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.*

*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) 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) 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), (**no** numerical problems on callipers and screw gauge), simple pendulum; time period, frequency, graph of length l vs. T^2 only; slope of the graph. Formula $T=2.\circledR.\sqrt{l/g}$ [**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; 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) 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 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, 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 a*p* = a*(mv) = m*a*v for mass remaining constant, rate of change of momentum;*

a *p/*a *t = m*a*v /*a*t = ma or*

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

Simple numerical problems combining F = a*p /*a*t = ma and equations of motion. Units of force - only cgs and SI.*

(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 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°g; simple daily life examples, (i) broadness of the base of a dam, (ii) Diver's suit etc. some consequences of p = h°g ; transmission of pressure in liquids; Pascal's law; examples; atmospheric pressure; common manifestation and consequences. Variations of pressure with altitude, (qualitative only); applications such as weather forecasting and altimeter. (Simple numerical problems)

(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 ° >, = or < the density °' of the fluid in which it is immersed.

RD and Archimedes' principle. Experimental determination of RD of a solid and liquid denser than water. Floatation: principle of floatation; 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; ($°_1/°_2 = V_2/V_1$); apparent weight of floating object; application to ship, submarine, iceberg, balloons, etc.

Simple numerical problems involving Archimedes' principle, buoyancy and floatation.

5. Heat and Energy

(i) Concepts of heat and temperature.

Heat as energy, SI unit – joule,

1 cal = 4.186 J exactly.

(ii) *Anomalous expansion of water; graphs showing variation of volume and density of water with temperature in the 0 to 10 ^0C range. Hope's experiment and consequences of Anomalous expansion.*

(iii)Energy flow and its importance:

Understanding the flow of energy as Linear and linking it with the laws of Thermodynamics- 'Energy is neither created nor destroyed' and 'No Energy transfer is 100% efficient.

(iv) 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 hydro electrical powers for light and tube wells.

(v) Global warming and Green House effect:

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

Energy degradation –meaning and examples.

6. Light

(i) Reflection of light; images formed by a pair of parallel and perpendicular plane mirrors; .

Laws of reflection; experimental verification; characteristics of images formed in a pair of mirrors, (a) parallel and (b) perpendicular to each other; uses of plane mirrors.

(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; 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); 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) 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 (^{a}), velocity (V), relation V = f^{a}. (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 f*requencies* and their applications.

Elementary ideas and simple applications only. Difference between ultrasonic and supersonic.

8. Electricity and Magnetism

(i) 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)

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.

(*No derivation of formula****)*** *simple numerical problems.*

Social initiatives: Improving efficiency of existing technologies and introducing new eco-friendly technologies. Creating awareness and building trends of sensitive use of resources and products, e.g. reduced use of electricity.

(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.

(iii) Introduction of electromagnet and its uses.

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 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. 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 $M=V.\rho$, $W=mg$). 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.*

*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, 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 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.

(ii) Uniform circular motion.

As an example of constant speed, though acceleration (force) is present. Differences between centrifugal and centripetal force.

(iii) 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].

(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), efficiency (η), relation between η and MA,VR (derivation included); for all practical machines η <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.

(vi) Principle of Conservation of energy.

Statement of the principle of conservation of energy; 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. Applications of refraction of light.

Partial reflection and refraction due to change in medium. Laws of refraction; the effect on speed (V), wavelength (ª) 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 μ = c/V, V = fª. 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 plate/mirror; 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) μ = 1/sinC. 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 ¢ = 90º and 180º (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.

(iv) *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,; 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. 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 [formula and numerical problems **not** included]. Applications of lenses.*

(v) 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.*

(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; interdependence of: pitch and frequency; quality and waveforms (with examples).

4. Electricity and Magnetism

(i) Ohm's Law; concepts of emf, potential difference, 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^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 × 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 (ring system), power distribution; main circuit (3 wires-live, neutral, earth) with fuse / MCB, 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, colour coding of wires.

(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, the DC electric motor- simple sketch of main parts (coil, magnet, split ring commutators and brushes); brief description and type of energy transfer(working not required): Simple introduction to electromagnetic induction; frequency of AC in house hold supplies , Fleming's Right Hand Rule, AC Generator - Simple sketch of main parts, brief description and type of energy transfer(working not required). Advantage of AC over DC. Transformer- its types, characteristics of primary and secondary coils in each type (simple labelled diagram and its uses).

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 (^oC, K); thermal (heat) capacity C' = Q/∆T... (SI unit of C): Specific heat Capacity C = Q/m∆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 sp. heat of water. [Simple numerical problem].

(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 (SI unit). Simple numerical problems. Common physical phenomena involving latent heat of fusion.

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. ~, and ¥ - their nature and properties; changes within the nucleus. One example each of ~ and 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 Energy: working on safe disposal of waste. Safety measures to be strictly reinforced.

(ii)*Nuclear fission and fusion; basic introduction and equations.*

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. 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 $i_1=40^0$, 50^0, 60^0 and 70^0). 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 $A=60^0$, 45^0 and 90^0.
8. 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.
9. Determination of sp. heat of a metal by method of mixtures.
10. Determination of specific latent heat of ice.
11. Using as 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 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.

SCIENCE (52)

CHEMISTRY

SCIENCE Paper - 2

Aims:

1. To acquire the knowledge of terms, concepts, processes, techniques and principles related to the subject.
2. To develop the ability to apply the knowledge of contents and principles of chemistry in unfamiliar situations.
3. To acquire skills in proper handling of apparatus and chemicals.
4. To develop scientific temper, attitude and problem solving skills.
5. To recognize Chemical Science as having an important impact on the environment relating to cycles in nature; natural resources, pollution.

CLASS IX

There will be one paper of ***two hours*** *duration of 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: *All chemical reactions should be studied with reference to the reactants, products, conditions, observations and the (balanced) equation.*

1. Matter and its Composition: Law of Conservation of mass

(i) Explanation of change of state of matter on the basis of Kinetic Theory of Matter.

Main postulates of Kinetic Theory of Matter and explanation of change of state on the basis of. Inter-particle space and Inter-particle attraction and collision.

(ii) Law of Conservation of Mass

Statement and explanation with examples.

2. Study of Gas Laws

(i) The behaviour of gases under changes of temperature and pressure; explanation in terms of molecular motion (particles, atoms, molecules); Boyle's Law and Charles' Law; absolute zero; gas equation; simple relevant calculations.

The behaviour of gases under changes of temperature and pressure; explanation in terms of molecular motion (particles, atoms, molecules). Boyle's Law (statement, mathematical form, simple calculations).

Charles' Law; (statement, mathematical form, simple calculations). Absolute zero; Kelvin scale of temperature. Gas equation $P_1 V_1 / T_1 = P_2 V_2 / T_2$*; simple relevant calculations based on gas equation.*

(ii) Relationship between Kelvin Scale and Celsius Scale of temperature; Standard temperature and pressure.

Conversion of temperature from Celsius Scale to Kelvin scale and vice versa. Standard temperature and pressure. (simple calculations).

3. Elements, Compounds and Mixtures

(i) General characteristics and differences between elements, compounds and mixtures.

Reasons for considering a substance as an element, compound or mixture may be given to make the concepts clear.

