

Classification Exam for the Study of Medicine
Faculty of Medicine University of Rijeka

TOPICS IN PHYSICS

- definitions of SI units for physical quantities and application of prefixes
- define and calculate average speed, current speed and acceleration
- Linear motion at a constant acceleration; falling objects
- Newton's 1st, 2nd and 3rd law
- Force and momentum, definition and units
- Distinction between vector and scalar quantities
- Weight and density, definition and units
- Addition and resolution of forces
- Contact forces: normal force and friction force
- Work, kinetic energy, potential energy, power
- Conversion of mechanical energy, energy transformations
- Projectile motion. Horizontally and vertically launched projectiles.
- Uniform circular motion; centripetal acceleration
- Rigid-body definition
- Conditions for equilibrium of rigid-body
- Find the resultant force acting on a rigid-body
- Definition and units for angular velocity, period and frequency
- Definition and units for pressure
- Hydrostatic pressure: definition, equation, and calculations
- Application of Archimedes' principle
- define the physical quantity for description of periodic oscillations
- define simple harmonic oscillations and damped harmonic oscillations
- equation for period of simple pendulum
- explain the resonance
- Properties of waves: wavelength, frequency, velocity
- Wave motion, transverse and longitudinal waves

- Propagation of waves: reflection, refraction and diffraction
- Elasticity, stress, strain, Hook's law and Young's modulus
- Temperature, kinetic theory of gases and molecular interpretation of temperature
- First Law of Thermodynamics
- Specific heat and latent heat
- Second Law of Thermodynamics
- Applied equations for thermal expansion of solids and liquids
- Application of equations for isothermal, isobaric and isochoric process
- The Ideal Gas Law
- Adiabatic process
- describe melting and hardening, define melting point, heat capacity, specific heat capacity
- describe evaporation, define boiling point, latent heat of vaporization (boiling)
- Electric charge, Electric current, definition and units
- Equation for Coulombs force
- Definition and units for the electric field and potential difference
- Ohm's law, electrical resistance, resistivity, conductivity
- Definition and unit for capacitance
- The capacitance of a parallel plate capacitor with or without dielectric
- Equations for capacitors in series and in parallel
- Application of Kirchhoff's rules
- Equations for resistors connected in series and parallel
- Magnets and magnetic fields
- Magnetic field of straight wires supplied with electric current
- Force on an electric current in a magnetic field and on electric charge moving in a magnetic field
- Faraday's law of induction; Lenz's law
- Alternating current
- Transformers; The transformers equation
- Capacitance in an AC circuit; calculation of capacitive reactance

- Inductance in an AC circuit; calculation of inductive reactance
- Electromagnetic waves and the electromagnetic spectrum, production of electromagnetic waves
- The ray model of light
- Reflection of light, formation of image by plane mirrors and spherical mirrors, total internal reflection
- Refraction, Snell's law index of refraction
- Thin lenses, focal point, focal length, optical power, ray tracing: converging and diverging lenses
- The thin lenses equation; magnification
- Huygens principle, diffraction, interference, polarization
- Photoelectric effect
- Structure of the atom. Bohr model and spectra of hydrogen atom
- Structure and properties on the nucleus, nuclear size
- Binding energy and nuclear forces
- Radioactivity: alpha, beta and gamma decay; conservation of nucleon number and charge
- The law of radioactive decay; the half-life time
- Nuclear reactions and transmutation of elements
- Nuclear fission and fusion

TOPICS IN BIOLOGY

- Prokaryotes:
 - basics of the organism structure in Eubacteria and Cyanobacteria
 - how do Bacteria produce energy: autotrophic and heterotrophic bacteria
- Eucaryotic cells: basics of the cell architecture in an animal and plant cell
 - the structure of biological membranes: phospholipids, glycolipids, cholesterol, proteins, carbohydrates
 - cytoskeleton
 - membrane-bound and non-membrane bound organelles and their main functions
 - vesicular traffic between organelles

- primary and mature (secondary) lysosomes
- plastids, thylakoid membrane, Calvin cycle,
- transport of molecules across biological membranes: diffusion, osmosis, facilitated diffusion, active transport, endocytosis, pinocytosis, phagocytosis,
- one cell eukaryotic organisms: Protozoa (examples)
- phases of the cell cycle

Basics of macromolecules' structure: DNA: nucleotides, purine and pyrimidine nitrogenous bases, pentose sugar, a phosphate group, protein structure, amino acids

Mitosis: kinetochore, a mitotic spindle, karyokinesis, cytokinesis, diploid chromosome number

