BRIDGE COURSE - PHYSICAL SCIENCE

From Class - IX to Class - X

PHYSICAL SCIENCE

S.No	Date	Day	Period	Topic
1	13.03.2026	FRI	Period 6	1.Complete syllabus analysis. 2.SSC exam pattern & blue print 3.Performance improvement strategies
2	18.03.2026	Wed	Period 4	Chemical Reactions and Equations
3	21.03.2026	Sat	Period 4	1.1 chemical equations,1.1.1 writing a chemical equation,1.1.2 balanced chemical equations
4	24.03.2026	Tue	Period 6	1.2 types of chemical reactions,1.2.1 combination reaction
5	25.03.2026	Wed	Period 4	1.2.2 decomposition reaction
6	26.03.2026	Thu	Period 4	1.2.3 displacement reaction
7	28.03.2026	Sat	Period 4	1.2.4 double displacement reaction
8	31.03.2026	Tue	Period 6	1.2.5 oxidation and reduction
9	01.04.2026	Wed	Period 4	1.3 have you observed the effects of oxidation in daily life? 1.3.1 corrosion 1.3.2 rancidity
10	02.04.2026	Thur	Period 4	Chapter Recap / Revision-study
11	04.04.2026	Sat	Period 4	Chapter test
12	07.04.2026	Tue	Period 6	introduction and 9.1 reflection of light, activity 9.1

S.No	Date	Day	Period	Topic
13	08.04.2026	Wed	Period 4	9.2 spherical mirrors, activity 9.2,9.2.1 image formation by spherical mirrors, activity 9.3
14	09.04.2026	Thu	Period 4	9.2.2 representation of images formed by spherical mirrors using ray diagrams, activity 9.4, uses of concave mirrors
15	10.04.2026	Fri	Period 4	image formation by convex mirrors, activity 9.6
16	11.04.2026	Sat	Period 4	9.2.3 sign convention, 9.2.4 mirror formula,magnification, ex;9.1,9.2
17	15.04.2026	Wed	Period 4	9.3 refraction of light, act. 9.7, 9.8,9.9
18	16.04.2026	Thu	Period 4	9.3.1 refraction through a rectangular glass slab
19	17.04.2026	Fri	Period 4	9.3.2 refractive index, 9.3.3 refraction by spherical lenses, act.9.11
20	18.04.2026	Sat	Period 4	9.3.4 image formation by lenses, 9.3.5 image formation by lenses using ray diagrams 9.3.6 sign convention for spherical lenses, 9.3.7 lens formula and magnification, 9.4,9.3.8 power of lens.
21	22.04.2026	Wed		Grand test
22	23.04.2026	Thu	Period 4	Review on Test results - Guidance

BRIDGE COURSE FOR CLASS 10

{ PHYSICAL SCIENCE }

Suggestions for Teachers :

Chapters to be covered   -   1. Chemical Reactions and Equations

2. Light: Reflection and Refraction

Chemical Reactions and Equations:

1. Use Real-Life Examples as much as possible: Use familiar situations like rusting of iron, burning of fuel, cooking, or digestion to introduce chemical reactions so students see their relevance.

2. Step-by-Step Equation Balancing: Teach balancing gradually, starting with simple reactions with more involvement of students to check each element.

3. Use Structured Board Work: Highlight coefficients and subscripts clearly.

4. Hands-On Demonstrations: Perform simple experiments related to types of reactions.

5. Regular Practice & Revision: Use the chapter synopsis to reinforce key definitions, reaction types, and frequently tested patterns.

Light: Reflection and Refraction:

1. Connect to Everyday Life: Introduce concepts using mirrors, spectacles, cameras, or lenses so students relate theory to their daily experiences.

2. Emphasize Ray Diagrams: Demonstrate drawing principal rays for concave/convex mirrors and lenses systematically, explaining image position, size, and nature.

3. Use Visual Aids & Models: Utilize mirrors, lenses, torches, and charts to illustrate reflection, refraction, and image formation clearly.

4. Structured Notes & Key Formulas: Encourage students to maintain a formula sheet and labeled ray diagrams for quick exam revision. Better to prepare Ray diagram chart showing Concave mirror and Convex lens as comparison.

5. Active Participation: Ask students to draw diagrams on the board, solve simple numerical problems on Power of lens, Refractive index, Mirror formula, Lens formula. Provide extra practice material during holidays for reinforcement.

General Suggestions:

1. Encourage Active Learning: Involve students in discussions, problem-solving on the board, and demonstrations so they understand concepts deeply rather than memorizing.

2. Use Summaries & Synopses: Use concise chapter summaries provided by SCERT AP, highlighting key definitions, formulas, and diagrams to help students. Utilize additional materials, if required, to cover concepts not fully addressed in the synopsis.

3. More time for practice: Perfection in these two chapters results from vigorous Practice only. Encourage students to use summer vacation for reinforcement of topics.

SYLLABUS OVERVIEW & SSC WEIGHTAGES

Subject: GENERAL SCIENCE-1
Unit/Paper:

SSC PUBLIC EXAMINATIONS 2026 : MODEL PAPER -1 : BLUEPRINT

Max Marks: 50 MARKS   **Class:** 10 TH CLASS   **Time:** 2 Hr.

S. No.	Content Unit / Sub Unit	Knowledge (20%) E/LA 8m	SA 4m	VSA 2m	O 1m	Understanding (25%) E/LA 8m	SA 4m	VSA 2m	O 1m	Application (20%) E/LA 8m	SA 4m	VSA 2m	O 1m	Analysis (15%) E/LA 8m	SA 4m	VSA 2m	O 1m	Evaluation (10%) E/LA 8m	SA 4m	VSA 2m	O 1m	Creation (10%) E/LA 8m	SA 4m	VSA 2m	O 1m	Total (Row-wise)
1	Chemical Reactions and Equations													1											1	9
2	Acids Bases and Salts								1		2														1	10
3	Metals and non metals					1																			1	9
4	Carbon and it's compounds			1					1					1												11
5	Light-Reflection and Refraction										1	1							1		1					11
6	The Human Eye and Colourful world	1							1																	9
7	Electricity	1							1															1		11
8	Magnetic effects of electric current					1																				8
	Total (Col-wise)	16		2		16			4		12	2		16					4		1			2	3	50 (+28 as choice)
		10 (8)				**12 (8)**				**10 (4)**				**8 (8)**				**5**				**5**				

Notes: Figures within brackets to indicate the marks of question given as internal choice.

Summary:

Form		No.	Marks
Essay (E)	:	3	24
Short Answer (SA)	:	3	12
Very Short Answer (VSA)	:	3	6
Objective (0)	:	8	8

Pattern of Options : Internal Choice for Q.Nos 12, 15,16 and 17

Scheme of Sections : 4 (8x1=8; 3x2=6; 3 x4=12; 3x8=24)

1 . CHEMICAL REACTIONS AND EQUATIONS

Introduction

Changes are like permanent changes, temporary changes, natural changes, and artificial changes. Again, changes are classified into two types:

a) Physical Changes

b) Chemical Changes

Chemical Reaction

A chemical reaction is a process in which one or more substances (reactants) are transformed into one or more new substances (products) with different properties.

