PACE IIT | MEDICAL | MHT-CET

ANDHERI / BORIVALI / DADAR / CHEMBUR / THANE / MULUND/ NERUL / POWAI

BATCH NNPJC1,2,3 | **TW TEST** | **MARKS: 80**

TOPIC: RAY OPTICS | **DATE: 18/10/2016**

Solution & ANSWER KEY

1. (a) By using $\frac{\mu_2}{v} - \frac{\mu_1}{u} = \frac{\mu_2 - \mu_1}{R}$

   where $\mu_1 = \frac{4}{3}$, $\mu_2 = 1$, $u = -6\,cm$, v = ?

   On putting values $v = -5.2\,cm$

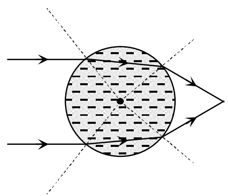
2. (d) Apparent distance of fish from lens $u = 0.2 + \frac{h}{\mu}$

   $= 0.2 + \frac{0.4}{4/3} = 0.5\,m$

   From $\frac{1}{f} = \frac{1}{v} - \frac{1}{u} \Rightarrow \frac{1}{(+3)} = \frac{1}{v} - \frac{1}{(-0.5)}$ $v = -0.6\,m$

   The image of the fish is still where the fish is 0.4 m below the water surface.

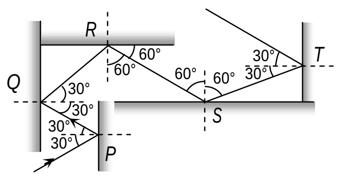
3. (b) A water drop in air behaves as converging lens.



4. (a) When light ray goes from denser to rarer medium (i.e. more μ to less μ) it deviates away from the normal while if light ray goes from rarer to denser medium (i.e. less μ more μ) it bend towards the normal.

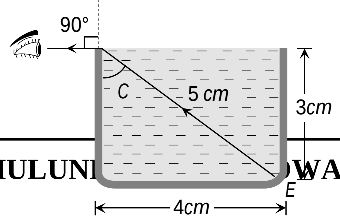
   This property is satisfying by the ray diagram (i) only.

5. (c)



6. (a) Light ray is going from liquid (Denser) to air (Rarer) and angle of refraction is 90^o, so angle of incidence must be equal to critical angle

   from figure



$$\sin C = \frac{4}{5}$$

Also $\mu = \frac{1}{\sin C} = \frac{5}{4} = 1.2$

7. (a) Focal length of lens will increase by four times (i.e. 12 cm) while focal length of mirror will not affected by medium.

8. (c) $\Delta x = \left(1 - \frac{1}{\mu}\right) t$

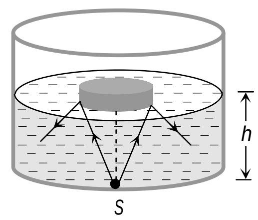
$$= \left(1 - \frac{1}{1.5}\right) \times 6$$

= 2 cm.

Distance of object from mirror = 42 cm.

9. (c) Suppose the maximum height of the liquid is h for which the source is not visible.

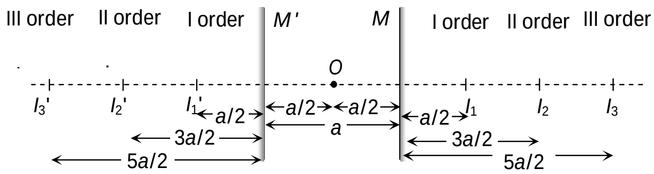
Hence radius of the disc



$$r = \frac{h}{\sqrt{\mu^2 - 1}}$$

$$1 = \frac{h}{\sqrt{\left(\frac{5}{3}\right)^2 - 1}} \Rightarrow h = 1.33cm$$

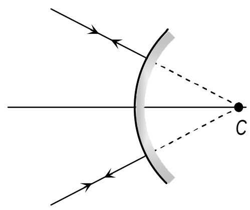
10. (b)



From above figure it can be proved that separation between nth order image formed in the two mirrors = 2na

11. (c) Here object and image are at the same position so this position must be centre of curvature

$\therefore$ R = 12 cm



$$\Rightarrow f = \frac{R}{2}$$

12. (b) For TIR at PQ ; $\theta < C$

From geometry of figure $\theta = 60$ i.e. $60 > C$ $\Rightarrow \sin 60 > \sin C$

$$\Rightarrow \frac{\sqrt{3}}{2} > \frac{\mu_{Liquid}}{\mu_{Prism}} \Rightarrow \mu_{Liquid} < \frac{\sqrt{3}}{2} \times \mu_{Prism}$$

$\Rightarrow \mu_{Liquid} < \frac{\sqrt{3}}{2} \times 1.5 \Rightarrow \mu_{Liquid} < 1.3$.

