SCIENCE (52)

PAPER I: PHYSICS

Aims:

1. To acquire knowledge and understanding of the terms, facts, concepts, definitions, laws, principles and processes of Physics.
2. To develop skills in practical aspects of handling apparatus, recording observations and in drawing diagrams, graphs, etc.
3. To develop instrumental, communication, deductive and problem-solving skills.
4. To discover that there is a living and growing physics relevant to the modern age in which we live.

CLASS IX

There will be one paper of ***one*** *and* ***half-hours*** *duration carrying 80 marks and Internal Assessment of practical work carrying 20 marks.*

The paper will be divided into ***two*** *sections, Section I (40 marks) and Section II (40 marks).*

Section I (compulsory) *will contain short answer questions on the entire syllabus.*

Section II *will contain six questions. Candidates will be required to answer any* ***four*** *of these* ***six*** *questions.*

Note: *Unless otherwise specified, only S I. Units are to be used while teaching and learning, as well as for answering questions.*

1. **Measurements and Experimentation**

(i) Estimation by orders of magnitude of size (length, area and volume), mass and time.

Order of magnitude as statement of magnitude in powers of ten; familiarity with the orders of magnitude of some common sizes (length, area and volume), masses and time intervals e.g. idea of, mass of atoms, bottle of water, planets, diameter of atom, length of football field, inter stellar distances, pulse rate, age of earth etc.

(ii) International System of Units, **the required SI units with correct symbols are given at the end of this syllabus.** Other commonly used system of units - fps and cgs.

(iii) Measurements using common instruments (metre rule, Vernier calipers and *micrometer* screw gauge for length, volume by displacement using a measuring cylinder, stop watch and simple pendulum for time, equal arm beam balance for comparison of masses).

This section should be taught along with demonstration or laboratory experiments. Measurement of length using metre rule, Vernier calipers and micrometer screw gauge. They have increasing accuracy and decreasing least-count; zero error, zero correction (excluding negative zero error in Vernier calipers), pitch of the screw and least-count (LC); ***no*** *numerical problems on calipers and screw gauge. Volume units, m^3, cm^3, litre and milliliter; their mutual relations. Measurement of volume of irregular solid bodies both heavier and lighter than water including those soluble in water, by displacement of water or other liquids in a measuring cylinder. Measurement of time using stopwatch; simple pendulum; time period, frequency, experiment for the measurement of T, graph of length l vs. T^2 only; slope of the graph. Formula $T=2.\pi.\sqrt{l/g}$ [****no**** derivation]. Only simple numerical problems. Beam balance; simple introduction; conditions for balance to be true (without proof). Faulty balance is* <u>*not*</u> *included.*

(iv) Presentation of data in tabular and graphical form (straight line graphs only).

*Presentation of data in tabular form of two types: headed columns (e.g. simple pendulum) and numbered rows (e.g., volume measurement). Graph — various steps in plotting a graph, such as title, selection of origin and axes, labeling of axes, scale, plotting the points, best-fit straight line, etc. Meaning of slope and of straight-line graph. [**No** numerical problems].*

2. Motion in one dimension

Distance, speed, velocity, acceleration; graphs of distance-time and speed-time; equations of uniformly accelerated motion with derivations.

Rest and motion; [motion in two and three dimensions not to be covered in Class IX]; distance and displacement; speed and velocity; acceleration and retardation; distance-time and velocity-time graphs; meaning of slope of the graphs; [Non-uniform acceleration excluded].

Equations to be derived: $v = u + at$;

$S = ut + \frac{1}{2}at^2$; $S = \frac{1}{2}(u+v)t$; $v^2 = u^2 + 2aS$. *[Equation for* S_n^{th} *is **not** included].*

Simple numerical problems.

3. Laws of Motion

(i) Newton's First Law of Motion (qualitative discussion) to introduce the idea of inertia, mass and force.

*Newton's first law; statement and qualitative discussion; definitions of inertia and force from first law, examples of inertia as illustration of first law. (Inertial mass **not** included).*

(ii) Newton's Second Law of Motion (including **F**=ma); weight and mass.

