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SCIENCE PHYSICS (52)

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CISCE

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Excellence - The Indian and Global experience.
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- Schools to have an 'Indian Ethos', strong roots in the national psyche and be sensitive to national aspirations.

SCIENCE (52)

PHYSICS

SCIENCE Paper - 1

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 **two hours** duration carrying 80 marks and Internal Assessment of practical work carrying 20 marks.

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

1. Measurements and Experimentation

- (i) 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.
- (ii) Concept of least count of common instruments, Measurements using common instruments, Vernier callipers and *micro-metre* screw gauge for length, and simple pendulum for time.

Measurement of length using, Vernier callipers and micro-metre screw gauge. Decreasing least-count leads to an increase in accuracy; least-count (LC) of Vernier callipers and screw gauge), zero error (basic idea), Focus more on screw gauge with pitch 1mm and least count 0.01 mm. Only pictorial numerical of Vernier callipers and screw gauge are included, simple pendulum; time period, frequency, graph of length l versus T^2 only; slope of the graph. Formula $T=2\pi\sqrt{l/g}$ [no derivation]. Only simple numerical problems.

2. Motion in One Dimension

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

Examples of Scalar and vector quantities only, rest and motion in one dimension including motion under gravity; distance and displacement; speed and velocity; acceleration and retardation; distance-time and velocity-time graphs; information that can be derived from these graphs, [non-uniform acceleration excluded].

Equations to be derived graphically: $v = u + at$.

$S = ut + \frac{1}{2}at^2$; $S = \frac{1}{2}(u+v)t$; $v^2 = u^2 + 2aS$.

Simple numerical problems.

3. Laws of Motion

- (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 non-contact forces (gravitational, electric and magnetic). General properties of non-contact forces. Inverse square relation, cgs and SI units of force and their relation with Gravitational units.

- (ii) Newton's First Law of Motion (qualitative discussion) introduction of the idea of inertia, mass and force.

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

- (iii) 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;

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

Simple numerical problems combining

$F = \Delta p / \Delta t = ma$ and equations of motion. Units of force - only cgs and SI. Applications of the law.

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

Statement with qualitative discussion; examples of action - reaction pairs, (F_{BA} and F_{AB}); action and reaction always act on different bodies.

- (v) Gravitation.

Universal Law of Gravitation- Statement, equation and its importance, applications of the law. 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 $p=h\rho g$); Transmission of pressure in liquids;

Thrust and Pressure and their units; pressure exerted by a liquid column $p = h\rho g$; simple daily life examples; Factors affecting the pressure in stationary fluid (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 (Concept and simple numerical problems); examples; [working of hydraulic machines not included]

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

Buoyancy, upthrust (F_B); definition, characteristic properties of upthrust; Archimedes' principle; explanation of cases where bodies with different densities as compared with the densities of liquid in which it is immersed; different cases:

Case I: $F_B < \text{weight } W$ of the body, $d_B > d_{\text{fluid}}$, Apparent weight, Relative Density (RD) and Archimedes' principle. Experimental determination of RD of a solid denser than water and R.D. of liquid. Applications.

Case II: $F_B = \text{weight } W$ of the body, $d_B = d_{\text{fluid}}$, Apparent weight.

Case III: $F_B > \text{weight } W$ of the body, $d_B < d_{\text{fluid}}$, Apparent weight.

Modification of Archimedes' principle for case II and case III (floatation); relation between the density of a floating body, density of the liquid in which it is floating and the fraction of the volume of the body immersed; ($\frac{\rho_1}{\rho_2} = \frac{V_2}{V_1}$); apparent weight of floating objects; application to ship, submarine, iceberg, balloons, etc. Simple numerical problems involving Archimedes' principle in all the three cases above.

