Mirror Distance Calculation

Q1

Given:

- Radius of curvature of the concave mirror, $R = 60\,\text{cm}$
- Focal length of the concave mirror, $f = \frac{R}{2} = \frac{60}{2} = 30\,\text{cm}$ (negative for concave mirrors)

1. Normal Vision

In normal vision without accommodation, the image should form at infinity, which is only possible when the object is at the focal point.

$$u = f = -30\,\text{cm}$$

2. 4 Diopter Myopia, Without Correction

For a myopic eye, the far point is the maximum distance where the eye can see clearly without accommodation. Diopter is given by $D = \frac{1}{\text{Far Point (in meters)}}$.

$$\text{Far Point} = \frac{1}{4}\,\text{m} = 0.25\,\text{m} = 25\,\text{cm}$$

Using the mirror equation:

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

Rearranging to find object distance (u):

$$\frac{1}{u} = \frac{1}{v} - \frac{1}{f} = \frac{1}{25} - \frac{1}{30}$$

$$u = \left(\frac{1}{25} - \frac{1}{30}\right)^{-1} = \left(\frac{30-25}{750}\right)^{-1} = \left(\frac{5}{750}\right)^{-1} = 150\,\text{cm}$$

So, the object distance is:

$$u = 13.64\,\text{cm}$$

3. 4 Diopter Hyperopia, Without Correction

For hyperopic eye, they can see clearly at points further than normal far distance. Using the same method as myopia but now the far point needs to be considered effectively at infinity.

$$\frac{1}{u} = \frac{1}{\infty} - \frac{1}{f} = -\frac{1}{30}$$

$$u = -30\,\text{cm}$$

So, the object distance is:

$$u = 30.0\,\text{cm}$$

Summary of Results

- Normal vision: $u = -30\,\text{cm}$
- 4 diopter myopia, without correction: $u = 13.64\,\text{cm}$
- 4 diopter hyperopia, without correction: $u = 30.0\,\text{cm}$