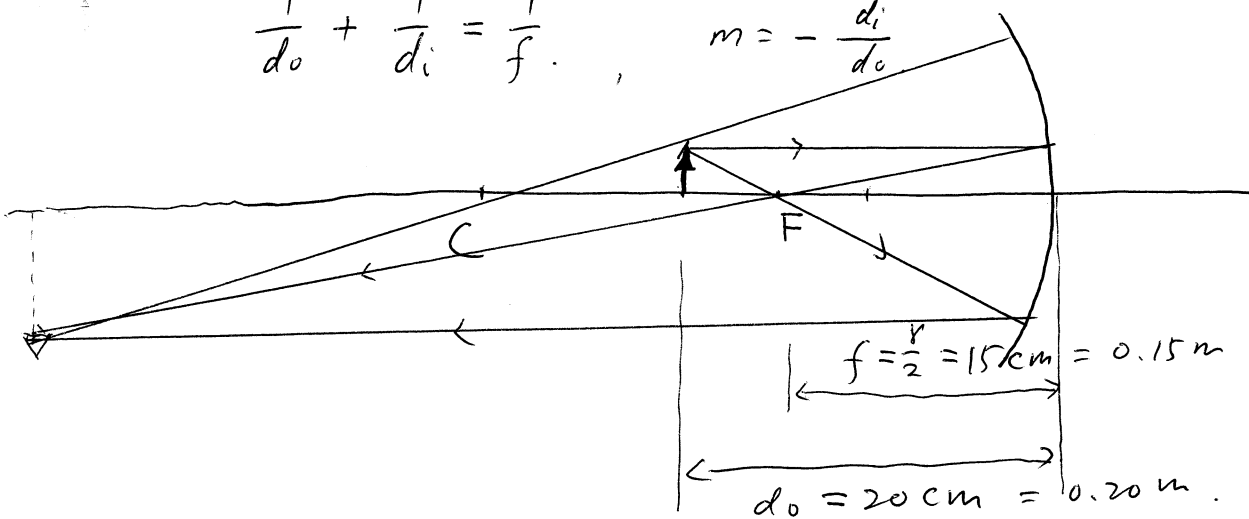


e.g. 32-4. Image in a concave mirror.

$$\frac{1}{d_o} + \frac{1}{d_i} = \frac{1}{f}, \quad m = -\frac{d_i}{d_o}$$



a). $d_i = ?$

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

$$d_i = \frac{f d_o}{d_o - f} = \frac{0.15 \times 0.2}{0.20 - 0.15} = \frac{0.03}{0.05} = 0.60 \text{ m} = 60 \text{ cm}$$

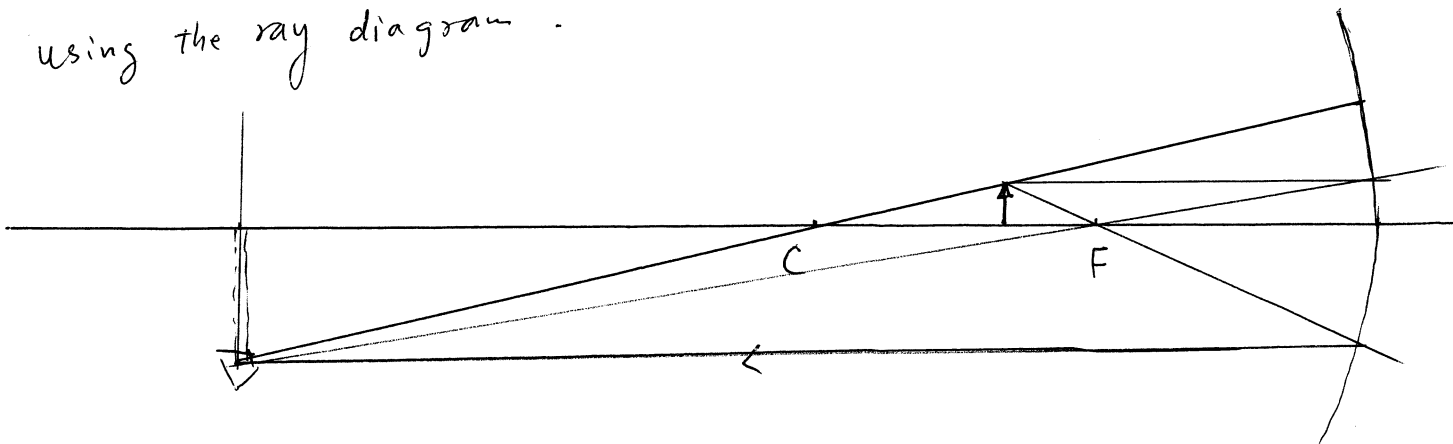
b). $m = -\frac{d_i}{d_o} = -\frac{0.60}{0.20} = -3$. $\frac{h_i}{h_o} = m$.

