DPP

DAILY PRACTICE PROBLEMS

Class : XIIth
Date :

Solutions

Subject : PHYSICS
DPP No. : 9

Topic :- RAY OPTICS AND OPTICAL INSTRUMENTS

1 **(d)**

$\mu = \frac{c_a}{c_w} = \frac{t_w}{t_a} \Rightarrow t_w = \frac{25}{3} \times \frac{4}{3} = 11\frac{1}{9} = 11 \text{ min } 6\ s$

2 **(b)**

Wavelength of a certain colour in air $\lambda_{\text{air}} = 600$ nm.

Wavelength of a certain colour in glass of refractive index $\mu = 1.5$

$\therefore \lambda_{\text{glass}} = \frac{\lambda_{\text{air}}}{\mu_{\text{glass}}} = \frac{600}{1.5}$

$\lambda_{\text{glass}} = 400$ nm

Also, $v_{\text{glass}} = \frac{v_{\text{air}}}{\mu_{\text{glass}}} = \frac{3 \times 10^8}{1.5}$

$v_{\text{glass}} = 2.0 \times 10^8 \text{ ms}^{-1}$

3 **(a)**

$\frac{1}{F} = \frac{1}{+18} + \frac{1}{(-19)} \Rightarrow F = -18\ cm$ (*i.e.*, concave lens)

4 **(d)**

In minimum deviation $i = e = 30°$, so angle between emergent ray and second refracting surface is $90° - 30 = 60°$

5 **(b)**

Critical angle C is equal to incident angle if ray reflected normally $\therefore C = 90°$

6 **(b)**

Red light is used in danger signals so that the danger signals can be seen distinctly up to large distances. The light used in the danger signals should not get scattered much, while passing through the atmosphere. Since, the red colour is scattered through a small amount due to its longer wavelength, the danger signals make use of red light.

7 **(a)**

For concave mirror

$u = -\frac{15}{2}$ cm, $v = ?$

$f = -\frac{10}{2}$ cm $= -5$ cm

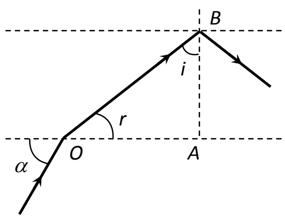
$$\frac{1}{v}=\frac{1}{f}-\frac{1}{u}=\frac{1}{-5}-\frac{1}{-15/2}$$
$$=-\frac{1}{5}+\frac{2}{15}=\frac{-1}{15}$$
Or $v=-15$ cm
Clearly, the position of the final image is on the pole of the convex mirror

8 **(b)**

Here the requirement is that $i > c$

$\Rightarrow \sin i > \sin c \Rightarrow \sin i > \frac{\mu_2}{\mu_1}$ ...(i)

From Snell's law $\mu_1=\frac{\sin\alpha}{\sin r}$ ...(ii)



Also in ΔOBA

$r+i=90° \Rightarrow r=(90-i)$

Hence from equation (ii)

$\sin\alpha=\mu_1\sin(90-i)$

$\Rightarrow \cos i=\frac{\sin\alpha}{\mu_1}$

$\sin i=\sqrt{1-\cos^2 i}=\sqrt{1-\left(\frac{\sin\alpha}{\mu_1}\right)^2}$ ...(iii)

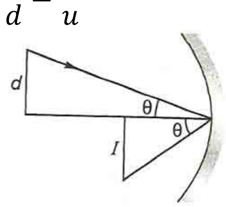
From equation (i) and (iii) $\sqrt{1-\left(\frac{\sin\alpha}{\mu_1}\right)^2}>\frac{\mu_2}{\mu_1}$

$\Rightarrow \sin^2\alpha<(\mu_1^2-\mu_2^2) \Rightarrow \sin\alpha<\sqrt{\mu_1^2-\mu_2^2}$

$\alpha_{\max}=\sin^{-1}\sqrt{\mu_1^2-\mu_2^2}$

9 **(a)**

$$\frac{I}{d}=\frac{f}{u}$$



Or $I=\frac{d}{u}f$ or $I=\theta f$

10 **(d)**

Resolving power $=\frac{d}{1.22\,\lambda}=\frac{0.1}{1.22\times 6000\times 10^{-10}}$