(ii) Types of mixtures: of two solids, a solid and a liquid, two liquids, liquid and gas, two gases.

Definition of mixture; each type of mixture should be shown to the students (including both homogeneous and heterogeneous types) – true solution, suspension and colloidal solution to make the concepts clear.

(iii) Separation of mixtures involving - use of a solvent, filtration, evaporation and distillation, fractional distillation, simple paper chromatography Centrifugation immiscible liquid.

The following examples should be used to illustrate the principles of separation of mixtures by using following methods

(a) use of solvent and filtration (e.g. sodium chloride + sand, (water as solvent), carbon and sulphur (Carbon tetra chloride as solvent)

(b) evaporation e.g. sodium chloride from its aqueous solution

(c) distillation e.g. purification of water containing dissolved solids.

(d) fractional distillation involves the difference in boiling points of liquids e.g. benzene + toluene.

(e) simple paper chromatography (limited to separation of colouring matter in ink);

(f) Centrifugation (involving separation of cream from milk).

(g) immiscible liquids (separating funnel e.g water + carbon tetra chloride).

4. The language of Chemistry

Symbol of an element; valency; formulae of radicals and formulae of compounds. Balancing of simple chemical equations.

Symbol – definition; symbols of the elements used often.

Valency - definition; hydrogen combination and number of valence electrons of the metals and non-metals; mono, di, tri and tetra valent elements.

Radicals – definition of radicals; formula and valencies of the radicals and formula of compounds.

Chemical equation – definition and examples of chemical equations with one reactant and two or three products, two reactants and one product, two reactants and two products and two reactants and three or four products; balancing of equations. (By partial equation method and hit and trial method)

5. Physical and Chemical Changes

(i) Definitions and distinction between Physical and Chemical changes.

Simple experiments like dissolution of sugar in water, burning of paper should be shown to make the concepts of physical and chemical change clear. More examples of such type may be given.

(ii) Conditions for chemical change.

Close contact, heat, light, electricity, pressure, catalysts with examples.

(iii) Types of chemical change.

Direct combination; decomposition; displacement; double decomposition with examples.

(iv) Energy changes in a chemical change.

Exothermic and endothermic reactions with examples – evolution/absorption of heat, light and electricity.

(v) Burning: Definition and conditions of burning.

Definition; (Air is used for combustion) conditions for burning (combustible substance, supporter of combustion and ignition temperature); comparison of respiration and burning; burning of magnesium or candle to show that substances gain weight on burning; students to be made aware of how the balance of O_2 and CO_2 is maintained in nature. O_2 and CO_2 Cycle.

6. Water

Water as a compound and as a universal solvent; its physical and chemical properties.

Why water is considered a compound? Chief physical properties should include: density, b.p, m.p. Experiment to show that the water we drink, contains dissolved solids and dissolved gases (air); their significance. Solutions as 'mixtures' of solids in water; saturated solutions; qualitative effect of temperature on solubility (e.g. solutions of calcium sulphate, potassium nitrate, sodium chloride in water).

Water Pollution – Causes – household, detergents, sewage, industrial waste, offshore and oil drilling.

Treatment of Water Pollution – Proper collection and disposal of domestic sewage, treatment of industrial waste to yield safe effluents.

Chemical Properties: The action of cold water on sodium and calcium; the action of hot water on magnesium and steam on iron; reversibility of reaction between iron and steam.

Students can be shown the action of sodium and calcium on water in the laboratory; they must be asked to make observations (equations for the above reactions) and form reactivity series based on reactions.

7. Atomic Structure

Structure of an Atom mass number and atomic number, Isotopes and Octet Rule.

Definition of an element, definition of an atom; constituents of an atom - nucleus (protons, neutrons) with associated electrons; mass number, atomic number. Electron distribution in the orbits - $2n^2$ rule, Octet rule. Reason for chemical activity of an atom. Definition and examples of isotopes (hydrogen, carbon, chlorine).

8. The Periodic Table

Dobereiner's Triads, Newland's law of Octaves, Mendeleev's contributions; Modern Periodic Law, the Modern Periodic Table. (groups and periods)

General idea of Dobereiner's triads, Newland's law of Octaves, Mendeleev's periodic law, Discovery of Atomic Number and its use as a basis for Modern Periodic law, Modern Periodic Table (groups 1 to 18 and periods 1 to 7).

9. Study of the First Element -Hydrogen

Position of the non-metal (Hydrogen) in the periodic table and general group characteristics with reference to valency electrons, burning, ion formation applied to the above mentioned element.

(i) Hydrogen from water (ii) hydrogen from dilute acids (iii) hydrogen from alkalies.

Hydrogen from water. Cold water and metals; hot water and metals; steam and metals; steam and non-metals. Application of activity series for the above mentioned preparations. Displacement of hydrogen from dilute sulphuric acid or hydrochloric acid by zinc or iron (no reaction with copper). Displacement of hydrogen from alkalis (NaOH, KOH) by Zn, Al – unique nature of these elements.

(ii)The preparation and collection of hydrogen by a standard laboratory method other than electrolysis.

In the laboratory preparation, the reason for using zinc, the impurities in the gas, their removal and the precautions in the collection of the gas must be mentioned.

Industrial manufacture of hydrogen by Bosch process with main reactions and conditions; separation of CO_2 and CO from it.

10. Atmospheric pollution

(a) Acid rain – composition, cause and its impact.

Sulphur in fossil fuels giving oxides of sulphur when burnt. High temperatures in furnaces and internal combustion engines produce oxides of nitrogen. (Equations to be included). Acid rain affects soil chemistry and water bodies.

(b) Global warming:

Greenhouse gases – their sources and ways of reducing their presence in the atmosphere.

(water vapour, carbon dioxide, methane and oxides of nitrogen)

(c) Ozone depletion

Formation of ozone – relevant equations

Function in the atmosphere.

Destruction of the ozone layer – chemicals responsible for this to be named but reactions not required.

INTERNAL ASSESSMENT OF PRACTICAL WORK

Candidates will be asked to observe the effect of reagents and/or of heat on substances supplied to them. The exercises will be simple and may include the recognition and identification of certain gases listed below.

Gases: Hydrogen, Oxygen, Carbon dioxide, Chlorine, Hydrogen chloride, Sulphur dioxide, Hydrogen sulphide, Ammonia, Water vapour, Nitrogen dioxide.

Candidates are expected to have completed the following minimum practical work.

Simple experiments on:

1. Heat the given (unknown) substance, make observations, identify any products and make deductions where possible.
   (a) copper carbonate, zinc carbonate
   (b) washing soda, copper sulphate crystals
   (c) zinc nitrate, copper nitrate, lead nitrate
   (d) ammonium chloride, iodine, ammonium dichromate
2. Add dilute sulphuric acid to the unknown substance, warm if necessary, make observation, identify the product and make deductions.
   (a) a sulphide
   (b) a carbonate
   (c) a metal
3. Apply the flame test to identify the metal in the unknown substance.
   (a) a sodium salt
   (b) a potassium salt
   (c) a calcium compound
4. The percentage composition of a mixture of powdered salt and water-washed sand.