Characteristics of Chemical Reactions

a. **Change in Color:** A color change indicates the formation of new substances.
Example: When iron rusts, it changes color from metallic gray to reddish-brown.

b. **Change in Temperature:** Some reactions release heat (exothermic reactions), while others absorb heat (endothermic reactions).
Example: Burning of wood releases heat (exothermic), and photosynthesis absorbs heat (endothermic).

c. **Formation of Precipitate:** A solid (precipitate) is formed when two solutions are mixed.
Example: Mixing barium chloride ($BaCl_2$) with sodium sulphate (Na_2SO_4) forms a white precipitate of barium sulphate ($BaSO_4$).

d. **Evolution of Gas:** Gases are produced in many reactions.
Example: In the reaction between sodium bicarbonate ($NaHCO_3$) and hydrochloric acid (HCl), carbon dioxide (CO_2) gas is produced.

e. **Conservation of Mass:** The law of conservation of mass must be followed.

Word Equation

The simplest way to represent a chemical reaction is to write it in the form of a word equation.

Example: When a magnesium ribbon is burnt in oxygen, it gets converted into magnesium oxide.

$$\text{Magnesium} + \text{Oxygen} \rightarrow \text{Magnesium oxide}$$
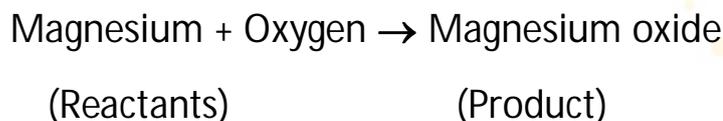
(Reactants) (Product)

Writing Chemical Equations

Chemical equations are symbolic representations of chemical reactions. They show the reactants and products involved using chemical formulas.

General Form of a Chemical Equation:

$$\text{Reactants} \rightarrow \text{Products}$$
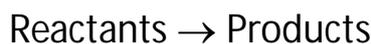
For example: The reaction between hydrogen and oxygen to form water can be written as:

$$2H_2 + O_2 \rightarrow 2H_2O$$
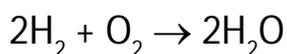
Questions for Students:

1. Give two daily life examples each for Physical change and Chemical Change.

2. Mention any four characteristics that may associate with Chemical reactions.

3. Given examples of the reactions that involve absorption of heat energy.

4. Define reactants.

5. Define chemical equations.

6. What is the use of writing chemical equations.

Balancing Chemical Equations

To satisfy the law of conservation of mass, the number of atoms of each element must be the same on both sides of the equation. This is achieved by adjusting the coefficients (the numbers in front of the chemical formulas).

Steps for Balancing Chemical Equations

Every chemical equation must obey the law of conservation of mass. Therefore, the number of atoms of each element must be the same on both sides of a chemical equation. This is achieved by balancing the equation by adjusting the coefficients (the numbers placed before chemical formulas).

Example: $Fe + H_2O \rightarrow Fe_3O_4 + H_2$

Step-1: First draw boxes around each formula in the chemical equation.

$$\boxed{Fe} + \boxed{H_2O} \rightarrow \boxed{Fe_3O_4} + \boxed{H_2}$$
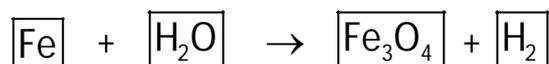
Step-2: List the number of atoms of different elements present in the unbalanced chemical equation.

Element	Number of atoms in reactants (LHS)	Number of atoms in products (RHS)
Fc	1	3
H	2	2
O	1	4

Step-3: Start balancing with the compound that contains the maximum number of atoms.

$$\boxed{Fe} + 4\boxed{H_2O} \rightarrow \boxed{Fe_3O_4} + \boxed{H_2}$$
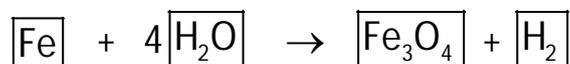
Step-4: Next balance the hydrogen atoms.

$$\boxed{Fe} + 4\boxed{H_2O} \rightarrow \boxed{Fe_3O_4} + 4\boxed{H_2}$$
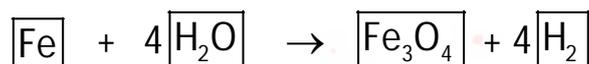
Step-5: Next balance the iron atoms.

$$3\boxed{Fe} + 4\boxed{H_2O} \rightarrow \boxed{Fe_3O_4} + 4\boxed{H_2}$$
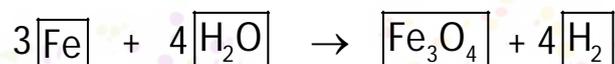
Step-6: Finally, count the atoms of each element on both sides of the equation.

$$3\,\boxed{Fe} \;+\; 4\,\boxed{H_2O} \;\rightarrow\; \boxed{Fe_3O_4} \;+\; 4\,\boxed{H_2}$$
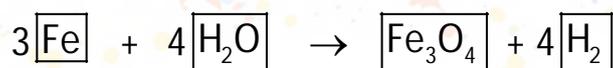
Step-7: Write the symbols of physical states carefully.

$$3\,\boxed{Fe}_{(s)} \;+\; 4\,\boxed{H_2O}_{(g)} \;\rightarrow\; \boxed{Fe_3O_4}_{(s)} \;+\; 4\,\boxed{H_2}_{(g)}$$
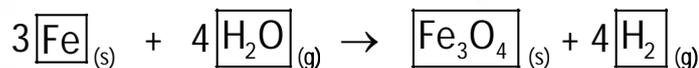
Questions for Students:

1. Name the law that needs to be satisfied to balance chemical reaction.
2. Balance the following reactions.

$$Fe + H_2O \rightarrow Fe_3O_4 + H_2$$
$$NaOH + H_2SO_4 \rightarrow Na_2SO_4 + H_2O$$
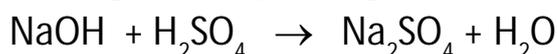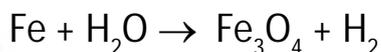
DAY-4: TUESDAY   DATE : 24.03.2026

Types of Chemical Reactions

Chemical reactions can be classified into various types based on the nature of the chemical change occurring.

Combination Reaction :

A reaction in which a single product is formed from two or more reactants is known as a combination reaction.

General Equation: $A + B \rightarrow AB$

Example: Calcium oxide reacts vigorously with water to produce slaked lime.

$$CaO + H_2O \rightarrow Ca(OH)_2$$
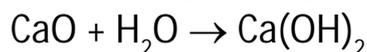
Activity

Aim: Observe the combination reaction between quick lime and water.

Apparatus: Calcium oxide/quick lime, water, beaker.

Procedure:

Take a small amount of calcium oxide/quick lime in a beaker. Slowly add water to the quick lime.

$$CaO_{(s)} + H_2O_{(l)} \rightarrow Ca(OH)_{2(aq)} + Heat$$
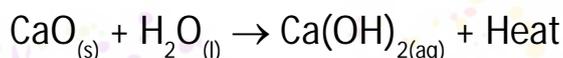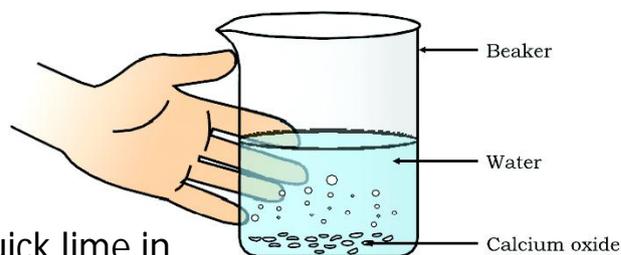
Observation: Calcium oxide reacts vigorously with water to produce calcium hydroxide (slaked lime), releasing a large amount of heat. These type of reactions that release heat are called Exothermic reactions.

