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CLASS X · SCIENCE (086) · PHYSICS · CBSE BOARD EXAMINATION 2027

CHAPTER 9

Light – Reflection and Refraction

Chapter Practice Booklet · Questions only · Answers in the separate Answer Booklet

12 note blocks + 8 ray diagrams | 67 practice questions | 3 case studies | Board question index

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STUDENT DETAILS

NAME _____

CLASS & SECTION _____

ROLL NO. _____

BOOKLET STARTED ON _____

CHAPTER TEST SCORE ____ / 20

1

READ THIS FIRST

Chapter Notes

The whole chapter in short-note form: every definition, activity, diagram, formula and reason. Revise from here – you should not need the textbook again.

1 Reflection of light

- Light travels in straight lines; a polished surface such as a mirror sends back (reflects) most of the light falling on it.
- **Laws of reflection:** (i) angle of incidence = angle of reflection; (ii) the incident ray, the normal at the point of incidence and the reflected ray all lie in the **same plane**. They hold for all reflecting surfaces, including curved ones.
- **Plane mirror image:** virtual and erect, same size as the object, as far behind the mirror as the object is in front, and **laterally inverted** (left looks right).

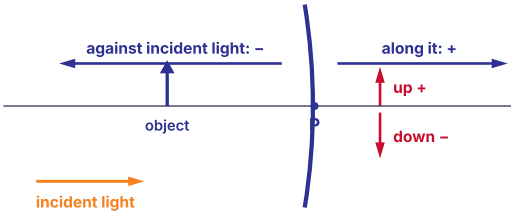
Real image: formed where reflected or refracted rays actually meet; can be caught on a screen. **Virtual image:** rays only appear to meet; cannot be caught on a screen.

2 Spherical mirrors – the words you must know

Concave mirror	Reflecting surface curved **inwards** (faces the centre of the sphere). Converging mirror.
Convex mirror	Reflecting surface curved **outwards**. Diverging mirror.
Pole (P)	Centre of the reflecting surface.
Centre of curvature (C)	Centre of the sphere of which the mirror is a part; in front of a concave mirror, behind a convex mirror.
Radius of curvature (R)	Radius of that sphere = distance PC.
Principal axis	Straight line through P and C.
Principal focus (F)	Concave: point on the axis where rays parallel to it **meet** after reflection. Convex: point from which they **appear to come**.
Focal length (f)	Distance PF. For mirrors of small aperture **R = 2f**: F lies midway between P and C.

3 Rays to draw, and the sign convention

Ray 1	Parallel to the principal axis → passes through F (concave) or appears to come from F (convex).
Ray 2	Through F (or directed towards F, convex) → comes out parallel to the axis.
Ray 3	Through C (or directed towards C) → reflected back along the same path.
Ray 4	Falling obliquely at P → reflected at an equal angle on the other side of the axis.

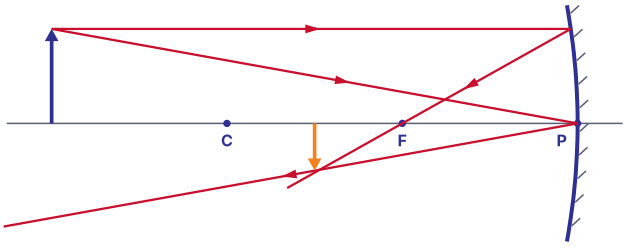


New Cartesian sign convention (pole or optical centre as origin)

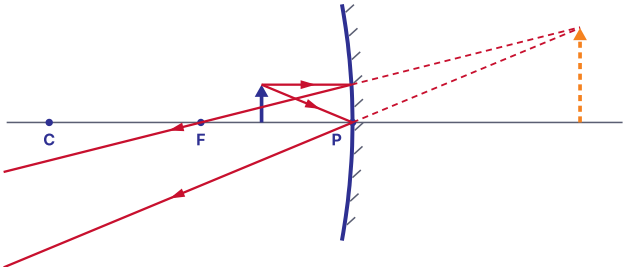
- The object is always placed on the **left**, so the object distance **u is negative**.
- Distances measured in the direction of the incident light are +, against it –; heights above the axis +, below –.
- Concave mirror: f negative. Convex mirror: f positive. Real image (in front of the mirror): v negative.

