

Physics Syllabus

There is one paper of two hours duration carrying 80 marks and Internal Assessment of practical work carrying 20 marks. The paper is divided into two sections: Section I (40 marks) and Section II (40 marks).

Section I (compulsory) contains short answer questions on the entire syllabus. Section II contains six questions. You are required to answer any four of these six questions.

1. Force, Work, Energy and Power

(i) Contact and non-contact forces; cgs & SI units.

Examples of contact forces (frictional force, normal reaction force, tension force as applied through strings and force exerted during collision) and non-contact forces (gravitational, electric and magnetic). General properties of non-contact forces. cgs and SI units of force and their relation, Gravitational unit. [No numerical problems]

(ii) Turning forces concept; moment of a force; forces in equilibrium; centre of gravity; (discussions using simple examples and simple direct problems).

Elementary introduction of translation and rotation; moment (turning effect) of a force, also called torque and its cgs and SI units; common examples - door, steering wheel, bicycle pedal, etc.; clockwise and anticlockwise moments; conditions for a body to be in equilibrium (translational and rotational); principle of moment and its verification using a metre rule suspended by two spring balances with slotted weights hanging from it; simple numerical problems; Centre of gravity (qualitative only) with examples of some regular bodies and irregular lamina (students should be encouraged to try it out).

(iii) Uniform circular motion.

As example of constant speed, though acceleration (force) is present. Basic idea of centrifugal and centripetal force (qualitative only).

(iv) Machines as force multipliers; load, effort, mechanical advantage, velocity ratio and efficiency; simple treatment of levers, inclined plane and pulley systems showing the utility of each type of machine.

Functions and uses of simple machines: Terms - effort E , load L , mechanical advantage $MA = L/E$, velocity ratio $VR = V_E/V_L = d_E/d_L$, input (W_i), output (W_o), efficiency (η), relation between η and MA, VR ; for all practical machines $\eta < 1$; $MA < VR$.

Lever: principle. First, second and third class of levers; examples: MA and VR in each case. Examples of each of these classes of levers as found in the human body.

Pulley system; simple fixed, single movable, combination of movable pulleys, block and tackle; MA , VR and η in each case. [No derivation details.] Gear (toothed wheel) -

practical applications in watches, vehicles, uphill, downhill motion, (no numerical).

Inclined plane: MA, VR and η . [derivation not required]. Utility of each type of machine. Simple numerical problems.

(v) Work, energy, power and their relation with force.

Definition of work. $W = FS \cos\theta$; special cases of $\theta = 0^\circ, 90^\circ$. $W = mgh$. Definition of energy, energy as work done. Various units of work and energy and their relation with SI units.[erg, calorie, kW h and eV]. Definition of Power, $P = W/t$; SI and cgs units; other units, kilowatt (kW), megawatt (MW) and gigawatt (GW); and horse power (1hp=746W) [Simple numerical problems on work, power and energy].

(vi) Different types of energy (e.g., chemical energy, Mechanical energy, heat energy, electrical energy, nuclear energy, sound energy, light energy).

Mechanical energy: potential energy (U) gravitational, due to change in configuration, examples; kinetic energy $K = \frac{1}{2}mv^2$ (derive); forms of kinetic energy; translational , rotational and vibrational - only simple examples. [Numerical problems on K and U only in case of translational motion]; qualitative discussions of electrical, chemical, heat, nuclear, light and sound energy, conversion from one form to another; common examples.

(vii) Energy sources.

Solar, wind, water and nuclear energy (only qualitative discussion of steps to produce electricity). Renewable versus non-renewable sources (elementary ideas with example).

Renewable energy: biogas, solar energy, wind energy, energy from falling of water, run-of-the river schemes, energy from waste, tidal energy, etc. Issues of economic viability and ability to meet demands.

Non-renewable energy - coal, oil, natural gas. Inequitable use of energy in urban and rural areas. Use of hydroelectrical powers for light and tube wells.

Energy degradation - In all energy transformations some energy is lost to surroundings which is not useful for any productive work (day to day examples).

(viii) Principle of Conservation of energy.

Statement: Total energy of an isolated system remains constant; OR energy can be converted from one form to another but it cannot be created or destroyed. Theoretical verification that $U + K = \text{constant}$ for a freely falling body. Application of this law to simple pendulum (qualitative only); simple numerical problems.

2. Light

(i) Refraction of light through a glass block and a triangular prism qualitative treatment of simple applications such as real and apparent depth of objects in water and

apparent bending of sticks in water.

