Sri Chaitanya IIT Academy, India

A.P, TELANGANA, KARNATAKA, TAMILNADU, MAHARASHTRA, DELHI, RANCHI

A right Choice for the Real Aspirant

ICON CENTRAL OFFICE, MADHAPUR-HYD

Sec: Sr. IPLCO **JEE ADVANCED** **DATE : 13-12-15**

TIME : 02:00 PM TO 05: 00 PM **2012_P2 MODEL** **MAX MARKS : 198**

KEY & SOLUTIONS

PHYSICS

1	**B**	2	**C**	3	**A**	4	**B**	5	**D**	6	**D**
7	**B**	8	**A**	9	**B**	10	**D**	11	**B**	12	**A**
13	**A**	14	**C**	15	**BD**	16	**AC**	17	**ABC**	18	**CD**
19	**BC**	20	**ABC**								

CHEMISTRY

21	**A**	22	**C**	23	**A**	24	**C**	25	**B**	26	**B**
27	**A**	28	**C**	29	**A**	30	**C**	31	**A**	32	**B**
33	**C**	34	**A**	35	**BC**	36	**ABC**	37	**ABC**	38	**ABC**
39	**BCD**	40	**CD**								

MATHEMATICS

41	**A**	42	**C**	43	**A**	44	**A**	45	**C**	46	**B**
47	**B**	48	**B**	49	**D**	50	**B**	51	**B**	52	**D**
53	**B**	54	**D**	55	**BCD**	56	**AB**	57	**AD**	58	**BCD**
59	**BC**	60	**ABCD**								

PHYSICS

1. Image formation due to convex lens

$\Rightarrow \frac{1}{v}-\frac{1}{-36}=\frac{1}{30} \Rightarrow v=\frac{30\times 36}{6}=180$ cm

This image will act like a virtual object for mirror and after reflection from mirror its image (shown by I2) will be formed at 80 cm below optical axis of convex lens.

For concave lens, this image will be object at a position of 15 cm below the lens.

For final image formed by concave lens.

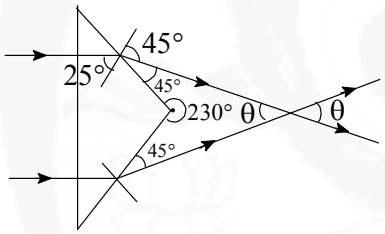
$\Rightarrow \frac{1}{20}-\frac{1}{15}=\frac{1}{f} \Rightarrow \frac{1}{f}=\frac{-5}{300}$

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

Or $\Rightarrow -\frac{5}{300}=\left(\frac{3}{2}-1\right)\left(\frac{-2}{R}\right) \Rightarrow R=\frac{300}{5}$

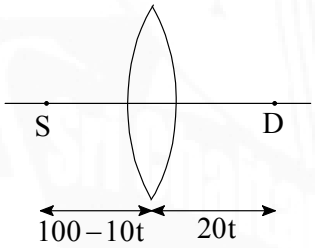
Ans. radius of curvature = 60 cm

2. $\frac{\sin 25^\circ}{\sin r}=\frac{1}{1.66}$



3. The detector will receive the maximum light when the image of point source of light coincides with the position of detector.

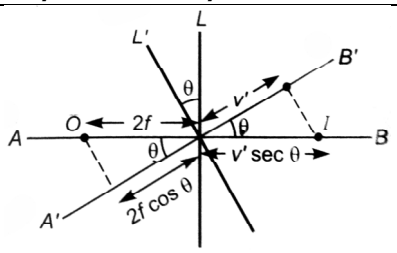
Let at any time t, image of S and detector coincides then, for u = - (100-10t)cm, v = 20t cm, f = 10cm



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

$\Rightarrow \frac{1}{20t}=\frac{1}{-(100+10t)}=\frac{1}{10} \Rightarrow t=0.56s \text{ and } t=8.94s$

4. The object distance along the OA in rotated position of lens is $u'=-2f\cos\theta$



$$\frac{1}{v'}=\frac{1}{-2f\cos\theta}=\frac{1}{f}\Rightarrow v'=\frac{2f\cos\theta}{2\cos\theta-1}$$

$$v=v'\cos\theta=\frac{2f}{2\cos\theta-1}$$

Velocity of image is, $\frac{dv}{dt}=\frac{2f}{(2\cos\theta-1)^2}\times(-2\omega\sin\theta)$

For $\theta=1^\circ$

$\cos\theta\approx 1$

5. For surface P, $\frac{1}{v_1}=\frac{1}{f}-\frac{1}{u}=1-\frac{1}{3}=\frac{2}{3}\Rightarrow v_1=\frac{3}{2}m$

For surface Q, $\frac{1}{v_2}=\frac{1}{f}-\frac{1}{u}=1-\frac{1}{5}=\frac{4}{5}\Rightarrow v_2=\frac{5}{4}m$

$\therefore\ v_1-v_2=0.25m$

Magnification of $P=\frac{v_1}{u}=\frac{3/2}{3}=\frac{1}{2}$

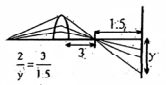
$\therefore$ Height of $P=\frac{1}{2}\times 2=1m$

Magnification of $Q=\frac{v_2}{u}=\frac{5/4}{5}=\frac{1}{4}$

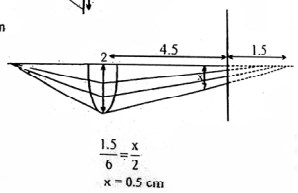
$\therefore$ Height of $Q=\frac{1}{4}\times 2=0.5m$

6.