4 Images formed by a concave mirror

Object at	Image at	Size	Nature
Infinity	F	Highly diminished, point-sized	Real, inverted
Beyond C	Between F and C	Diminished	Real, inverted
C	C	Same size	Real, inverted
Between C and F	Beyond C	Enlarged	Real, inverted
F	Infinity	Highly enlarged	Real, inverted
Between P and F	Behind the mirror	Enlarged	Virtual, erect

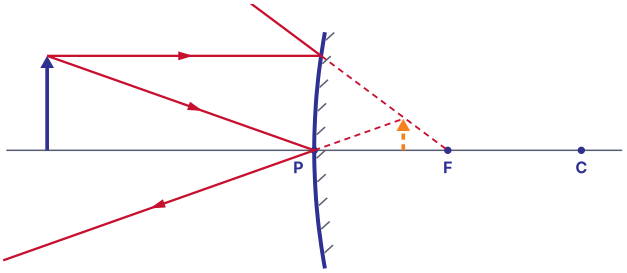


Concave mirror, object beyond C: real, inverted, diminished image between F and C



Concave mirror, object between P and F: virtual, erect, enlarged image behind the mirror

5 Convex mirror and uses of mirrors



Convex mirror: virtual, erect, diminished image between P and F (behind the mirror)

- Convex mirror: object anywhere → image **between P and F**, behind the mirror, **virtual, erect, diminished** (object at infinity: at F, point-sized).
- **Convex mirror uses:** rear-view (wing) mirrors of vehicles – always erect image and a **wider field of view**, because it curves outwards; also at sharp road bends and in shops.
- **Concave mirror uses:** torches, searchlights and headlights (bulb at F gives a strong parallel beam); shaving and make-up mirrors (large erect image of the face); dentists' mirrors (large image of teeth); solar furnaces (focus sunlight to produce heat).

6 Mirror formula and magnification

Mirror formula: $\frac{1}{v}+\frac{1}{u}=\frac{1}{f}$

Magnification: $m=\frac{h'}{h}=-\frac{v}{u}$

- Put every value **with its sign**; never change the formula.
- m **negative** → real and inverted; m **positive** → virtual and erect. |m| > 1 enlarged; |m| < 1 diminished; m = +1 plane mirror.
- A convex mirror always gives m between 0 and +1.

WORKED EXAMPLE

Object 4 cm tall, 15 cm in front of a concave mirror, f = 10 cm. u = −15, f = −10. 1/v = 1/f − 1/u = −1/10 + 1/15 = −1/30, so v = −30 cm (real, in front). m = −v/u = −(−30)/(−15) = −2; h′ = −8 cm: real, inverted, twice as large.

7 Refraction of light

Refraction: change in the direction of light when it passes obliquely from one transparent medium into another, because its **speed changes**.

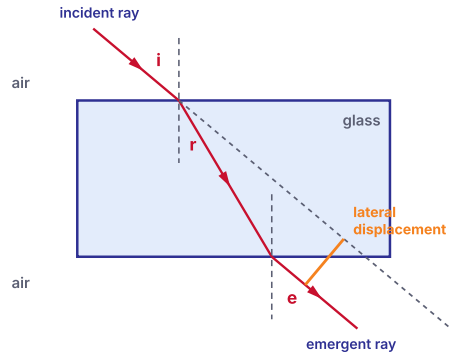
- Everyday examples: a pencil looks bent in a glass of water; a pond or tank looks shallower than it is; letters seen through a glass slab look raised; a lemon in water looks bigger.
- **Rarer → denser** (air to glass): light slows down and bends **towards** the normal. **Denser → rarer**: speeds up and bends **away** from the normal.
- A ray falling along the normal (i = 0) goes straight through without bending.
- **Laws of refraction:** (i) incident ray, refracted ray and normal lie in one plane; (ii) **Snell's law**: for a given colour and pair of media, $\frac{\sin i}{\sin r}$ = constant (the refractive index of the second medium with respect to the first).

