JEE MAIN ANSWER KEY & SOLUTIONS

SUBJECT :- PHYSICS
CLASS :- 12th **PAPER CODE :- CWT-7**
CHAPTER :- RAY OPTICS

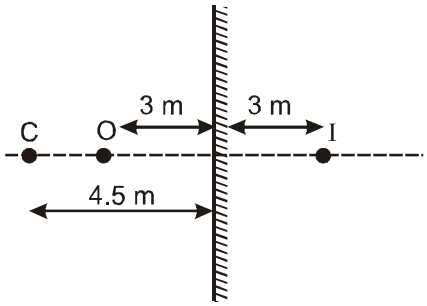
ANSWER KEY

1.	(D)	**2.**	(A)	**3.**	(D)	**4.**	(B)	**5.**	(B)	**6.**	(B)	**7.**	(B)
8.	(C)	**9.**	(C)	**10.**	(D)	**11.**	(C)	**12.**	(A)	**13.**	(A)	**14.**	(D)
15.	(A)	**16.**	(D)	**17.**	(B)	**18.**	(A)	**19.**	(C)	**20.**	(C)	**21.**	8
22.	18	**23.**	16	**24.**	2	**25.**	2	**26.**	225	**27.**	3	**28.**	30
29.	27	**30.**	400										

SOLUTIONS

1. (D)

Sol.



From diagram distance of camera from image = 4.5 + 3 = 7.5 m.

2. (A)

Sol. $m = \frac{v}{u} = \frac{f}{f+u}$

$n = \frac{f}{f+u}$

$u = \frac{f(1-n)}{n}$

Distance $= \frac{-f(1-n)}{n} = \frac{f(n-1)}{n}$

3. (D)

Sol. For air

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

$$\frac{1}{10} = (1.52 - 1)\frac{2}{R}$$

$R = 10 \times 2 \times .52$

For liquid

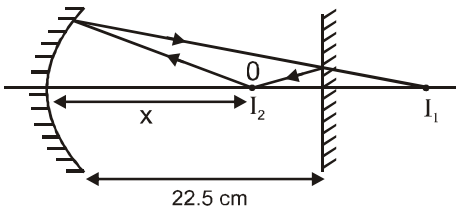
$$\frac{1}{f} = \left(\frac{1.52}{1.68} - 1\right)\frac{2}{R}$$

$$\frac{1}{f} = -\frac{.16}{1.68} \times \frac{2}{10 \times 2 \times .52}$$

$f = -54.60$ cm **Ans.**

4. (B)

Sol.



I_1 is the image formed by concave mirror.
For reflection by concave mirror
$u = -x$, $v = -(45 - x)$, $f = -10$ cm,

$$\frac{1}{-10} = \frac{1}{-(45-x)} + \frac{1}{-x}$$

$$\frac{1}{10} = \frac{x + 45 - x}{x(45-x)}$$

$\Rightarrow$ $x^2 - 45x + 450 = 0$

$\Rightarrow$ $x = 15$ cm, 30 cm

but $x = 30$ cm is not acceptable because $x < 22.5$ cm.

5. (B)

Sol. $P = P_1 + P_2$

$2 = 5 + P_2$

$P_2 = -3$ D

$$\frac{\omega_1}{\omega_2} = -\frac{f_1}{f_2} = -\frac{P_2}{P_1} = \frac{3}{5}$$

6. (B)

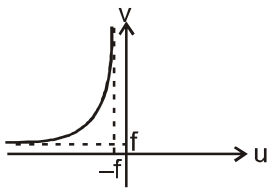
Sol. For a convex lens

$u = -$ve $f = +$ve

If $v = \infty$, $u = f$ and if $u = -\infty$, $v = f$.

We have $v = +$ve and $u = -$ve

and u and v are symmetrical. Hence graph is shown,

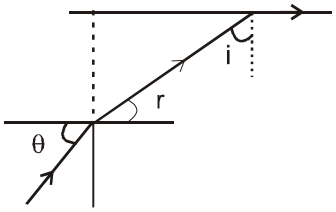


7. (B)

Sol. Larger aperture increases the amount of light gathered by the telescope increasing the resolution.

8. (C)

Sol.



$\sin\theta = \frac{2}{\sqrt{3}} \sin r = \frac{2}{\sqrt{3}} \cos i$ ....(i)

and $\frac{2}{\sqrt{3}} \sin i = \sin 90° \Rightarrow i = 60°$ ....(ii)

From (i) and (ii) $\sin\theta = \frac{1}{\sqrt{3}}$

9. (C)

Sol. $\theta = \frac{10}{x}$, $\theta_1 = \frac{10}{x}(20)$

Now 20 times nearer

10. (D)