   The experiment would test techniques in dissolving, filtering or decanting, washing and weighing. It may be counted out as taking too much time. The weakness could be met by supplying a given weight of the mixture; also by choosing sand of such grain size that filtering or decanting will not be slow and yet not so large that separation of salt and sand cannot be done simply by sorting out mechanically the sand from the salt. The experiment should take about 20 minutes using 10g mixture (4g sand, 6g salt).
5. Simple experiments based on hard water and soft water – identification of hardness – simple softening – by heating the temporary hard water, using washing soda and advantage of using detergents over soap in hard water.
6. Find out the sources of pollution of water bodies in the locality and determine the quality of water.

CLASS X

*There will be one paper of **two hours** duration of 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:** All chemical process/reactions should be studied with reference to the reactants, products, conditions, observation, the (balanced) equation and diagram.*

1. Periodic Properties and variations of Properties – Physical and Chemical.

(i) Periodic properties and their variations in groups and periods.

Definitions of following periodic properties and trends in these properties in groups and periods should be studied:

- *atomic size,*
- *metallic character*
- *non-metallic character*
- *ionisation potential*
- *electron affinity*
- *electronegativity*

(ii) Periodicity on the basis of atomic number for elements.

Relation between atomic number for light elements (proton number) and atomic mass for light elements; the modern periodic table up to period 3 (students to be exposed to the complete modern periodic table but no questions will be asked on elements beyond period 3 – Argon); periodicity and other related properties to be described in terms of shells (not orbitals); special reference to the alkali metals and halogen groups.

2. **Chemical Bonding**

Electrovalent, covalent and co-ordinate bonding, structures of various compounds – orbit structure and electron dot structure.

Definition of Electrovalent Bond.

Structure of Electrovalent compounds NaCl, $MgCl_2$, CaO;

Characteristic properties of electrovalent compounds – state of existence, melting and boiling points, conductivity (heat and electricity), ionisation in solution, dissociation in solution and in molten state to be linked with electrolysis.

Covalent Bond – definition and examples, structure of Covalent molecules on the basis of duplet and octet of electrons (example : hydrogen, chlorine, nitrogen, water, ammonia, carbon tetrachloride, methane.)

Characteristic properties of Covalent compounds – state of existence, melting and boiling points, conductivity (heat and electricity), ionisation in solution.

Comparison of Electrovalent and Covalent compounds.

Definition of Coordinate Bond: The lone pair effect of the oxygen atom of the water molecule and the nitrogen atom of the ammonia molecule to explain the formation of H_3O^+ and OH^- ions in water and NH_4^+ ion. The meaning of lone pair; the formation of hydronium ion and ammonium ion must be explained with help of electron dot diagrams.

3. Study of Acids, Bases and Salts

(i) Simple definitions in terms of the molecules and their characteristic properties.

Self-explanatory.

(ii) Ions present in mineral acids, alkalis and salts and their solutions; use of litmus and pH paper to test for acidity and alkalinity.

Examples with equation for the ionisation/dissociation of ions of acids, bases and salts: acids form hydronium ions

(only positive ions) which turn blue litmus red, alkalis form hydroxyl ions (only negative ions) with water which turns red litmus blue. Salts are formed by partial or complete replacement of the hydrogen ion of an acid by a metal should be explained with suitable examples. Introduction to pH scale to test for acidity, neutrality and alkalinity by using pH paper or Universal indicator.

(iii) Definition of salt; types of salts.

Types of salts: normal salts, acid salt, basic salt, definition and examples.

(iv) General properties of salts:

- Deliquescence, efflorescence, water of crystallization.

Definition and example of each of the above.

- *Decomposition of hydrogen carbonates, carbonates, chlorides and nitrates by appropriate acids with heating if necessary. (relevant laboratory work must be done).*

Action of dilute acids on carbonates, hydrogen carbonates and action of concentrated acid. Equations of formation of Acid rain. (Sulphuric acid) on chlorides and nitrates, to obtain carbon dioxide, hydrogen chloride and nitric acid, respectively should be taught. This will assist the students in their practical work.

(v) Preparation: laboratory preparation of salts (normal and acid salts) – relevant laboratory work is essential (no apparatus details are required).

Laboratory preparation of salts (normal and acid salts): Direct combination; decomposition; displacement; double decomposition; neutralization.

4. Analytical Chemistry – Use of Ammonium Hydroxide and Sodium Hydroxide

(i) On solution of salts: colour of salt and its solution; formation and colour of hydroxide precipitated for solutions of salts of Ca, Fe, Cu, Zn and Pb; special action of ammonium hydroxide on solutions of copper salt and sodium hydroxide on ammonium salts.

On solution of salts:

- *Colour of salt and its solution.*
- *Action on addition of Sodium Hydroxide to solution of Ca, Fe, Cu, Zn, and Pb salts drop by drop in excess. Formation and colour of hydroxide precipitated to be highlighted. with the help of equations.*
- *Action on addition of Ammonium Hydroxide to solution of Ca, Fe, Cu, Zn, and Pb salts drop by drop in excess. Formation and colour of hydroxide precipitated to be highlighted with the help of equations.*
- *Special action of Ammonium Hydroxide on solutions of copper salts and sodium hydroxide on ammonium salts.*

(ii) On certain metals and their oxides (relevant laboratory work is essential).

The metals must include zinc and aluminium, their oxides and their hydroxides, which react with caustic alkalis (NaOH, KOH), showing the amphoteric nature of these substances.

5. Mole Concept and Stoichiometry

(i) Gay Lussac's Law of Combining Volumes; Avogadro's Law.

Idea of mole – a number just as dozen, a gross; Avogadro's Law - statement and explanation; Gay Lussac's Law of Combining Volumes. – statement and explanation, "the mass of 22.4 litres of any gas at S.T.P. is equal to its molar mass". (Questions will not be set on formal proof but may be taught for clear understanding) – simple calculations based on the molar volume.

(ii) Refer to the atomicity of hydrogen, oxygen, nitrogen and chlorine (proof not required).

The explanation can be given using equations for the formation of HCl, NH_3, and NO.

(iii) Relative atomic masses (atomic weight) and relative molecular masses (molecular weights): either H=1 or $^{12}C=12$ will be accepted; molecular mass = 2×vapour density (formal proof not required). Deduction of simple (empirical) and molecular formula from the percentage composition of a compound; the molar volume of a gas at S.T.P.; simple calculations based on chemical equations; both reacting weight and volumes.

Idea of relative atomic mass and relative molecular mass – standard H atom or 1/12th of carbon 12 atom.

Relating mole and atomic mass; arriving at gram atomic mass and then gram atom; atomic mass is a number dealing with one atom; gram atomic mass is the mass of one mole of atoms.

Relating mole and molecular mass arriving at gram molecular mass and gram molecule – molecular mass is a number dealing with a molecule, gram molecular mass is the mass of one mole of molecules.

Molecular mass = 2òvapour density (questions will not be set on formal proof but may be taught for clear understanding); - simple calculations based on the formula.

Deduction of simple (empirical) and molecular formula from the percentage composition of a compound.

6. Electrolysis

(i) Electrolytes and non-electrolytes.

Definitions and examples.

(ii) Substances containing molecules only, ions only, both molecules and ions.