8 Refractive index and the glass slab

$$n_{21} = \frac{\text{speed in medium 1}}{\text{speed in medium 2}} = \frac{v_1}{v_2}$$ Absolute: $n_m = \frac{c}{v}$, c = 3 × 10⁸ m/s

Air	Water	Kerosene	Crown glass	Diamond
1.0003	1.33	1.44	1.52	2.42

- Higher n = **optically denser** = light travels slower. Diamond (2.42) has the highest n here. Optical density is not the same as mass density (kerosene is optically denser than water but lighter).



Glass slab: the emergent ray is parallel to the incident ray but shifted sideways

- In a glass slab the bending at the two parallel faces is equal and opposite, so the **emergent ray is parallel** to the incident ray (i = e) but shifted sideways – **lateral displacement**.

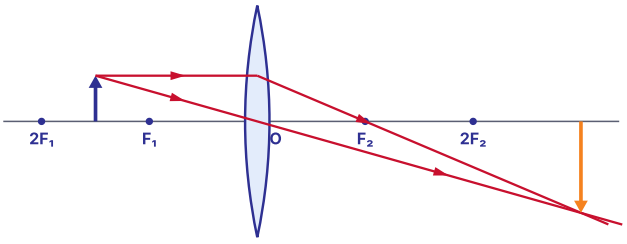
9 Spherical lenses – words and rays

Convex lens	Thicker in the middle; **converging** lens.
Concave lens	Thicker at the edges; **diverging** lens.
Optical centre (O)	Central point of the lens; a ray through it goes **undeviated**.
Principal foci F_1, F_2	A lens has two foci, one on each side. Parallel rays meet at F_2 (convex) or appear to come from F_1 (concave).
Focal length f	Distance OF; $2F_1$ and $2F_2$ lie at twice the focal length.

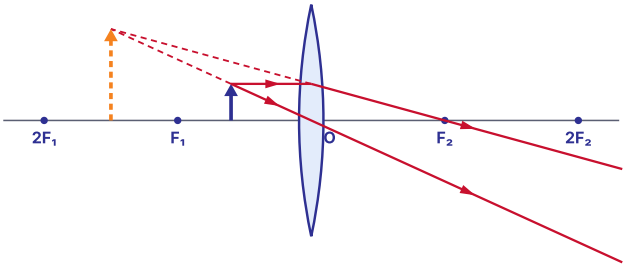
- **Ray 1:** parallel to the axis → through F_2 (convex) or appears to come from F_1 (concave).
- **Ray 2:** through F_1 (convex) or towards F_2 (concave) → emerges parallel to the axis.
- **Ray 3:** through O → goes straight on, undeviated.

10 Images formed by a convex lens

Object at	Image at	Size	Nature
Infinity	F_2	Point-sized	Real, inverted
Beyond $2F_1$	Between F_2 and $2F_2$	Diminished	Real, inverted
$2F_1$	$2F_2$	Same size	Real, inverted
Between F_1 and $2F_1$	Beyond $2F_2$	Enlarged	Real, inverted
F_1	Infinity	Highly enlarged	Real, inverted
Between F_1 and O	Same side as object	Enlarged	Virtual, erect

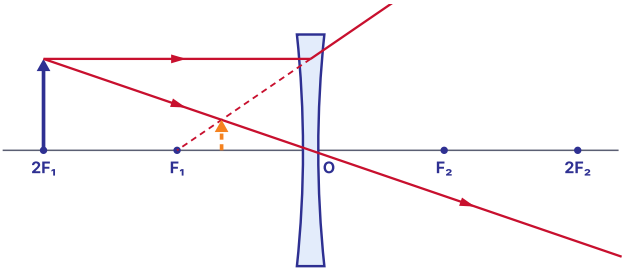


Convex lens, object between F_1 and $2F_1$: real, inverted, enlarged image beyond $2F_2$



Convex lens, object between F_1 and O: virtual, erect, enlarged image (magnifying glass)

11 Concave lens and the lens formula



Concave lens: virtual, erect, diminished image between F_1 and O

- Concave lens: object anywhere → image **between F_1 and O**, on the same side, **virtual, erect, diminished** (object at infinity: at F_1, point-sized).

Lens formula: $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$ **Magnification:** $m = \frac{h'}{h} = \frac{v}{u}$

- Convex lens: f positive. Concave lens: f negative. Real image (other side of the lens): v positive.
- Note the signs: mirror formula has 1/v + 1/u and m = −v/u; lens formula has 1/v − 1/u and m = +v/u.