Questions for Students:

1. Define Chemical Combination reaction.
2. Give an example for Exothermic reaction.

DAY-5: WEDNESDAY	DATE : 25.03.2026

Decomposition Reaction :

A reaction in which a single substance decomposes to give two or more substances is known as a decomposition reaction.

General Equation: $AB \rightarrow A + B$

Example: Decomposition of calcium carbonate into calcium oxide and carbon dioxide on heating.

$$CaCO_3 + heat \rightarrow CaO + CO_2$$
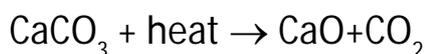
Types of Decomposition Reactions

1. Thermal Decomposition: Heat is absorbed by reactants.
2. Photo decomposition Reaction: Light is absorbed by reactants.
3. Electrolytic Decomposition: Electricity is utilized.

Electrolytic Decomposition - Activity

Aim: Electrolysis of water.

Apparatus: Plastic mug, water, test tubes, graphite rods, rubber stoppers, 6 V battery, switch, and sulphuric acid.

Procedure:

1. Take a plastic mug. Drill two holes at its base and fit rubber stoppers in these holes. Insert carbon electrodes into these rubber stoppers.
2. Connect these electrodes to a 6-volt battery. Fill the mug with water such that the electrodes are immersed.
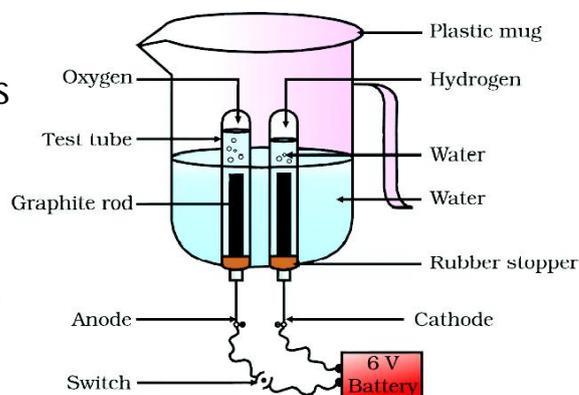
3. Add a few drops of dilute Sulphuric acid to the water. Take two test tubes filled with water and invert them over the two carbon electrodes.

4. Switch on the current and leave the apparatus undisturbed for some time.

Observation: Gas bubbles are collected as two colourless gases above water levels intest tubes kept above cathode and anode in 2:1 ratio respectively. These two gases are hydrogen and oxygen respectively.

Questions for Students:

1. Define Chemical decomposition reaction.
2. How can you say electrolysis of water is a decomposition reaction. Explain with an activity.

DAY-6: THURSDAY	DATE : 26.03.2026

Displacement Reaction

The reaction in which an element displaces or removes another element from a compound is called a displacement reaction.

General Equation: $\quad A + BC \rightarrow AC + B$

Example: Iron displaces copper from copper sulphate solution.

$$Fe + CuSO_4 \rightarrow FeSO_4 + Cu$$
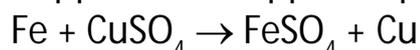
ACTIVITY

Aim: To demonstrate that iron displaces copper from copper sulphate solution.

Apparatus: Test tubes, iron nails, copper sulphate solution, sandpaper.

Procedure:

1. Take three iron nails and clean them by rubbing with sandpaper.
2. Take two test tubes marked as A and B.
3. In each test tube, take about 10 ml copper sulphate solution.
4. Tie two iron nails with a thread and immerse them carefully in the copper sulphate solution in the tube B for about 20 minutes.
5. Keep one iron nail aside for comparison.

Stand —
Test tube
Thread
Copper sulphate solution
Iron nail
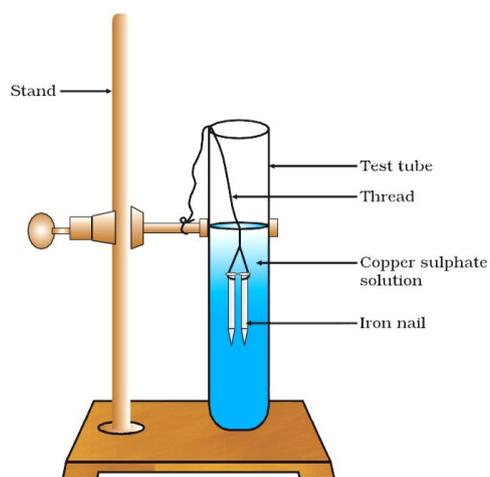
6. After 20 minutes, take out the iron nails from the copper sulphate solutions.

7. Compare the intensity of the blue colour of copper sulphate solutions in test tube A and B.

8. Compare the colour of the iron nails dipped in the solution with the one kept aside.

Observation: Brown coating is formed on Iron nail in $CuSO_4$ solution due to deposition of copper.

Questions for Students:

1. Define Chemical displacement reaction. Explain with an activity.
2. Is displacement reaction possible between $FeSO_4$ and Cu?

| DAY-7: SATURDAY | DATE : 28.03.2026 |

Double displacement reaction:

The reaction in which there is an exchange of ions between the reactants is called a double displacement reaction.

General Equation: $AB + CD \rightarrow AD + CB$

Example: Sodium sulphate and barium chloride react and exchange their ions.

$$Na_2SO_4 + BaCl_2 \rightarrow BaSO_4 + 2NaCl$$
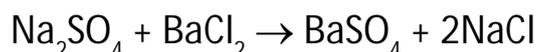
ACTIVITY

Aim: To demonstrate double displacement reaction.

Apparatus: Sodium sulphate solution, barium chloride solution, test tubes.

Procedure:

Take about 3 ml of sodium sulphate solution in a test tube.

In another test tube, take about 3 ml of barium chloride solution.

Mix the solutions properly.

Test tube containing solution of sodium sulphate

Test tube containing solution of barium chloride

$$Na_2SO_{4\ (aq)} + BaCl_{2\ (aq)} \rightarrow BaSO_{4\ (s)} + 2NaCl_{(aq)}$$
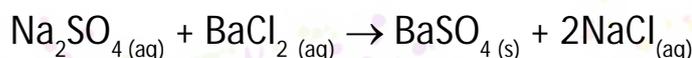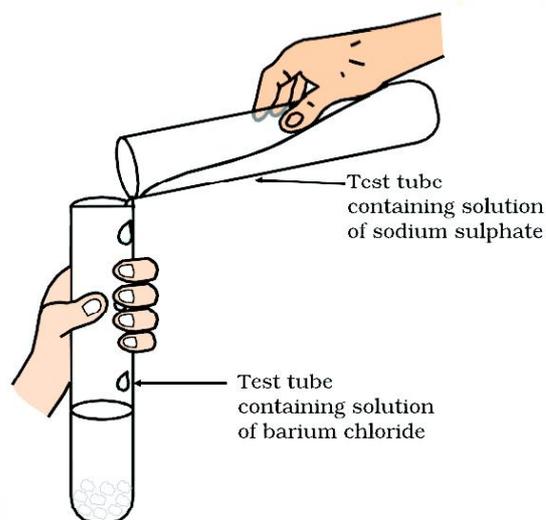
Observation:

An insoluble white precipitate of barium sulphate is formed by the reaction of

SO_4^{-2} and Ba^{2+}

Exchange of ions occurs between the reactants.