Meiosis, fertilization and embryogenesis: gametogenesis, crossing-over, gametes, haploid chromosome number, a blastula, blastomeres, an ovum, a zygote, a pronucleus, an implantation, an oocyte, embryoblast, trophoblast, internal fertilization (which organisms have it), embryonic endoderm, embryonic mesoderm, embryonic ectoderm, Leydig cells

Recombinant DNA technology: restriction endonucleases, plasmids

Molecular genetics: DNA transcription, mRNA translation, DNA replication, genetic code, genetic codon, genetic anticodon, peptide bond formation, an enzyme, complementary nitrogenous bases, salivary glands and polytene chromosomes of *Drosophila melanogaster*

Human chromosomes: a karyotype, a chromosome, a chromatid, sister chromatids, a centromere, a telomere, the chromosome arms, Turner syndrome, Down syndrome, numerical chromosome aberrations (aneuploidy and polyploidy), diploidy

Human genetics: gene, genotype, phenotype, linked genes, sex-linked genes, sex-linked human traits and diseases, Mendel's Laws, Mendelian monohybrid cross with dominance, Mendelian monohybrid cross with incomplete dominance, Mendelian dihybrid cross with dominance, homozygosity, heterozygosity, dominant genes, recessive genes, codominant genes, a clone, calculating the recurrence risk for monogenic human diseases (hemophilia, color blindness), chromosome number in *Drosophila*, genetic mutation, allele

- Human physiology: types of anemia, lack of the vitamins and illnesses, hematopoietic organs, allergic reaction, digestion system, digestive enzymes
 - the genesis of the blood cells: erythrocytes, leukocytes (representation of the particular white blood cell type), platelets, the blood types and universal blood donor; the bone marrow
 - endocrine glands and their hormones, male and female sex-hormones, adenohypophysis, neurohypophysis

- exocrine glands
- erythrocyte architecture
- Krebs cycle (where does it occur)
- glycolysis
- allergic reaction, histamin
- pulmonary and systemic blood circulation, the heart valves, the sinoatrial node, the atrioventricular node, the bundle of Hiss,
- the thermoregulatory centre
- the pacemaking centre
- the nephrone
- digestive system
- respiratory system
- blood sugar control (hormone)

Ecology, evolution and systematics: factors that drive evolutionary changes, binomial or binary nomenclature, Carl Linne, a biocenosis, a biome, a biotope, an ecological amplitude (valence), an ecological community, an ecological climax, a population, a pure line, an endemism, a species range, a relict, a land reclamation, an ecological succession, an ecosystem, natural selection, genetic drift, gene flow, abiotic factors, biotic factors, mimicry.

Topics in Chemistry

- General and Inorganic Chemistry
 - chemical and physical changes
 - mixtures and pure substances; elements and compounds
 - states of matter
 - atom and atomic mass
 - structure of atom; isotopes
 - electronic shells, subshells and orbitals; electron configuration
 - periodic system of elements
 - atomic and ionic radii, ionisation energy, electron affinity and electronegativity
 - noble gasses
 - chemical bonds

- ionic and covalent compounds; double and triple covalent bond
- intermolecular forces
- molecules and molecular mass
- relative atomic and relative molecular mass; molar mass
- simple gas laws; standard molar volume of gas
- mole, Avogadro's constant
- mass percent composition of a compound
- empirical and molecular formula
- ionic and molecular crystals
- metal bond; alloys
- solutions
- solution stoichiometry: mass percent, molarity and molality
- electrolytic dissociation
- acids, bases and salts
- neutralisation and hydrolysis
- pH, pOH
- enthalpy; exothermic and endothermic processes and reactions
- rate of reaction; activation energy
- equilibrium constant; Le Chatelier's principle
- redox-reactions; oxidation and reduction; oxidation numbers
- galvanic and electrolytic cells; electromotive force
- physicochemical properties of hydrogen
- classification and properties of metals
- alkali metals and their properties
- alkaline earth metals and their properties
- technically important metals: aluminium, iron and copper
- halogen elements and their properties
- Organic Chemistry
 - classification of organic compounds

- hydrocarbons: classification and properties
- isomerism, stereoisomerism
- reaction of substitution and addition
- cycloalkanes: structure and properties
- aromatic compounds: structure and properties
- mono- and disubstituted benzene derivatives
- alcohols, ethers and phenols: classification, production and properties
- amines: classification and properties
- aldehydes and ketones
- properties and production of formaldehyde, acetaldehyde and acetone
- carboxylic acids: classification and properties
- hydroxy acids, amino acids
- esters, fats and oils: structure and properties; ester bond
- soaps and detergents
- carbohydrates: structure, classification and properties
- proteins: structure and classification; peptide bond
- nucleic acids: structure and classification