AVIRAL
JEE | NEET | FOUNDATIONS

WEEKLY TEST OYM TEST - 25 BALLIWALA
SOLUTION Date 13-10-2019

[PHYSICS]

1.

Magnifying power $= \frac{f_o}{f_e} = \frac{\beta}{\alpha}$

$\therefore \quad \beta = \alpha \times \frac{100}{2} = 0.5° \times 50 = 25°.$

2.

Here, $f_a = 0.15$ m, $\mu_g = 3/2, \mu_w = 4/3$

According to lens maker's formula,

$$\frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right), \quad \text{where } \mu = \frac{\mu_l}{\mu_m}$$

$$\frac{1}{f_a} = \left(\frac{\mu_g}{\mu_a} - 1\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

$$= \left[\frac{(3/2)}{1} - 1\right]C, \text{ where } C = \left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

$$\frac{1}{f_a} = \frac{C}{2} \quad \ldots \text{(i)}$$

Also, $$\frac{1}{f_w} = \left(\frac{\mu_g}{\mu_w} - 1\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

$$= \left[\frac{(3/2)}{(4/3)} - 1\right]C$$

$$\frac{1}{f_w} = \frac{C}{8} \quad \ldots \text{(ii)}$$

From eqns. (i) and (ii), we get;

$$\frac{f_w}{f_a} = \frac{C}{2} \times \frac{8}{C} = 4$$

or $$f_w = 4\ f_a = 4 \times 0.15 \text{ m} = 0.6 \text{ m}.$$

3.

Here, $v = +15$ cm, $u = +(15 - 5) = +10$ cm.

According to lens formula,

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

$$\frac{1}{15} - \frac{1}{10} = \frac{1}{f}$$

$$f = -30 \text{ cm}.$$

4.

Erect, virtual and diminished image is formed by convex mirror and concave lens. In case of concave mirror and convex lens, erect, virtual and enlarged image is formed when object is placed between focus and the pole.

5.

Given: $u + v = 80$ cm ...(i)

and $m = \left| -\frac{v}{u} \right| = +3$ ...(ii)

The image is inverted, $v = 3u$

$\therefore \quad u + 3u = 80$ cm or $u = 20$ cm

$\therefore \quad \frac{1}{20} + \frac{1}{60} = \frac{1}{f}$ or $f = 15$ cm

Object is between F and $2F$ ($u = 20$ cm). So, real, inverted, magnified image is formed beyond $2F$ (80 cm > 30 cm).

$\therefore \quad v > 2f.$

6.

For a plano-convex lens,

$$\frac{1}{f} = (\mu - 1)\left(\frac{1}{R}\right)$$

Given: $\mu = 1.5, \ f = 20$ cm

$\therefore \quad R = (\mu - 1)f = (1.5 - 1)20 = 10$ cm.

7.

Focal length of each plano-convex lens = 24 cm

for the liquid lens, $\frac{1}{f} = (\mu - 1)\left(\frac{-2}{12}\right) = \frac{1-\mu}{6}$

$\therefore \quad -\frac{1}{60} = \frac{1}{12} + \frac{1-\mu}{6}$

or $\mu = 1.6$.

8.

9.

Lens maker's formula,

$$\frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

(where, $R_2 = \infty, R_1 = 0.3$ m)

$$\therefore \quad \frac{1}{f} = \left(\frac{5}{3} - 1\right)\left(\frac{1}{0.3} - \frac{1}{\infty}\right)$$

$$\frac{1}{f} = \frac{2}{3} \times \frac{1}{0.3}$$

or $f = -0.45$ m.

10.

$$\theta = \pm 1^\circ = \left(\frac{\pi}{180}\right) \text{rad}$$

$$a = \frac{\lambda}{\sin\theta} = \frac{420 \times 10^{-9}}{\sin(\pi/180)} = \frac{420 \times 10^{-9}}{\pi/180}$$

$= 24\ \mu$m

11.

$$P_a = (\mu_l - \mu_a)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

$$P_m = (\mu_l - \mu_m)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

$\therefore$ $$\frac{P_m}{P_a} = \frac{\mu_l - \mu_m}{\mu_l - \mu_a} = \frac{1.5 - 1.6}{1.5 - 1.0}$$

$\therefore$ $$P_m = \frac{-0.1}{0.5} \times -5 = 1\text{ D.}$$

12.

The concave lens forms the virtual image of a real object. So, let

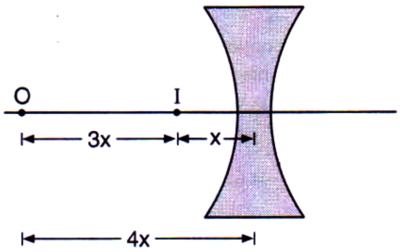
$$u = -4x \quad \text{and} \quad v = -x$$

then $3x = 10\text{ cm}$

or $x = \frac{10}{3}\text{ cm}$

$\therefore$ $u = -\frac{40}{3}\text{ cm}$

and $v = -\frac{10}{3}\text{ cm}$



Substituting in $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$, we get;

$$\frac{1}{f} = -\frac{3}{10} + \frac{3}{40}$$

or $f = -\frac{40}{9} = -4.4\text{ cm.}$

13.

We know that;

$$\frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right) = \frac{2(\mu - 1)}{R}$$

(Where $R_1 = R$ and $R_2 = -R$ for equiconvex lens.)

We also know that when the equiconvex lens is cut along XOX' axis, then radius of curvature of both the convex surfaces in each half remains same. Therefore, focal length of each half remains the same as that of equiconvex lens, *i.e.*,

$$f' = f = \frac{R}{2(\mu - 1)}$$

When the equiconvex lens is cut along the YOY' axis, then each half has one plane surface, *i.e.*, $R_2 = \infty$. Therefore, in this case relation for the focal length (f'') is:

$$\frac{1}{f''} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

$$= (\mu - 1)\left(\frac{1}{R} - \frac{1}{\infty}\right)$$

or $$\frac{1}{f''} = \left(\frac{\mu - 1}{R}\right) = \frac{1}{2f}$$

or $$f'' = 2f.$$

14.

15.

For dispersion without deviation

$$\delta_1 + \delta_2 = 0$$

$$(\mu_1 - 1)A_1 + (\mu_2 - 1)A_2 = 0$$

$$A_2 = -\frac{(\mu_1 - 1)A_1}{(\mu_2 - 1)}$$

Substituting the given values, we get

$$A_2 = -\frac{(1.5 - 1)15°}{(1.75 - 1)} = -10°$$

–ve sign shows that prism must be joined in opposition.