Change of medium causes partial reflection and refraction. The refracted beam has a change in speed (V) and wavelength (λ); frequency (ν) remains constant; the direction changes (except for $i = 0$). Values of speed of light (c) in vacuum, air, water and glass; refractive index $n = c/V$, $V = \nu\lambda$. Values of n for common substances; laws of refraction; experimental verification; refraction through glass block; lateral displacement; multiple images in thick glass plate/mirror; refraction through a glass prism; relation $i_1 + i_2 = A + \delta$ and $r_1 + r_2 = A$ (without proof); $i - \delta$ graph. Unique δ_{\min} with, $i_1 = i_2$ and $r_1 = r_2$ - refracted ray parallel to the base. No geometrical proof - only recognition from ray diagrams; simple applications: real and apparent depth of objects in water; apparent bending of a stick under water. (no calculations but approximate ray diagrams required); Simple numerical problems].

(ii) Total internal reflection: Critical angle; examples in triangular glass prisms; comparison with reflection from a plane mirror (qualitative only).

Transmission of light from a denser medium (say glass) to a rarer medium (air) at different angles of incidence; critical angle (c) $n = 1/\sin c$. essential conditions for total internal reflection. Total internal reflection in a triangular glass prism; ray diagram, different cases - angles of prism ($60^\circ, 60^\circ, 60^\circ$), ($60^\circ, 30^\circ, 90^\circ$), ($45^\circ, 45^\circ, 90^\circ$); use of right angle prism to obtain $\delta = 90^\circ$ and 180° (ray diagram); comparison of total internal reflection from a prism and reflection from a plane mirror. [No numerical problems].

(iii) Lenses (converging and diverging) including characteristics of the images formed (using ray diagrams only); magnifying glass; location of images using ray diagrams and thereby determining magnification (sign convention and problems using the lens formulae are excluded).

Types of lenses (converging and diverging), convex, concave, (sketch of shapes only); detailed study of refraction of light in equi-convex and equi-concave spherical lenses only through ray diagrams; action of a lens as a set of prisms; technical terms; centre of curvature, radii of curvature, principal axis, foci, focal plane and focal length. Experimental determination of f of convex lens by distant object method, and by auxiliary plane mirror; ray diagrams and simple description; formation of images - principal rays or construction rays; location of images from ray diagram for various positions of a small linear object on the principal axis; characteristics of images. When the object is at focus, image is formed at infinity and can be seen. Ray diagrams only [relation between u , v and f and problems not included]. Magnifying glass or simple microscopes: location of image and magnification from ray diagram only [formula and problems not included].

(iv) Using a triangular prism to produce a visible spectrum from white light; Electromagnetic spectrum. Scattering of light.

Deviation produced by a triangular prism; dependence on colour (wavelength) of light; dispersion and spectrum; electromagnetic spectrum: broad classification and approximate ranges of wavelength; properties common to all types; simple properties

and uses of each type. Simple application of scattering of light e.g. blue colour of the sky. [No numerical problems].

3. Sound

(i) Reflection of Sound Waves; echoes: their use; simple numerical problems on echoes.

Production of echoes, condition for formation of echoes; simple numerical problems; use of echoes by bats, dolphins, fishermen, medical. SONAR.

(ii) Forced, natural vibrations, resonance (through examples).

Examples of natural and forced vibrations - qualitative discussion; resonance, a special case of forced vibration; examples - sympathetic vibration of pendulums, machine parts, stretched string, sound box of musical instrument - guitar, only brief qualitative description.

(iii) Loudness, pitch and quality of sound:

Characteristics of sound; loudness and intensity; subjective and objective nature of these properties; sound level in db (as unit only); noise pollution; pitch and frequency examples; quality and waveforms examples. [No numerical problems].

4. Electricity and Magnetism

(i) Ohm's Law; concepts of emf, potential difference, resistance; resistances in series and parallel; simple direct problems using combinations of resistors in circuits.

Review of Class IX topics as introduction. Concepts of pd (V), current (I) and resistance (R) and Charge (Q) by comparison with gravitational (free fall), hydrostatic (water flow), heat (conduction) and electric current through a resistor, compare V with h and Q with mg (force) in mgh, pd as work done / charge. Ohm's law: statement, $V=IR$; SI units; experimental verification; graph of V vs I and resistance from slope; ohmic and non-ohmic resistors, super conductors, electromotive force (emf); combination of resistances in series and parallel and derivations of expressions for equivalent resistance. Simple direct problems using the above relations. Avoid complicated network of resistors.

(ii) Electrical power and energy.

