

SECTION 6.4 – Mirrors: Plane, Concave, and Convex

Explore Notes

1. **Multi-Step Problems**

2. **Real-World**

3. **Historical**

4. **Vocabulary**

5. **Introduction**

6. **Objectives**

- I can determine image properties formed by plane mirrors using geometric principles
- I can use the mirror equation to find image location and size for curved mirrors
- I can draw ray diagrams for concave and convex mirrors
- I can explain real-world applications of different mirror types

Opening

All mirrors follow the law of reflection, but different mirror shapes produce different image characteristics. Understanding mirror geometry allows us to predict image position and size.

Objectives

- I can determine image properties formed by plane mirrors using geometric principles
- I can use the mirror equation to find image location and size for curved mirrors
- I can draw ray diagrams for concave and convex mirrors
- I can explain real-world applications of different mirror types

Introduction

Plane mirrors produce virtual, upright images of the same size as the object. Curved mirrors are sections of spheres and reflect light differently depending on curvature. Concave mirrors converge light. Convex mirrors diverge light.

Real-World

Convex mirrors are used in telescopes and headlights because they focus light. Convex mirrors are used in security and side-view mirrors because they provide a wide field of view.

Historical

Curved mirror principles developed with geometric optics in the 1600s. Understanding spherical reflection enabled the construction of early telescopes.

Vocabulary

Plane Mirror: A flat, reflective surface that produces virtual, upright images of the same size as the object.

Virtual Image: An image formed at a location where light does not actually travel; appears behind a mirror.

Upright: Image orientation property where the image is right-side up (not inverted).

Same Size: Image property where the image is the same size as the object.

Curved Mirrors: Mirrors whose surfaces are part of a sphere; includes concave and convex mirrors.

Concave Mirrors: Curved mirrors that curve inward; also called converging mirrors because they bring light rays together.

Convex Mirrors: Curved mirrors that curve outward; also called diverging mirrors because they spread light rays apart.

Focal Point (F): The point where parallel light rays converge after reflection from a concave mirror.

Center of Curvature (C): The center of the sphere of which a curved mirror is a part.

Focal Length (f): The distance from a mirror to its focal point; for a curved mirror, $f = \frac{R}{2}$.

Formula

Mirror Equation:

$$\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$$

Magnification:

$$M = -\frac{d_i}{d_o} = \frac{h_i}{h_o}$$

Focal Length and Radius:

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

Core Strategies

1. Identify the Mirror Type First

Determine whether the mirror is plane, concave, or convex before choosing an equation. Concave mirrors have positive focal length. Convex mirrors have negative focal length.

2. Apply the Mirror Equation Carefully

Use the mirror equation to determine image location:

$$\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$$

3. Use Magnification to Determine Image Size and Orientation

Magnification is given by:

$$M = -\frac{d_i}{d_o} = \frac{h_i}{h_o}$$

A negative magnification indicates an inverted image.

4. Use the Focal Length Relationship When Needed

If the radius of curvature is given:

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

Example 1

An object is placed 25 cm in front of a plane mirror. Determine the image distance and describe the image.

1. **Multi-Step Problems**

2. **Real-World**

3. **Historical**

4. **Vocabulary**

5. **Introduction**

6. **Objectives**

- I can determine image properties formed by plane mirrors using geometric principles
- I can use the mirror equation to find image location and size for curved mirrors
- I can draw ray diagrams for concave and convex mirrors
- I can explain real-world applications of different mirror types

Example 1

An object is placed 25 cm in front of a plane mirror. Determine the image distance and describe the image.

1. **Multi-Step Problems**

2. **Real-World**

3. **Historical**

4. **Vocabulary**

5. **Introduction**

6. **Objectives**

- I can determine image properties formed by plane mirrors using geometric principles
- I can use the mirror equation to find image location and size for curved mirrors
- I can draw ray diagrams for concave and convex mirrors
- I can explain real-world applications of different mirror types

Example 2

A concave mirror has a focal length of 12 cm. An object is placed 30 cm in front of the mirror. Determine the image distance and classify the image.