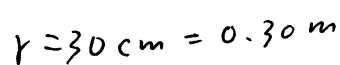
$$h_i = m \cdot h_o = (-3) \times (0.015) = -0.045 \text{ m} = -4.5 \text{ cm}$$

(inverted)

check:

using the ray diagram.





$$f = \frac{r}{2} = 15 \text{ cm} = 0.15 \text{ m}.$$

$$d_0 = 10 \text{ cm} = 0.10 \text{ m}.$$

$$h_0 = 1.00 \text{ cm} = 0.01 \text{ m}.$$

~~use cm as length unit :~~ $\frac{1}{d_i} + \frac{1}{d_o} = \frac{1}{f}$

$$\frac{1}{d_i} = \frac{1}{f} - \frac{1}{d_o} = \frac{d_o - f}{f d_o} = \dots$$

$$d_i = \frac{f - d_o}{d_o f}$$

$$d_i = \frac{f d_o}{d_o - f} = \frac{0.15 \times 0.10}{0.10 - 0.15} = -0.30 \text{ m} = -30 \text{ cm}$$

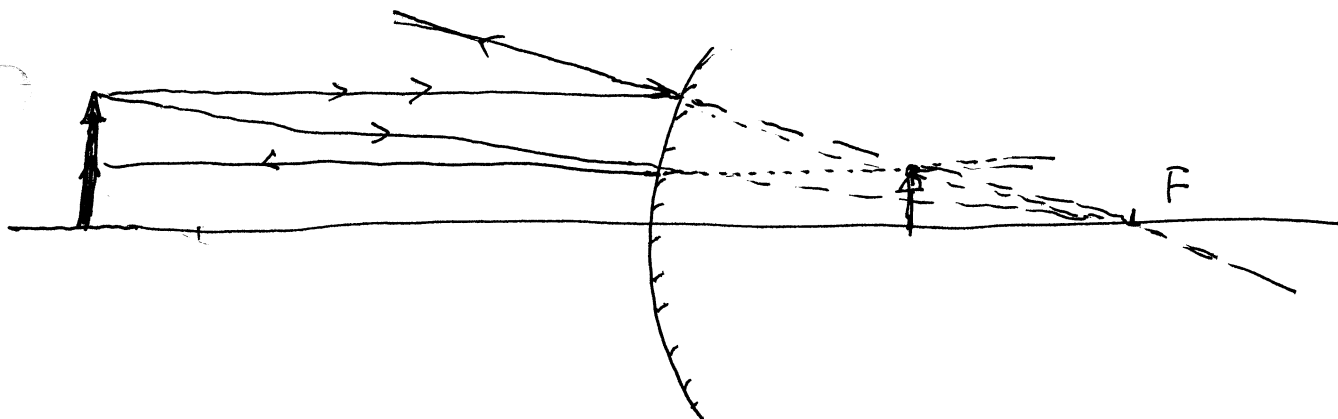
↑
" - " behind the mirror.

$$m = - \frac{d_i}{d_o} = - \frac{-0.30}{0.10} = 3$$

+ : up right .

e.g. 32-7. Convex rearview mirror

23-3.