5. Heat and Energy

- (i) Concepts of heat and temperature.
Heat as energy, SI unit – joule.
 $1 \text{ cal} = 4.186 \text{ J}$ exactly.
- (ii) *Anomalous expansion of water; graphs showing variation of volume and density of water with temperature in the 0 to 10°C range. Hope's experiment and consequences of Anomalous expansion.*
- (iii) Global warming and Green House effect.
Meaning, causes and impact on the life on earth.
Energy degradation – meaning and examples.

6. Light

- (i) Reflection of light; images formed by a pair of parallel and plane mirrors.
Laws of reflection; experimental verification; characteristics of images formed in a pair of mirrors, uses of plane mirrors. Formation of multiple images when two plane mirrors are placed parallel to each other.
- (ii) Spherical mirrors; characteristics of image formed by these mirrors. Uses of concave and convex mirrors. (Only simple direct ray diagrams are required).
Brief introduction to spherical mirrors - concave and convex mirrors, centre and radius of curvature, pole and principal axis, focus and focal length; path of specific rays [rays parallel to the principal axis, rays passing through the focus, rays through centre of curvature, rays parallel to each other, rays through a single point on the focal plane]; location of images from ray diagram for various positions of a small linear object on the principal axis of concave and convex mirrors; characteristics of images.
 $f = R/2$ (without proof); Cartesian sign convention and direct numerical problems using the mirror formulae are included. (Derivation of formulae not required)
Uses of spherical mirrors.
Scale drawing or graphical representation of ray diagrams not required.

7. Sound

- (i) Introduction to wave motion. Types of mechanical waves, transverse and longitudinal waves, their comparison, Nature of Sound waves. Requirement of a medium for sound waves to travel; propagation and speed in different media; comparison with speed of light.
Sound propagation, terms – frequency (f), wavelength (λ), velocity (V), time period(T), relation $V = f\lambda$. (Simple numerical problems) effect of different factors on the speed of sound; comparison of speed of sound with speed of light; consequences of the large difference in these speeds in air; thunder and lightning.
- (ii) Infrasonic, sonic, ultrasonic frequencies and their applications.
Elementary ideas and simple applications only. Difference between ultrasonic, and supersonic; and infrasonic and subsonic.

8. Electricity and Magnetism

- (i) Free electrons, Simple electric circuit using an electric cell and a bulb to introduce the idea of current (including its relationship to charge); electric charge, potential difference; insulators and conductors; closed and open circuits; direction of current (electron flow and conventional); Resistance.

Current Electricity: Concept of free electrons, types of conductors (good conductors, bad conductors, semi-conductors and superconductors), electric charge(Q) and its SI unit, quantum nature of the charge, direction of flow of charge, electric current as the rate of flow of electric charge (direction of current conventional and electronic), elementary idea about work done in transferring charge through a conductor wire; potential difference $V = W/q$. (No derivation of formula), SI unit, concept of resistance (R), SI unit, 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, brief introduction of sources of direct current - cells, accumulators (construction, working and equations excluded); Ohm's Law, $V = IR$. Simple numerical problems.

- (ii) Induced magnetism, Magnetic field of earth. Neutral points in magnetic fields.

Magnetism: 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. 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.

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 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 corrects 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 $4\pi^2 \times \text{slope}$.
6. 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 $T_C = 0$.
7. 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.
8. 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.
9. 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.

10. 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.
11. 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?
12. 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 $M = V \cdot \rho$, $W = mg$). Use the above result to verify Archimedes principle.

CLASS X

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

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

1. Force, Work, Power and Energy

- (i) Turning forces concept; moment of a force; forces in equilibrium; centre of gravity; [discussions using simple examples and simple numerical problems].

Elementary introduction of translational and rotational motions; 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); principle of moment and its verification using two spring balances with slotted weights suspended from the meter rule; simple numerical problems; Centre of gravity (qualitative only) with examples of some regular bodies and irregular lamina, factors affecting centre of gravity of the body.

Stable, unstable and neutral equilibrium examples. Static and linear dynamic equilibrium. Principle of moment and its verification using a metre rule and suspended weights; simple numerical problems.