Sol. When i = 35° and e = 79° then $\delta = 40°$

$\delta = i + e - A$

$40° = 35 + 79 - A$

$A = 74°$

Since $i \neq e$ so δ_{min} will less than 40°

$$n = \frac{\sin\left(\frac{\delta_{min} + A}{2}\right)}{\sin\left(\frac{A}{2}\right)}$$

$$n = \frac{\sin\left(\frac{40° + 74}{2}\right)}{\sin\left(\frac{74}{2}\right)} = \frac{\sin(57°)}{\sin(37°)} = \frac{0.84}{0.60} = 1.4$$

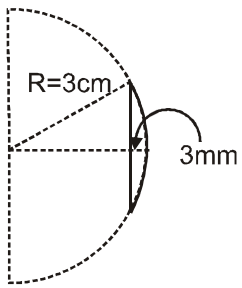
Since δ_{min} will be less than 40° so

n will be less than 1.4

so the closest answer will be 1.5

11. (C)

Sol. $n = \frac{3}{2}$



$3^2 + (R - 3mm)^2 = R^2$

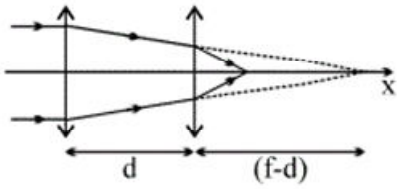
$\Rightarrow 3^2 + R^2 - 2R(3mm) + (3mm)^2 = R^2$

$\Rightarrow R \approx 15$ cm

$\frac{1}{f} = \left(\frac{3}{2} - 1\right)\left(\frac{1}{15}\right) \Rightarrow f = 30cm$

12. (A)

Sol. For second lens,

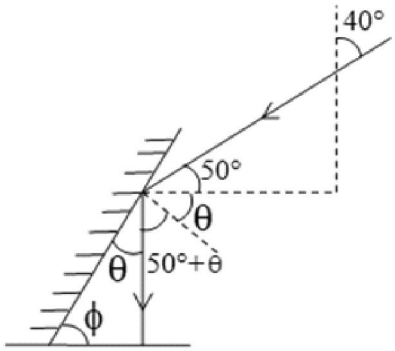


$$\Rightarrow v = \frac{f(f-d)}{2f-d}$$

$$\Rightarrow x = d + v = d + \frac{f(f-d)}{2f-d}$$

13. (A)

Sol.



$50 + 2\theta = 90$,

$\theta = 20°$

$\phi = 90 - q$

$\phi = 70°$

14. (D)

Sol. Using Newton formula

$ab = f^2 \Rightarrow f = \sqrt{ab}$

15. (A)

Sol. $C < i_b$

here i_b is "brewester angle"

and c is critical angle

$\sin_c < \sin i_b$ since $\tan i_b = \mu_{0_{rel}} = \frac{1.5}{\mu}$

$$\frac{1}{\mu} < \frac{1.5}{\sqrt{\mu^2 + (1.5)^2}} \therefore \sin i_b = \frac{1.5}{\sqrt{\mu^2 + (1.5)^2}}$$

$$\sqrt{\mu^2 + (1.5)^2} < 1.5 \times \mu$$

$$\mu^2 + (1.5)^2 < (\mu \times 1.5)^2$$

$$\mu < \frac{3}{\sqrt{5}}$$

Slab $\mu = 1.5$

16. (D)

Sol. The limit of resolution,

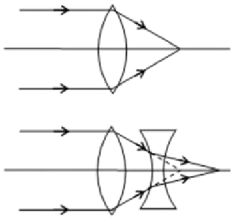
$\Delta\theta = 1.22\lambda / a = \left(1.22 \times 500 \times 10^{-9} / 200 \times 10^{-2}\right)$

$= 3.05 \times 10^{-7}$

$\Delta\theta = 305 \times 10^{-9}$ radian

17. (B)

Sol.



18. (A)

Sol. $f_\ell = \frac{R}{\mu - 1} = 120\text{cm}, f_m = R/2 = 30\text{cm},$

$P = P_L + P_M$

$-\frac{1}{f} = \frac{2}{f_\ell} - \frac{1}{f_m} = \frac{1}{60} + \frac{1}{30} = \frac{1}{20}$

f = –20 cm

19. (C)

Sol. $m = \frac{-2.4}{160} = \frac{v}{u}$

$v = \frac{-2.4u}{168} = \frac{-u}{70}$

$-\frac{70}{u} - \frac{1}{u} = \frac{1}{5.5}$

u = –71 × 5.5 cm = –39 m

20. (C)

Sol. (1.34/v)–(1/∞)=(1.34/–1)7.8

1.34/v = 0.34/7.8

v = (1.34 × 7.8)/0.34

v = 30.7 mm = 3.1 cm

21. 8

Sol. $\sin\theta = \frac{\frac{4}{3}}{n_{glass}}$

$n_{glass} = \frac{8}{3\sqrt{3}}$

$t = \frac{\frac{9\sqrt{3}}{10}}{\frac{3\times10^8}{\left(\frac{8}{3\sqrt{3}}\right)}} = \frac{\frac{9\sqrt{3}}{10}}{\frac{9\sqrt{3}\times10^8}{8}}$