$r = -16.0 \text{ m}$. ("-" : centre of curvature is behind the mirror)

$$f = \frac{r}{2} = -8.0 \text{ m}.$$

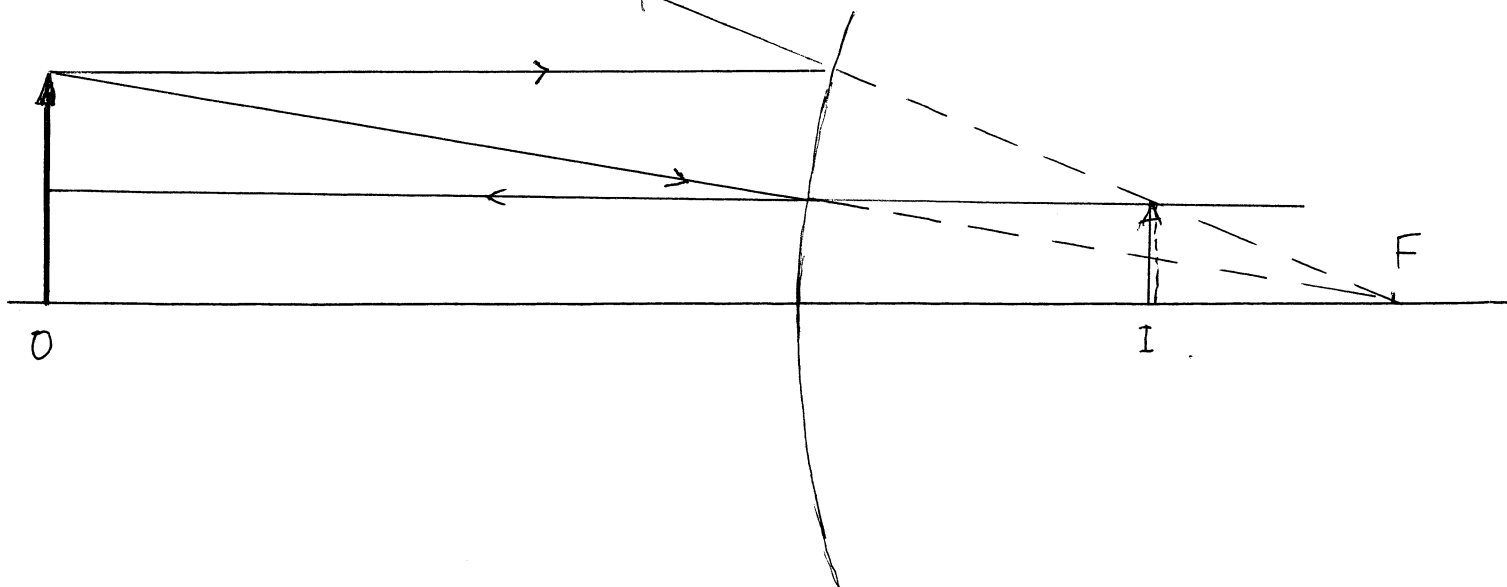
$$d_o = 10 \text{ m}.$$

$$d_i: \quad \frac{1}{d_i} + \frac{1}{d_o} = \frac{1}{f}, \quad \frac{1}{d_i} = \frac{d_o - f}{f d_o}, \quad d_i = \frac{f d_o}{d_o - f}$$

$$d_i = \frac{10 \times (-8.0)}{10 - (-8.0)} = \frac{-80}{18} = \cancel{-4.44 \text{ m}} = -4.4 \text{ m}.$$

$$m = -\frac{d_i}{d_o} = -\frac{(-4.44)}{10} = 0.44.$$

upright, smaller.



e.g. 32-9.

Apparent depth of a pool.

$$n_1 \sin \theta_1 = n_2 \sin \theta_2$$

$$n_1 \sin \theta_1 = \sin \theta_2$$

Small angle. $\sin \theta \approx \theta$.

$$n_1 \theta_1 = \theta_2$$

$$\frac{\theta_2}{\theta_1} = n_1 = n$$

$$\frac{x}{d'} = \tan \theta_2 \approx \theta_2$$

$$\frac{x}{d} = \tan \theta_1 \approx \theta_1$$

$$\frac{\theta_2}{\theta_1} = n = \frac{\frac{x}{d'}}{\frac{x}{d}} = \frac{d}{d'}$$

$$\therefore d' = \frac{d}{n}$$