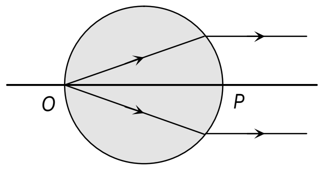
13. (c) ${}_1\mu_2 = \frac{1}{\sin C} \Rightarrow \frac{\mu_2}{\mu_1} = \frac{\lambda_1}{\lambda_2} = \frac{1}{\sin C}$

$\Rightarrow \frac{6000}{4000} = \frac{1}{\sin C} \Rightarrow C = \sin^{-1}\left(\frac{2}{3}\right)$

14. (c) Two plano-convex lens of focal length f, when combined will give rise to a convex lens of focal length $f/2$.

The image will be of same size if object is placed at 2f i.e. at a distance f from optical centre.

15. (c) Considering pole at P, we have

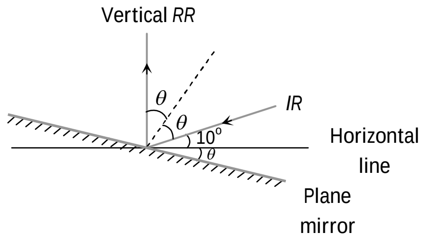


$\frac{\mu_2}{v} - \frac{\mu_1}{u} = \frac{\mu_2 - \mu_1}{R}$

$\Rightarrow \frac{1}{\infty} - \frac{\mu}{(-2R)} = \frac{1-\mu}{(-R)}$

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

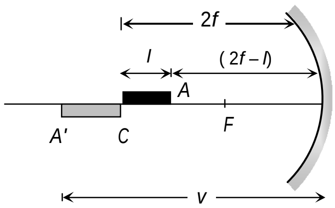
16. (a) From figure



$\theta + \theta + 10 = 90$

$\Rightarrow \theta = 40^o$

17. (b)

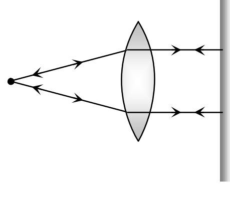


End A of the rod acts as an object for mirror and A' will be its image so u = 2f – l = 20 – 5 = 15 cm

$\because \frac{1}{f} = \frac{1}{v} + \frac{1}{u} \Rightarrow \frac{1}{-10} = \frac{1}{v} - \frac{1}{15} \Rightarrow$ v = – 30 cm .

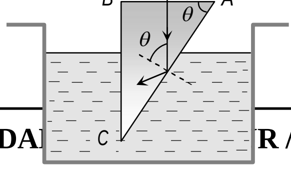
Now $m = \frac{\text{Length of image}}{\text{Length of object}} = \frac{(30-20)}{5} = 2$

18. (a) When the object is placed at focus the rays are parallel. The mirror placed normal sends them back. Hence image is formed at the object itself as illustrated in figure.



19. (a) For TIR at AC

$\theta > C$

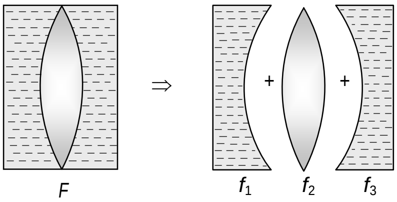


$\Rightarrow \sin\theta \geq \sin C$

$\Rightarrow \sin\theta \geq \frac{1}{{}_w\mu_g}$

$\Rightarrow \sin\theta \geq \frac{\mu_w}{\mu_g} \Rightarrow \sin\theta \geq \frac{8}{9}$

20. (d) $\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2} + \frac{1}{f_3}$



$\frac{1}{f_1} = (1.6-1)\left(\frac{1}{\infty} - \frac{1}{20}\right) = -\frac{0.6}{20} = -\frac{3}{100}$ …(i)

$\frac{1}{f_2} = (1.5-1)\left(\frac{1}{20} - \frac{1}{-20}\right) = \frac{1}{20}$ …(ii)

$\frac{1}{f_3} = (1.6-1)\left(\frac{1}{-20} - \frac{1}{\infty}\right) = -\frac{3}{100}$ …(iii)

$\Rightarrow \frac{1}{F} = -\frac{3}{100} + \frac{1}{20} - \frac{3}{100} \Rightarrow F = -100\ cm$