1. **Multi-Step Problems**

2. **Real-World**

3. **Historical**

4. **Vocabulary**

5. **Introduction**

6. **Objectives**

- I can determine image properties formed by plane mirrors using geometric principles
- I can use the mirror equation to find image location and size for curved mirrors
- I can draw ray diagrams for concave and convex mirrors
- I can explain real-world applications of different mirror types

Example 3

A concave mirror has a radius of curvature of 40 cm. An object is placed 10 cm from the mirror. Determine the focal length and predict whether the image is real or virtual.

1. **Multi-Step Problems**

2. **Real-World**

3. **Historical**

4. **Vocabulary**

5. **Introduction**

6. **Objectives**

- I can determine image properties formed by plane mirrors using geometric principles
- I can use the mirror equation to find image location and size for curved mirrors
- I can draw ray diagrams for concave and convex mirrors
- I can explain real-world applications of different mirror types

Example 4

An object 5 cm tall is placed 20 cm in front of a convex mirror with focal length -15 cm. Determine the image distance and magnification.

1. **Multi-Step Problems**

2. **Real-World**

3. **Historical**

4. **Vocabulary**

5. **Introduction**

6. **Objectives**

- I can determine image properties formed by plane mirrors using geometric principles
- I can use the mirror equation to find image location and size for curved mirrors
- I can draw ray diagrams for concave and convex mirrors
- I can explain real-world applications of different mirror types

Example 4

An object 5 cm tall is placed 20 cm in front of a convex mirror with focal length -15 cm. Determine the image distance and magnification.

1. **Multi-Step Problems**

2. **Real-World**

3. **Historical**

4. **Vocabulary**

5. **Introduction**

6. **Objectives**

- I can determine image properties formed by plane mirrors using geometric principles
- I can use the mirror equation to find image location and size for curved mirrors
- I can draw ray diagrams for concave and convex mirrors
- I can explain real-world applications of different mirror types

Example 4

An object 5 cm tall is placed 20 cm in front of a convex mirror with focal length -15 cm. Determine the image distance and magnification.

1. **Multi-Step Problems**

2. **Real-World**

3. **Historical**

4. **Vocabulary**

5. **Introduction**

6. **Objectives**

- I can determine image properties formed by plane mirrors using geometric principles
- I can use the mirror equation to find image location and size for curved mirrors
- I can draw ray diagrams for concave and convex mirrors
- I can explain real-world applications of different mirror types

Example 4

An object 5 cm tall is placed 20 cm in front of a convex mirror with focal length -15 cm. Determine the image distance and magnification.

1. **Multi-Step Problems**

2. **Real-World**

3. **Historical**

4. **Vocabulary**

5. **Introduction**

6. **Objectives**

- I can determine image properties formed by plane mirrors using geometric principles
- I can use the mirror equation to find image location and size for curved mirrors
- I can draw ray diagrams for concave and convex mirrors
- I can explain real-world applications of different mirror types

Example 4

An object 5 cm tall is placed 20 cm in front of a convex mirror with focal length -15 cm. Determine the image distance and magnification.

1. **Multi-Step Problems**

2. **Real-World**

3. **Historical**

4. **Vocabulary**

5. **Introduction**

6. **Objectives**

- I can determine image properties formed by plane mirrors using geometric principles
- I can use the mirror equation to find image location and size for curved mirrors
- I can draw ray diagrams for concave and convex mirrors
- I can explain real-world applications of different mirror types

Example 4

An object 5 cm tall is placed 20 cm in front of a convex mirror with focal length -15 cm. Determine the image distance and magnification.

1. **Multi-Step Problems**

2. **Real-World**

3. **Historical**

4. **Vocabulary**

5. **Introduction**

6. **Objectives**

- I can determine image properties formed by plane mirrors using geometric principles
- I can use the mirror equation to find image location and size for curved mirrors
- I can draw ray diagrams for concave and convex mirrors
- I can explain real-world applications of different mirror types

Example 4

An object 5 cm tall is placed 20 cm in front of a convex mirror with focal length -15 cm. Determine the image distance and magnification.

1. **Multi-Step Problems**

2. **Real-World**

3. **Historical**

4. **Vocabulary**

5. **Introduction**

6. **Objectives**

- I can determine image properties formed by plane mirrors using geometric principles
- I can use the mirror equation to find image location and size for curved mirrors
- I can draw ray diagrams for concave and convex mirrors
- I can explain real-world applications of different mirror types

Example 4

An object 5 cm tall is placed 20 cm in front of a convex mirror with focal length -15 cm. Determine the image distance and magnification.