Substances containing molecules only, ions only, both molecules and ions. Examples; relating their composition with their behaviour as electrolyte (strong and weak), non-electrolyte.

Definition and explanation of electrolysis, electrolyte, electrode, anode, cathode, anion, cation, oxidation and reduction (on the basis of loss and gain of electrons).

(iii) An elementary study of the migration of ions, with reference to the factors influencing selective discharge of ions, illustrated by the electrolysis of: molten lead bromide; acidified water with platinum electrodes and aqueous copper (II) sulphate with copper electrodes; electron transfer at the electrodes.

The above electrolytic processes can be studied in terms of electrolyte used, electrodes used, ionization reaction, anode reaction, cathode reaction, use of selective discharge theory wherever applicable.

(iv) Applications of electrolysis: electroplating with nickel and silver; purification of copper; choice of electrolyte for electroplating.

Reasons and conditions for electroplating;; names of the electrolytes and the electrodes used should be given. Equations for the reactions at the electrodes should be given for electroplating, refining of copper.

(v) Acids, bases and salts as electrolytes: reference should be made to the activity series as indicating the tendency of metals, e.g. Na, Mg, Fe, Cu, to form ions.

7. Metallurgy

(i) Definition of Metals and Non-metals.

Self-explanatory.

(ii) Position of the metals (alkali metals and alkaline earth metals) in the Periodic table and general characteristics applied to these elements with reference to the following – occurrence, nature, bonding, action of air, action of water, action of acids.

Self-explanatory.

(iii) Comparison of Metals and Non-metals.

General properties with special reference to physical properties: state, lustre, melting point, density, ductility, malleability, brittleness, conduction of electricity (exceptions to be specifically noted - e.g. graphite, mercury); chemical properties: a metal forms at least one basic oxide; non-metal, an acidic or neutral oxide; discharge of metallic ions at the cathode from fused metallic chlorides (link with bonding and ion

formation); many metals liberate hydrogen from dilute HCl and H_2SO_4.In the physical properties of metals and non-metals, atomicity and valence electrons should also be included; suitable examples must be given for basic, acidic and neutral oxides; formation and discharge of ions at the cathode (metallic) and anode (non-metallic) should be explained with examples.

(iv) Reduction of metallic oxides; some can be reduced by hydrogen, carbon and carbon monoxide (e.g. copper oxide, lead oxide, iron (II) oxide) and some cannot (e.g. Al_2O_3, MgO) - refer to activity series).

Equations with conditions and observations should be given.

(v) Extraction of metals based on the activity series.

Extraction of metals: principle of extraction of metal from its compounds by reduction – carbon reduction, electrolytic reduction. Active metals by electrolysis e.g. sodium, aluminium (reference only).

(vi) Corrosion of iron and its prevention.

Experiment to illustrate that moisture and oxygen in air are responsible for the corrosion. Reaction of corrosion. Prevention by painting and galvanization.

(vii) Metals and their alloys: common ores of iron, aluminium and zinc. Extraction of Aluminium.

Metals and their alloys: Occurrence of metals in nature - mineral and ore. Common ores of iron, aluminium and zinc. Dressing of the ore – hydrolytic method, magnetic separation, froth flotation method, chemical method by using chemical - NaOH for purifying bauxite – Baeyer's Process.

Extraction of Aluminium: the constituents in the charge, method of electrolytic extraction (flow chart to be used); structure of electrolytic cell and reason for using cryolite, electrolyte, electrodes,, electrode reaction.

Description of the changes occurring, purpose of the substances used and the main reactions with their equations.

(a) Uses of iron, aluminium and zinc and their alloys.

Uses of iron, aluminium and zinc and their alloys. Composition of their alloys – steel, duralumin, brass.

(b) Other important alloys – bronze, fuse metal and solder.

Uses only.

8. Study of Compounds

- **Hydrogen Chloride**

Hydrogen chloride: preparation of hydrogen chloride from sodium chloride; refer to the density and solubility of hydrogen chloride (fountain experiment); reaction with ammonia; acidic properties of its solution.

Preparation of hydrogen chloride from sodium chloride; (the laboratory method of preparation can be learnt in terms of reactants, product, condition, equation, diagram or setting of the apparatus, procedure, observation, precaution, collection of the gas and identification).

Simple experiment to show the density of the gas (Hydrogen Chloride) –heavier than air.

*Solubility of hydrogen chloride (fountain experiment); (setting of the apparatus, procedure, observation, inference) – method of preparation of hydrochloric acid by dissolving the gas in water- the special arrangement and the mechanism by which the back suction is avoided should be le*arnt.

Reaction with ammonia

Acidic properties of its solution - (reaction with metals, their oxides, hydroxides and carbonates to give their chlorides; decomposition of carbonates, hydrogen carbonates, sulphides, sulphites, thiosulphates and nitrates).

- ***Ammonia***

(i) Ammonia: its laboratory preparation from ammonium chloride and collection;

ammonia from nitrides like Mg_3N_2 and AlN and ammonium salts. Manufacture by Haber's Process; density and solubility of ammonia (fountain experiment); aqueous solution of ammonia; its reactions with hydrogen chloride and with hot copper (II) oxide and chlorine; the burning of ammonia in oxygen; uses of ammonia.

Laboratory preparation from ammonium chloride and collection (the preparation can be studied in terms of, setting of the apparatus and diagram, procedure, observation, collection and identification).

Manufacture of ammonia on a large scale - reference should be made to Haber Process for the manufacture of ammonia.

Ammonia from nitrides like Mg_3N_2 and AlN and ammonium salts; the reactions can be studied in terms of reactant, product, condition, equation.

Density and solubility of ammonia (fountain experiment); the property can be learnt in terms of setting of the apparatus, procedure and observation and inference.

Aqueous solution of ammonia - reaction with sulphuric acid, nitric acid, hydrochloric acid and solutions of iron(III) chloride, iron(II) sulphate, lead nitrate, zinc nitrate and copper sulphate.

Its reaction with: hydrogen chloride, hot copper (II) oxide, with chlorine in excess and ammonia in excess, burning of ammonia in oxygen; all these reactions may be studied in terms of reactants, products, condition, equation and observation; reference should be made to preparation of nitrogen from air and from ammonium nitrite.

Uses of ammonia - manufacture of fertilizers, explosives, nitric acid, refrigerant gas (Chlorofluro carbon – and its suitable alternatives which are non-ozone depleting), cleansing agents, source of hydrogen.

(ii) The catalytic oxidation of ammonia, as the source of nitric acid; (refer to Ostwald process) simple diagram for a catalytic oxidation of ammonia in the laboratory (with conditions and reactions only).

Self-explanatory.

- **Nitric Acid**

Nitric Acid: one laboratory method of preparation of nitric acid from potassium nitrate or sodium nitrate. Nitric acid as an oxidizing agent.

Nitric Acid: Laboratory method of preparation of nitric acid from potassium nitrate or sodium nitrate; the laboratory method can be studied in terms of reactant, product, condition, equation, setting, diagram, precaution, collection, identification.

As an oxidising agent: its reaction with copper, carbon, sulphur.