Detailed study of the second law. Linear momentum, $p = mv$*; change in momentum* $\Delta p = \Delta(mv) = m\Delta v$ *for mass remaining constant rate of change of momentum;*

$\Delta p/\Delta t = m\Delta v/\Delta t = ma$

or $\left\{\frac{p_2 - p_1}{t} = \frac{mv - mu}{t} = \frac{m(v-u)}{t} = ma\right\}$;

Numerical problems combining $F = \Delta p/\Delta t = ma$ *and equations of motion. Units of force - only cgs and SI (non gravitational).*

(iii) Newton's Third Law of Motion (qualitative discussion only); simple examples.

Statement with qualitative discussion; examples of action - reaction pairs, say F_{BA} *and* F_{AB}*; action and reaction always act on different bodies. Numerical problems based on second law.*

(iv) Gravitation,

Universal Law of Gravitation. (Statement and equation) and its importance. Gravity, acceleration due to gravity, free fall. Weight and mass, Weight as force of gravity comparison of mass and weight; gravitational units of force, simple numerical problems (problems on variation of gravity excluded).

4. Fluids

(i) Change of pressure with depth (including the formula p=hρg); Transmission of pressure in liquids; atmospheric pressure.

Thrust and Pressure and their units; pressure exerted by a liquid column $p = h\rho g$*; derivation of* $p = h\rho g$ *and simple daily life examples, (i) broadness of the base of a dam, (ii) Diver's suit etc. some consequences of* $p = h\rho g$ *; transmission of pressure in liquids; Pascal's law; examples; atmospheric pressure; laboratory demonstration; common manifestation (and consequences). Variations of pressure with altitude, qualitative only; mention applications such as weather forecasting and altimeter. Simple numerical problems on* $p = h\rho g$.

(ii) Buoyancy, Archimedes' Principle; floatation; relationship with density; relative density; determination of relative density of a solid.

Buoyancy, upthrust (F_B)*; definition; different cases,* $F_B >, =$ *or* $<$ *weight W of the body immersed; characteristic properties of upthrust; Archimedes' principle; explanation of cases where bodies with density* $\rho >, =$ *or* $<$ *the density* ρ' *of the fluid in which it is immersed.*

Floatation: principle of floatation; experimental verification; relation between the density of a floating body, density of the liquid in which it is floating and the fraction of volume of the body immersed; ($\rho_1/\rho_2 = V_2/V_1$); apparent weight of floating object; application to ship, submarine, iceberg, balloons, etc. Relative density RD=ρ_1/ρ_2=m_1/m_2 for volume same; RD and Archimedes' principle; RD = $W_1/(W_1$-$W_2)$. Experimental determination of RD of a solid denser/lighter than water. [RD of a liquid using Archimedes' Principle and RD using specific gravity bottle are ***not*** *included].*

The hydrometer: common hydrometer for RD of liquid heavier/lighter than water - qualitative only; common practical applications, such as lactometer and battery hydrometer. Simple numerical problems involving Archimedes' principle, buoyancy and floatation.

5. Heat

(i) Concepts of heat and temperature.

Heat as energy, SI unit – joule,

1 cal = 4.186 J exactly.

(ii) Expansion of solids, liquids and gases (qualitative discussion only); uses and consequences of expansion (simple examples); anomalous expansion of water.

Expansion of solids, and cubical expansion of liquids and gases; real and apparent expansion of liquids; simple examples of the uses of expansion of solids; steel rims, riveting; disadvantages of expansion; examples - railway tracks, joints in metal pipes and electric cables. Anomalous expansion of water; graphs showing variation of volume and density of water with temperature in the 0 to 10 ^{0}C range. Simple numerical problems with α, β, γ in solids.

(iii) Thermometers

Temperature scales – Celsius, Fahrenheit, Kelvin and their relation. Simple ***problems*** *based on conversion between these scales. [Problems on faulty thermometer* ***not*** *included].*

(iv) Transfer of heat (simple treatment) by conduction, convection and radiation; thermal insulation; keeping warm and keeping cool; vacuum flask; ventilation.

