blood, mixed venous blood.
O_2 content and saturation of arterial and mixed venous blood. pO_2-O_2 saturation relationship of hemoglobin based on data.
CO_2 content of arterial amd mixed venous blood.
Clearance of inulin and PAH.
Pressures in the glomerulus.
Filtration fraction.
Range of osmolarity in the urine.
Ratios of K^+ and Na^+ permeabilities in resting state and at the peak of action potential of a neuron.
Values of resting membrane potential and action potential of the motoneuron.
Volume, daily production and pressure values of the cerebrospinal fluid.