Class 10 Science – Light: Reflection and Refraction – Topic: Reflection of Light and Spherical Mirrors (Topicwise Notes)

ALPHA CLASSES DEOBAND | Session 2026–27 | CBSE Board Pattern

Concept – The Big Picture

- Light travels in straight lines (seedhi line mein chalna) — this basic property explains shadows, eclipses, and how every mirror and lens works.
- When light hits a polished surface and bounces back, it follows two strict **laws of reflection** — the angle going in always equals the angle coming out (andar jaane ka angle = bahar aane ka angle), and all three lines stay in one plane.
- Spherical mirrors are pieces of a hollow sphere — a **concave mirror** curves inward like a cave (andar ki taraf) and **converges** light to a point; a **convex mirror** curves outward (bahar ki taraf) and **diverges** light.
- Every spherical mirror has a set of special points — Pole (P), Centre of Curvature (C), Focus (F) — and the golden rule is: **focal length is exactly half the radius of curvature** ($f = R/2$).
- Four standard ray-tracing rules let you predict exactly where an image will form — master these rules (in chaar rules ko yaad karo) and you can solve any mirror problem the board throws at you.

Key Definitions

Term	Definition
Reflection of Light	The bouncing back of light when it strikes a surface. The light ray returns into the same medium from which it came.
Incident Ray	The ray of light that falls on a reflecting surface.
Reflected Ray	The ray of light that bounces back from the reflecting surface after reflection.
Normal	An imaginary line drawn perpendicular to the reflecting surface at the point where the incident ray strikes.
Angle of Incidence ($\angle i$)	The angle between the incident ray and the normal at the point of incidence.

Term	Definition
Angle of Reflection ($\angle r$)	The angle between the reflected ray and the normal at the point of incidence.
Concave Mirror	A spherical mirror whose reflecting surface is curved inward (towards the centre of the sphere). It converges parallel rays of light. Also called a converging mirror.
Convex Mirror	A spherical mirror whose reflecting surface is curved outward (away from the centre of the sphere). It diverges parallel rays of light. Also called a diverging mirror.
Pole (P)	The geometric centre of the reflecting surface of a spherical mirror.
Centre of Curvature (C)	The centre of the sphere of which the mirror's reflecting surface is a part. It lies in front of a concave mirror and behind a convex mirror.
Radius of Curvature (R)	The distance between the pole (P) and the centre of curvature (C) of a spherical mirror.
Principal Axis	A straight line passing through the pole (P) and the centre of curvature (C) of a spherical mirror.
Principal Focus (F)	The point on the principal axis where rays parallel to the principal axis converge (concave) or appear to diverge from (convex) after reflection.
Focal Length (f)	The distance between the pole (P) and the principal focus (F) of a spherical mirror.
Aperture	The diameter of the reflecting surface of a spherical mirror. It determines how much light the mirror can collect.

Important Formulas

1. Laws of Reflection

First Law: The angle of incidence equals the angle of reflection.

$$\angle i = \angle r$$

Second Law: The incident ray, the reflected ray, and the normal to the reflecting surface at the point of incidence all lie in the same plane.

2. Relation between Focal Length and Radius of Curvature

For a spherical mirror with a small aperture:

$$f = \frac{R}{2} \quad \text{or equivalently,} \quad R = 2f$$

3. New Cartesian Sign Convention (for reference)

- All distances are measured from the pole (P) of the mirror.

- Distances measured in the direction of the incident light (left to right) are taken as **positive**.
- Distances measured opposite to the direction of the incident light (right to left) are taken as **negative**.
- Heights measured upward from the principal axis are **positive**; downward are **negative**.

Quick check: For a concave mirror, f and R are **negative** (focus is in front of the mirror). For a convex mirror, f and R are **positive** (focus is behind the mirror).