Conduction: examples to illustrate good and bad conductors and their uses; water is a bad conductor of heat. Convection; Phenomenon in liquids and gases; some consequences including land breeze and sea breeze. Radiation; detection by blackened bulb thermometer.

Applications: simple common uses; thermal insulation, simple examples of house insulation, personal insulation; insulation of household appliances, laboratories. Vacuum flask. Global warming – melting polar ice caps - polar ice caps reflects solar radiation back whereas sea water absorbs it. Increase in CO_2 content in the atmosphere enhances ***green house effect****.*

6. Light

(i) Reflection of light; image formed by a plane mirror regular and irregular reflection; images formed by a pair of parallel and perpendicular plane mirrors; simple periscope.

Regular and irregular reflection; laws of reflection; experimental verification; images of (a) point object and (b) extended object formed in by a plane mirror - using ray diagrams and their characteristics; lateral inversion; characteristics of images formed in a pair of mirrors, (a) parallel and (b) perpendicular to each other; uses of plane mirrors; simple periscope with ray diagram with two plane mirrors.

(ii) Spherical mirrors; characteristics of image formed by these mirrors. Uses of concave and convex mirror. (Only simple direct ray diagrams are required).

Brief introduction to spherical mirrors - concave and convex mirrors, center and radius of curvature, pole and principal axis, focus and focal length; f = R/2 with proof; simple ray diagram for the formation of images in (a) concave mirror, when a small linear object is placed on the principal axis at very large distance (u>> R), at the center *of curvature, between C and F, at F, between F and P. (b) convex mirror a small linear object is placed on the principal axis in front of the mirror.*

7. Sound

(i) Nature of Sound waves. Requirement of a medium for sound waves to travel; propagation and speed in different media; comparison with speed of light.

*Introduction about sound and its production from vibrations; sound propagation, terms – frequency (ν), wavelength (λ), velocity (V), relation $V = \nu\lambda$. and medium [qualitative ideas only]; bell jar experiment. Speed of sound in different media; some values; values of v in air, water and steel as examples including v_o at 0^oC in air as standard value. [**No** derivation, **no** numerical problems]; comparison of speed of sound with speed of light; consequences of the large difference in these speeds in air; thunder and lightning.*

(ii) Range of hearing; ultrasound, a few applications.

Elementary ideas and simple applications only. Frequency ranges for (i) hearing and (ii) speaking. Difference between ultrasonic and supersonic.

8. Electricity and Magnetism

(i) Static electricity – electric charge; charging by friction; simple orbital model of the atom; detection of charge (pith ball and electroscope); sparking; lightning conductors.

Historical introduction; charging by friction; examples; different types of charges on comb and glass rod: attraction, repulsion; simple orbital model of atom with examples of H, He and another atom; positive and negative ions; charge on electrons as quantum of electric charge, Q = n.e; explanation of charge on a body in terms of transfer of electron and its detection, lightning; lightning conductor - action; prevention and control of damage due to lightning.

[No numerical problems].

(ii) Simple electric circuit using an electric cell and a bulb to introduce the idea of current (including its relationship to charge); potential difference; insulators and conductors; closed and open circuits; direction of current (electron flow and conventional); resistance in series and parallel.

Current Electricity: brief introduction of sources of direct current - cells, accumulators (construction, working and equations excluded); Electric current as the rate of flow of electric charge (direction of current - conventional and electronic), symbols used in circuit diagrams. Detection of current by Galvanometer or ammeter (functioning of the meters not to be introduced). Idea of electric circuit by using cell, key, resistance wire/resistance box/rheostat, qualitatively.; elementary idea about work done in transferring charge through a conductor wire; potential difference V = W/q; resistance R from Ohm's law V/I = R; Insulators and conductors. ***(No derivation of formula, calculation or numerical problems).***

(iii) *Properties of a bar magnet; induced magnetism; lines of magnetic field, Magnetic field of earth. Neutral points in magnetic fields.*