Questions for Students:

1. Define Double displacement reaction. Explain with an activity.

2. Give an example for Precipitate reaction.

DAY-8: TUESDAY	DATE : 31.03.2026

Oxidation and Reduction

A chemical reaction in which one substance is oxidized (loses electrons) and another is reduced (gains electrons) is called a redox reaction.
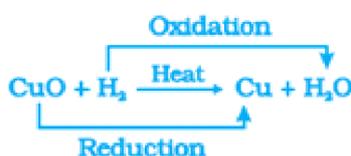
(In this reaction, H_2 is oxidized to H_2O and CuO is reduced to Cu.)
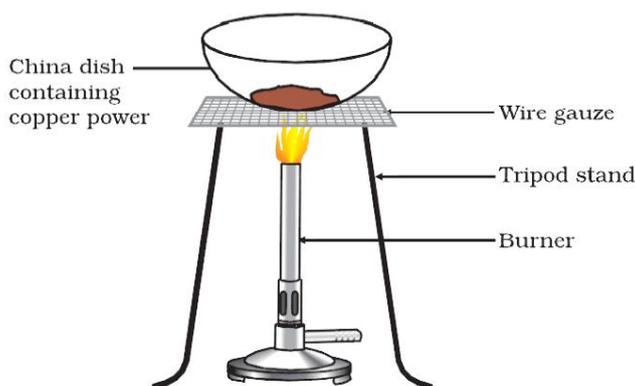
a. Precipitation reaction: Any reaction that produces a precipitate can be called a precipitation reaction.

b. Exothermic reaction: A reaction in which energy is given out along with the products is called an exothermic reaction.

Example: Formation of carbon dioxide is an exothermic reaction.

$$C(s) + O_{2(g)} \rightarrow CO_{2(g)} + 393.7 \text{ kJ}$$

c. Endothermic reaction: A reaction in which energy is absorbed is known as an endothermic reaction.

Example: Formation of nitric oxide is an endothermic reaction.

$$N_{2(g)} + O_{2(g)} \rightarrow 2NO_{(g)} + 180.5 \text{ kJ}$$
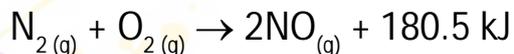
Questions for Students:

1. Define Redox reaction. Give an example

2. Explain Exothermic and Endothermic reactions.

DAY-9: WEDNESDAY   DATE : 01.04.2026

Effects of Oxidation and Reduction in Everyday Life

(a) Corrosion: When a metal is attacked by substances around it such as moisture, acids, etc., it is said to corrode and this process is called corrosion. The black coating on silver and the green coating on copper are examples of corrosion. Corrosion causes damage to car bodies, bridges, iron railings, ships, and all objects made of metals.

(b) Rancidity: When fats or oils containing food materials are kept for a long time, they become rancid and their smell and taste change. This is called rancidity.

Keeping food in airtight containers helps to slow down oxidation. Chip manufacturers usually flush bags of chips with gases such as nitrogen to prevent the chips from getting oxidized.

Questions for Students:

1. Give examples for the effects of Oxidation in daily life.

2. Define Rancidity. How to prevent rancidity of food materials.

3. Chips packets are usually filled with Nitrogen gas. Why?

Balancing Chemical equations - Revision Exercise

1. Translate the following statements into chemical equations and then balance them.

    (a) Hydrogen gas combines with nitrogen to form ammonia.

    (b) Hydrogen sulphide gas burns in air to give water and sulpur dioxide.

    (c) Barium chloride reacts with aluminium sulphate to give aluminium chloride and a precipitate of barium sulphate.

    (d) Potassium metal reacts with water to give potassium hydroxide and hydrogen gas.

2. Balance the following chemical equations.

    (a) $HNO_3 + Ca(OH)_2 \rightarrow Ca(NO_3)_2 + H_2O$

    (b) $NaOH + H_2SO_4 \rightarrow Na_2SO_4 + H_2O$

    (c) $NaCl + AgNO_3 \rightarrow AgCl + NaNO_3$

    (d) $BaCl_2 + H_2SO_4 \rightarrow BaSO_4 + HCl$

3. Write the balanced chemical equations for the following reactions.

    (a) Calcium hydroxide + Carbon dioxide $\rightarrow$ Calcium carbonate + Water

    (b) Zinc + Silver nitrate $\rightarrow$ Zine nitrate + Silver

    (c) Aluminium + Copper chloride $\rightarrow$ Aluminium chloride + Copper

    (d) Barium chloride + Potassium sulphate $\rightarrow$ Barium sulphate + Potassium chloride

4. Write the balanced chemical equation for the following and identify the type of reaction in each case.

    (a) Potassium bromide(aq) + Barium iodide(aq) $\rightarrow$ Potassium iodide(aq) + Barium bromide(s)

    (b) Zinc carbonate(s) $\rightarrow$ Zinc oxide(s) + Carbon dioxide(g)

    (c) Hydrogen(g) + Chlorine(g) $\rightarrow$ Hydrogen chloride(g)

    (d) Magnesium(s) + Hydrochloric acid (aq) $\rightarrow$ Magnesium chloride(aq) + Hydrogen(g)

Questions for Students:

1. Write one equation each for decomposition reactions where energy is supplied in the form of heat, light or electricity.

2. What is the difference between displacement and double displacement reactions? Write equations for these reactions.

3. In the refining of silver, the recovery of silver from silver nitrate solution involved displacement by copper metal. Write down the reaction involved.

4. What do you mean by a precipitation reaction? Explain by giving examples.

5. Explain the following in terms of gain or loss of oxygen with two examples each.
   (a) Oxidation   (b) Reduction

6. A shiny brown coloured element 'X' on heating in air becomes black in colour. Name the element 'X' and the black coloured compound formed.

Chapter Recap

COMBINATION (SYNTHESIS)
$A + B \rightarrow AB$
Example
Burning Magnesium Ribbon
$(Mg + O_2 \rightarrow MgO)$
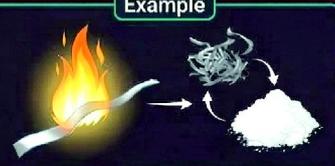
DECOMPOSITION
$AB \rightarrow A + B$
Electrolysis
Plastic mug — Oxygen Gas (O_3) — Hydrogen Gas (H_2) — Test tube — Water level in H_2 test tube — Graphite rod — Water (with electrolyte) — Water level in O_2 test tube — Rubber stopper — Anode (+) — Cathode (-) — Switch — 6V DC Battery — 6V Power Source
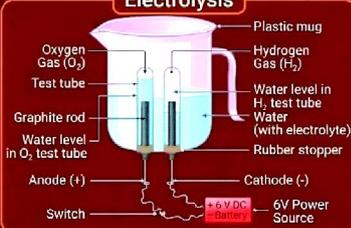
DOUBLE DISPLACEMENT
$AB + CD \rightarrow AD + CB$
Silver Nitrate and Sodium Chloride
$(AgNO_3 + NaCl \rightarrow AgCl_{(s)} + NaNO_3)$
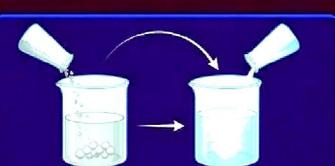
CHEMICAL REACTIONS: TYPES & EXAMPLES

SINGLE DISPLACEMENT
$A + BC \rightarrow AC + B$
Zinc and Hydrochloric Acid
$(Zn + 2HCl \rightarrow ZnCl_2 + H_2)$
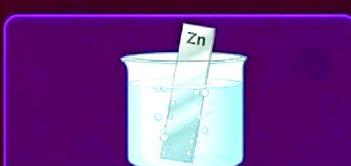
DAY-11: SATURDAY   DATE : 04.04.2026

CHAPTER SLIP TEST

9. LIGHT : REFLECTION AND REFRACTION

Introduction

9.1 Reflection of Light

Reflection of light is the bouncing back of light when it falls on a surface.