- **Sulphuric Acid**

Sulphuric Acid: its behaviour as an acid when dilute, as an oxidizing agent when concentrated - oxidation of carbon and sulphur; as a dehydrating agent - dehydration of sugar and copper (II) sulphate crystals; its non-volatile nature.

Manufacture by Contact process (reference only). Detail of the process to be avoided.

Its behaviour as an acid when dilute - reaction with metal, metal oxide, metal hydroxide, metal carbonate, metal bicarbonate, metal sulphite, metal sulphide.

Concentrated sulphuric acid as an oxidizing agent - the oxidation of carbon and sulphur.

Concentrated sulphuric acid as a dehydrating agent- (a) the dehydration of sugar (b) Copper(II) sulphate crystals.

Non-volatile nature of sulphuric acid - reaction with sodium or potassium chloride and sodium or potassium nitrate.

8. Organic Chemistry

(i) Introduction to Organic compounds.

Unique nature of Carbon atom – tetra valency, catenation, formation of single, double and triple bonds, straight chain, branched chain and cyclic compounds.

(ii) Structure and Isomerism.

Structure of compounds with single, double and triple bonds; Isomerism – structural (chain, position)

(iii) Homologous series – characteristics with examples.

Alkane, alkene, alkyne series and their gradation in properties and the relationship with the molecular mass or molecular formula.

(iv) Simple nomenclature.

Simple nomenclature - of the hydrocarbons with simple functional groups – (double bond, triple bond, alcoholic, ether, aldehydic, keto, carboxylic group) longest chain rule and smallest number for functional groups rule – trivial and IUPAC names.

(v) Hydrocarbons: alkanes, alkenes, alkynes.

Alkanes - general formula; methane (greenhouse gas) and ethane - methods of preparation from sodium ethanoate (sodium acetate), sodium propanoate (sodium propionate), from iodomethane (methyl iodide) and bromoethane (ethyl bromide). Oxidation of methane and ethane in presence of oxygen under suitable conditions, reaction of methane and ethane with chlorine through substitution.

Alkenes – (unsaturated hydrocarbons with a double bond); ethene as an example. Methods of preparation of ethene by dehydro halogenation reaction and dehydration reactions.

Alkynes -(unsaturated hydrocarbons with a triple bond); ethyne as an example of alkyne; Methods of preparation from calcium carbide and 1,2 dibromoethane ethylene dibromide). Only main properties, particularly addition products with hydrogen and halogen namely Cl, Br and I; structural formulae of hydrocarbons. Structural formula must be given for: alkanes (up to butane), alkene (C_2H_4); alkynes (C_2H_2). Uses of methane, ethane, ethene, acetylene.

(vi) Alcohols: ethanol – preparation, properties and uses.

Preparation of ethanol:

- *hydration of ethene;*
- *by hydrolysis of alkyl halide;*
- *Properties – Physical: Nature, Solubility, Density, Boiling Points. Chemical: Combustion, Oxidation with acidified Potassium dichromate, action with sodium, ester formation with acetic acid, dehydration with conc. Sulphuric acid with reference to Ethanol.*
- *Denatured alcohol:*
- *Important uses of Ethanol.*

(vii) Carboxylic acids (aliphatic - mono carboxylic acid): Acetic acid – preparation, properties and uses of acetic acid.

Preparation of acetic acid from Ethyl alcohol.

Properties of Acetic Acid: Physical properties – odour (vinegar), glacial acetic acid (effect of sufficient cooling to produce ice like crystals). Chemical properties – action with litmus, alkalis and alcohol (idea of esterification).

Uses of acetic acid.

INTERNAL ASSESSMENT OF PRACTICAL WORK

Candidates will be asked to observe the effect of reagents and/or of heat on substances supplied to them. The exercises will be simple and may include the recognition and identification of certain gases and ions listed below. The examiners will not, however, be restricted in their choice to substances containing the listed ions.

Gases: Hydrogen, Oxygen, Carbon dioxide, Chlorine, Hydrogen chloride, Sulphur dioxide,

Hydrogen sulphide, Ammonia, Water vapour, Nitrogen dioxide.

Ions: Calcium, Copper, Iron, Lead, Zinc and Ammonium, Carbonate, Chloride, Nitrate, Sulphide, Sulphite and Sulphate.

Knowledge of a formal scheme of analysis is not required. Semi-micro techniques are acceptable but candidates using such techniques may need to adapt the instructions given to suit the size of the apparatus being used.

Candidates are expected to have completed the following minimum practical work:

1. Make a solution of the unknown substance: add sodium hydroxide solution or ammonium hydroxide solution, make observations and give your deduction. Warming the mixture may be needed. Choose from substances containing Ca^{2+}, Cu^{2+}, Fe^{2+}, Fe^{3+}, Pb^{2+}, Zn^{2+}, NH_4^+.
2. Supply a solution of a dilute acid and alkali. Determine which is acidic and which is basic, giving two tests for each.
3. Add concentrated hydrochloric acid to each of the given substances, warm, make observations, identify any product and make deductions: (a) copper oxide (b) manganese dioxide.
4. Use of pH in soil analysis, water analysis, medical field – simple identification with universal indicator.

EVALUATION

The assignments/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 section/class**. For example, a teacher of Chemistry of Class VIII may be deputed to be an External Examiner for Class X Chemistry projects.)

The Internal Examiner and the External Examiner will assess the assignments 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.

NOTE: *According to the recommendation of International Union of Pure and Applied Chemistry (IUPAC), the groups are numbered from 1 to 18 replacing the older notation of groups IA ….. VIIA, VIII, IB …..… VIIB and 0. However, for the examination both notations will be accepted.*

Old notation	IA	IIA	IIIB	IVB	VB	VIB	VIIB	VIII			IB	IIB	IIIA	IVA	VA	VIA	VIIA	0
New notation	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18

SCIENCE (52)

BIOLOGY

SCIENCE Paper - 3

Aims:

1. To acquire the knowledge of the economic importance of plants and animals.
2. To develop an understanding of the inter-relationship between sustainability and environmental adaptations.
3. To develop an understanding of the interdependence of plants and animals so as to enable pupils to acquire a clearer comprehension of the significance of life and its importance in human welfare.
4. To understand the capacities and limitations of all the biological and economic activities so as to be able to use them for a better quality of life.
5. To acquire the ability to observe, experiment, hypothesis, infer, handle equipment accurately and make correct recordings.

CLASS IX

There will be one paper *of two **hours*** duration of 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.*

1. Basic Biology

(i) The cell, a unit of life, protoplasm, basic difference between prokaryotic and eukaryotic cell; differences between an animal and a plant cell.

A basic understanding of the cell theory, structure of plant and animal cell with functions of various cell organelles. (Protoplam, Cytoplasm, Cell Wall, Cell Membrane, Nucleus, Nucleolous, Mitochondria, Endoplasmic Reticulum, Ribosome, Golgibodies, Plastids, Lysosomes, Centrosome and Vacuole). Difference between a plant cell and an animal cell should be mainly discussed with respect to cell wall, centrosome and vacuoles and plastids.

(ii) Tissues: Types of plant and animal tissues.

To be taught in brief with respect to location, basic structure and function, giving typical examples of their location so as to enable pupils to understand their role in different physiological processes in plants and animals.