4. Four Ray Rules for Spherical Mirrors

Rule	Incident Ray	Reflected Ray
Rule 1	Parallel to the principal axis	Passes through F (concave) or appears to come from F (convex)
Rule 2	Passes through F (concave) or directed towards F (convex)	Reflects parallel to the principal axis
Rule 3	Passes through C (concave) or directed towards C (convex)	Reflects back along the same path
Rule 4	Incident at the pole P	Reflects at an equal angle on the other side of the principal axis

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Solved Examples

Example 1 — State the Laws of Reflection

Q. State the two laws of reflection of light.

Solution:

Step 1: First Law. The angle of incidence ($\angle i$) is always equal to the angle of reflection ($\angle r$).

$$\angle i = \angle r$$

Step 2: Second Law. The incident ray, the reflected ray, and the normal to the reflecting surface at the point of incidence all lie in the same plane.

∴ The two laws are: **(i)** $\angle i = \angle r$, and **(ii) the incident ray, reflected ray, and normal are coplanar**.

Example 2 — Finding Focal Length from Radius of Curvature

Q. The radius of curvature of a concave mirror is 30 cm. Find its focal length.

Solution:

Step 1: Write the relationship between focal length and radius of curvature.

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

Step 2: Substitute the given value.

$$f = \frac{30}{2} = 15 \text{ cm}$$

Step 3: Apply sign convention. Since the mirror is concave, the focus lies in front of the mirror. Using the New Cartesian Sign Convention, the focal length is negative: $f = -15$ cm.

∴ The focal length of the concave mirror is **15 cm** (or -15 cm using sign convention).

Example 3 — Concave vs Convex Mirror: Comparison

Q. Distinguish between a concave mirror and a convex mirror. Give two uses of each.

Solution:

Feature	Concave Mirror	Convex Mirror
Reflecting surface	Curved inward	Curved outward
Effect on parallel light	Converges (brings together)	Diverges (spreads out)
Nature of focus	Real (rays actually meet at F)	Virtual (rays appear to come from F behind the mirror)
Image type	Can form both real and virtual images	Always forms virtual, erect, and diminished images

Uses of concave mirror: (i) Used in torches, headlights, and searchlights to get a powerful beam of parallel light. (ii) Used as shaving mirrors / makeup mirrors — when the face is placed between P and F, a magnified, erect image is obtained.

Uses of convex mirror: (i) Used as rear-view (side) mirrors in vehicles — they always give an erect image and provide a wider field of view. (ii) Used at sharp road bends and in ATM machines for security surveillance.

∴ Concave mirrors converge light and are used in **torches and shaving mirrors**; convex mirrors diverge light and are used in **rear-view mirrors and road safety**.

Example 4 — Tracing a Ray on a Concave Mirror

Q. A ray of light is incident on a concave mirror parallel to its principal axis. Describe the path of the reflected ray and state the ray rule used.

Solution:

Step 1: Identify the applicable ray rule. This uses **Rule 1**: A ray parallel to the principal axis, after reflection from a concave mirror, passes through the principal focus (F).

Step 2: Describe the path. The incident ray travels parallel to the principal axis and hits the concave mirror surface. After reflection, it is directed towards the principal focus F, passing through it.

Step 3: Note for convex mirror. If the same parallel ray falls on a convex mirror, the reflected ray appears to diverge from the focus F behind the mirror (the ray is reflected outward, but its backward extension passes through F).

∴ The reflected ray **passes through the principal focus (F)** of the concave mirror. This is **Ray Rule 1**: a ray parallel to the principal axis reflects through F.

Example 5 — Board-Level: Why Convex Mirrors as Rear-View Mirrors?

Q. Why are convex mirrors preferred as rear-view mirrors in vehicles? Give two reasons.

Solution:

Step 1: Nature of image. A convex mirror always forms a **virtual, erect, and diminished** (smaller) image, regardless of where the object is placed. This means the driver always sees an upright image of vehicles behind — no confusion about orientation.

Step 2: Field of view. A convex mirror has a **wider field of view** compared to a plane mirror of the same size. Because the reflecting surface curves outward, it can cover a larger area behind the vehicle, allowing the driver to see more traffic.

Step 3: Safety advantage. Since the image is diminished, objects appear smaller and farther away — this lets the driver see a wider range of vehicles and obstacles, improving road safety.

∴ Convex mirrors are preferred as rear-view mirrors because **(i) they always produce erect images** (easy to interpret) and **(ii) they provide a wider field of view** (more area visible), making driving safer.