A smooth and polished surface, such as a mirror, reflects most of the light that falls on it.

Laws of Reflection

First Law:

The angle of incidence is equal to the angle of reflection. $\angle i = \angle r$

Second Law:

The incident ray, the normal at the point of incidence, and the reflected ray all lie in the same plane.

Incident ray   Normal   Reflected ray

Angle of incidence   Angle of reflection

$\angle i$ $\angle r$
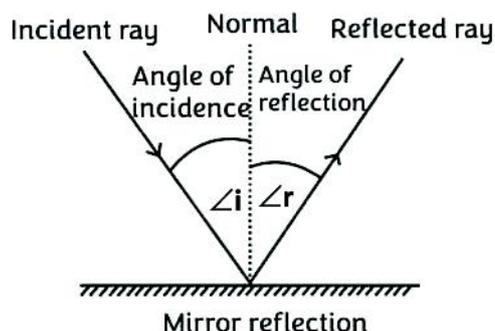
Mirror reflection

These laws of reflection are true for all reflecting surfaces, including spherical mirrors.

Formation of Image by a Plane Mirror

A plane mirror forms an image of the object placed in front of it.

Properties of the Image Formed by a Plane Mirror

1. The image is virtual (it cannot be obtained on a screen).
2. The image is erect.
3. The size of the image is equal to the size of the object. Hence magnification of Plane mirror is considered as +1

4. The image is formed as far behind the mirror as the object is in front of the mirror.

5. The image is laterally inverted (left and right sides are reversed).

Questions for Students:

1. State laws of Reflections.

2. Magnification of Plane mirror is considered as +1 . Why?

DAY-13: WEDNESDAY   DATE : 08.04.2026

9.2 Spherical Mirrors

Spherical mirrors are mirrors whose reflecting surface is part of a sphere.

The reflecting surface of a spherical mirror can be curved inward or curved outward.

Types of Spherical Mirrors

Concave "converging" mirror — Convex "diverging" mirror

1. Concave Mirror

   The reflecting surface is curved inward.

   It faces the centre of the sphere.
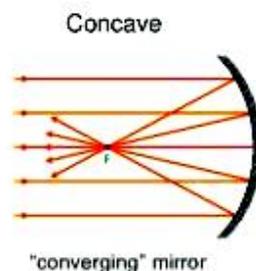
2. Convex Mirror

   The reflecting surface is curved outward.

   It bulges away from the centre of the sphere.
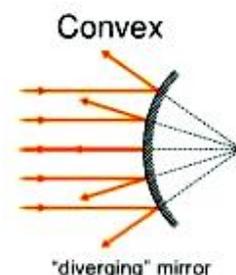
RAY DIAGRAMS : TERMINOLOGY

Centre of Curvature (C)

The centre of the sphere of which the reflecting surface of a spherical mirror forms a part is called the centre of curvature.

(1) Centre of Curvature C
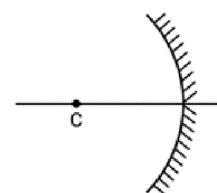
Radius of Curvature (R)

The radius of the sphere of which the reflecting surface of a spherical mirror forms a part is called the radius of curvature.

(2) Radius of Curvature R
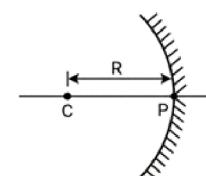
Pole (P)

The centre point of the reflecting surface of a spherical mirror is called the pole.

(3) Pole P
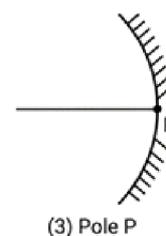
Principal Axis

The straight line passing through the pole and the centre of curvature of a spherical mirror is called the principal axis.
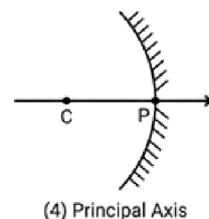
(4) Principal Axis

Principal Focus (F)

When rays parallel to the principal axis fall on a spherical mirror, the point on the principal axis where the reflected rays meet (in a concave mirror) or appear to come from (in a convex mirror) is called the principal focus.
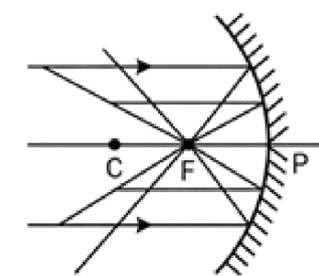
(5) Concave Mirror Principal Focus F
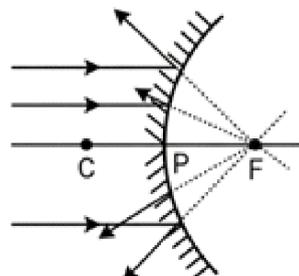
(6) Convex Mirror Principal Focus F

Focal Length (f)

The distance between the pole (P) and the principal focus (F) of a spherical mirror is called the focal length.
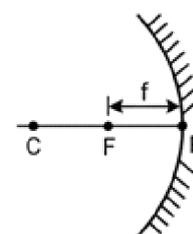
(7) Focal Length f (Concave)

Object Distance (u)

The distance between the object and the pole (P) of a spherical mirror is called the object distance.

Image Distance (v)

The distance between the image formed and the pole (P) of the mirror is called the image distance.

Relationship between the radius of curvature R, and focal length f, of a spherical mirror :

the radius of curvature is equal to twice the focal length.

$$\boxed{R = 2f}$$

(For spherical mirrors of small apertures)

9.2.1 Image Formation by Concave Mirror

Position of the object	Position of the image	Size of the image	Nature of the image
At infinity	At the focus F	Highly diminished, point-sized	Real and inverted
Beyond C	Between F and C	Diminished	Real and inverted
At C	At C	Same size	Real and inverted
Between C and F	Beyond C	Enlarged	Real and inverted
At F	At infinity	Highly enlarged	Real and inverted
Between P and F	Behind the mirror	Enlarged	Virtual and erect

Questions for Students:

1. Define Radius of Curvature and Focal length.

2. What is the relation between Radius of Curvature and Focal length.

3. Define Pole.

4. If focal length of concave mirror is 25 cm. then find its radius of curvature.

5. When do a concave mirror gives virtual and erect image.

6. When do a concave mirror gives a real and enlarged image.

7. Where do you place a cooking vessel before a concave solar reflector.

Rules for Ray Diagrams (Concave Mirror)

To locate the image of a point object, at least two reflected rays must intersect.

(i) Ray Parallel to the Principal Axis

A ray parallel to the principal axis is reflected through the principal focus (F).
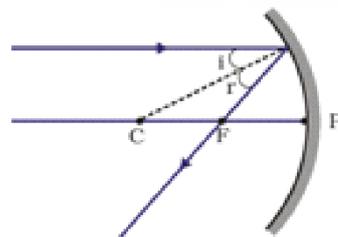
(ii) Ray Passing Through the Principal Focus (F)

A ray passing through the principal focus is reflected parallel to the principal axis.
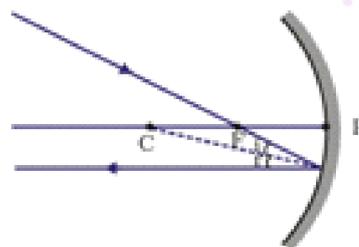
(iii) Ray Passing Through the Centre of Curvature (C)

A ray passing through the centre of curvature is reflected back along the same path.
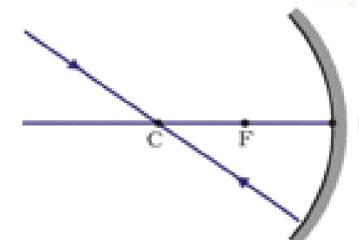
(iv) Ray Passing Through the Pole (P)

A ray incident obliquely towards the pole (P) is reflected obeying the law of reflection (angle of incidence = angle of reflection).
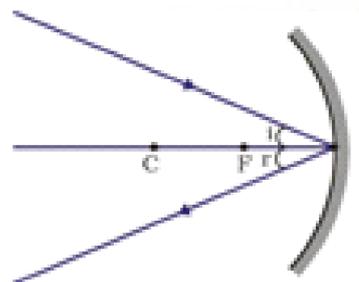
Questions for Students:

State rules for drawing ray diagrams for Concave mirror.