Magnetism: properties of a bar magnet; magnetism induced by bar magnets on magnetic materials; induction precedes attraction; lines of magnetic field and their properties; evidences of existence of earth's magnetic field, magnetic compass. Plotting uniform magnetic field of earth and non-uniform field of a bar magnet placed along magnetic north-south; neutral point; properties of magnetic field lines. **[No problems or formula].**

INTERNAL ASSESSMENT OF PRACTICAL WORK

Candidates will be asked to carry out experiments for which instructions are given. The experiments may be based on topics that are not included in the syllabus but theoretical knowledge will not be required. A candidate will be expected to be able to follow simple instructions, to take suitable readings and to present these readings in a systematic form. He/she may be required to exhibit his/her data graphically. Candidates will be expected to appreciate and use the concepts of least count, significant figures and elementary error handling.

A set of 6 to 10 experiments may be designed as given below or as found most suitable by the teacher. Students should be encouraged to record their observations systematically in a neat tabular form - in columns with column heads including units or in numbered rows as necessary. The final result or conclusion may be recorded for each experiment. Some of the experiments may be demonstrated (with the help of students) if these cannot be given to each student as lab experiments.

1. Determine the least count of the Vernier callipers and measure the length and diameter of a small cylinder (average of three sets) - may be a metal rod of length 2 to 3 cm and diameter 1 to 2 cm.
2. Determine the zero error, zero correction, pitch and least count of the given screw gauge and measure the mean radius of the given wire, taking three sets of readings in perpendicular directions.
3. Measure the length, breadth and thickness of a glass block using a metre rule (each reading correct to a mm), taking the mean of three readings in each case. Calculate the volume of the block in cm^3 and m^3. Determine the mass (not weight) of the block using any convenient balance in g and kg. Calculate the density of glass in cgs and SI units using mass and volume in the respective units. Obtain the relation between the two density units.
4. Measure the volume of a metal bob (the one used in simple pendulum experiments) from the readings of water level in a measuring cylinder using displacement method. Also calculate the same volume from the radius measured using Vernier callipers. Comment on the accuracies.
5. Obtain five sets of readings of the time taken for 20 oscillations of a simple pendulum of lengths about 70, 80, 90, 100 and 110 cm; calculate the time periods (T) and their squares (T^2) for each length (l). Plot a graph of l vs. T^2. Draw the best - fit straight - line graph. Also, obtain its slope. Calculate the value of g in the laboratory. It is $4\pi^2$ x slope.
6. Make a test tube hydrometer using a test tube, lead shots, and a strip of graph paper. Determine the RD of any two liquids.
7. Take a beaker of water. Place it on the wire gauze on a tripod stand. Suspend two thermometers - one with Celsius and the other with Fahrenheit scale. Record the thermometer readings at 5 to 7 different temperatures. You may start with ice-cold water, then allow it to warm up and then heat it slowly taking temperature (at regular intervals) as high as possible. Plot a graph of T_F vs. T_C. Obtain the slope. Compare with the theoretical value. Read the intercept on T_F axis for $T_C = 0$.
8. Using a plane mirror strip mounted vertically on a board, obtain the reflected rays for three rays incident at different angles. Measure the angles of incidence and angles of reflection. See if these angles are equal.
9. Place three object pins at different distances on a line perpendicular to a plane mirror fixed vertically on a board. Obtain two reflected rays (for each pin) fixing two pins in line with the image. Obtain the positions of the images in each case by extending backwards (using dashed lines), the lines representing reflected rays. Measure the object distances and image distances in the three cases. Tabulate. Are they equal? Generalize the result.
10. Obtain the focal length of a concave mirror (a) by distant object method, focusing its real image on a screen or wall and (b) by one needle method removing parallax or focusing the image of the illuminated wire gauze attached to a ray box. One could also improvise with a candle and a screen. Enter your observations in numbered rows.
11. Connect a suitable dc source (two dry cells or an acid cell), a key and a bulb (may be a small one used in torches) in series. Close the circuit by inserting the plug in the key. Observe the bulb as it lights up. Now open the circuit, connect another identical bulb in between the first bulb

and the cell so that the two bulbs are in series. Close the key. Observe the lighted bulbs. How does the light from any one bulb compare with that in the first case when you had only one bulb? Disconnect the second bulb. Reconnect the circuit as in the first experiment. Now connect the second bulb across the first bulb. The two bulbs are connected in parallel. Observe the brightness of any one bulb. Compare with previous results. Draw your own conclusions regarding the current and resistance in the three cases.