2. Flowering Plants

(i) Vegetative Propagation: Artificial methods, advantages and disadvantages. Economic importance of artificial propagation, Hybridisation.and Micro Propagation. Brief idea of Biotechnology and its applications role in medicine and industry.

The concept in brief with suitable examples.

Artificial methods: cutting, grafting and layering with examples. Advantages and disadvantages of vegetative reproduction to be discussed.

Economic importance of artificial propagation.

Hybridization: Meaning and benefits.

Micro Propagation: meaning, uses and limitations.

Brief idea of biotechnology (example - human insulin from E.coli. Applications of biotechnology: in medicine – penicillin, tetracycline; in industry (example – cheese, vinegar, yogurt, alcoholic beverages; *synthesis of vitamins namely vitamin C; and enzymes - namely lipase).*

(ii) Flower: Structure of a bisexual flower, functions of various parts.

A brief introduction to complete and incomplete flowers. Essential and non-essential whorls of a bisexual flower; their various parts and functions. Use of charts or actual specimens help enhance clarity of concepts.

Inflorescence and placentation (types are not required in both cases).

(iii) Pollination: self and cross-pollination.

Explanation, advantages and disadvantages of self and cross-pollination, agents of pollination and the characteristic features of flowers pollinated by various agents to be discussed.

(iv) Fertilisation.

Events taking place between pollination and fertilisation should be discussed up to fusion of male gamete with egg cell in the embryo sac. Students should be familiar with the terms double fertilization and triple fusion. Fruit and Seed (definition) and significance of Fruit and Seed.

3. Plant Physiology

(i) Structure of dicot and monocot seeds, Germination of seeds, types, and conditions for seed germination.

Structure and germination of Bean seed and Maize grain. Differences between hypogeal and epigeal germination. Conditions for seed germination should be dealt with by experiments.

(ii) Respiration in plants: outline of the process, gaseous exchange.

A brief outline of the process mentioning the term Glycolysis, Krebs cycle and their significance. Reference to be made to aerobic and anaerobic respiration with chemical equations in each case. Experiments on gaseous exchange and on heat production.

4. Diversity in living organisms / Eco systems

(i) Understanding ecosystems – Definition. Interaction between biotic and abiotic factors.

Biotic component consisting of producers, consumers, decomposers. Terms of food chain, food web, pyramid.

Brief account of Abiotic or nonliving components such as air, soil, water and climatic factors like sunlight, temperature, humidity and wind.

Only Forest Ecosystem with its flora and fauna to be taught.

(ii) A brief outline of five Kingdom classification:

Main characteristics of each kingdom with suitable examples Monera, Protista, Fungi, Plantae (Thallophyta, Bryophyta, Pteridophyta and Spermatophyta) and Animalia (Non-chordates from Porifera to Echinodermata and Chordates - all five Classes)

(iii) Economic importance of Bacteria:

Economic importance of bacteria:

Useful role of bacteria - medicine (antibiotics, serums and vaccines); agriculture; (nitrogen fixing, nitrifying and denitrifying bacteria) and industry (curing of tea, tanning of leather)

Harmful role of bacteria in spoilage of food, disease in plants and animals, bio-weapons, denitrification.

(iv) Economic importance of Fungi:

Economic importance of Fungi:

Useful role of Fungi in breweries, bakeries, cheese processing, mushroom cultivation (Processes of manufacture are not required in each case).

5. Human Anatomy and Physiology

(a) Nutrition:

(i) Classes of food: balanced diet. Malnutrition and deficiency diseases.

Functions of carbohydrates, fats, proteins, mineral salts (calcium, iodine, iron and sodium), vitamins and water in proper functioning of the body to be discussed. Sources of vitamins their functions and deficiency diseases to be discussed. Students should be familiar with the term 'Balanced Diet'. Importance of cellulose in our diet should be discussed. Students should be taught about Kwashiorkor and Marasmus.

(ii) The structure of a tooth, different types of teeth.

Structure of a tooth to be discussed with the help of a diagram. Functions of different types of teeth must also be taught.

(iii) Digestive System: Organs and digestive glands and their functions (including enzymes and their functions in digestion; absorption, utilisation of digested food); tests for reducing sugar, starch, protein and fats.

Organs and their functions; functions of saliva; brief idea of peristalsis; digestion in various parts of alimentary canal. Tests for sugar, starch, protein and fats.

(b) Movement and Locomotion:

(i) *Functions of human skeleton*

(ii) Axial and Appendicular Skeleton

(iii) Types of joints – immovable, slightly movable and freely movable (hinge joint, ball and socket joint, gliding joint, pivot joint.)

(c) Structure and functions of skin.

Various parts of the skin and their functions to be taught with the help of diagrams; heat regulation, vasodilation, vasoconstriction to be explained.

(d) Respiratory System: Organs; mechanism of breathing; tissue respiration, heat production.

Differences between anaerobic respiration in plants and in man. Brief idea of respiratory volumes, effect of altitude on breathing and asphyxiation should be taught. Role of diaphragm and intercostals muscles in breathing must be explained to provide a clear idea of breathing process. Brief idea of gaseous transport and tissue respiration to be given.

6. Health and Hygiene

Cause of diseases:

(i) Bacteria - *types of bacteria, bacterial control, three examples of diseases caused by bacteria e.g. Tuberculosis, Tetanus, Syphilis (Veneral disease).*

(ii) Virus - *nature of viruses, three examples of viral diseases e.g. Poliomyelitis, Mumps, Rabies, etc. Introduction to HIV, its outline structure and spread.*

(iii) Parasites - *two examples, roundworm, tapeworm and their control.*

(iv) Brief idea of endemic, epidemic, pandemic, and sporadic.

(v) Hygiene*: simple personal hygiene and social conditions affecting this. Disease carriers (vectors) flies, rats and cockroaches, contamination of water, waterborne diseases.*

General idea of personal hygiene, public hygiene and sanitation, control of housefly, mosquitoes, cockroaches and rats (life history not required). Water borne diseases like cholera, dysentery and Hepatitis.

7. Waste generation and management

(a) Sources of waste - domestic, industrial, agricultural, commercial and other establishments.
Domestic waste: *paper, glass, plastic, rags, kitchen waste, etc.*
Industrial: *mining operations, cement factories, oil refineries, construction units*.
Agricultural: *plant remains, animal waste, processing waste.*
Municipal sewage: *Sewage, degradable and non-degradable waste from offices, etc.*
E-waste*: brief idea about e-waste*.

(b) Methods of safe disposal of waste: segregation, dumping, composting, drainage, treatment of effluents before discharge, incineration, use of scrubbers and electro static precipitators.
Segregation of domestic waste into biodegradable and non-biodegradable by households: sweeping from gardens to be converted to compost; sewage treatment plants.

INTERNAL ASSESSMENT OF PRACTICAL WORK

The practical work will be designed to test the ability of the candidates to make accurate observations from specimens of plants and animals. For this, candidates should be familiar with the use of a hand lens of not less than x 6 *magnification. They should be trained to make both simple and accurate drawings and brief notes as a means of recording their observations.*

The practical examiners will assume that candidates would have carried out the practical work outlined below.

NOTE: Candidates are expected to have a basic idea of plant morphology.

