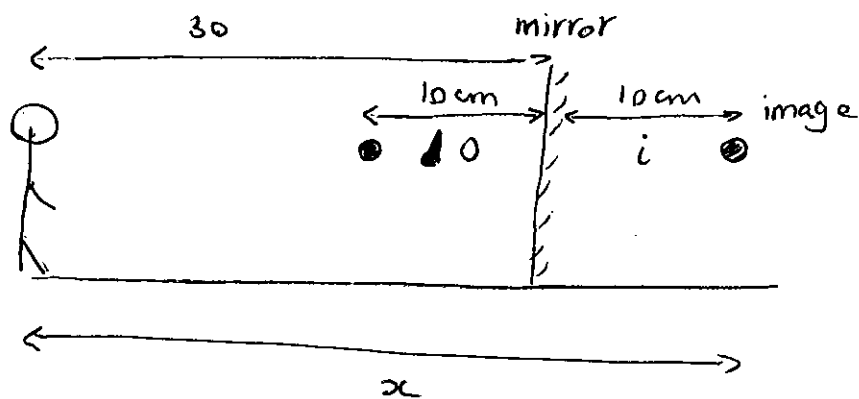


Unit 29 - Homework Solution

35-21

$$O = i \Rightarrow i = 10 \text{ cm}$$

$$x = 30 + i = 40 \text{ cm}$$



35-27

$$I = \frac{P_s}{4\pi r^2}$$

without the mirror : $I_1 = \frac{P_s}{4\pi d^2}$

with the mirror : $I_2 = \underbrace{\frac{P_s}{4\pi d^2}}_{\text{intensity due to source}} + \underbrace{\frac{P_s}{4\pi (3d)^2}}_{\text{intensity due to image}} = \frac{P_s}{4\pi d^2} \left(\frac{1}{1} + \frac{1}{9} \right)$

$$= \frac{10}{9} \left(\frac{P_s}{4\pi d^2} \right)$$

$$\frac{I_2}{I_1} = \frac{10}{9}$$

35-29

$$r = 35.0 \text{ cm} \Rightarrow f = \frac{r}{2} = 17.5 \text{ cm}$$

$$m = +2.50 \quad m = -\frac{i}{o} \Rightarrow 2.5 = -\frac{i}{o} \Rightarrow i = (-2.5)o$$

$$\frac{1}{o} + \frac{1}{i} = \frac{1}{f} \Rightarrow \frac{1}{o} - \frac{1}{(2.5)o} = \frac{1}{17.5} \Rightarrow \frac{1}{o} \left(\frac{1.5}{2.5} \right) = \frac{1}{17.5}$$

$$\Rightarrow \boxed{o = 10.5 \text{ cm}} \quad \text{virtual image}$$

a) Concave $\Rightarrow f = +20 \text{ cm} \Rightarrow r = 40 \text{ cm}$

$$\frac{1}{o} + \frac{1}{i} = \frac{1}{f} \Rightarrow \frac{1}{i} = \frac{1}{+20} - \frac{1}{+10} = \frac{-1}{20} \Rightarrow \underline{i = -20 \text{ cm}} \Rightarrow \underline{\text{Virtual image}}$$

$$m = -\frac{i}{o} = -\frac{-20}{10} = 2 \Rightarrow \underline{\text{Not inverted}}$$

b) $m = -\frac{i}{o} \Rightarrow +1 = -\frac{i}{+10} \Rightarrow \underline{i = -10 \text{ cm}}$

$$\frac{1}{o} + \frac{1}{i} = \frac{1}{f} = \frac{1}{10} - \frac{1}{10} = 0 \Rightarrow \underline{f = \infty} \Rightarrow \underline{r = \infty} \Rightarrow \underline{\text{Flat mirror}}$$

Not inverted

c) $f = +20 \text{ cm} \Rightarrow \underline{\text{Concave mirror}} \quad r = 40 \text{ cm}$

$$\frac{1}{i} = \frac{1}{f} - \frac{1}{o} = \frac{1}{20} - \frac{1}{30} = \frac{10}{60} = \frac{1}{6} \Rightarrow \underline{i = +6 \text{ cm}} \Rightarrow \text{real image}$$

$$m = -\frac{i}{o} = -\frac{6}{30} = -\frac{1}{5} \Rightarrow \underline{\text{inverted}}$$

d) $m = -0.5 \Rightarrow \underline{\text{inverted}} \quad m = -\frac{i}{o} \Rightarrow -0.5 = -\frac{i}{60} \Rightarrow \underline{i = 30 \text{ cm}}$
real image

$$\frac{1}{f} = \frac{1}{o} + \frac{1}{i} = \frac{1}{60} + \frac{1}{30} = \frac{1}{20} \Rightarrow \underline{f = +20 \text{ cm}} \Rightarrow r = 40 \text{ cm} \Rightarrow \text{Concave mirror}$$

e) $r = -40 \text{ cm} \Rightarrow f = -20 \text{ cm} \Rightarrow \underline{\text{convex mirror}} \quad i = -10 \text{ cm} \Rightarrow \underline{\text{Virtual image}}$

$$\frac{1}{o} = \frac{1}{f} - \frac{1}{i} = \frac{1}{-20} - \frac{1}{-10} = \frac{1}{20} \Rightarrow \underline{o = 20 \text{ cm}}$$

$$m = -\frac{i}{o} = -\frac{-10}{20} = \frac{1}{2} \Rightarrow \underline{\text{not inverted}}$$

f) $m = +0.1 \Rightarrow \text{Not inverted} \Rightarrow \text{virtual image}$

$$m < 1 \Rightarrow \text{convex mirror} \Rightarrow f = -20 \text{ cm} \Rightarrow r = -40 \text{ cm}$$

$$m = -\frac{i}{o} \Rightarrow +0.1 = -\frac{i}{o} \Rightarrow i = (-0.1)o$$

$$\frac{1}{o} + \frac{1}{i} = \frac{1}{f} \Rightarrow \frac{1}{o} - \frac{1}{(0.1)o} = \frac{1}{-20} \Rightarrow \boxed{o = 180 \text{ cm}} \Rightarrow \boxed{i = -18 \text{ cm}}$$

g) ~~Convex~~ Convex mirror $\Rightarrow r = -40 \text{ cm} \Rightarrow f = -20 \text{ cm}$

$\hookrightarrow$ virtual image $\Rightarrow i = -4 \text{ cm}$

$$\frac{1}{o} = \frac{1}{f} - \frac{1}{i} = \frac{-1}{20} - \frac{1}{-4} = \frac{1}{5} \Rightarrow \underline{o = 5 \text{ cm}}$$

$$m = -\frac{i}{o} = \frac{4}{5} = 0.8 \Rightarrow \text{not inverted}$$

h) ~~inverted~~ inverted image $\Rightarrow m = -0.5$

$$m = -\frac{i}{o} \Rightarrow -0.5 = -\frac{i}{24} \Rightarrow \underline{i = +12 \text{ cm}} \Rightarrow \text{real image}$$

$$\frac{1}{f} = \frac{1}{o} + \frac{1}{i} = \frac{1}{24} + \frac{1}{12} = \frac{1}{8} \Rightarrow f = +8 \text{ cm} \Rightarrow r = +16 \text{ cm} \Rightarrow \text{concave}$$