12 Power of a lens

Power: the degree of convergence or divergence of light by a lens. $P = \frac{1}{f\ (\text{in metres})}$ Unit: **dioptre (D)**.

- **1 dioptre** is the power of a lens of focal length 1 metre (1 D = 1 m^{-1}).
- Convex lens: power **positive**; concave lens: power **negative**. A short focal length means a high power.
- Lenses in contact: **P = P_1 + P_2 + P_3 + …** (used by opticians to test eyes, and in cameras and microscopes to reduce defects).

WORKED EXAMPLE
f = −25 cm = −0.25 m → P = 1/(−0.25) = −4 D (concave). Lenses of +3 D and −1 D in contact: P = +2 D, f = 1/2 m = +50 cm (converging).

Formulas and signs at a glance

Learn this table by heart

Quantity	Mirror	Lens
Formula	1/v + 1/u = 1/f	1/v − 1/u = 1/f
Magnification	m = h′/h = −v/u	m = h′/h = v/u
Sign of f	Concave −, convex +	Convex +, concave −

Quantity	Mirror	Lens
Real image	v negative (in front)	v positive (other side)
Always virtual, erect, diminished	Convex mirror	Concave lens
Refractive index	$n = c / v$; $n_{21} = v_1 / v_2 = \sin i / \sin r$	
Power	$P = 1 / f$ (f in m), in dioptre; $P = P_1 + P_2$ for lenses in contact	

Explain why – quick answers

Common 1- and 2-mark reasons

Convex mirrors are used as rear-view mirrors – erect image and a wider field of view.

Headlights use concave mirrors – a bulb at F gives a strong parallel beam.

A ray through C retraces its path – it falls along the normal to the mirror.

A plane mirror has m = +1 – the image is erect and of the same size.

A pool looks shallower – light from the bottom bends away from the normal on leaving water.

Light bends towards the normal in glass – it slows down in the optically denser medium.

Emergent ray from a slab is parallel – equal and opposite bending at two parallel faces.

A ray through O is not deviated – near O the lens is like a thin parallel-sided slab.

Diamond has a high refractive index – light travels very slowly in it (2.42 times slower).

A convex lens is a magnifying glass – object within F gives a virtual, erect, enlarged image.

A concave lens cannot form a real image – it spreads light out; rays never meet.

Power of a concave lens is negative – its focal length is negative.

Exam snapshot

What the board asks, and how to prepare

SYLLABUS 2026–27

- Reflection by curved surfaces; images by spherical mirrors; centre of curvature, principal axis, principal focus, focal length; **mirror formula** (derivation not required); magnification.
- Refraction; laws of refraction; refractive index.
- Refraction by spherical lenses; images by lenses; **lens formula** (derivation not required); magnification; **power of a lens**.

BOARD WEIGHTAGE

25 / 80

Physics = 25 marks (Section C). Unit III **Natural Phenomena** (Ch 9 + Ch 10) = 12 marks. This chapter alone got 7 marks in the 2026 board paper (MCQ, a 2-mark lens question and the 4-mark case) and 7 marks in the 2026–27 Sample Paper.

MOST ASKED IN BOARD AND SAMPLE PAPERS, 2025–2027 (5 PAPERS CHECKED)

How often	Question type	Marks	Papers
★★★	Spherical mirrors: rays, images, uses, mirror formula	1–4	3 of 5
★★★	Refraction: laws, refractive index, glass slab, apparent depth	1–3	3 of 5
★★★	Lenses: ray diagrams and nature of images	1–4	5 of 5
★★★	Lens formula, magnification and power (numericals)	2–5	3 of 5

MISTAKES THAT COST MARKS

- Dropping signs: u is **negative** for a real object; f of a concave mirror and a concave lens is **negative**.
- Mixing the formulas: mirror 1/v + 1/u, lens 1/v − 1/u; mirror m = −v/u, lens m = +v/u.
- Forgetting to change f into **metres** before finding power.
- Ray diagrams: no arrowheads, virtual rays drawn as solid lines (they must be **dotted**), image not labelled.
- Writing only "real image" – always give **position, size and nature**.
- Saying light bends towards the normal when it goes from glass into air – it bends **away**.