12. Plot the magnetic field lines of earth (without any magnet nearby) using a small compass needle. On another sheet of paper place a bar magnet with its axis parallel to the magnetic lines of the earth, i.e. along the magnetic meridian or magnetic north south. Plot the magnetic field in the region around the magnet. Identify the regions where the combined magnetic field of the magnet and the earth is (a) strongest, (b) very weak but not zero, and (c) zero. Why is neutral point, so called?

13. Using a spring balance obtain the weight (in N) of a metal ball in air and then completely immersed in water in a measuring cylinder. Note the volume of the ball from the volume of the water displaced. Calculate the upthrust from the first two weights. Also calculate the mass and then weight of the water displaced by the bob $M=V.\rho$, $W=mg$). Use the above result to verify Archimedes principle.

CLASS X

There will be one paper of ***one*** *and* ***half-hours*** *duration carrying 80 marks and Internal Assessment of practical work carrying 20 marks.*

The paper will be divided into ***two*** *sections, Section I (40 marks) and Section II (40 marks).*

Section I *(compulsory) will contain short answer questions on the entire syllabus.*

Section II *will contain six questions. Candidates will be required to answer any* ***four*** *of these* ***six*** *questions.*

Note: *Unless otherwise specified, only S. I. Units are to be used while teaching and learning, as well as for answering 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 anti-clockwise 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* $\theta = 0^0$, 90^0*. 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= ½ 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).

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 = 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 - δ 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 (60º,60º,60º), (60º,30º,90º), (45º,45º,90º); use of right angle prism to obtain δ = 90º and 180º (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* $W = VIt = I^2 Rt = (V^2/R)t$ *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 >1or< 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 ^oC and kelvin. ($\Delta T = 1\ ^oC = 1K$). Unit of C': SI unit, $J/K = J/^oC$; old unit (still used) $cal/^oC = cal/K$; 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) = J/kg. ^oC also cal/g. ^oC = 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.

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 florescence 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.

[No Numerical problems].

A NOTE ON SI UNITS

SI units (*Systeme International d'Unites*) were adopted internationally in 1968.

Fundamental units

The system has seven fundamental (or basic) units, one for each of the fundamental quantities.

Fundamental quantity	Unit	
	Name	Symbol
Mass	kilogram	kg
Length	metre	m
Time	second	s
Electric current	ampere	A
Temperature	kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mol

Derived units

These are obtained from the fundamental units by multiplication or division; no numerical factors are involved. Some derived units with complex names are:

Derived quantity	Unit	
	Name	Symbol
Volume	cubic metre	m^3
Density	kilogram per cubic metre	$kg.m^{-3}$
Velocity	metre per second	$m.s^{-1}$
Acceleration	metre per second squared	$m.\ s^{-2}$
Momentum	kilogram metre per second	$kg.m.s^{-1}$

Some derived units are given special names due to their complexity when expressed in terms of the fundamental units, as below:

Derived quantity	Unit	
	Name	Symbol
Force	newton	N
Pressure	pascal	Pa
Energy, Work	joule	J
Power	watt	W
Frequency	hertz	Hz
Electric charge	coulomb	C
Electric resistance	ohm	Ω
Electromotive force	volt	V

When the unit is named after a person, the *symbol* has a capital letter.