1. **Multi-Step Problems**

2. **Real-World**

3. **Historical**

4. **Vocabulary**

5. **Introduction**

6. **Objectives**

- I can determine image properties formed by plane mirrors using geometric principles
- I can use the mirror equation to find image location and size for curved mirrors
- I can draw ray diagrams for concave and convex mirrors
- I can explain real-world applications of different mirror types

Example 4

An object 5 cm tall is placed 20 cm in front of a convex mirror with focal length -15 cm. Determine the image distance and magnification.

1. **Multi-Step Problems**

2. **Real-World**

3. **Historical**

4. **Vocabulary**

5. **Introduction**

6. **Objectives**

- I can determine image properties formed by plane mirrors using geometric principles
- I can use the mirror equation to find image location and size for curved mirrors
- I can draw ray diagrams for concave and convex mirrors
- I can explain real-world applications of different mirror types

Example 4

An object 5 cm tall is placed 20 cm in front of a convex mirror with focal length -15 cm. Determine the image distance and magnification.

1. **Multi-Step Problems**

2. **Real-World**

3. **Historical**

4. **Vocabulary**

5. **Introduction**

6. **Objectives**

- I can determine image properties formed by plane mirrors using geometric principles
- I can use the mirror equation to find image location and size for curved mirrors
- I can draw ray diagrams for concave and convex mirrors
- I can explain real-world applications of different mirror types

Example 4

An object 5 cm tall is placed 20 cm in front of a convex mirror with focal length -15 cm. Determine the image distance and magnification.

1. **Multi-Step Problems**

2. **Real-World**

3. **Historical**

4. **Vocabulary**

5. **Introduction**

6. **Objectives**

- I can determine image properties formed by plane mirrors using geometric principles
- I can use the mirror equation to find image location and size for curved mirrors
- I can draw ray diagrams for concave and convex mirrors
- I can explain real-world applications of different mirror types

Example 4

An object 5 cm tall is placed 20 cm in front of a convex mirror with focal length -15 cm. Determine the image distance and magnification.

1. **Multi-Step Problems**

2. **Real-World**

3. **Historical**

4. **Vocabulary**

5. **Introduction**

6. **Objectives**

- I can determine image properties formed by plane mirrors using geometric principles
- I can use the mirror equation to find image location and size for curved mirrors
- I can draw ray diagrams for concave and convex mirrors
- I can explain real-world applications of different mirror types

Example 4

An object 5 cm tall is placed 20 cm in front of a convex mirror with focal length -15 cm. Determine the image distance and magnification.

1. **Multi-Step Problems**

2. **Real-World**

3. **Historical**

4. **Vocabulary**

5. **Introduction**

6. **Objectives**

- I can determine image properties formed by plane mirrors using geometric principles
- I can use the mirror equation to find image location and size for curved mirrors
- I can draw ray diagrams for concave and convex mirrors
- I can explain real-world applications of different mirror types

Example 4

An object 5 cm tall is placed 20 cm in front of a convex mirror with focal length -15 cm. Determine the image distance and magnification.

1. **Multi-Step Problems**

2. **Real-World**

3. **Historical**

4. **Vocabulary**

5. **Introduction**

6. **Objectives**

- I can determine image properties formed by plane mirrors using geometric principles
- I can use the mirror equation to find image location and size for curved mirrors
- I can draw ray diagrams for concave and convex mirrors
- I can explain real-world applications of different mirror types

Example 4

An object 5 cm tall is placed 20 cm in front of a convex mirror with focal length -15 cm. Determine the image distance and magnification.

1. **Multi-Step Problems**

2. **Real-World**

3. **Historical**

4. **Vocabulary**

5. **Introduction**

6. **Objectives**

- I can determine image properties formed by plane mirrors using geometric principles
- I can use the mirror equation to find image location and size for curved mirrors
- I can draw ray diagrams for concave and convex mirrors
- I can explain real-world applications of different mirror types

Example 4

An object 5 cm tall is placed 20 cm in front of a convex mirror with focal length -15 cm. Determine the image distance and magnification