CLASS X

*There will be one paper of **two 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).

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 = 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/△T. Note that the change in temperature has the same magnitude in ^oC and kelvin. (△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△T; and Q = mc.△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.

(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 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.*

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

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

[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
0^{-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 slab 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.