

Medicine and Surgery I Year 2019-2020 – Entrance Exam

Material to study for the scientific questions

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Biology

The chemistry of living things. The biological importance of weak interactions. The organic molecules present in living organisms and their respective functions. The role of enzymes. The cell as the basis of life. Cell theory. Cellular dimensions. The prokaryotic and eukaryotic, animal and plant cell. Viruses. The cell membrane: structure and functions - transport across the membrane. Cellular structures and their specific functions. Cell cycle and cell reproduction: mitosis and meiosis - chromosomal set and chromosomal maps. Bioenergetics. The energy currency of cells: ATP. Redox reactions in living things. Energy processes: photosynthesis, glycolysis, aerobic respiration and fermentation. Reproduction and Inheritance. Life cycles. Sexual and asexual reproduction. Mendelian genetics: the laws of Mendel and their applications. Classical genetics: chromosomal theory of inheritance - models of inheritance. Molecular genetics: DNA structure and duplication; the genetic code; protein synthesis. The DNA of prokaryotes. The structure of the eukaryotic chromosome. Genes and regulation of gene expression. Human genetics: transmission of mono and polyfactorial characters; autosomal inherited diseases related to the X chromosome. Biotechnologies: recombinant DNA technology and its applications. Inheritance and the environment. Mutations. Natural and artificial selection. The evolutionary theories. The genetic bases of evolution. Anatomy and Physiology of animals and humans. Animal tissues. Anatomy and physiology of human systems and related interactions. Homeostasis.



Chemistry

The constitution of matter: the aggregation states of matter; heterogeneous systems and homogeneous systems; compounds and elements. Perfect gas laws. The structure of the atom: elementary particles; atomic number and mass number, isotopes, electronic structure of atoms of various elements. The periodic system of elements: groups and periods; transition elements; periodic properties of the elements: atomic radius, ionisation potential, electronic affinity; metallic property. Relationships between electronic structure, position in the periodic system and properties of the elements. Chemical bonds: ionic bond, covalent bond and metallic bond. Bond energy. Bond polarity. Electronegativity. Intermolecular bonds. Fundamentals of inorganic chemistry: nomenclature and main properties of inorganic compounds: oxides, hydroxides, acids, salts. Chemical reactions and stoichiometry: atomic and molecular mass, Avogadro number, concept of a mole and its application, elementary stoichiometric calculations, balancing of simple reactions, different types of chemical reactions. Solutions: water solvent properties, solubility, main ways of expressing solution concentrations. Equilibrium in aqueous solution. Elements of chemical kinetics and catalysis. Oxidation and reduction: oxidation number, the concept of oxidising and reducing. Balancing simple reactions. Acids and bases: the concept of an acid and a base. Acidity, neutrality and basicity of aqueous solutions. The pH. Hydrolysis. Buffer solutions. Fundamentals of organic chemistry: links between carbon atoms, rough and structured formulas, concept of isomerism. Aliphatic, alicyclic and aromatic hydrocarbons. Functional groups: alcohols, ethers, amines, aldehydes, ketones, carboxylic acids, esters, amides. Elements of nomenclature.



Physics

Measurements: direct and indirect measurements, fundamental and derived quantities, physical dimensions of quantities, knowledge of the metric system and the CGS, Technical (or Practical) (MKS) and International (SI) measurement systems, and knowledge of the units of measurement (names and relationships between fundamental and derived units), multiples and submultiples (names and values). Kinematics: kinematic quantities, various motions with particular regard to uniform and uniformly accelerated linear motion; uniform circular motion; harmonic motion (for all motions: definition and relationships between the connected kinematic quantities). Dynamics: vectors and operations on vectors. Forces, moments of force about a point. Moment of a force couple. Vector composition of forces. Definitions of mass and weight. Acceleration of gravity. Density and specific weight. Law of universal gravitation, 1st, 2nd and 3rd principles of dynamics. Work, kinetic energy, potential energies. Principle of energy conservation. Impulse and momentum. Principle of momentum conservation. Fluid mechanics: pressure and its units of measurement (not only in the SI system). Archimedes' principle. Pascal's principle. Stevino's law. Thermology, thermodynamics: thermometry and calorimetry. Specific heat, thermal capacity. Mechanisms of heat propagation. Changes in state and latent heat. Perfect gas laws. First and second law of thermodynamics. Electrostatics and electrodynamics: Coulomb's law. Field and electric potential. Dielectric constant. Capacitors. Capacitors in series and in parallel. Direct current. Ohm's law. Kirchhoff's rules. Electrical resistance and resistivity, electrical resistances in series and in parallel. Work, Power, Joule effect. Generators. Electromagnetic induction and alternating currents. Effects of electric currents (thermal, chemical and magnetic).

Mathematics

Numerical sets and algebra: natural, whole, rational, real numbers. Sorting and comparison; order of magnitude and scientific notation. Operations and their properties. Proportions and percentages. Powers with an integer exponent (rational exponent) and their properties. Radicals and their properties. Logarithms (in base 10 and in base e) and their properties. Overview of combinatorial calculus. Algebraic expressions, polynomials. Notable products, n-th power of a binomial, factorization of polynomials. Algebraic fractions. First and second degree algebraic equations and inequalities. Equation systems. Functions: basic notions about functions and their graphical representations (domain, codomain, sign, maxima and minima, growth and decline, etc.). Elementary functions: whole and fraction algebraic, exponential, logarithmic, trigonometric. Compound functions and inverse functions. Trigonometric equations and inequalities. Geometry: polygons and their properties. Circumference and circle. Measurements of lengths, surfaces and volumes. Isometries, similarities and equivalence on the plane. Geometric places. Measuring angles in degrees and radians. Sine, cosine, tangent of an angle and their notable values. Trigonometric formulas. Solution of triangles. Cartesian coordinate system in the plane. Distance of two points and the midpoint of a segment. Equation of the line. Conditions of parallelism and perpendicularity. Distance of a point from a line. Equation of the circumference, the parabola, the hyperbola and the ellipse, and their representation in the Cartesian plane. Pythagorean theorem. Euclid's theorems (first and second). Probability and statistics: frequency distributions according to the type of character and main graphical representations. The concept of random experiment and event. Probability and frequency.