HOW TO USE THIS BOOKLET

1. **Day 1:** Read the notes and the key tables; then Part A (NCERT).
2. **Day 2:** Part B (Exemplar) and Part C (board pattern). Do every MUST DO question first.
3. **Day 3:** Part D (case studies) and the real board questions listed in Part E.
4. **Tue 15 Dec (zero period): Physics chapter test – 20 marks, 40 minutes.**
5. Check every answer in the **Answer Booklet**. Write each mistake on the My Mistakes page (Part F).

A

PART A · NCERT PRACTICE

NCERT Practice

The ideas of every NCERT activity, in-text question and exercise, asked in new words. Finish every question.

Spherical mirrors

A1. Define the principal focus of a concave mirror. [1]

A2. The radius of curvature of a spherical mirror is 32 cm. Find its focal length. [1]

A3. Name the type of mirror that can give an erect and enlarged image of an object. Where must the object be? [1]

A4. Why do we prefer a convex mirror as a rear-view mirror in vehicles? MUST DO [2]

A5. Name the mirror used in (i) the headlights of a car (ii) a shaving mirror (iii) a solar furnace. Give a reason for each. [3]

A6. An object 3 cm tall is placed 30 cm in front of a concave mirror of focal length 20 cm. Where should a screen be placed to get a sharp image? Find the size and nature of the image. MUST DO [3]

A7. The rear-view convex mirror of a bus has a radius of curvature of 4 m. A car is 6 m behind the mirror. Find the position, nature and magnification of the image. MUST DO [3]

A8. Draw a ray diagram to show the image formed by a concave mirror when the object is between its pole and principal focus. Give two uses of this. MUST DO [3]

Refraction and refractive index

A9. A ray of light enters water from air at an angle. Does it bend towards or away from the normal? Why? [2]

A10. The refractive index of glass is 1.5. Find the speed of light in glass. ($c = 3 \times 10^8$ m/s) MUST DO [2]

A11. Refractive indices: water 1.33, benzene 1.50, crown glass 1.52, diamond 2.42. Which is optically densest? In which does light travel fastest? [2]

A12. The refractive index of diamond is 2.42. What does this mean? [2]

A13. State the two laws of refraction of light. MUST DO [2]

A14. Draw the path of a ray of light passing obliquely through a rectangular glass slab. Mark the angles of incidence, refraction and emergence. Why is the emergent ray parallel to the incident ray? MUST DO [3]

Spherical lenses and power

A15. Where should an object be placed in front of a convex lens to get a real image of the same size? [1]

A16. Which lens is used as a magnifying glass? Where is the object kept, and what kind of image is formed? [2]

A17. Define 1 dioptre of power. [1]

A18. A convex lens forms a real, inverted image of a pin 40 cm from the lens, of the same size as the pin. Where is the pin placed? Find the power of the lens. MUST DO [3]

A19. A concave lens of focal length 20 cm forms an image 12 cm from the lens. How far is the object from the lens? [3]

A20. An object 4 cm tall is 15 cm from a convex lens of focal length 10 cm. Find the position, size and nature of the image. MUST DO [3]

A21. Find the power of a concave lens of focal length 2 m. [1]

A22. The power of a lens is −2.0 D. Find its focal length and name the lens. [2]

A23. A doctor prescribes a lens of power +1.5 D. Find the focal length and the type of lens. [2]

B

PART B · EXEMPLAR PRACTICE

Exemplar Practice

Exemplar-style questions, one step harder. Show the formula, signs and units in every numerical.

Multiple choice

1 mark each

B1. Which of these can form a real image of a real object? [1]

(a) Plane mirror (b) Convex mirror (c) Concave lens (d) Concave mirror

B2. A spherical mirror and a thin lens both have a focal length of −15 cm. They are probably: [1]

(a) both concave (b) both convex
(c) concave mirror and convex lens (d) convex mirror and concave lens

B3. A concave mirror gives a virtual, erect and enlarged image. The object is: [1]

(a) at infinity (b) between F and C (c) between P and F (d) at F

B4. The magnification produced by a convex mirror is always: [1]

(a) more than +1 (b) positive and less than 1
(c) equal to −1 (d) negative

B5. In which of these does light travel fastest? [1]