$\equiv 1.36\times 10^5 radian$

11 **(b)**

For glass-water interface ${}_{g}\mu_{w} = \frac{\sin i}{\sin r}$

For water air interface ${}_{w}\mu_{a} = \frac{\sin r}{\sin 90°}$

$\Rightarrow {}_{g}\mu_{w} \times {}_{w}\mu_{a} = \frac{\sin i}{\sin r} \times \frac{\sin r}{\sin 90°} = \sin i$

or $\frac{\mu_w}{\mu_g} \times \frac{\mu_a}{\mu_w} = \sin i$

$\Rightarrow \mu_g = \frac{1}{\sin i}$

13 **(d)**

If initially the objective (focal length F_o) forms the image at distance v_o then $v_o = \frac{u_o f_o}{u_o - f_o} = \frac{3 \times 2}{3 - 2} = 6\ cm$

Now as in case of lenses in contact

$$\frac{1}{F_o} = \frac{1}{f_1} + \frac{1}{f_2} + \frac{1}{f_3} + \dots = \frac{1}{f_1} + \frac{1}{F'_o}$$

$$\left\{\text{where } \frac{1}{F'_o} = \frac{1}{f_2} + \frac{1}{f_3} + \dots\right\}$$

So if one of the lens is removed, the focal length of the remaining lens system

$$\frac{1}{F'_o} = \frac{1}{F_0} - \frac{1}{f_1} = \frac{1}{2} - \frac{1}{10} \Rightarrow F'_o = 2.5\ cm$$

This lens will form the image of same object at a distance v_o' such that

$$v'_o = \frac{u_o F'_o}{u_o - F'_o} = \frac{3 \times 2.5}{(3 - 2.5)} = 15\ cm$$

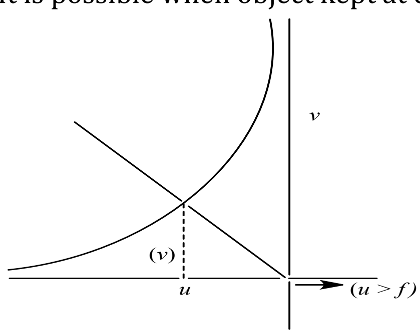
So to refocus the image, eye-piece must be moved by the same distance through which the image formed by the objective has shifted *i.e.* $15 - 6 = 9\ cm$

14 **(b)**

Due to high refractive index its critical angle is very small so that most of the light incident on the diamond is total internally reflected repeatedly and diamond sparkles

15 **(a)**

It is possible when object kept at center of curvature.

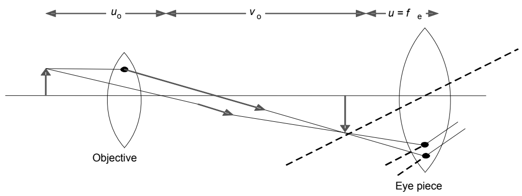


$u = v$

$u = 2f, v = 2f.$

16 **(a)**

The following ray diagram shows the formation of image by a compound microscope.



Given, $f_e = 10$ cm, $f_0 = 4$ cm, $u_0 =$ -5 cm, $D = 20$ cm

For objective lens

$$\frac{1}{f_0} = \frac{1}{v_0} - \frac{1}{u_0}$$

$$\frac{1}{4} = \frac{1}{v_0} - \frac{1}{-5}$$

$$\Rightarrow \frac{1}{v_0} = \frac{1}{4} - \frac{1}{5} = \frac{1}{20}$$

$$\Rightarrow v^0 = 20cm$$

Magnification $M = \ -\frac{v_0}{u_0} = \left(1 + \frac{D}{f_e}\right)$

$$= -\frac{20}{-5}\left(1 + \frac{20}{10}\right) = 4(1 + 2) = 12$$

17 **(c)**

$I_1 = \frac{L}{r_1^2} = \frac{L}{16}$ and $I_2 = \frac{L}{r_2^2} = \frac{L}{9}$

% increase in illuminance

$$= \frac{I_2 - I_1}{I_1} \times 100 = \left(\frac{16}{9} - 1\right) \times 100 \approx 78\%$$

18 **(a)**

For lens $u =$ wants to see $= -30\ cm$

And $v =$ cab see $= -10\ cm$

$$\therefore \frac{1}{f} = \frac{1}{v} - \frac{1}{u} = \frac{1}{-10} - \frac{1}{(-30)} \Rightarrow f = -15\ cm$$

20 **(b)**

$r = f tan\theta$

Or $r \propto f$

$\therefore \quad \pi r^2 \propto f^2$

ANSWER-KEY										
Q.	1	2	3	4	5	6	7	8	9	10
A.	D	B	A	D	B	B	A	B	A	D
Q.	11	12	13	14	15	16	17	18	19	20
A.	B	A	D	B	A	A	C	A	B	B