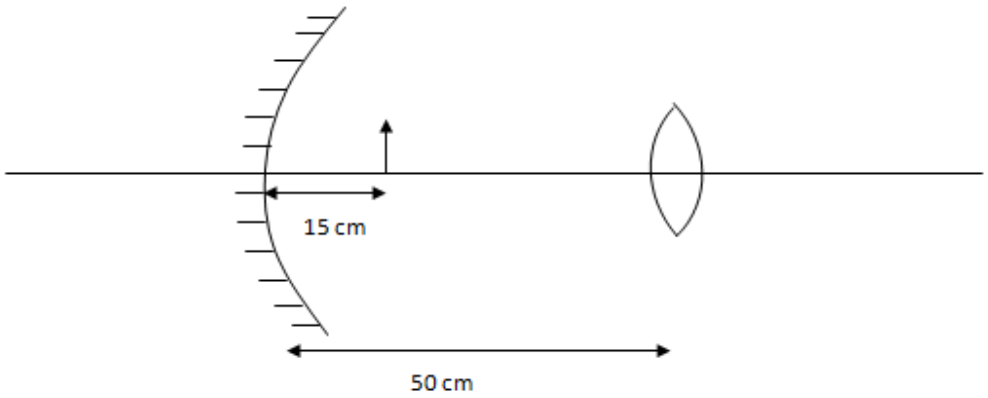
8. Consider a concave mirror and a convex lens (refractive index = 1.5) of focal length 10 cm each, separated by a distance of 50 cm in air (refractive index = 1) as shown in the figure. An object is placed at a distance of 15 cm from the mirror. Its erect image formed by this combination has magnification M_1. When the set- up is kept in a medium of refractive index 7/6, the magnification becomes M_2. The magnitude $\left|\frac{M_2}{M_1}\right|$ is



Answer: For Mirror f=10 cm, u = 15 cm. Applying mirror formula to find image distance from mirror:

$$\frac{1}{V_m}+\frac{1}{-15}=\frac{1}{-10}\ or\ \frac{1}{V_m}=\frac{1}{15}-\frac{1}{10}=\frac{2-3}{30}=-\frac{1}{30}\ or\ V_m=-30\ cm.$$

Thus mirror forms image at 30 cm on the same side (as the object).

This image serves as object for the lens therefore object distance for the lens=50-30=20 cm.

Now applying lens formula (in air):$\frac{1}{f_a}=(\mu-1)\left(\frac{1}{R_1}-\frac{1}{R_2}\right)=(1.5-1)\left(\frac{1}{R_1}-\frac{1}{R_2}\right)\rightarrow(1)$

Now applying lens formula (in medium):$\frac{1}{f_m}=\left(\frac{\mu}{\mu_m}-1\right)\left(\frac{1}{R_1}-\frac{1}{R_2}\right)=\left(\frac{1.5}{7/6}-1\right)\left(\frac{1}{R_1}-\frac{1}{R_2}\right)\rightarrow(2)$

From (1) and (2):$\frac{\frac{1}{10}}{\frac{1}{fm}}=\frac{0.5}{\frac{2}{7}}=\frac{3.5}{2}\ or\ f_m=\frac{35}{2}$

Magnification of mirror is independent of medium i.e. $M_m=\frac{v}{u}=-\frac{30}{15}=-2$

Magnification of lens in air :$(M_l)_{air}=\frac{f}{f+u}=\frac{10}{10+(-20)}=-1$

Magnification of lens in medium :$(M_l)_{medium}=\frac{f}{f+u}=\frac{35/2}{35/2+(-20)}=-\frac{37}{5}$=-7

$\left|\frac{M_2}{M_1}\right|=\left|\frac{M_m(M_l)_{medium}}{M_m(M_l)_{air}}\right|=\left|\frac{-2\times(-7)}{-2\times(-1)}\right|$=7

Correct Answer is 7