

Plane Mirrors - Theory & Questions

(CBSE Class 10 Physics)

Introduction to Plane Mirrors

A **plane mirror** is a flat, smooth, and highly reflective surface that forms images by reflecting light according to the **laws of reflection**. It is widely used in homes, vehicles, and optical instruments.

Characteristics of a Plane Mirror

1. **Forms a Virtual and Erect Image** – The image cannot be captured on a screen.
2. **Same Size as the Object** – The image has the same height and width as the object.
3. **Laterally Inverted** – The left and right sides of the image are reversed.
4. **Image Distance = Object Distance** – If an object is placed at a distance dd in front of a plane mirror, the image appears at the same distance dd behind the mirror.

MCQ:

1. The image formed by a plane mirror is:
 - (a) Real and inverted
 - (b) Virtual and erect
 - (c) Diminished
 - (d) Enlarged

Answer: (b) Virtual and erect

Laws of Reflection

A plane mirror follows two fundamental laws of reflection:

Law 1: The Angle of Incidence is Equal to the Angle of Reflection

The angle between the incident ray and the normal (**angle of incidence, θ_i**) is always equal to the angle between the reflected ray and the normal (**angle of reflection, θ_r**).

$\theta_i = \theta_r$

Law 2: The Incident Ray, the Reflected Ray, and the Normal Lie in the Same Plane

The incident ray, the reflected ray, and the normal (a perpendicular line to the mirror at the point of incidence) **all lie in the same plane**.

MCQ:

2. The angle between an incident ray and the reflected ray is 60° . What is the angle of incidence?
- ☐ (a) 30°
 - ☐ (b) 60°
 - ☐ (c) 90°
 - ☐ (d) 45°

Answer: (a) 30°

Focal Point of a Plane Mirror

The **focal point** of a mirror is where parallel rays of light either **converge** (concave mirror) or appear to **diverge from** (convex mirror).

- **For a plane mirror, the focal point is at infinity** because the reflected rays remain parallel and never meet.

Assertion-Reason Based Question:

3. **Assertion:** The focal length of a plane mirror is infinite.

Reason: A plane mirror does not converge or diverge parallel light rays.

- (a) Both A and R are correct, and R explains A
- (b) Both A and R are correct, but R does not explain A
- (c) A is correct, but R is incorrect
- (d) Both A and R are incorrect

Answer: (a) Both A and R are correct, and R explains A

Lateral Inversion

Lateral inversion means that the image in a plane mirror appears **flipped from left to right**. This is why text appears reversed in a mirror.

Very Short Answer Question:

4. What is lateral inversion?

Answer: The phenomenon where the left and right sides of an image appear reversed in a plane mirror.

Image Distance in a Plane Mirror

If an object is placed at a distance d in front of a plane mirror, the image appears at the same distance d behind the mirror. The **total distance between the object and image** is **$2d$** .

MCQ:

5. A person stands 3 meters away from a plane mirror. How far is their image from them?
- (a) 3 meters
 - (b) 6 meters
 - (c) 1.5 meters
 - (d) 9 meters

Answer: (b) 6 meters

Rotation of a Plane Mirror

When a **plane mirror is rotated by an angle θ** , the **reflected ray rotates by 2θ** .

Short Answer Question:

6. If a mirror is rotated by 10° , by what angle does the reflected ray rotate?

Answer: The reflected ray rotates by **20°** .

Applications of Plane Mirrors

1. **Mirrors in Homes and Vehicles** – Used for grooming and as rear view mirrors.
2. **Periscopes** – Used in submarines and tanks to see above obstacles.
3. **Kaleidoscopes** – Used in optical instruments and toys.
4. **Optical Illusions** – Used in infinity mirrors.

Short Answer Question:

7. Why are plane mirrors used in periscopes?

Answer: Plane mirrors reflect light at a fixed angle, allowing people to see

around obstacles without being detected.

Assertion-Reason Questions

8. **Assertion:** The image formed by a plane mirror cannot be obtained on a screen.

Reason: A plane mirror forms a virtual image where light rays actually meet.

- (a) Both A and R are correct, and R explains A
- (b) Both A and R are correct, but R does not explain A
- (c) A is correct, but R is incorrect
- (d) Both A and R are incorrect

Answer: (c) Assertion is correct, but Reason is incorrect.

Explanation: A plane mirror forms a **virtual image**, but the image is formed where **light rays appear to meet**, not where they actually meet. That is why the image cannot be captured on a screen.

Case-Based Question

Scenario:

A student is standing in front of a plane mirror with a book in his hand. The book has the word "**MIRROR**" printed on it.

Questions:

9. How will the text appear in the mirror?

Answer: The text will appear **laterally inverted**, meaning it will be reversed from left to right.

10. If the student moves 2 meters closer to the mirror, how far will the image move?

Answer: The image will move $2 \times 2 = 4$ meters closer.

