Al-Mustaqbal University

Department of Optics Techniques

Medical and optical physics 1

First stage

Assist. Lec. Tamara Nuhad Abbas

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

Assist. Lec. Tamara Nuhad Abbas

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.

Assist. Lec. Tamara Nuhad Abbas

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 → The image is inverted

• If m is positive → 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

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

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

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

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:

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

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

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=13.3cm

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

Substitute:

v = +13.3, u = -40

m = $-\frac{13.3}{40}$ Negative × Negative = Positive

m = +0.33

Image is imaginary, Moderate , and smaller .