PLANT LIFE

(i) The examination of an onion peel under the microscope to study various parts of the cell.

Students should be given an idea of removal of onion peel, staining, mounting the specimen and handling the microscope. They should observe the structures and draw labelled diagrams.

(ii) A cross-pollinated flower to be examined and identified and the parts to be studied and labelled e.g. Hibiscus.

Specimens should be provided to the students from which they should be asked to draw diagrams showing the various parts.

The flower to be discussed in order of the four whorls with diagrams of the complete flower, reproductive parts and T.S of ovary to show the arrangement of ovules. Students should draw directly from the specimen provided so that they have a clear idea of the whorls and their location.

(iii) Specimens of germinating seeds with plumule and radicle (the bean seed and maize grain) for examination, identification, drawing and labelling the parts.

Seeds soaked in water should be provided. The students themselves should see the external and internal structure so that they can identify the various parts and draw and label them.

ANIMAL LIFE

(i) The examination of a human cheek cell under the microscope to study various parts of the cell.

Students should be given an idea of staining, mounting the specimen and handling the microscope. They should observe the structures and draw labelled diagrams

(ii) Identification of sugar, starch, protein and fat.

Students should perform different tests for identification and write down their observations and inference in tabular form.

(iii) Examination and identification of specimens belonging to the following groups of animals: Porifera, Coelenterata, Annelida, Platyhelminthes, Nemathelminthes, Arthropoda. Mollusca and Echinodermata.

The specimens or models of the given groups of animals should be shown to the students and reasons for their identification in that particular group should be given. Diagrams should be drawn as observed in the specimens and not from the books. Only those structures that are observed should be drawn and labelled.

(iv) Study of different types of movable joints in human beings.

(v) Identification of the structure of the following organs through specimens/models and charts:, Lung.and skin.

(vi) Experiments to show the mechanism of breathing.

Bell jar experiment should be discussed. Comparison should be made with the human lungs and respiratory tract to show the mechanism of breathing.

(vii) Visit a few establishments in the locality such as motor repair workshops, kilns, pottery making units, fish and vegetable markets, restaurants, dyeing units. Find out the types of wastes and methods prevalent for their disposal. On the basis of the information collected prepare a report, suggest measures to improve the environmental conditions.

(viii) Visit a water treatment plant, sewage treatment plant or garbage dumping or vermi composting sites in the locality and study their working.

CLASS X

There will be one paper of ***two hours*** *duration of 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.*

1. Basic Biology

(i) Cell Cycle and Cell Division:

Cell cycle – Interphase (G_1, S, G_2) and M.phase

Cell Division: Mitosis and its stages. A basic understanding of Meiosis as a reduction division (stages not required). Significance and major differences between mitotic and meiotic division.

(ii) Structure of chromosome:

Basic structure of chromosome with elementary understanding of terms such as chromatin, chromatid, gene structure of DNA and centromere.

(iii) Genetics: Mendel's laws of inheritance and sex linked inheritance of diseases.

Monohybrid cross, dihybrid cross. The following terms to be covered: gene, allele, heterozygous, homozygous, dominant, recessive, mutation, variation, phenotype, genotype. Sex determination in human beings.

Sex linked inheritance of diseases to include haemophilia and colour blindness (only criss cross inheritance).

2. Plant Physiology

(i) Absorption by roots, imbibition; diffusion and osmosis; osmotic pressure, root pressure; turgidity and flaccidity; plasmolysis and deplasmolysis,; the absorption of water and minerals, active and passive transport (in brief) ; the importance of root hair.

Characteristics of roots, which make them suitable for absorbing water, should be discussed with the process of absorption. Structure of a single full-grown root hair should be explained.

(ii) The rise of water up to the xylem; a general idea of Cohesive, Adhesive forces and transpirational pull); demonstrated by the use of dyes.

Experiments to show the conduction of water through the xylem should be discussed. Mention of the causative forces must be made for better understanding but as per the syllabus.

Transpiration, process and significance; experimental work includes the loss in weight of a potted plant or a leafy shoot in a test tube, the use of cobalt chloride paper. Ganong's potometer and its limitations. The effect of external conditions on the rate of water loss should be stressed.

Mechanism of stomatal transpiration must be explained so that concept of the process is clear. Adaptations in plants to reduce transpiration to be discussed. A brief idea of guttation and bleeding should be given.

(iii) Photosynthesis: the nature of the process itself and the great importance of photosynthesis to life in general; experiments to show the necessity of light, carbon dioxide & chlorophyll and also the formation of starch and the output of oxygen; carbon cycle.

The internal structure of chloroplast should be explained to give an idea of the site of light and dark reaction. Opening and closing of stomata should be explained. Teachers should stress upon the importance of a correct balanced chemical equation. The terms "photochemical" for light phase and "biosynthetic" for dark phase must be introduced. In the light reaction, activation of chlorophyll molecule followed by photolysis of water, release of O_2, formation of ATP and NADPH should be taught. In the dark reaction (detailed equations are not required), only combination of hydrogen released by NADP with CO_2 to form glucose to be discussed. Adaptations in a plant for

photosynthesis and experiments with regard to the factors essential for the process should be discussed.

3. Human Anatomy and Physiology

(i) Circulatory System: Main features; the structure and working of the heart, blood vessels, structure and functions of blood and circulation of blood (only names of the main blood vessels entering and leaving the heart, liver and kidney will be required).

Composition of blood (Structure and functions of RBC, WBC and platelets). Brief idea of tissue fluid and lymph. Increase in efficiency of mammalian red blood cells due to absence of certain organelles should be explained with reasons. A brief idea of blood coagulation. Structure of vein, artery and capillary should be explained with the help of diagrams to bring out clearly the relationship between their structure and function. ABO blood group system, Rh factor; concept of double circulation; concept systole and diastole; blood pressure. Reference to portal system should be made. Working of the heart along with names of the main blood vessels entering and leaving the heart, the liver and the kidney must be taught. Examination of a blood smear under a microscope.

(ii) Excretory System: Elementary treatment of the structure and function of the kidneys; the kidneys treated as comprising cortex and medulla and consisting of a branched system of tubules well supplied with blood vessels leading to the ureter (details of the courses of the tubules and their blood vessels not required).

External and internal structure of the kidney; parts of the excretory system along with the blood vessels entering and leaving it should be taught with the help of charts or models. Students should be able to draw the diagrams with correct labelling and know the functions of various parts. A general idea of the structure of a kidney tubule nephron should be given. A brief idea of ultra-filtration, selective reabsorption and tubular secretion in relation to the composition of blood plasma and urine formed.

(iii) Nervous system: Structure of Neuron; central, autonomous and peripheral nervous system (in brief); brain and spinal cord; reflex action and how it differs from voluntary reflex.

Sense organs – Eye and ear; Eye defects and corrective measures (myopia, hypermetropia, presbiopia, astigmatism and cataract).

Various parts of the external structure of the brain and its parts (Medulla Oblongata, Cerebrum, Cerebellum, Thalamus, Hypothalamus) and their functions; reference should be made to the distribution of white and gray matter internally. Diagrammatic explanation of the reflex arc, showing the pathway from receptor to effector, differences between natural and acquired reflex should be taught. Structure and function of the Eye and Ear and their various parts. The external and V.S. of the eye must be taught with a brief idea of stereoscopic vision. The course of perception of sound in human ear. Role of ear in maintaining balance.