$v_1=\frac{uf}{u+f}=\frac{-6\times 2}{-6+2}=3$ cm



$v_2=\frac{uf'}{u+f'}=\frac{-6\times 3}{-6+3}=+6$cm



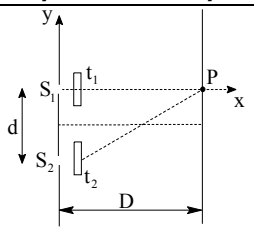
7. $t_1=t_0\cos^2\theta^\circ$ $t_1=$ thickness in front of S_1

$$t_2=t_0\cos^2\left[\frac{5\pi}{4d}(-d)\right]$$

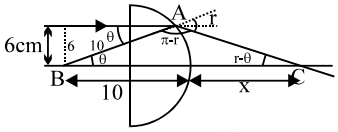
$$(S_2P-S_1P)+(\mu-1)(t_2-t_1)=0$$

$$\frac{d\times(d/2)}{D}=(\mu-1)\left[t_0-t_2\cos^2\frac{5\pi}{4}\right]$$

$$\frac{d^2}{2D}=(\mu-1)\left(t_0-\frac{t_0}{2}\right)\Rightarrow t_0=\frac{2d^2}{D}$$



8. R = 10 cm



Applying Snell's law r = 53°

By sine law in $\Rightarrow \frac{\sin\theta}{\sin r}=\frac{3}{4}$ and $\Rightarrow \frac{\sin(r-\theta)}{10}=\frac{\sin(\pi-r)}{(10+x)}$

9&10. $\frac{1}{f_{eq}}=\left[\frac{3}{2}-1\right]\left[\frac{1}{R}\frac{1}{-R}\right]$; $f_{eq}=R$; $\therefore$ object should be placed at

$2f_{equivalent}=R$

$\frac{1}{f}=\frac{1}{f_{glass}}-\frac{1}{f_{water}}=\left(\frac{3}{2}-1\right)\left(\frac{1}{R}-\frac{1}{-R}\right)+\left(\frac{4}{3}-1\right)\left(\frac{1}{-R}-\frac{1}{\infty}\right)=\frac{1}{R}-\frac{1}{3R}$

$f=\frac{3}{2}R$ image will coincide with object if it placed at focus because if object is placed at this position ray will be incident normally on mirror.

$\frac{3R}{2}=15=10\,cm$

Since image coincides with object when object is at 15 cm $\Rightarrow$ equivalent focal length is $\frac{15}{2}=7.5\,cm$

11&12.

$S_2P+(m\mu g-1)t-s_1P=0$

$S_1P-S_2P=\frac{d.x}{D}$

$x=4.33\,mm$

Path difference from point O.

$=(m\mu_g-1)t$

Phase difference $=\frac{13}{3}\pi$

Path difference at 0.

$\Delta x=(m\mu g-1)t$

= 1300 nm

For maxima at $0.\Delta x=n\lambda$

$\lambda=\frac{1300}{n}$

$\lambda=1300,650,443.3nm$

So, $\lambda = 650\,\text{nm}$

13. Conceptual

14. Conceptual

15. Image distance is 30cm $\frac{1}{F}=\frac{1}{f}+\frac{1}{f}\Rightarrow\frac{1}{30}=\frac{2}{f}\Rightarrow f=60\text{cm}$

As optical axis shifts down by (y – x) for second lens.

$$y=\frac{y-x-1}{y-x}\Rightarrow y=4.5\text{cm}$$

16. Conceptual

17. Conceptual

18. $\vec{v}_{OG}=10\cos 53\hat{i}+10\sin 53\hat{j}=6\hat{i}+8\hat{j}$

$\vec{v}_{MG}=10\cos 37\hat{i}+10\sin 37\hat{j}=8\hat{i}+6\hat{j}$

Along x-axis, $\vec{v}_{OM}=-\vec{v}_{IM}\Rightarrow\vec{v}_{IG}=10\text{m/s}$

Along y-axis, $\vec{v}_{OG}=\vec{v}_{IG}\Rightarrow\vec{v}_{IG}=+8$

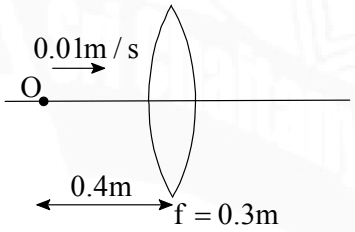
So, $\vec{v}_{IG}=10\hat{i}+8\hat{j}$

$\vec{v}_{IM}=\vec{v}_{IG}-\vec{v}_{MG}=2\hat{i}-2\hat{j}$

$\vec{v}_{IO}=\vec{v}_{IG}-\vec{v}_{OG}=4\hat{i}+0\hat{j}$

19. $\frac{m_1}{m_2}=\left(\frac{D+x}{D-x}\right)^2$ and $f=\frac{D^2-x^2}{4D}$

20.



From $\frac{1}{v}-\frac{1}{u}=\frac{1}{f}\Rightarrow v=120\text{m}$

$$dv=\left(\frac{v}{u}\right)^2.du\Rightarrow m=\frac{dv}{du}=\frac{v^2}{u^2}=\left(1-\frac{v}{f}\right)^2$$

$$\frac{dm}{dt}=-\frac{2}{f}\left(1-\frac{v}{f}\right)\frac{dv}{dt}=1.8\text{m/s}$$