Class 10 Science Chapter 9: Light – Reflection and Refraction - Notes, Important Questions and MCQs (2026-27)

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These Class 10 Science Chapter 9 PDF Notes explain Light – Reflection and Refraction completely: laws of reflection, spherical mirrors, image formation tables, sign convention, the mirror and lens formulas, refraction, refractive index and power of a lens, with solved numericals.

This is the most numerical-heavy chapter in Class 10 Science. Ray diagrams and formula-based questions appear in every board paper, so practise both regularly.

Use the table of contents below to jump to the part you need, or read top to bottom for a complete revision of the chapter.

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Chapter Overview

Light travels in straight lines and lets us see objects when it reflects from them into our eyes. Mirrors reflect light and lenses refract it, forming images that can be real or virtual, erect or inverted, magnified or diminished.

The chapter covers plane and spherical mirrors, how to locate images using ray diagrams and formulas, the bending of light when it passes from one medium to another, Snell’s law, refractive index, and the action of convex and concave lenses.

Important Topics and Concepts

Laws of reflection

(i) The angle of incidence equals the angle of reflection. (ii) The incident ray, the reflected ray and the normal at the point of incidence lie in the same plane. These laws apply to all reflecting surfaces, including spherical mirrors. A plane mirror forms a virtual, erect image of the same size, as far behind the mirror as the object is in front, laterally inverted.

Spherical mirror terms

Pole (P): centre of the mirror surface. Centre of curvature (C): centre of the sphere of which the mirror is a part. Radius of curvature (R): distance PC. Principal axis: line through P and C. Principal focus (F): point where rays parallel to the axis meet (concave) or appear to diverge from (convex). Focal length f = PF, and R = 2f.

Rules for ray diagrams

- A ray parallel to the principal axis passes through (or appears to come from) the focus after reflection.
- A ray through the focus becomes parallel to the principal axis.
- A ray through the centre of curvature is reflected back along the same path.
- A ray hitting the pole obliquely is reflected making an equal angle with the axis.

Uses of mirrors

- Concave: torches, searchlights and vehicle headlights (parallel beam), shaving mirrors (enlarged image), dentists' mirrors, solar furnaces.
- Convex: rear-view mirrors in vehicles, because they always give an erect, diminished image and a wider field of view.

Sign convention (New Cartesian)

The object is placed to the left of the mirror/lens. All distances are measured from the pole (or optical centre). Distances in the direction of incident light (to the right) are positive; against it (to the left) are negative. Heights above the principal axis are positive and below are negative. So for a concave mirror, f is negative; for a convex mirror, f is positive.

Refraction of light

Light bends when it passes obliquely from one medium to another because its speed changes. It bends towards the normal when going into a denser medium and away from the normal when going into a rarer medium. Through a rectangular glass slab, the emergent ray is parallel to the incident ray but laterally displaced.

Laws of refraction and refractive index

(i) The incident ray, refracted ray and normal lie in the same plane. (ii) Snell's law: $\sin i / \sin r$ = constant for a given pair of media and a given colour of light. Refractive index $n_{21} = v_1 / v_2$ (speed of light in medium 1 ÷ speed in medium 2). Absolute refractive index $n = c / v$, where $c = 3 \times 10^8$ m/s. Examples: water 1.33, crown glass 1.52, diamond 2.42 (highest in the NCERT table). Optical density is different from mass density.

Spherical lenses

A convex lens is thicker at the middle and converges light; a concave lens is thinner at the middle and diverges light. Terms: optical centre (O), principal foci F_1 and F_2, focal length f. A ray through the optical centre passes without deviation. Convex lens f is positive; concave lens f is negative.

Power of a lens

P = 1/f, where f is in metres. Unit: dioptre (D). A convex lens has positive power and a concave lens negative power. For lenses in contact, $P = P_1 + P_2 + \ldots$

Key Equations and Formulas

Name	Equation / Formula	Note
Mirror formula	$1/v + 1/u = 1/f$	u, v, f with sign convention
Magnification (mirror)	$m = h'/h = -v/u$	m negative: real, inverted; m positive: virtual, erect
Lens formula	$1/v - 1/u = 1/f$	Same sign convention
Magnification (lens)	$m = h'/h = v/u$	$\|m\| > 1$ enlarged
Radius and focal length	$R = 2f$	For spherical mirrors
Refractive index	$n = c/v$; $n_{21} = v_1/v_2$	$c = 3 \times 10^8$ m/s
Snell’s law	$\sin i / \sin r = n_{21}$	Constant for a pair of media
Power of lens	$P = 1/f$ (f in m)	Unit: dioptre (D)

Image Formation by a Concave Mirror (and Convex Lens)

A convex lens forms images in the same positions and with the same nature, with F_1 and $2F_1$ in place of F and C.