Standard prefixes

Decimal multiples and submultiples are attached to units when appropriate, as below:

Multiple	Prefix	Symbol
10^9	giga	G
10^6	mega	M
10^3	kilo	k
10^{-1}	deci	d
10^{-2}	centi	c
10^{-3}	milli	m
10^{-6}	micro	μ
10^{-9}	nano	n
10^{-12}	pico	p
10^{-15}	femto	f

INTERNAL ASSESSMENT OF PRACTICAL WORK

Candidates will be asked to carry out experiments for which instructions will be given. The experiments may be based on topics that are not included in the syllabus but theoretical knowledge will not be required. A candidate will be expected to be able to follow simple instructions, to take suitable readings and to present these readings in a systematic form. He/she may be required to exhibit his/her data graphically. Candidates will be expected to appreciate and use the concepts of least count, significant figures and elementary error handling.

Note: Teachers may design their own set of experiments, preferably related to the theory syllabus. A comprehensive list is suggested below.

1. Lever - There are many possibilities with a meter rule as a lever with a load (known or unknown) suspended from a point near one end (say left), the lever itself pivoted on a knife edge, use slotted weights suspended from the other (right) side for effort.

   Determine the mass of a metre rule using a spring balance or by balancing it on a knife edge at some point away from the middle and a 50g weight on the other side. Next pivot (F) the metre rule at the 40cm, 50cm and 60cm mark, each time suspending a load L or the left end and effort E near the right end. Adjust E and or its position so that the rule is balanced. Tabulate the position of L, F and E and the magnitudes of L and E and the distances of load arm and effort arm. Calculate MA=L/E and VR = effort arm/load arm. It will be found that MA <VR in one case, MA=VR in another and MA>VR in the third case. Try to explain why this is so. Also try to calculate the real load and real effort in these cases.
2. Inclined Plane - Use a roller (to minimize friction) as the load. Determine the effort required to roll it up an inclined plane with uniform speed. Apply effort at the end of a string tied to the roller, passing over a pulley and a scale pan attached. Calculate the MA=L/E and VR=$^1/\sin\theta$ = $^1/h$ obtained from measurements of the inclined plane. Repeat for two other angles of inclination. Why is MA<VR?
3. Determine the VR and MA of a given pulley system.
4. Trace the course of different rays of light refracting through a rectangular glass prism at different angles of incidence, measure the angles of incidence, refraction and emergence. Also measure the lateral displacement.
5. Determine the focal length of a convex lens by (a) the distant object method and (b) using a needle and a plane mirror.
6. Determine the focal length of a convex lens by using two pins and formula f = uv/(u+v).
7. For a triangular prism, trace the course of rays passing through it, measure angles i_1, i_2, A and δ.Repeat for four different angles of incidence (say $i_1=40^0$, 50^0, 60^0 and 70^0). Verify $i_1+ i_2=A+\delta$ and $A = r_1 + r_2$.
8. For a ray of light incident normally ($i_1=0$) on one face of a prism, trace course of the ray. Measure the angle δ. Explain briefly. Do this for prisms with $A=60^0$, 45^0 and 90^0.
9. Calculate the sp. heat of the material of the given calorimeter, from the temperature readings and masses of cold water, warm water and its mixture taken in the calorimeter.
10. Determination of sp. heat of a metal by method of mixtures.
11. Determination of specific latent heat of ice.
12. Using as simple electric circuit, verify Ohm's law. Draw a graph, and obtain the slope.
13. Set up model of household wiring including ring main circuit. Study the function of switches and fuses.

Teachers may feel free to alter or add to the above list. The students may perform about 10 experiments. Some experiments may be demonstrated.

EVALUATION

The practical work/project work are to be evaluated by the subject teacher and by an External Examiner. (The External Examiner may be a teacher nominated by the Head of the school, who could be from the faculty, **but not teaching the subject in the relevant section/class**. For example, a teacher of Physics of Class VIII may be deputed to be an External Examiner for Class X, Physics projects.)

The Internal Examiner and the External Examiner will assess the practical work/project work independently.

Award of marks (20 Marks)

Subject Teacher (Internal Examiner) 10 marks

External Examiner 10 marks

The total marks obtained out of 20 are to be sent to the Council by the Head of the school.

The Head of the school will be responsible for the entry of marks on the mark sheets provided by the Council.