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Syllabus for entrance examination. Physics

1. Kinematics.
• Relativity of mechanical motion.
• Uniform rectilinear motion. Speed. The law of uniform rectilinear motion.
• Rectilinear uniformly varied motion. Acceleration. The law of rectilinear uniformly varied motion. Motion of bodies on the vertical.
• Curvilinear motion. Uniform circular motion. Angular speed. Centripetal acceleration.

Ex. *The speed during uniform rectilinear motion is a constant vector quantity equal to:*

a) multiplication product between a physical body motion in an interval and dimensions of that interval;

b) multiplication product between a physical body distance in an interval and dimensions of that interval;

c) the ratio between an interval and physical body motion in that interval;

d) the ratio between a physical body motion and the interval in which the motion has been performed;

e) none of above mentioned is true.

2. Dynamics.
• Interactions. Forces in nature.
• Principles (laws) of dynamics.
• Motion of bodies under the forces of gravity, elasticity and friction.
• The Hooke's law. Laws of friction.

Ex. *Elasticity force appears:*

a) only by stretching;

b) only by compression;

c) only by bending;

d) only by twisting;

e) none of above mentioned is true.

3. Mechanical work and energy. Mechanical impulse. Mechanical balance.
• Mechanical work. Force. Kinetic energy. Potential energy. The law of transformation and conservation of mechanical energy.
• Mechanical impulse. The law of conservation of mechanical impulse for isolated system of bodies.
• Mechanical balance.
• Mechanical balance in the gravitational field.

Ex. *The force is a physic measure equal to:*

a) the ratio between force and time of its action;

b) the multiplication product of the work done and time while it has been done;

c) the ratio between the work done and time while it has been done;

d) the ratio between the force which acts on a physical body and his speed;

e) none of above mentioned is true.

4. Mechanical oscillations and waves.

• Mechanical oscillations. Oscillatory motion. Harmonic oscillator. Elastic pendulum. Gravitational pendulum. Power of harmonic oscillator. Conservation of mechanical power in oscillation motion.
• Mechanical waves. Transverse and longitudinal waves. Features of waves.
• Reflection and refraction of waves.
• Interference of mechanical waves. Diffraction of mechanical waves.

Ex. *To have a total reflection at the passage of light in a medium with refractive index n_1 to a medium with refractive index n_2, it is necessary that:*

a) $n_1 = n_2$;   d) $n_1 < n_2$;

b) $n_1 = 1$;   e) $n_1 \neq n_2$.

c) $n_1 > n_2$;

5. Thermodynamics and molecular physics.

• Thermodynamic system. Thermodynamic system state. State parameters. The pattern "ideal gas". Fundamental formula of kinetic-molecular theory (without deduction). Temperature. The equation of state of ideal gas. Simple transformations of an ideal gas.
• Internal energy of mono-atomic ideal gas.
• Thermodynamic work and the amount of heat.
• First law of thermodynamics.
• Thermal engines. Environmental Pollution.

Ex. *Mendeleev-Clapeyron equation for an arbitrary mass of ideal gas is expressed by the following formula:*

a) $PV = vRT$;

b) $PV = RT$;

c) $PV = mRT/M$;

d) $PV = MRT/m$;

e) $PV = MRT$.

6. Electrostatics.

• The electric field and its characteristics. Coulomb's Law.
• The work of electric field in moving of a load point. Voltage.
• Conductors and dielectrics in electrostatic field.
• Electrical capacity. Capacitor plan.
• Energy of the electrostatic field.

Ex. *Coulomb's Law is expressed by the following formula:*

a) $F = km_1m_2/r^2$;

b) $F = kq_1q_2/r$;

c) $F = q_1q_2k/r^2$;

d) $F = kq/r^2$;

e) $F = kq_1q_2r^2$.

7. Electrokinetics. Electric current in different environments.

• Stationary Electric current. Ohm's Laws for a circuit portion and a whole (simple) circuit.
• Environment conductors of electric current.
• Electric current in semiconductors. P-n junction. Applications of semiconductors.

Ex. *Which of the following formulas do not refer to the parallel connection of conductors?*
a) $1/R = 1/R_1 + 1/R_2$;
b) $R = R_1R_2/R_1+R_2$;
c) $U_1/U_2 = R_1/R_2$;
d) $I = I_1 + I_2$;
e) $I = I_1 = I_2$.

8. Electromagnetism.
• The magnetic field of the electric current. The magnetic induction.
• Action of magnetic field on moving electrical charge carriers. Lorentz force law.
• Magnetic flux. Electromagnetic induction. The law of electromagnetic induction. Lenz's law.
Ex. *Lorentz force appears only if:*
a) positive electric charge is moving in a magnetic field;
b) electric charge is moving in a homogeneous magnetic field;
c) electric charge has a perpendicular velocity on field lines;
d) electric charge which is moving is composed of electrons;
e) none of above mentioned is true.

9. Alternating current.
• Alternating current. Generating of alternative electromotive voltage by means of electromagnetic induction. The actual values of current intensity and alternative voltage.
• Production and transportation of electrical power. Alternating electric current generator. The transformer.
Ex. *Potential difference among two points is equal to 1 V, if:*
a) during the movement of an electric charge with 1 C from a point to another, the intensity of electric field decreases with a unit;
b) during the movement of an electric charge with 1 C from a point to another, the electric field performs an activity of 1 J in 1 s;
c) during the intensity of a power with 1 A, an electric charge of 1 C goes through a cross section of a conductor;

10. Electromagnetic oscillations and waves.
• Oscillating circuit. Electromagnetic waves propagation. Classification of electromagnetic waves. Principles of radiocommunication. Radiolocation.
• Optic waves. The evolution of concepts about the nature of light.
• Electromagnetic nature of light. Interference of light. Diffraction of light. Diffraction pattern.
• The types of radiation.
Ex. *Diffraction of light:*
a) explains the bypassing by the light of the obstacles when their size are comparable to the wavelength used;
b) can be highlighted only for the visible spectrum radiation;
c) is the decomposition of the white light into colors of the spectrum;
d) is the variation of refractive index with wavelength;
e) none of above mentioned is true.

11. Elements of quantum physics.
• External photoelectric effect. Photoelectric cells.
• The concept of quantum of energy. Photon.

Ex. *A photon possesses energy equal to* $6 \cdot 10^{-19}$ *J. What's the impulse of that photon? (c=$3 \cdot 10^8$ m/s)*

a) $2 \cdot 10^{-27}$ *kg·m/s;*

b) $3 \cdot 10^{-27}$ *kg·m/s;*

c) $3 \cdot 10^{-26}$ *kg·m/s;*

d) $2 \cdot 10^{-26}$ *kg·m/s;*

e) $2 \cdot 10^{-28}$ *kg·m/s.*

12. Elements of physics of the atom and atomic nucleus.

• Models of atoms. Rutherford's experiment. Types of spectra.

• Bohr's postulates.

• The atomic nucleus. The constituents of the atomic nucleus. Isotopes.

• Radioactivity.

• Nuclear reactions. Laws of conservation in nuclear reactions.

• Fission and fusion of nuclei.

Ex. *Which of the following statements about Bohr's postulates are incorrect?*

a) the light radiation occurs at the atomic transition from a stationary state with lower energy into a stationary state with higher energy;

b) the energy of the radiated photon is equal to the energy difference of the stationary states;

c) Bohr's first postulate is in contradiction with the classical mechanics;

d) the first postulate contradicts also Maxwell's electrodynamics;

e) none of above mentioned is true.