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Light Test

1. R.I of glass slab = 1.5

Speed in air = 3×10^8 m/s

$$R.I = \frac{\text{speed of light in air}}{\text{speed in medium of light}}$$

$$1.5 = \frac{3 \times 10^8}{x} \quad (\text{let speed of light in glass slab be } x)$$

$$x = \frac{3 \times 10^8 \times 10}{1.5 \times 10} \Rightarrow \frac{30 \times 10^8}{15}$$

\therefore speed of light in glass $\Rightarrow \underline{\underline{2 \times 10^8 \text{ m/s}}}$

2. (a) When light ray passes from rarer to denser medium, it bends towards the normal.

Alcohol
R.I = 1.36

Kerosene
R.I = 1.44

Turpentine oil
R.I = 1.47

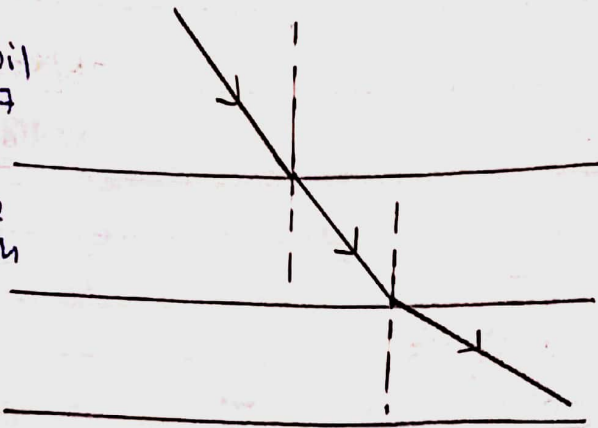


(b) When it goes from denser to rarer medium, light ray bends away from the normal.

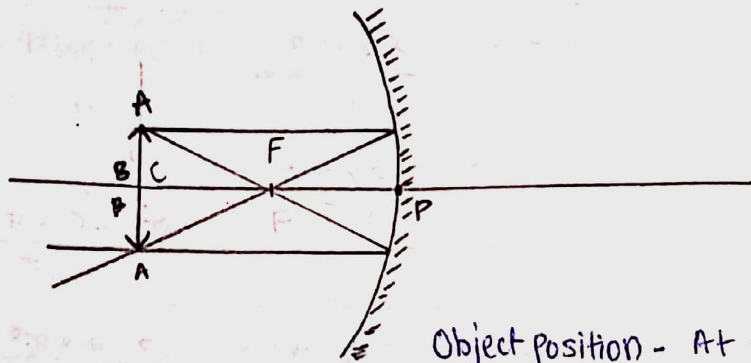
Turpentine oil
R.I = 1.47

Kerosene
R.I = 1.44

Alcohol
R.I = 1.36



3.



Object position - At C
Image Position - At C
Nature and size - Real
inverted, same size as
Object.

4.

$$P_1 = 5D$$

$$P_2 = +7.5D$$

$$\begin{aligned} \text{Combination of lenses} &= P_1 + P_2 \\ &= -5 + 7.5 \\ &= 2.5D \end{aligned}$$

\therefore the combination acts as a convex lens.

$$\begin{array}{r} 7.5 \\ -5.0 \\ \hline +2.5 \end{array}$$

5.

$$h_o = 10\text{cm}$$

$$u = -36\text{cm}$$

$$f = -12\text{cm}$$

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

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

$$\Rightarrow \frac{1}{v} = \frac{1}{-12} - \frac{1}{-36}$$

$$\Rightarrow \frac{1}{-12} + \frac{1}{36} \Rightarrow \frac{-3+1}{36}$$

$$= \frac{-2}{36} \Rightarrow \frac{-1}{18}$$

$$\therefore v = \underline{\underline{-18}}$$

$$M = \frac{h_i}{h_o} = \frac{-v}{u}$$

$$\Rightarrow \frac{h_i}{10} = \frac{18}{-36}$$

$$\Rightarrow h_i = \frac{18 \times 10}{-36}$$

$$\therefore h_i = \underline{\underline{-5}}$$

\therefore the nature of the image is real and inverted.

6. a. 3rd observation.

$$u = -30 \text{ and } v = 30$$

\therefore the object is at $2F$,

$$\therefore 2F = 30$$

$$\therefore F = \frac{30}{2}$$

$$\therefore F = 15 \text{ cm}$$

\therefore focal length is 15 cm

b. The last observation, we see that $u = 15 \text{ cm}$, which means object is between F and optical center, since $f = 30$. This would form a virtual image, which cannot be captured on a screen and forms at infinity.

c. The third observation. We see that both object distance and image distance are equal.

∴ The image is at $2F_2$ and object at $2F_1$. This means the image and object size ~~are~~ are equal.

7. $f = +12 \text{ cm}$

$v = 48 \text{ cm}$

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

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

$$= \frac{1}{48} - \frac{1}{12}$$

$$= \frac{1 - 4}{48}$$

$$= \frac{-3}{48} \Rightarrow \frac{-1}{16}$$

∴ $u = -16 \text{ cm}$