- (ii) Work, energy, power and their relation with force. (Work - energy theorem without derivation.)

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, kWh and eV]. Definition of Power, $P = W/t$; SI and cgs units; other units, kilowatt (kW), megawatt (MW) and gigawatt (GW); and horsepower (1hp=746W) [Simple numerical problems on work, power and energy].

- (iii) Principle of Conservation of energy.

Statement of the principle of conservation of energy; theoretical verification that $U + K = \text{constant}$ for a freely falling body. Application of this law to simple pendulum (qualitative only); [simple numerical problems].

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

Mechanical energy: potential energy $U = mgh$ (derivation included) gravitational PE, examples; kinetic energy $K = \frac{1}{2}mv^2$ (derivation included); 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.

- (v) Machines as force multipliers; load, effort, mechanical advantage, velocity ratio and efficiency; simple treatment of levers, 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), Power output (PO), Power Input (PI), efficiency (η), relation between η and MA, VR (derivation included); 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 also found in the human body.

Pulley system: single fixed, single movable, block and tackle; MA, VR and η in each case [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. Applications of refraction of light.

Partial reflection and refraction due to change in medium. Laws of refraction; the effect on speed (V), wavelength (λ) and frequency (f) due to refraction of light; conditions for a light ray to pass undeviated. Values of speed of light (c) in vacuum, air, water and glass; refractive index $\mu = c/V$, $V = f\lambda$. Values of μ for common substances such as water, glass and diamond; experimental verification; refraction through glass block; lateral displacement; multiple images in thick glass plane/mirror without its ray diagram; refraction through a glass prism, simple applications: real and apparent depth of objects in water; apparent bending of a stick under water. (Simple numerical problems and approximate ray diagrams required).

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

Transmission of light from a denser medium (glass/water) to a rarer medium (air) at different angles of incidence; critical angle (C) $\mu = 1/\sin C$. 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.

- (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.

Types of lenses (converging and diverging), convex and concave, 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; methods to find focal length of convex lens detailed study of refraction of light in spherical lenses through ray diagrams; 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. Cartesian Sign convention and direct numerical problems using the lens formula are included (derivation of formula not required).

Scale drawing or graphical representation of ray diagrams not required.

*Power of a lens (concave and convex) – [simple direct numerical problems]: magnifying glass or simple microscope: location of image and magnification from ray diagram only [magnifying power formula ($M = 1 + \frac{D}{f}$) and numerical based on this formula are **not** included]. Applications of lenses.*

- (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 (names only arranged in order of increasing wavelength); properties common to all electromagnetic radiations; properties and uses of infrared and ultraviolet radiation. Simple application of scattering of light e.g. blue colour of the sky.

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 field. SONAR.

- (ii) Natural vibrations, Damped vibrations, Forced vibrations and Resonance - a special case of forced vibrations.

Meaning and simple applications of natural, damped, forced vibrations and resonance. Applications of resonance.

- (iii) Loudness, pitch and quality of sound.

Characteristics of sound: loudness and intensity; subjective and objective nature of all characteristics; sound level in decibel(dB) (as unit only); interdependence of: pitch and frequency, quality and waveforms (with examples).

4. Electricity and Magnetism

- (i) Ohm's Law; concepts of emf, potential difference (pd), resistance; resistances in series and parallel, internal resistance.

Concepts of pd (V), current (I), resistance (R) and charge (Q). Ohm's law: statement, $V=IR$; SI units; experimental verification; graph of V vs I and resistance from slope; ohmic and non-ohmic resistors, factors affecting resistance (including specific resistance) and internal resistance; super conductors, electromotive force (emf); combination of resistances in series and parallel and derivation of expressions for equivalent resistance. Simple numerical problems using the above relations. [Simple 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 $P = (W/t) = VI = I^2 R = V^2/R$. 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 $\times$ hour = kWh), [simple numerical problems].