Long Answer Question

11. Experiment to Verify Laws of Reflection

Aim:

To verify the **laws of reflection** using a plane mirror.

Apparatus Required:

- A plane mirror
- A protractor
- A white sheet of paper
- A laser pointer or ray box

Procedure:

1. Fix the mirror on a white sheet and mark a normal (perpendicular line) at the center.
2. Shine a ray of light at a known angle (say 30°) from the normal.
3. Mark the reflected ray and measure its angle.
4. Repeat the experiment for different angles and record the values.

Observations:

- The angle of incidence is always **equal to** the angle of reflection.
- The incident ray, the normal, and the reflected ray **lie in the same plane**.

Conclusion:

The experiment confirms that a plane mirror follows the **laws of reflection**.

Final Summary

- **Plane mirrors** form **virtual, erect, laterally inverted** images of the same size as the object.
- **Image distance** is equal to the **object distance**.
- **Laws of reflection:**

1. $\theta_i = \theta_r$

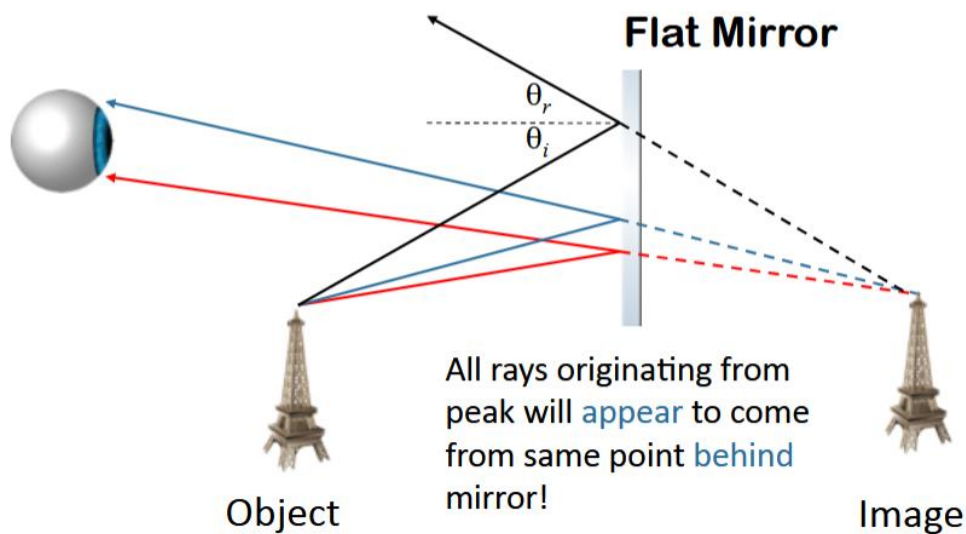
2. Incident ray, reflected ray, and normal lie in the same plane.

- **Focal length of a plane mirror is infinite** as it does not converge or diverge light.
 - **Used in** periscopes, kaleidoscopes, and mirrors at home.
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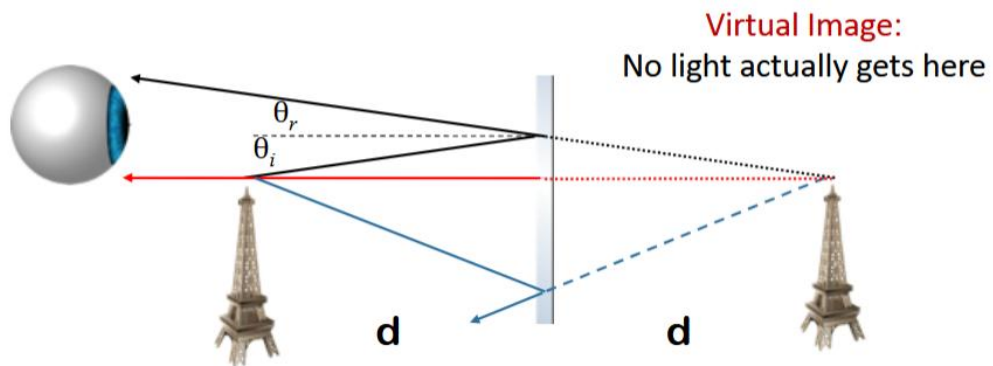
Image Formation by Plane Mirror

All you see is what reaches your eyes

You think object's location is where rays **appear** to come from.



- 1) Draw first ray perpendicular to mirror $0 = \theta_i = \theta_r$
- 2) Draw second ray at angle. $\theta_i = \theta_r$
- 3) Lines appear to intersect a distance d behind mirror. This is the image location.



A woman is looking at her reflection in a flat vertical mirror. The lowest part of her body she can see is her knee. If she stands **closer to the mirror**, what will be the lowest part of her reflection she can see in the mirror.

- A) Above her knee
- B) Her knee**
- C) Below her knee