Object position	Image position	Size	Nature
At infinity	At F	Highly diminished, point-sized	Real, inverted
Beyond C	Between F and C	Diminished	Real, inverted
At C	At C	Same size	Real, inverted
Between C and F	Beyond C	Enlarged	Real, inverted
At F	At infinity	Highly enlarged	Real, inverted
Between P and F	Behind the mirror	Enlarged	Virtual, erect
Convex mirror (any position)	Behind mirror, between P and F	Diminished	Virtual, erect
Concave lens (any position)	Between F_1 and O, same side	Diminished	Virtual, erect

Important Definitions and Terms

Term	Meaning
Reflection	Bouncing back of light from a surface
Refraction	Bending of light when it passes from one medium to another

Term	Meaning
Pole	Centre of the reflecting surface of a spherical mirror
Centre of curvature	Centre of the sphere of which the mirror is a part
Principal focus	Point where parallel rays meet or appear to diverge from after reflection/refraction
Focal length	Distance between the pole (or optical centre) and principal focus
Real image	Image formed where rays actually meet; can be taken on a screen
Virtual image	Image formed where rays appear to meet; cannot be taken on a screen
Magnification	Ratio of image height to object height
Refractive index	Ratio of speeds of light in two media
Optical centre	Central point of a lens through which light passes undeviated
Dioptre	Unit of power of a lens; 1 D = 1 m^{-1}
Lateral inversion	Left-right reversal of an image in a plane mirror

Short Answer Questions

Q1. Why do we prefer a convex mirror as a rear-view mirror in vehicles?

A convex mirror always forms an erect, diminished image and covers a much wider field of view, so the driver can see more of the traffic behind.

Q2. The radius of curvature of a spherical mirror is 20 cm. What is its focal length?

f = R/2 = 20/2 = 10 cm.

Q3. Name a mirror that can give an erect and enlarged image of an object.

A concave mirror, when the object is placed between its pole and principal focus.

Q4. A ray of light travelling in air enters obliquely into water. Does it bend towards or away from the normal? Why?

It bends towards the normal, because water is optically denser than air and light slows down when entering it.

Q5. Light enters from air to glass with refractive index 1.50. What is the speed of light in glass?

$v = c/n = (3 \times 10^8)/1.5 = 2 \times 10^8$ m/s.

Q6. Define 1 dioptre of power of a lens.

1 dioptre is the power of a lens whose focal length is 1 metre.

Q7. Find the power of a concave lens of focal length 2 m.

P = 1/f = 1/(−2) = −0.5 D.

Q8. Why does a pencil partly immersed in water appear bent?

Light from the immersed part bends away from the normal as it leaves water and enters air, so the pencil appears raised and bent at the surface.

Long Answer Questions

Q1. An object 5 cm high is placed 25 cm in front of a convex lens of focal length 10 cm. Find the position, size and nature of the image.

Given: u = −25 cm, f = +10 cm, h = 5 cm.

Lens formula: 1/v − 1/u = 1/f → 1/v = 1/f + 1/u = 1/10 − 1/25 = (5 − 2)/50 = 3/50.

So v = 50/3 ≈ +16.7 cm (on the other side of the lens).

Magnification m = v/u = (50/3)/(−25) = −2/3 ≈ −0.67.

Image height h′ = m × h = −0.67 × 5 ≈ −3.3 cm.

Answer: The image forms about 16.7 cm behind the lens; it is real, inverted and diminished (about 3.3 cm tall).

Q2. An object is kept 20 cm in front of a concave mirror of focal length 15 cm. Find the position and nature of the image.

Given: u = −20 cm, f = −15 cm.

Mirror formula: 1/v + 1/u = 1/f → 1/v = 1/f − 1/u = −1/15 + 1/20 = (−4 + 3)/60 = −1/60.

v = −60 cm, so the image is 60 cm in front of the mirror.

m = −v/u = −(−60)/(−20) = −3.

Answer: The image is real, inverted and three times enlarged, formed 60 cm in front of the mirror.

