

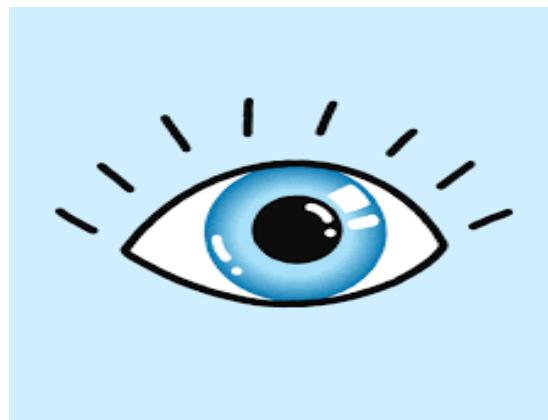


Al-Mustaql University

Department of Optics Techniques

Medical and optical physics 1

First stage



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Convex and Concave Mirrors



Introduction:

Mirrors are an essential part of our daily lives, car mirrors and telescopes. To understand how they work, we need to know two main types of spherical mirrors: concave, convex, Plane Mirror

First: Concave Mirrors

Definition: A mirror with an inward reflecting surface .



Properties:

- 1-Converges parallel incident light rays toward a focus.
- 2-Used to magnify images.

Examples of their use:

- 1- car headlights.
- 2- Microscopes
- 3-Reflecting telescopes

Image characteristics by body location:

| Object location | Image type | Size | Nature |
|----------------------------------------|------------|-----------|----------|
| Behind the center | Real | smaller | inverted |
| At the center | Real | same size | inverted |
| Between the center and the focal point | Real | larger | inverted |
| At the focal point | no image | | |
| Between the focal point and the mirror | Imaginary | larger | upright |

Secondly: Convex Mirrors

Definition: A mirror with an external reflecting surface .

✿ Properties:

- 1-Divergence of incident parallel rays.
- 2-The image is always imaginary, Moderate , and smaller .

Examples of their use:

- 1-Car side mirrors "Objects are closer than they appear".
- 2-Security cameras.
- 3-Magnifying Glasses.

Mirror law

$$\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$$

f: Focal length

u: Object distance from mirror

v: Image distance from mirror

Sign convention:

Distances in the direction of incident light Negative

Distances in the opposite direction of light Positive

Concave mirror

f Negative

Real image v: Negative

Convex mirror:

f Positive

v always Positive

Magnification Law

$$m = -\frac{v}{u}$$

- If m is negative \rightarrow The image is inverted
- If m is positive \rightarrow The image is upright

EX/ Concave Mirror

A concave mirror has a focal length $f = -10$ cm. An object is placed at a distance $u = -30$ cm.

$$\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$$

$$\frac{1}{-10} = \frac{1}{-30} + \frac{1}{v}$$

Step (1): Isolate $\frac{1}{v}$ **عزل $\frac{1}{v}$**

نقل للطرف الآخر وتغيير الاشارة: **Transpose $-\frac{1}{-30}$ to the other side, changing the sign:**

$$\frac{1}{v} = \frac{1}{-10} + \frac{1}{30}$$

Step (2): Find a common denominator = 30 **توحيد المقامات**

$$\frac{1}{-10} = -\frac{3}{30}$$

$$-\frac{3}{30} + \frac{1}{30} = -\frac{2}{30}$$

$$\frac{1}{v} = -\frac{2}{30}$$

Step (3): Take the reciprocal

$$v = \frac{30}{-2} = -15 \text{ cm}$$

The signal is negative because the object and focus are in front of the mirror.

The image is real, inverted, and smaller.

$$m = -\frac{v}{u} = -\frac{-15}{-30} = -0.5$$

EX/ Convex Mirror

A convex mirror has a focal length $f = +20$ cm. An object is placed at a distance $u = -40$ cm.

$$\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$$

$$\frac{1}{20} = \frac{1}{-40} + \frac{1}{v}$$

We move $1/-40$ to the other side by changing the sign:

$$\frac{1}{v} = \frac{1}{20} - \left(\frac{1}{-40} \right)$$

$$\frac{1}{v} = \frac{1}{20} + \frac{1}{40}$$

The smallest common denominator between 20 and 40 is 40

$$= \frac{3}{40}$$

We take the reciprocal of both sides.

$$V = \frac{40}{3}$$

$$v = 13.3\text{cm}$$

$$m = -\frac{v}{u}$$

Substitute:

$$v = +13.3, u = -40$$

$$m = -\frac{13.3}{40} \quad \text{Negative} \times \text{Negative} = \text{Positive}$$

$$m = +0.33$$

Image is imaginary, Moderate , and smaller .



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