(iv) Endocrine System: General study of the following glands: Adrenal, Pancreas, Thyroid and Pituitary. Difference in Endocrine and Exocrine glands.

Correct location and shape of the gland in the human body should be discussed along with the hormones they secrete (Pancreas: insulin and glucagon to be taught; Thyroid: only thyroxin to be taught). Effects of hypo secretion and hyper secretion of hormones must be discussed. The term tropic hormones should be explained in the study of pituitary. Brief idea of feedback mechanism must be given.

(v) The Reproductive System: Organs, fertilisation and a general outline of nutrition and respiration of the embryo. Menstrual cycle, outline of menstrual cycle.

Functions of organs and accessory glands must be discussed. An idea of secondary sexual characters, structure and functions of the various parts of the sperm and an egg. Fertilization, implantation, placenta, foetal membranes, gestation and parturition

identical and fraternal twins to be explained briefly.

(vi) Population: Problems posed by the increase in population in India; need for adopting control measures - population control.
Main reasons for the sharp rise in human population in India and in the world. The terms demography, population density, birth rate, death rate and growth rate of population should be explained. With population growth, increased consumption and urbanization, there is a need to keep a check on demands of urban areas over rural areas, of exploitative use of resources rather than sustainable use. Methods of population control to be taught.

4. Physical Health and Hygiene

(i) Aids to health: an understanding of the use and action of the following - vaccination; immunisation; antitoxin; serum; antiseptics; disinfectants; penicillin; sulphonamide drugs; First Aid.

An idea of local defense system and their merits, active and passive immunity, difference between antiseptics and disinfectants to be discussed. Basic principles of first aid to be taught.

(ii) Health organisations: Red Cross, WHO; common health problems in India.

Major activities of Red Cross and WHO should be discussed. Common health problems in India.

5. Pollution

(i) Types of pollution - air, water, (fresh and marine) soil, radiation and noise.
Self-explanatory.

(ii) Sources of pollution and major pollutant:

Air: *Vehicular, industrial, burning garbage, brick kilns.*

Water: *Household detergents, sewage, industrial waste, oil spills, thermal pollution.*

Soil: *Industrial waste, urban commercial and domestic waste, chemical fertilizers, biomedical waste, like needles, syringes, soiled dressings etc, biodegradable waste, like paper, vegetable peels, etc; Non-biodegradable waste like plastics, glass, Styrofoam etc.; Pesticides like DDT etc.*

Radiation: *X-rays; radioactive fallout from nuclear plants.*

(iii) Effects of pollution on climate, environment, human health and other organisms and its abatement.

Greenhouse effect and global warming, Acid rain, Ozone layer depletion.

Meaning of the terms, causes, effect on life on earth, idea about setting standards - Euro/Bharat stage vehicular standards.

INTERNAL ASSESSMENT OF PRACTICAL WORK

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The practical examiners will assume that candidates would have carried out the practical work outlined below.

PLANT LIFE

(i) Observation of permanent slides of mitosis.

Self-explanatory.

(ii) Experiments indicating osmosis, diffusion and absorption.

The teacher should give a demonstration and then the students should perform the experiments in order to have a better understanding of the processes.

(iii) Physiological experiments on transpiration to be set up by the teacher and the pupils to identify the products, draw and label the apparatus.

The teacher should set up the experiment stepwise so that the student gets a clear idea of the aim, apparatus, procedure and result of the experiment. For transpiration experiments the

$CoCl_2$ paper should be kept in a dessicator and its importance should be explained. Limitations for the use of Ganong's potometer should be given.

(iv) Experiments to show the necessity of light, carbon dioxide and chlorophyll essential for photosynthesis; release of O_2 during photosynthesis. Candidates to write down their observations and draw and label the apparat*us.*

Importance of destarching the plant before the experiment should be discussed. Diagrams should be drawn with the correct labelling. Pupils should be able to analyse the result.

ANIMAL LIFE

(i) Identification of the structure of the urinary system, heart (internal structure) and brain (external view) through models and charts

(ii) The identification of different types of blood cells under a microscope.

Different types of WBCs should be observed. Teacher should point out the differences between red blood cells and white blood cells. Ratio of red blood cells to white blood cells should be discussed.

(iii) The structure of the Ear and an Eye (candidates will be required to identify each structure in the models of these organs).

Models should be shown and students should draw correct labelled diagrams.

(iv) Identification and location of selected endocrine glands (Adrenal, Pancreas, Thyroid and Pituitary glands) with the help of a model or chart.

Correct labelled diagram to be drawn.

(v) Compiling material for a First Aid box.

Self-explanatory.

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 Biology of Class VIII may be deputed to be an External Examiner for Class X, Biology 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.

INTERNAL ASSESSMENT IN SCIENCE - GUIDELINES FOR MARKING WITH GRADES

Criteria	Preparation	Procedure/ Testing	Observation	Inference/ Results	Presentation
Grade I (4 marks)	Follows instructions (written, oral, and diagrammatic) with understanding; modifies if needed. Familiarity with and safe use of apparatus, materials, techniques.	Analyses problem systematically. Recognises a number of variables and attempts to control them to build a logical plan of investigation.	Records data/observations without being given a format. Comments upon, recognises use of instruments, degree of accuracy. Recording is systematic.	Processes data without format. Recognises and comments upon sources of error. Can deal with unexpected results, suggesting modifications.	Presentation is accurate and good. Appropriate techniques are well used.
Grade II (3 marks)	Follows instructions to perform experiment with step-by-step operations. Awareness of safety. Familiarity with apparatus, materials and techniques.	Specifies sequence of operation; gives reasons for any change in procedure. Can deal with two variables, controlling one.	Makes relevant observations. No assistance is needed for recording format that is appropriate.	Processes data appropriately as per a given format. Draws qualitative conclusions consistent with required results.	Presentation is adequate. Appropriate techniques are used.
Grade III (2 marks)	Follows instructions to perform a single operation at a time. Safety awareness. Familiarity with apparatus & materials.	Develops simple experimental strategy. Trial and error modifications made to proceed with the experiment.	Detailed instructions needed to record observations. Format required to record results.	Processes data approximately with a detailed format provided. Draws observations qualitative conclusions as required.	Presentation is reasonable, but disorganised in some places. Overwriting; rough work is untidy.
Grade IV (1 mark)	Follows some instructions to perform a single practical operation. Casual about safety. Manages to use apparatus & materials.	Struggles through the experiment. Follows very obvious experimental strategy.	Format required to record observations/ readings, but tends to make mistakes in recording.	Even when detailed format is provided, struggles or makes errors while processing data. Reaches conclusions with help.	Presentation is poor and disorganised but follows an acceptable sequence. Rough work missing or untidy.
Grade V (0 marks)	Not able to follow instructions or proceed with practical work without full assistance. Unaware of safety.	Cannot proceed with the experiment without help from time to time.	Even when format is given, recording is faulty or irrelevant.	Cannot process results, nor draw conclusions, even with considerable help.	Presentation unacceptable; disorganised, untidy/ poor. Rough work missing.