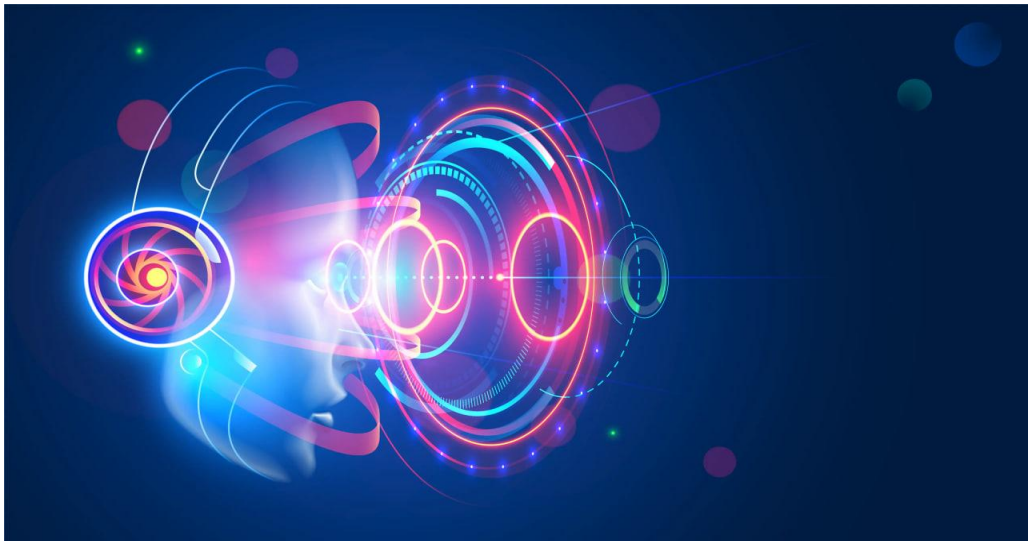
# Al-Mustaqbal University

## Department of Optics Techniques

## Medical and optical physics 1

## First stage

Assist. Lec. Hala Mohammed Subhi



## ➢ Lecture 6

# Examples and tutorials

• Examples of mirrors and magnification formula

**Example 1: An object with a height of 6cm is placed 24 cm from a convex mirror whose focal length is 8 cm. Find the distance and height of the image?**

**Solution:**

$d_o$= 24cm

f= -8cm

$d_i$= ?

$$\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i} \rightarrow \frac{1}{-8} = \frac{1}{24} + \frac{1}{d_i}$$

$$\frac{1}{d_i} = \frac{1}{-8} - \frac{1}{24} \rightarrow \frac{1}{d_i} = \frac{-4}{24}$$

$$\frac{1}{d_i} = -\frac{1}{6} \rightarrow \therefore\ d_i = -6\ cm$$

$$M = \frac{-d_i}{d_o} = -\frac{-6}{24}$$

$$M = \frac{1}{4}$$

$$M = \frac{h_i}{h_o}$$

$$\frac{1}{4} = \frac{h_i}{6} \rightarrow \therefore\ h_i = 1.5$$

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**Example 2: An object is placed in front of a concave mirror whose focal length is 5 cm. Find the distance of the image if the object is located 25 cm away.**

**Solution:**

$d_o$= 25cm

f= 5cm

$d_i$= ?

$$\frac{1}{f} = \frac{1}{d_i} + \frac{1}{d_o} \rightarrow \frac{1}{5} = \frac{1}{d_i} + \frac{1}{25}$$

$$\frac{1}{d_i} = \frac{1}{5} - \frac{1}{25} \rightarrow \frac{1}{d_i} = \frac{5-1}{25}$$

$$\frac{1}{d_i} = \frac{4}{25} \rightarrow d_i = \frac{25}{4}$$

$$\therefore\ d_i = 6.25\ cm$$

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**Example 3: What is the magnification if the object height is 6 cm and the image height is 18 cm above the principal axis?**

**Solution:**

As we know the magnification can be calculated using the following formula;

$$M = \frac{h_i}{h_o}$$

Given, height of image $h_i$ = 18cm, height of object $h_o$= 6cm

$$M = \frac{h_i}{h_o} = \frac{18}{6}$$

M=+3

The magnification is 3.

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**Example 4: An object is placed in front of a convex mirror with a radius of 40 cm at a distance of 30 cm. Find the dimension of the image and magnification.**

**Solution:**

As we know from mirror formula,

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

$$f = \frac{R}{2} \rightarrow f = \frac{40}{2} \rightarrow \therefore f = 20cm$$

$$\frac{1}{-20} = \frac{1}{d_i} + \frac{1}{30}$$

$$\frac{1}{d_i} = \frac{1}{20} - \frac{1}{30}$$

$$\frac{1}{d_i} = \frac{3-2}{60} \rightarrow \frac{1}{d_i} = \frac{1}{60}$$

$$\therefore d_i = 60\ cm$$

$$\mathrm{M} = \frac{-\mathrm{d_i}}{\mathrm{d_o}} \rightarrow \mathrm{M} = \frac{-60}{-30}$$

$$\therefore M = 2$$

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**Example 5 : An object is placed 30 cm in front of a concave mirror. If the image formed is virtual, erect, and three times the size of the object, calculate the focal length of the mirror.**

**Solution:**

Object distance ($d_o$) is = −30 cm (since it's placed in front of the mirror).

The image formed is virtual, erect, and three times the size of the object.

Magnification (M) is = 3

$$M = \frac{-d_i}{d_o} \rightarrow 3 = \frac{-d_i}{-30} \rightarrow d_i = 3 \times 30 = 90cm$$

$$\frac{1}{f} = \frac{1}{d_i} + \frac{1}{d_o} \rightarrow \frac{1}{f} = \frac{1}{90} + \frac{1}{-30}$$

$$f = -45cm$$

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**Example 6: A convex mirror form a virtual image at a distance of 6cm of an object placed at a distance of 30cm, find the focal length of the mirror and the radius of its curvature.**

**Solution:**

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

$$\frac{1}{f} = \frac{1}{d_i} + \frac{1}{d_o} \rightarrow \frac{1}{f} = \frac{1}{6} + \frac{1}{-30}$$

$$\frac{1}{f} = \frac{4}{30} \rightarrow \therefore f = \frac{30}{4}$$

$$f = \frac{15}{2} \rightarrow \therefore f = 7.5\ cm$$

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

$$R = 2 \times 7.5 = 15cm$$