Q3. State the laws of refraction. Explain refraction through a rectangular glass slab.

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): the ratio of sine of angle of incidence to sine of angle of refraction is constant for a given pair of media and a given colour of light: sin i / sin r = constant.

Glass slab: when light enters the slab from air, it bends towards the normal. When it comes out into air, it bends away from the normal. Because both surfaces are parallel, the emergent ray is parallel to the incident ray but shifted sideways (lateral displacement).

MCQs with Answers

1. The focal length of a spherical mirror of radius 30 cm is(a) 30 cm (b) 15 cm (c) 60 cm (d) 7.5 cmAnswer: (b) 15 cm

2. A convex mirror always forms an image that is(a) Real and enlarged (b) Virtual and diminished (c) Real and diminished (d) Virtual and enlargedAnswer: (b) Virtual and diminished

3. Which mirror is used in vehicle headlights?(a) Plane (b) Convex (c) Concave (d) CylindricalAnswer: (c) Concave

4. The mirror formula is(a) 1/v − 1/u = 1/f (b) 1/v + 1/u = 1/f (c) v + u = f (d) m = v/uAnswer: (b) 1/v + 1/u = 1/f

5. The unit of power of a lens is(a) Metre (b) Dioptre (c) Watt (d) JouleAnswer: (b) Dioptre

7. Light bends towards the normal when it goes from(a) Glass to air (b) Water to air (c) Air to glass (d) Glass to vacuumAnswer: (c) Air to glass

8. The refractive index of diamond is about(a) 1.33 (b) 1.52 (c) 2.42 (d) 1.00Answer: (c) 2.42

9. For an object at $2F_1$ of a convex lens, the image is(a) At F_2, diminished (b) At $2F_2$, same size, real (c) Beyond $2F_2$, enlarged (d) Virtual and erectAnswer: (b) At $2F_2$, same size, real

10. Magnification of a plane mirror is(a) −1 (b) 0 (c) +1 (d) 2Answer: (c) +1

Quick Revision Points

- Angle of incidence = angle of reflection; R = 2f.
- Concave mirror and convex lens can form real or virtual images; convex mirror and concave lens form only virtual, erect, diminished images.
- Sign convention: distances from pole; left negative, right positive.
- Mirror: 1/v + 1/u = 1/f, m = −v/u. Lens: 1/v − 1/u = 1/f, m = v/u.
- n = c/v; Snell’s law: sin i/sin r = constant.
- Denser medium → bends towards normal.
- P = 1/f (metres); convex +, concave −.

Chapter Summary

Light reflects from surfaces following the laws of reflection. Spherical mirrors form images whose position, size and nature depend on where the object is placed; these can be found with ray diagrams or the mirror formula using the New Cartesian sign convention. Concave mirrors are used in torches and shaving mirrors, while convex mirrors are used as rear-view mirrors.

Refraction is the bending of light due to a change in speed between media, governed by Snell’s law and measured by refractive index. Convex lenses converge light and concave lenses diverge it; their images are found with the lens formula, and their strength is measured as power in dioptres.

Exam Tips and PYQ Pattern

- A numerical using the mirror or lens formula is almost certain; always write the sign convention first.
- Draw ray diagrams with arrows, labels and at least two standard rays.
- Know uses of concave and convex mirrors; they are common 2-mark questions.
- Learn the refractive-index table values for water, glass and diamond.

Frequently Asked Questions

What is the difference between a real and a virtual image?

A real image is formed by actual meeting of rays and can be shown on a screen; a virtual image only appears to form and cannot.

Why is the focal length of a concave mirror negative?

How do you remember the sign difference between mirror and lens formulas?

Mirror formula has a plus (1/v + 1/u); lens formula has a minus (1/v − 1/u). Magnification is −v/u for mirrors and v/u for lenses.

Conclusion

Light – Reflection and Refraction rewards practice more than memory. Learn the sign convention, the two formulas and the image tables, then solve at least ten numericals and draw every ray diagram once. That routine will make this chapter one of your best scoring areas.

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Author Bio: Written and reviewed by the Nextoper Editorial Team, a group of CBSE science educators who build chapter notes directly from the NCERT textbook and past board paper patterns.

Freshness Note: These notes follow the NCERT Class 10 Science textbook (Reprint 2026-27) and the CBSE syllabus for the 2026-27 session. Last checked on 7 November 2026.