(a) Water (b) Glass (c) Diamond (d) Air

B6. Which of these is caused by refraction of light? [1]

(a) Image in a plane mirror (b) A pencil looking bent in water
(c) A shadow behind a ball (d) An echo

B7. A ray passing through the centre of curvature of a concave mirror, after reflection: [1]

(a) passes through F (b) becomes parallel to the axis
(c) comes back along the same path (d) goes behind the mirror

B8. A student uses a convex lens of focal length 12 cm to get a sharp image of a distant tree on a screen. The screen is about: [1]

(a) 6 cm from the lens (b) 12 cm from the lens
(c) 24 cm from the lens (d) more than 24 cm from the lens

B9. A lens has a power of −4 D. Its focal length and type are: [1]

(a) +25 cm, convex (b) −25 cm, concave (c) −4 m, concave (d) +4 m, convex

B10. To see the full-length image of a distant tall building in a small mirror, you should use a: [1]

(a) plane mirror (b) convex mirror (c) concave mirror (d) any of these

Short answer

2–3 marks

B11. Why does a ray of light passing through the optical centre of a thin lens go undeviated? [2]

B12. The magnification produced by a mirror is −1/3. What is the nature of the image? Which type of mirror is it? [2]

B13. Two thin lenses of power +2 D and −1.5 D are placed in contact. Find the power and focal length of the combination. MUST DO [2]

B14. Why do dentists use concave mirrors? [2]

B15. The absolute refractive index of medium A is 1.6 and of medium B is 1.2. Find (i) the speed of light in A (ii) the refractive index of A with respect to B. (iii) In which medium does light travel faster? ($c = 3 \times 10^8$ m/s) [3]

B16. Where is the image formed when an object is placed at the principal focus of a convex lens? Describe it. [2]

C

PART C · BOARD PATTERN

Board Pattern Practice

Question types from the 2025 and 2026 board papers and the CBSE sample papers. ★★★ = asked in 3 or more of the 5 papers checked · ★★ = 2 papers · ★ = 1 paper.

ASSERTION–REASON: HOW TO ANSWER

(a) Both A and R are true, and R is the correct explanation of A.
(b) Both A and R are true, but R is not the correct explanation of A.
(c) A is true, but R is false.
(d) A is false, but R is true.

Spherical mirrors

★★★ 3 of 5 papers · 1–4 marks

C1. A ray of light falls on a concave mirror along its principal axis (angle of incidence zero). After reflection it: [1]

(a) passes through F
(b) comes back along the same path
(c) becomes parallel to the axis
(d) goes off at 90°

C2. A ray parallel to the principal axis strikes a concave mirror. The reflected ray: [1]

(a) passes through the principal focus
(b) passes through the centre of curvature
(c) retraces its path
(d) stays parallel to the axis

C3. ASSERTION–REASON [1]

Assertion (A): Convex mirrors are used as rear-view mirrors in vehicles.

Reason (R): A convex mirror gives an erect, diminished image and a wider field of view.

C4. An object is placed 20 cm in front of a concave mirror of radius of curvature 40 cm. The image is formed: [1]

(a) at infinity
(b) at C
(c) at F
(d) behind the mirror

C5. A concave mirror of focal length 12 cm forms a virtual image three times the size of the object. Find the object distance and the image distance. MUST DO [3]

C6. Draw a ray diagram for an object placed between F and C of a concave mirror. State the position and nature of the image. MUST DO [3]

C7. Name the type of mirror that gives (i) an erect, diminished image for every object position (ii) a real image of the same size. Where is the object in (ii)? [2]

Refraction and refractive index

★★★ 3 of 5 papers · 1–3 marks

C8. When light passes from air into glass: [1]

(a) its speed increases and it bends away from the normal
(b) its speed decreases and it bends towards the normal
(c) its speed is unchanged
(d) it always goes straight

C9. ASSERTION–REASON [1]

Assertion (A): A swimming pool appears less deep than it really is.

Reason (R): Light from the bottom bends away from the normal as it passes from water into air.