- (iii) Stages of power distribution – main circuit; switches; fuses; earthing; safety precautions; three-pin plugs; colour coding of wires-live, neutral and earth wires.

Only stages of power distribution and corresponding voltages for heavy industries, light industries and domestic, frequency of AC in household supplies, meaning of Live, neutral and earth wire, their colour coding; Need for supplying power at high voltage; House wiring (ring system); main circuit with live, neutral and earth wires, kWh meter. Main distribution board, main fuse, main switch, MCB, switches. Connection of appliances in parallel combination and its advantages - circuit diagram, advantages of ring system; two-way switches, 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.

- (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 thumb rule – magnetic field due to a current in a loop; Electromagnets: their uses; comparisons with a permanent magnet; Fleming's Left Hand Rule, Working principle of transformer- Simple introduction to electromagnetic induction; frequency of AC in house hold supplies, Fleming's Right Hand Rule.

5. Heat

- (i) Calorimetry: Meaning, specific heat capacity; principle of method of mixtures; Numerical Problems on specific heat capacity using heat loss and gain and the method of mixtures.

Heat and its units (calorie, joule), temperature and its units ($^{\circ}C$, K); factors affecting heat absorbed and released, thermal (heat) capacity $C' = Q/\Delta T$ (SI unit of C'): Specific heat Capacity $C = Q/m \Delta T$ (SI unit of C) Mutual relation between Heat Capacity and Specific Heat capacity, values of C for some common substances (ice, water and copper). Principle of method of mixtures including mathematical statement.

Natural phenomenon involving specific heat. Consequences of high specific heat of water. [Simple numerical problems].

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

Change of phase (state); heating curve for water; latent heat; specific latent heat of fusion (SI unit). Simple numerical problems. Common physical phenomena involving latent heat of fusion. Heating and cooling curve. [No numerical involving latent heat of vaporization.]

6. Modern Physics

- (i) 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 comparative 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: Alpha emitters (Americium-241 smoke detector, Radium-223 treatment of cancer, Polonium-210 to remove static charges etc), beta emitters (Strontium-90 in controlling the thickness of the paper, Carbon-14 in carbon dating), gamma emitters (Cobalt-60 in tracers for irradiation, sterilisation and cancer treatment, Sodium-22 as tracer, Technetium-99m diagnostic imaging, Iodine-131 in treatment of thyroid cancer).

Harmful effects of radio isotopes: Strontium-90 causing eye and bone cancer.

Background radiation: X-rays; radioactive fallout from nuclear plants and other sources.

Nuclear Energy: working on safe disposal of waste. Safety measures to be strictly reinforced.

- (ii) Nuclear fission and fusion (Only definitions of the reactions and differences between them.)

A NOTE ON SI UNITS

SI units (*Système International d'Unités*) 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 square	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 $VR = \text{effort arm/load arm}$. 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. Determine the VR and MA of a given pulley system.
3. Trace the course of different rays of light refracting through a rectangular glass slab at different angles of incidence, measure the angles of incidence, refraction and emergence. Also measure the lateral displacement.
4. Determine the focal length of a convex lens by (a) the distant object method and (b) using a needle and a plane mirror.
5. Determine the focal length of a convex lens by using two pins and formula $f = uv/(u+v)$.
6. 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 $i_1=40^\circ$, 50° , 60° and 70°). Verify $i_1 + i_2 = A + \delta$ and $A = r_1 + r_2$.
7. 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 $A=60^\circ$, 45° and 90° .
8. Calculate the specific heat capacity 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.
9. Determination of specific heat capacity of a metal by method of mixtures.
10. Determination of specific latent heat of ice.
11. Using a simple electric circuit, verify Ohm's law. Draw a graph, and obtain the slope.
12. 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 ten 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 CISCE by the Head of the school.

The Head of the school will be responsible for the online entry of marks on CISCE's CAREERS portal by the due date.