Image formation by Concave Mirror
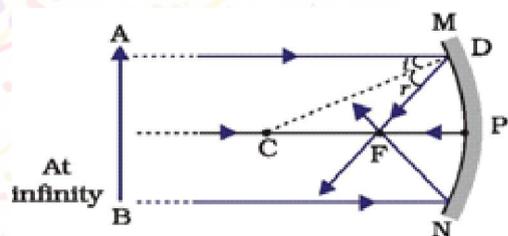
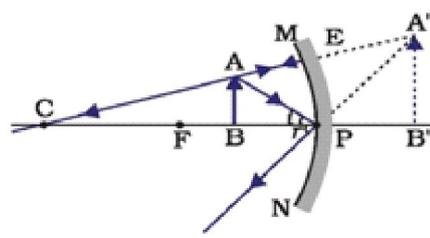*(a)*
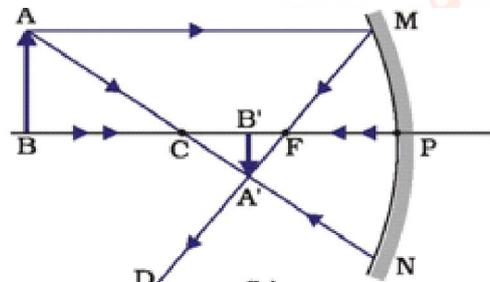
(b)
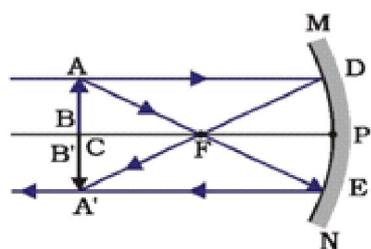
(c)
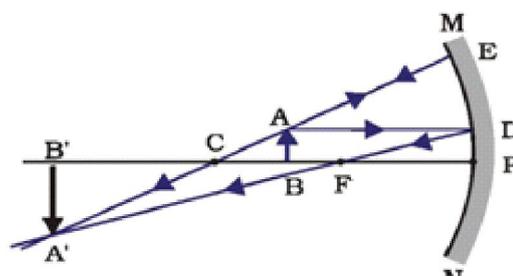
(d)
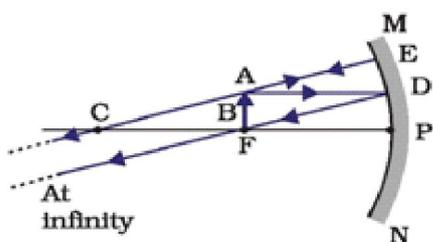
(e)

(f)

Uses of Concave Mirrors

1. In torches, searchlights, and vehicle headlights:

   Concave mirrors are used to produce powerful parallel beams of light.

2. As shaving mirrors:

   They form a magnified (larger) image of the face.

3. By dentists:

   Dentists use concave mirrors to see a large image of the teeth.

4. In solar furnaces:

   Large concave mirrors are used to concentrate sunlight to produce heat.

Nature, position and relative size of the image formed by a convex mirror

Position of the object	Position of the image	Size of the image	Nature of the image
At infinity	At the focus F behind the mirror	Highly diminished. point-sized	Virtual and erect
Between infinity and the pole P of the mirror	Between P and F behind the mirror	Diminished	Virtual and erect

Uses of Convex Mirrors :

1. As Rear-View Mirrors in Vehicles

   Convex mirrors are used as rear-view mirrors in vehicles because they always form an erect, diminished image and provide a wide field of view.

2. For Safe Driving at Ghat Roads

   Convex mirrors are placed at sharp bends on ghat to avoid accidents.

3. At ATMs

   Convex mirrors are installed at ATMs to provide a wide field of view, allowing users to see the area behind them for better safety and security.

Questions for Students:

1. Draw ray diagrams when Object is placed

   i) at C

   ii) at F

   iii) Between C and F before a Concave mirror.

   iv) Between F and P before a Concave mirror.

2. Write any two uses of Spherical mirrors in daily life.

3. Convex mirrors are used as Rear view mirrors. Why?

Sign Convention for Reflection by Spherical Mirrors

1. All distances are measured from the pole (P) of the mirror.
2. Distances measured in the direction of the incident light are taken as positive (+).
3. Distances measured opposite to the direction of the incident light are taken as negative (?).
4. Distances measured above the principal axis are taken as positive (+).
5. Distances measured below the principal axis are taken as negative (?).
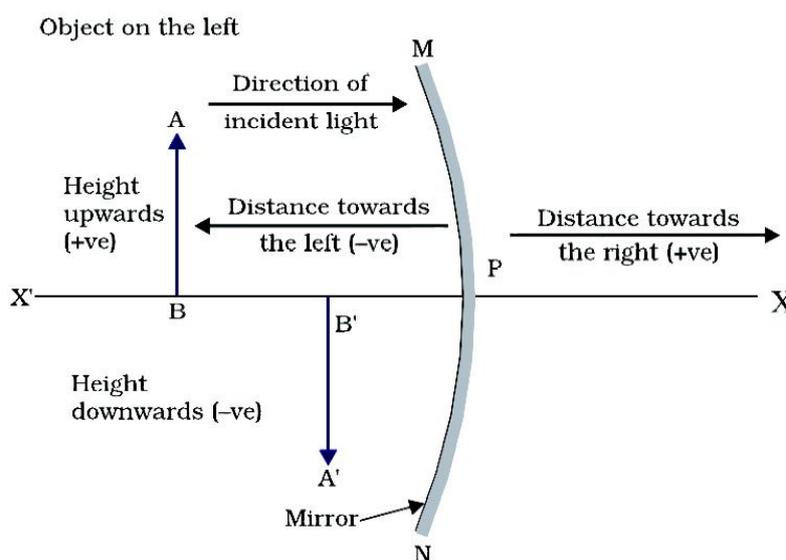
Mirror Formula

There is a mathematical relationship between object distance (u), image distance (v), and focal length (f). This relationship is called the mirror formula.

$$\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$$

While substituting the numerical values of object distance (u), image distance (v), focal length (f), and radius of curvature (R) in the mirror formula, the New Cartesian Sign Convention must always be followed while solving numerical problems.

Magnification:

Magnification is the ratio of the height of the image to the height of the object formed by a spherical mirror. It is represented by the letter m.

$$m = \frac{\text{Height of the image}}{\text{Height of the object}}$$

Example 9.1

A convex mirror used for rear-view on an automobile has a radius of curvature of 3.00 m. If a bus is located at 5.00 m from this mirror, find the position, nature and size of the image.

Solution

Radius of curvature, R = + 3.00 m;   Object-distance, u = ¡V 5.00 m;
Image-distance, v = ?   Height of the image, h' = ?