C10. A ray passes obliquely through a rectangular glass slab. The emergent ray is: [1]

(a) parallel to the incident ray but shifted sideways

(b) along the same line as the incident ray

(c) perpendicular to the incident ray

(d) bent towards the base

C11. A ray of light falls on a glass surface at an angle of incidence of 45° and is refracted at 28°. Find the refractive index of glass. (sin 45° = 0.707, sin 28° = 0.47) MUST DO [2]

C12. The speed of light is 2×10^8 m/s in medium A and 2.25×10^8 m/s in medium B. Which medium is optically denser? Find the refractive index of A with respect to B. [2]

C13. The refractive index of water is 1.33 and of glass is 1.5. Find (i) the speed of light in water (ii) the refractive index of glass with respect to water. (iii) Which way does a ray bend going from water into glass? ($c = 3 \times 10^8$ m/s) [3]

Lenses: ray diagrams and images

★★★ 5 of 5 papers · 1–4 marks

C14. A convex lens of focal length 12 cm forms a real image of the same size as the object. The object is at: [1]

(a) 12 cm (b) 24 cm (c) 6 cm (d) 36 cm

C15. A lens forms an image with magnification −1. The lens and object position are: [1]

(a) concave, object at F (b) convex, object at 2F

(c) convex, object at F (d) concave, object anywhere

C16. A student focuses sunlight with a convex lens; the smallest, brightest spot forms 18 cm from the lens. The focal length is about: [1]

(a) 9 cm (b) 18 cm (c) 36 cm (d) 54 cm

C17. ASSERTION–REASON [1]

Assertion (A): A concave lens always forms a virtual, erect and diminished image of a real object.

Reason (R): A concave lens spreads out (diverges) the rays falling on it.

C18. Draw a ray diagram for an object placed between F_1 and $2F_1$ of a convex lens. State the position, size and nature of the image. MUST DO [3]

C19. Draw a ray diagram to show the formation of an image by a concave lens. State the nature of the image. MUST DO [2]

C20. A lens gives an erect, enlarged image on the same side as the object. Name the lens and state where the object is placed. Can this image be caught on a screen? [2]

Lens formula, magnification and power

★★★ 3 of 5 papers · 2–5 marks

C21. A convex lens forms a real image three times the size of the object on a screen 60 cm from the lens. Find the object distance and the focal length. MUST DO [3]

C22. An object 6 cm tall is placed 30 cm from a convex lens of focal length 10 cm. Find the position and size of the image, and describe it. [3]

C23. An object is 30 cm from a concave lens and its image forms 15 cm from the lens on the same side. Find the focal length, power and magnification. MUST DO [3]

C24. A convex lens of focal length 20 cm and a concave lens of focal length 40 cm are placed in contact. Find the power of the combination and say whether it converges or diverges light. MUST DO [2]

C25. A student recorded these object and image distances (in cm) for a convex lens: (–60, +30), (–40, +40), (–30, +60), (–25, +80). (i) Find the focal length from the second reading. (ii) Which reading is wrong? What should it be? (iii) Which reading gives an image of the same size? [3]

Long answer

5 marks

C26. (a) Draw a ray diagram to show how a convex lens works as a magnifying glass. (b) An object 2 cm high is 15 cm from a convex lens of focal length 10 cm. Find the position and size of the image. (c) Find the power of the lens. MUST DO [5]

C27. (a) State the position, size and nature of the image formed by a concave mirror when the object is (i) beyond C (ii) at C (iii) between P and F. (b) An object is 12 cm in front of a concave mirror of focal length 18 cm. Find the image distance and magnification. (c) Give one use of a convex mirror. [5]

C28. (a) What is refraction? State its laws. (b) Define absolute refractive index. (c) Light enters glass (n = 1.5) from air. Find its speed in glass. (d) Why does a stick partly dipped in water look bent? [5]

D

PART D · SECTION C CASE STYLE

Case-Based Questions

Each case carries 4 marks (1 + 1 + 2), as in the case-based questions of the board paper.

D1. Case Study · The Reflecting Telescope [4]

Big telescopes use a large curved mirror instead of a lens to collect light from faint stars. The main mirror of a school telescope has a radius of curvature of 2.4 m. Light from a distant star falls on it as a parallel beam and is brought to a point, where a small flat mirror sends it to the eyepiece.