$t = \frac{8\times10^{-8}}{10}$ = 8 × 10⁻⁹ s

22. 18

Sol. $\frac{1}{15.5} = (1.504 - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

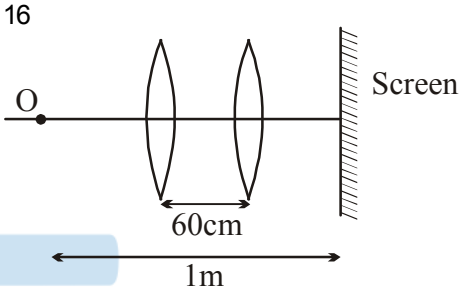
$\frac{1}{f} = (1.434 - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

$\frac{f}{15.5} = \frac{0.504}{0.434}$

$f = 15.5 \times \frac{252}{217}$ = 18 cm

23. 16

Sol.



D = 1m d = 0.60 m

$f = \frac{D^2 - d^2}{4D} = \frac{1-(0.6)^2}{4\times1}$ = 16 cm

f = 16 cm

24. 2

Sol. $\frac{1.5}{v_1} \quad \frac{1}{-6} = \frac{1.5-1}{R}$

$\frac{1.5}{v_1} = \frac{1}{2R} - \frac{1}{6} = \frac{3-R}{6R}$

$v_1 = \frac{9R}{3-R}$

$u_2 = \frac{9R}{3-R} - R = \frac{6R+R^2}{3-R}$

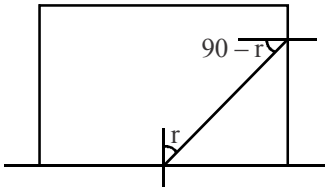
$\frac{R^2}{1.5} = \frac{32}{3}$

$R^2 + 22R - 48 = 0$

$R = -\frac{-22 \pm \sqrt{484+192}}{2}$ = 2 cm

25. 2

Sol. i sin i = n sin r



$$\sin(90^\circ - r) \geq \frac{1}{n}$$

$$\sqrt{1-\frac{\sin^2 i}{n^2}} \geq \frac{1}{n^2}$$

$n^2 - 1 \geq \sin^2 i$

$n_{max} = \sqrt{1+1} = \sqrt{2}$

26. 225

Sol. 1st refraction : $\frac{1.5}{v_1} - 0 = \frac{0.5}{15}$

$$v_1 = 45\text{cm}$$

2nd refraction : $\frac{1}{v_2} - \frac{1.5}{15} = \frac{-0.5}{-15}$

$$\Rightarrow \frac{1}{v_2} = \frac{1}{30} + \frac{1}{10}$$

$$\Rightarrow v_2 = +7.5 \text{ cm}$$

$\Rightarrow$ Distance from center = 22.5 cm
= 225 mm

27. 3

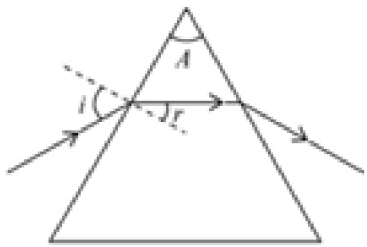
Sol. $\frac{V_{b/f}}{\frac{4}{3}} = \frac{-8}{\frac{4}{3}} + \frac{(-v)}{1}$

$$\Rightarrow \frac{-12}{\frac{4}{3}} = \frac{-8}{\frac{4}{3}} + \frac{(-v)}{1}$$

$\Rightarrow v = 3 \text{ m/s}$

28. 30

Sol.



The formula for the refractive index can be given as:

$$n = \frac{\sin i}{\sin r}$$

As the transparent liquid is filled in an equilateral hollow prism, the angle of refraction can be calculated as:

$$r = \frac{A}{2}$$

$$r = \frac{60^\circ}{2}$$

R= 30°

Substitute the known value of n and r in the refractive index formula.

$$\sqrt{2} = \frac{\sin i}{\sin(30^\circ)}$$

$$\sqrt{2}\left(\frac{1}{2}\right) \times \left(\frac{\sqrt{2}}{\sqrt{2}}\right) = \sin i$$

$$\frac{1}{\sqrt{2}} = \sin i$$

$$i = 45^\circ$$

Hence, the angle of minimum deviation for the liquid will be,

$$\delta_{min} = 2i - A$$

$$= 2(45^\circ) - (60^\circ)$$

$$= 90^\circ - 60^\circ$$

$$= 30^\circ$$

Therefore, the correct answer is 30.

29. 27

Sol. $1.5 \sin 60^\circ = n \sin 90^\circ$

$$1.5 \times \frac{\sqrt{3}}{2} = \frac{\sqrt{x}}{4}$$

$$x = 27$$

30. 400

Sol. The object after 10 second will be at u = -80 cm.

So, $\frac{1}{v} - \frac{1}{80} = -\frac{1}{100}$

$$\Rightarrow v = \frac{8000}{+20} = 400 \text{ cm}$$