Focal length, $f = R/2 = + \dfrac{3.00\,m}{2} = + 1.50$ m (as the principal focus of a convex mirror is behind the mirror)

Since $\dfrac{1}{f} = \dfrac{1}{v} + \dfrac{1}{u}$

or, $\dfrac{1}{v} = \dfrac{1}{f} - \dfrac{1}{u} = + \dfrac{1}{1.50} - \dfrac{1}{(-5.00)} = \dfrac{1}{1.50} + \dfrac{1}{5.00} = \dfrac{5.00 + 1.50}{7.50}$

$v = \dfrac{+7.50}{6.50} = 1.15\,m$

The image is 1.15 m at the back of the mirror.

Magnification, $m = \dfrac{h^{'}}{h} = -\dfrac{v}{u} = -\dfrac{1.15\,m}{-5.00\,m}$ = + 0.23
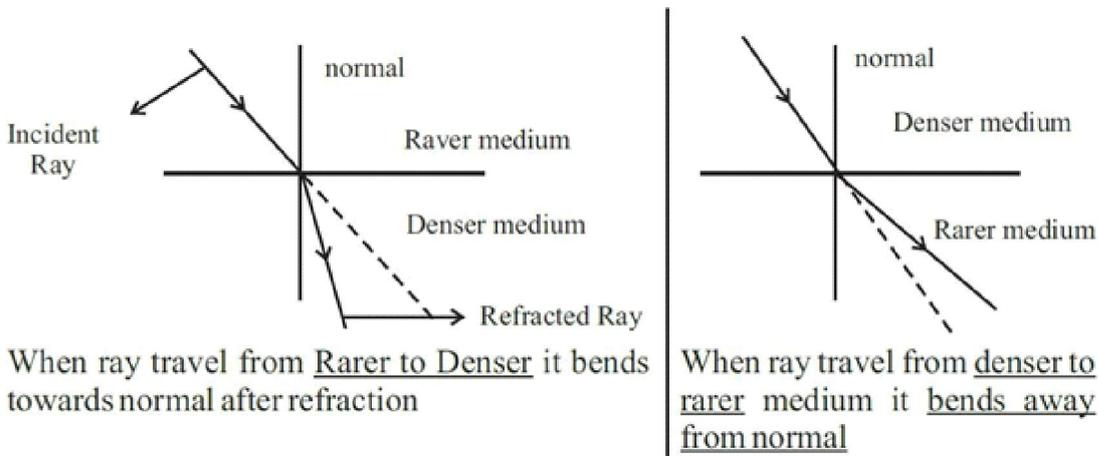
The image is virtual, erect and smaller in size by a factor of 0.23.

Questions for Students:

1. Write mirror formula. Explain the terms in it.
2. Define magnification.

9.3 Refraction of Light

The change in the direction of light when it passes from one transparent medium to another is called Refraction of light.

When ray travel from Rarer to Denser it bends towards normal after refraction | When ray travel from denser to rarer medium it bends away from normal

Daily Life Applications:

1. Pencil in water: A pencil partly immersed in water appears bent or displaced at the surface of water.

2. Bottom of a pond: The bottom of a pond or water tank appears raised .

3. Letters under glass slab: Printed letters appear raised when seen through a thick glass slab.

4. Lemon in water: A lemon placed in water appears bigger than its actual size.

Questions for Students:

1. Define refraction.

2. Write any two daily life applications of Refraction of light.

9.3.1 Refraction through a Rectangular Glass Slab

Materials Required :

Rectangular glass slab, Drawing board, White sheet of paper ,Drawing pins, Four identical pins, Pencil , Scale (ruler)

Procedure :

1. Fix a white sheet of paper on a drawing board using drawing pins.

2. Place a rectangular glass slab in the middle of the sheet.

3. Draw the outline of the glass slab with a pencil and name it ABCD.

4. Take four identical pins.

5. Fix two pins E and F vertically so that the line joining them is inclined to edge AB.

6. Look through the opposite side of the slab and observe the images of pins E and F.

7. Fix two more pins G and H such that G, H and the images of E and F lie in a straight line.

8. Remove the pins and the glass slab.

9. Join the positions of E and F and extend the line to meet AB at point O.

10. Join the positions of G and H and extend the line to meet CD at point O?.

11. Join O and O? and extend EF to point P (incident ray).

12. Incident ray and Emerging ray will be parallel to each other.

13. It indicates that Angle of deviation produced by rectangular glass slab is Zero.
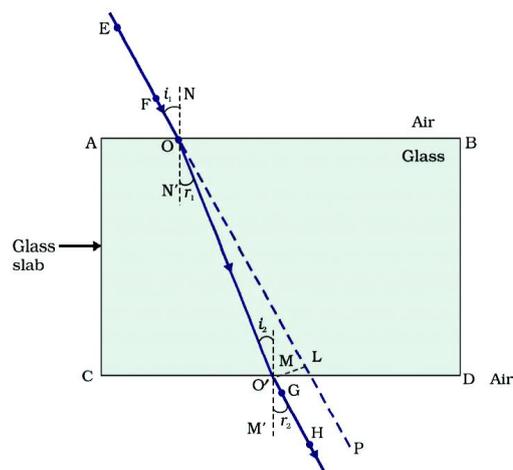
Laws of Refraction of Light:

Law 1:

The incident ray, the refracted ray, and the normal at the point of incidence all lie in the same plane.

Law 2 (Snell's Law):

For a given pair of transparent media and light of a particular colour, the ratio of the sine of the angle of incidence to the sine of the angle of refraction is constant.

$$\frac{Sin\,i}{Sin\,r} = constant$$

Where:

i = Angle of incidence

r = Angle of refraction

Questions for Students:

1. Define Snell's law.
2. Explain an activity to show refraction at rectangular glass slab.

DAY-19: FRIDAY   DATE : 17.04.2026

Refractive Index (n):

The ratio of the speed of light in air (or vacuum) to the speed of light in that medium id called the The absolute refractive index of that medium.

$$n = \frac{c}{v}$$

Where:

c = Speed of light in air (or vacuum)

v = Speed of light in the medium.

Table 9.3 Absolute refractive index of some material media

Material medium	Refractive index	Material medium	Refractive index
Air	1.0003	Canada Balsam	1.53
Ice	1.31		
Water	1.33	Rock salt	1.54
Alcohol	1.36		
Kerosene	1.44	Carbon disulphide	1.63
Sapphire	1.77	Diamond	2.42

Does an optically denser medium always have greater mass density?

No, an optically denser medium does not always have greater mass density. For example, kerosene has a higher refractive index than water, so it is optically denser than water, even though its mass density is less than that of water.

Problem:

Light enters from air into glass having a refractive index of 1.50. What is the speed of light in the glass? (Given: Speed of light in vacuum c = 3×10^8 ms^{-1})

Solution:

n = 1.5

c = 3×10^8 ms^{-1}

v = ?

We know that $n = \dfrac{c}{v}$

$\Rightarrow v = \dfrac{c}{n} = \dfrac{3 \times 10^8}{1.50} = 2 \times 10^8 \, \text{ms}^{-1}$

The refractive index of diamond is 2.42. What does this mean?

It means that light travels 2.42 times slower in diamond than in vacuum.

Questions for Students:

1. Define Refractive Index. Write its units.

2. Among Kerosene and water, which is optically denser?

3. Calculate velocity of light in Diamond. (The refractive index of diamond is 2.42)

9.3.3 Refraction by Spherical Lenses

Lenses:

A lens is a transparent material bounded by two surfaces, of which at least one surface is spherical.

