Topics of the semifinal exam

1.1. Body fluid compartments and their determination. The extracellular and intravascular fluid.

1.2. Structure, permeability and transport functions of the cell membrane.

1.3. Classification, function and main features of ion channels. Voltage-gated Ca^{2+} channels.

1.4. The development of the resting membrane potential.

1.5. The development of the action potential in excitable cells: similarities and differences between distinct cells. Conduction of the action potential.

1.6. Communication between cells. Secondary signaling mechanisms.

1.7. The mechanism of muscle contraction in striated muscles. The electromechanical coupling. Mechanical features of the contraction.

1.8. The functions of different types of smooth muscle.

1.9. Synaptic transmission and its regulation. Neurotransmitters.

1.10. The neuromuscular transmission in striated muscle.

1.11. Parasympathetic efferent mechanisms.

1.12. Sympathetic efferent mechanisms, adrenergic receptors.

2.1. Impulse generation in the heart. Mechanism of pacemaker potential. Control of pacemaker activity.

2.2. Impulse conduction in the heart. Nervous control of impulse conduction.

2.3. Normal human electrocardiogram. Methods for ECG recording.

2.4. Pump function of the heart, the heart cycle. Changes in pressure and volume during the cardiac cycle. Heart sounds.

2.5. Cardiac output and its control. Control of stroke volume.

2.6. Organization of the circulatory system. Hemodynamic functions of different vessels. Relationship of pressure and flow. Measurement of arterial blood pressure. Factors influencing arterial blood pressure.

2.7. Functional organization of microcirculation and its control.

2.8. Physiological vasoconstrictors.

2.9. Physiological vasodilators.

2.10. Control of interstitial fluid volume, Starling forces. Lymph flow.

2.11. Venous circulation, factors determining venous pressure and flow. Control of capacity vessels.

2.12. Reflex control of circulation: baroreceptor and chemoreceptor reflexes. Cardiovascular centers.

2.13. Local control of circulation. Characteristics of vascular smooth muscle. Myogenic, humoral, hormonal and neural control mechanisms.

2.14. Coronary circulation and its control.

2.15. Circulation of the skeletal muscle. Circulatory effects of physical exercise.

2.16. Splanchnic circulation and circulation of the skin.

2.17. Circulation of the brain. Cerebrospinal fluid. Blood-brain barrier.

3.1. Lung volumes. Dead space in the breathing apparatus. Alveolar ventilation. Mechanical properties of the airways, chest wall and lung. Pressure-volume relationship in the respiratory system, surface tension in the alveolus and compliance of the chest wall.

3.2. Gas exchange in the respiratory system.

3.3. The pulmonary circulation.

3.4. Oxygen and carbon dioxide transport. Hemoglobin. Types of hypoxia.

3.5. Cardiopulmonary adaptation during change in the body position and during physical exercise.

3.6. The muscles of respiration and the breathing movements. Neurogenesis of the regular breathing movements. Localization and function of the respiratory control center. Non-chemical control of the respiration.

3.7. Chemical control of the respiration. Pulmonary adaptations to training.

3.8. The role of ventilation in the regulation of the pH, in the development and compensation of the acid-base imbalances in the body.

4.1. Renal circulation, glomerular filtration.

4.2. Renal function: tubular functions.

4.3. Renal function: concentration, dilution.

4.4. Renal Na^+ and K^+ excretion and regulation.

4.5. Physiology of the renin-angiotensin system and the atrial natriuretic peptide. Regulation of body fluids.

4.6. Hypothalamic regulation of water conservation and uptake.

4.7. Basic terms of acid-base balance. Buffer systems of the body. Parameters of acid-base balance.

4.8. Role of the kidneys in the regulation of acid-base balance.

5.1. Regulation in the gastrointestinal tract: enteric nervous system and gastrointestinal hormones.

5.2. Motor functions of the gastrointestinal tract: Mechanism of chewing and swallowing. Gastric motility and emptying.

5.3. Motor functions of the gastrointestinal tract: Intestinal and colonic motility. Function of gallbladder.

5.4. Function of the salivary glands and regulation of salivary secretion. Gastric secretion.

5.5. Exocrine secretion of the pancreas, and regulation of pancreatic secretion.

5.6. Biliary secretion of the liver. Bile acid synthesis and secretion.

5.7. Digestion and absorption of carbohydrates. Natrium, calcium, and water absorption in the gastrointestinal tract.

5.8. Digestion and absorption of proteins. Absorption of vitamin B12 and iron in the gastrointestinal tract.

5.9. Digestion and absorption of lipids. Absorption of fat-soluble vitamins. Vitamin B12 and iron in the gastrointestinal tract. Lipoproteins and transport of lipids.