Electrical energy; examples of heater, motor, lamp, loudspeaker, etc. Electrical power; measurement of electrical energy, $W = QV = VIt$ from the definition of pd. Combining with ohm's law $W = VIt = I^2Rt = (V^2/R)t$ and electrical power $P = (W/t) = VI = I^2R = V^2/R$. Units: SI and commercial; Power rating of common appliances, household consumption of electric energy; calculation of total energy consumed by electrical appliances; $W = Pt$ (kilowatt x hour = kW h), simple numerical problems.

(iii) Household circuits - main circuit; switches; fuses; earthing; safety precautions; three-pin plugs; colour coding of wires.

House wiring system, (Power distribution); main circuit (3 wires-live, neutral, earth) with fuse, main switch; and its advantages - circuit diagram; two-way switch, staircase wiring, need for earthing, fuse, 3-pin plug and socket; Conventional location of live, neutral and earth points in 3 pin plugs and sockets. Safety precautions, conventional colour coding of wires. [No numerical problems].

(iv) Magnetic effect of a current (principles only, laws not required); electromagnetic induction (elementary); transformer.

Oersted's experiment on the magnetic effect of electric current; magnetic field (B) and field lines due to current in a straight wire (qualitative only), right hand (clasp) rule - thumb along current, curved fingers point along the B field or the other way; magnetic field due to a current in a loop; clockwise current - south pole and anticlockwise current - north pole; electromagnet; simple construction of I-shaped and U-shaped (horse shoe type) electromagnets; their uses; comparisons with a permanent magnet; the dc electric motor- simple sketch of main parts (coil, magnet, split ring commutators and brushes); brief description and type of energy transfer: Simple introduction to electromagnetic induction; frequency of ac, ac generator, similar treatment as of dc motor; advantage of ac over dc. The transformer; primary and secondary coils with turns ratio $N_S/N_P > 1$ or < 1 for step up or step down transformer. Representative diagrams (not symbolic). [No numerical problems].

5. Heat

(i) Specific heat capacities; Principle of method of mixtures; problems on specific heat capacity using heat loss and gain and the method of mixtures.

Review concepts of heat and temperature from Class IX text. Thermal (heat) capacity $C' = Q/\Delta T$. Note that the change in temperature has the same magnitude in $^{\circ}\text{C}$ and kelvin. ($\Delta T = 1^{\circ}\text{C} = 1\text{K}$). Unit of C' : SI unit, $\text{J/K} = \text{J}/^{\circ}\text{C}$; old unit (still used) $\text{cal}/^{\circ}\text{C} = \text{cal/K}$; Sp. heat capacity defined as heat capacity per unit mass or heat energy per unit mass per unit degree change of temperature. $C = Q/m\Delta T$; and $Q = mc\Delta T$. Units; J/kg.K (SI) = $\text{J/kg } ^{\circ}\text{C}$ also $\text{cal/g } ^{\circ}\text{C} = \text{cal/g.K}$.

Mutual relations, values of C for some common substances. Principle of method of mixtures including mathematical statement. Natural phenomena involving sp. heat; consequences of high sp. heat of water. Simple numerical problems.

(ii) Latent heat; loss and gain of heat involving change of state for fusion only.

Change of phase (state); heating curve for water; latent heat; sp latent heat of fusion; some values; unit J/kg or cal/g . Mutual relation between these units of latent heat. Mathematical expressions for heat loss and heat gain involving latent heat. Simple numerical problems. Common physical phenomena involving latent heat of fusion.

(iii) Greenhouse effect and global warming.

Meaning and impact on the life on earth; projections for the future; what needs to be done.

6. Modern Physics

(i) Thermionic emission; simple qualitative treatment of a hot cathode ray tube.

Simple introduction - electrons in metals, conduction electrons; thermionic emission; work functions and its value in eV for a few common substances; [application and use of diode or triode not included]. Hot cathode ray tube; principle - thermionic emission, deflection of charged particles (electrons) by electric fields and fluorescence produced by electrons; simple sketch (labeled) showing electron gun, anode, deflection plates and screen with vacuum tube, low tension (LT) connected to filament and high tension (HT) between anode and cathode; qualitative explanation of working, mention two uses. [No numerical problems].

(ii) Radioactivity and changes in the nucleus; background radiation and safety precautions. Brief introduction (qualitative only) of the nucleus, nuclear structure, atomic number (Z), mass number (A). Radioactivity as spontaneous disintegration. α , β and γ - their nature and properties; changes within the nucleus. One example each of α and β decay with equations showing changes in Z and A. Uses of radioactivity - radio isotopes. Harmful effects. Safety precautions.

Background radiation. Radiation: X-rays; radioactive fall out from nuclear plants and other sources.

Nuclear: working on safe disposal of waste. Safety measures to be strictly reinforced. [No Numerical problems].