Types of Lenses

1. Convex Lens:

   a) It is thicker at the middle and thinner at the edges.

   b) A convex lens has two spherical surfaces bulging outward.

   c) It converges parallel rays of light.

   d) Hence, it is also called a converging lens.
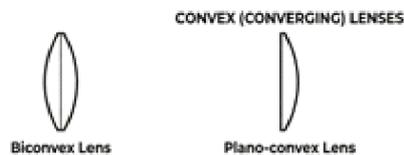
2. Concave Lens:

   a) It is thinner at the middle and thicker at the edges.

   b) A concave lens has two spherical surfaces curved inward.

   c) It diverges parallel rays of light.

   d) Hence, it is also called a diverging lens.

Questions for Students:

1. Define Lens. What are different types of lenses?

2. Write any four differences between Convex and Concave lens.

9.3.4 Image Formation by Convex Lens.

Activity :

1. Setup: Draw five parallel lines on a table; spacing = focal length of lens. Place convex lens on the central line with its optical centre aligned. Mark lines on either side as $F_1, 2F_1, F_2, 2F_2$

2. Procedure:

   I. Place a candle far beyond $2F_1$ and get a sharp image on a screen.

   II. Repeat with candle at:

       a) Just behind $2F_1$

       b) At $2F_1$

       c) Between $2F_1$ and F_1

       d) At F_1

       e) Between F_1 and optical centre (O)

3. Observations: Note position, nature, and size of the image for each object position.

Position of the object	Position of the image	Relative size of the image	Nature of the image
At infinity	At focus F_2	Highly diminished, point-sized	Real and inverted
Beyond $2F_1$	Between F_2 and $2F_2$	Diminished	Real and inverted
At $2F_1$	At $2F_2$	Same size	Real and inverted
Between F_1 and $2F_1$	Beyond $2F_2$	Enlarged	Real and inverted
At focus F_1	At infinity	Infinitely large or highly enlarged	Real and inverted
Between focus F_1 and optical centre O	On the same side of the lens as the object	Enlarged	Virtual and erect

Image Formation in Concave Lenses:

Position of the object	Position of the image	Relative size of the image	Nature of the image
At infinity	At focus F_1	Highly diminished, point-sized	Virtual and erect
Between infinity and optical centre O of the lens	Between focus F_1 and optical centre O	Diminished	Virtual and erect

9.3.5 Image Formation in Lenses: Ray Diagrams- Rules

1. Ray parallel to the principal axis
   a) Convex lens: A ray of light from the object, parallel to the principal axis, passes through the principal focus on the other side.
   b) Concave lens: A ray of light parallel to the principal axis appears to diverge from the principal focus on the same side.

(a)   *(b)*
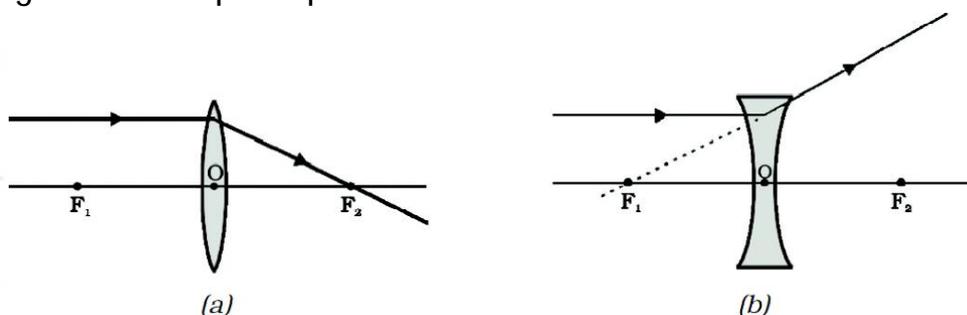
2. Ray passing through the principal focus
   a) Convex lens: A ray passing through the principal focus, after refraction, emerges parallel to the principal axis.
   b) Concave lens: A ray appearing to meet the principal focus, after refraction, emerges parallel to the principal axis.

(a)   *(b)*
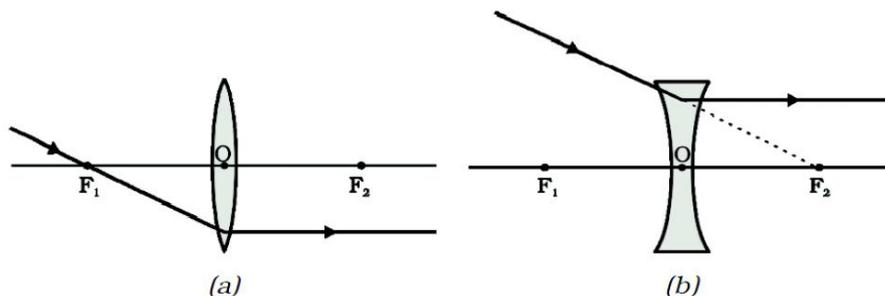
3. Ray passing through the optical centre

A ray passing through the optical centre of a lens emerges without deviation.
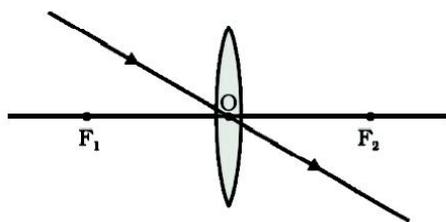
(a)
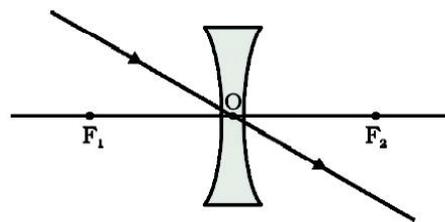
(b)

Image formation in a convex lens- Ray diagrams
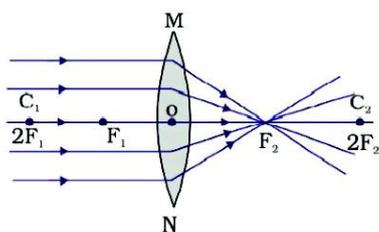
(a)

(b)

(c)

(d)

(e)

(f)

Position of the object	Position of the image	Relative size of the image	Nature of the image
At infinity	At focus F_2	Highly diminished, point-sized	Real and inverted
Beyond $2F_1$	Between F_2 and $2F_2$	Diminished	Real and inverted
At $2F_1$	At $2F_2$	Same size	Real and inverted
Between F_1 and $2F_1$	Beyond $2F_2$	Enlarged	Real and inverted
At focus F_1	At infinity	Infinitely large or highly enlarged	Real and inverted
Between focus F_1 and optical centre O	On the same side of the lens as the object	Enlarged	Virtual and erect

Questions for Students:

1. Draw ray diagrams for Image formation by Convex lens. When object is

   i) At $2F_1$

   ii) At F_1

   iii) Between $2F_1$ and F_1.

9.3.7 Lens Formula

This formula gives the relationship between object distance (u), image-distance (v) and the focal length (f). The lens formula is expressed as

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$

9.3.8 Power of a Lens

The power of a lens is defined as the reciprocal of its focal length.
It is represented by the letter P. SI unit of power of a lens is dioptre.

$$P = \frac{1}{f\,(in\,meters)}$$

Questions for Students:

1. State lens formula. Explain the terms in it.
2. Define Power of Lens. Write it's units.
3. Calculate the power of Concave lens whose focal length is -25cm.

Chapter Recap

| DAY-21 : WEDNESDAY | DATE : 22.04.2026 |

Grand Test

| DAY-22: THURSDAY | DATE : 23.04.2026 |

Review of Answer scripts and guidance for effective utilization of holidays for students.