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.

(ii) International System of Units (the required SI units are given at the end of this syllabus) and other commonly used units of the relevant physical quantities.

(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); least count of measuring instruments. Significant figures; percentage error associated with a measurement.

(iv) Presentation of data in tabular and graphical form (straight line graphs only); labelling of axes; scale and accuracy of plots; best-fit straight line; errors; identifying proportional relationships using straight line graphs.

2. Fluids

(i) Change of pressure with depth (including the formula $p=h\rho g$); transmission of pressure in liquids; atmospheric pressure.

(ii) Archimedes' Principle; upthrust (buoyancy); floatation; relationship with density; relative density; determination of relative density of a solid; qualitative description of a hydrometer.

3. Motion in one dimension

Distance, speed, velocity, acceleration; graphs of distance-time and speed-time; equations of motion $v = u + at$; $S = ut + ½at^2$; $S = ½(u+v)t$; $v^2 = u^2 + 2as$.

4. Newton's Laws of Motion

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

(ii) Newton's Second Law of Motion (elementary qualitative discussion) in terms of rate of change of momentum with time, definition of force.

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

5. Forces

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

(ii) Turning forces concept; moment of a force; forces in equilibrium; centre of gravity;

(discussions using simple examples and simple direct problems).

(iii) Uniform circular motion as example of constant speed, though force is present. Basic idea of centrifugal and centripetal force (qualitatively only).

6. Heat

(i) Concepts of heat and temperature.

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

(iii) Mercury thermometers, brief introduction; higher and lower fixed points of a thermometer; special case of the clinical thermometer; temperature scales - Celsius and Fahrenheit only. Problems on inter-conversion between the Celsius and Fahrenheit scales.

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

7. Light

(i) Rectilinear propagation of light; shadows.

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

(iii) Spherical mirrors; characteristics of image formed by these mirrors and their uses (only simple direct ray diagrams are required; sign convention, magnification, focal length and associated problems are not required).

8. Wave Motion

(i) Demonstrating that a medium is required for sound waves to travel; nature of sound, its propagation and speed in different media; comparison with speed of light.

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

9. 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.

(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 introduced through bulbs in series and parallel.

(iii) Properties of a bar magnet; induced magnetism; lines of magnetic force; neutral points.

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 null 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.ρ, 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.*

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

(ii) 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.

(iii) Work, energy, power, and their relation with force (simple numerical problems included).

(iv) Different types of energy (e.g., chemical energy, gravitational potential energy, kinetic energy, heat energy, elastic energy, electrical energy, nuclear energy, sound energy, light energy).

(v) Principle of Conservation of energy.

2. Light

(i) Refraction of light through a glass block and a triangular prism (no calculations but approximate ray diagrams required); qualitative treatment of simple applications such as real and apparent depth of objects in water and apparent bending of sticks in water.

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

(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**).

(iv) Using a triangular prism to produce a spectrum from white light; simple treatment of the electromagnetic spectrum.

3. Sound

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

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

(iii) Loudness, pitch and quality of sound; difference between music and noise (overtones, harmonics, nodes and anti-nodes are excluded).

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.

(ii) Electrical power and energy; household consumption of electrical energy (simple problems based on electricity bill calculations).

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

(iv) Magnetic effect of a current (principles only, laws not required); electromagnet; *dc* electric bell; *dc* motor; electromagnetic induction (elementary); *ac* generator; transformer (only qualitative description of the devices is required).

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.

(ii) Latent heat; loss & gain of heat involving change of state for fusion only (including simple problems); common phenomenon involving specific heat capacity and latent heat of fusion.

6. Modern Physics

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

(ii) Radioactivity and changes in the nucleus; the nature of alpha and beta particles and gamma rays (problems on half life excluded); background radiation and safety precautions.

Special Note: As mentioned above, numerical problems will be only from sub-units 1(i), 1(ii), 1(iii), 1(iv), 1(v), 3(i), 4(i), 4(ii), 5(i) & 5(ii) for Class X examination of 2009.

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=$^1/\sin\theta$ = $^l/h$ 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 concave mirror by (a) the distant object method and (b) one needle method removing parallax or using a ray box or candle and screen.

6. Do the same as above for a convex lens.

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 $i_1 + i_2 = A + \delta$.

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.

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

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 Principal, 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 Principal of the school.

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