(i) Which type of mirror is the main mirror? [1]

(ii) Where is the image of the star formed? [1]

(iii) Find the focal length of the main mirror. Describe the image of the star formed by it. [2]

OR

(iii) Why could a convex mirror not be used as the main mirror? Give one other use of the type of mirror used. [2]

D2. Case Study · The Watch Repairer's Lens [4]

A watch repairer looks at a tiny screw through a lens held 4 cm from it. The lens has a focal length of 5 cm. He sees a large, upright image of the screw and can work on it easily.

(i) Which type of lens is he using? [1]

(ii) State the nature of the image he sees. [1]

(iii) Find the image distance and the magnification. [2]

OR

(iii) Find the power of the lens. What happens to the image if he moves the lens until the screw is 10 cm away? [2]

D3. Case Study · The Coin in the Pool [4]

Meera drops a coin into a swimming pool. From the edge, the coin appears to be higher than it really is, and the pool looks shallow. Her teacher says that the refractive index of water is 4/3 and asks the class to explain what they see. ($c = 3 \times 10^8$ m/s)

(i) Name the phenomenon that makes the coin appear raised. [1]

(ii) Find the speed of light in water. [1]

(iii) Explain, with the direction of bending, why the pool looks shallower than it is. [2]

OR

(iii) A ray goes from air into water with $\sin i = 0.8$. Find $\sin r$. Does the ray bend towards or away from the normal? [2]

PART E · REAL BOARD QUESTIONS

E Board PYQ Index

Real questions from recent Science board papers and CBSE sample papers, by type. Open the official paper and solve the listed questions.

Frequency	Question type	Marks	Where asked (year: paper code, question number)	Practise here
★★★	**Spherical mirrors: rays, images, uses, mirror formula**	1–4	**2025:** OD Set 1 Q13 (reflected ray, concave mirror) · **2025:** Delhi Set 1 Q31 (concave mirror, virtual magnified image) · **SQP 2024–25:** Q13 (ray along the axis), Q19 (A–R, convex mirror), Q39 (case, reflecting telescope)	A1–A8, B1–B4, B7, B10, B12, B14, C1–C7, C27, D1
★★★	**Refraction: laws, refractive index, glass slab, apparent depth**	1–3	**2025:** OD Set 1 Q24 (refraction, refractive index) · **2025:** Delhi Set 1 Q11 (glass slab) · **SQP 2026–27:** Q32 (A–R, apparent depth), Q33 (Snell's law)	A9–A14, B5–B6, B15, C8–C13, C28, D3
★★★	**Lenses: ray diagrams and nature of images**	1–4	**2026:** 31/1/1 Q30 (same-size image), Q33(a), Q38(b) (concave lens diagram) · **2025:** OD Set 1 Q31 (ray diagram) · **2025:** Delhi Set 1 Q10 (magnification –1) · **SQP 2024–25:** Q24 (lens figure) · **SQP 2026–27:** Q30 (focal length using sunlight)	A15–A16, B8, B11, B16, C14–C20, C26, D2
★★★	**Lens formula, magnification and power (numericals)**	2–5	**2026:** 31/1/1 Q33(b), Q38(a), Q38(c) (power of combination) · **2025:** OD Set 1 Q31 (focal length from readings) · **SQP 2026–27:** Q35 (concave lens)	A17–A23, B9, B13, C21–C26, D2

PAPERS CHECKED (5)

- 2026 board paper 31/1/1 (Set 1) – first paper with separate Biology, Chemistry and Physics sections
- 2025 board paper, Outside Delhi Set 1
- 2025 board paper, Delhi Set 1
- CBSE Sample Question Paper 2024–25
- CBSE Sample Question Paper 2026–27 (the pattern for your exam)

★★★ = asked in 3 or more of the 5 papers checked · ★★ = 2 papers · ★ = 1 paper. Codes: OD = Outside Delhi. Each paper was read question by question; questions from the 2026–27 Sample Paper after Q20 were checked from a summary of the paper. Download the official papers from cbse.gov.in → Previous Year Question Papers and cbseacademic.nic.in → Sample Question Papers, and solve the exact questions listed.

F

PART F · YOUR RECORD

My Mistakes

Write down each mistake from this chapter, including the chapter test.

Every wrong answer is a free lesson. Write it here, find the rule you missed, and redo the question after three days. Bring this page to class before the chapter test.

Date	Part & Q No.	What went wrong	Correct rule or method	Redone ✓