Physicsaholics

DPP – 7 (Geometrical Optics & Dispersion)

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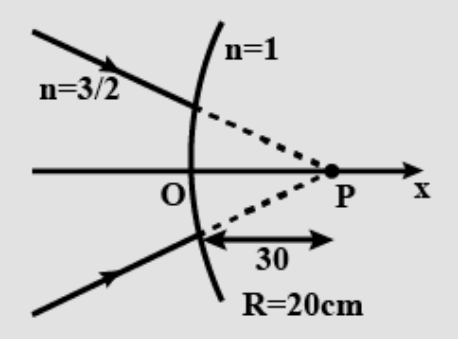
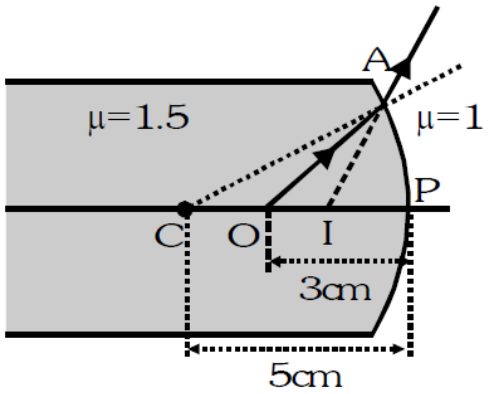
Q 1. The image for the converging beam after refraction through the curved surface is formed at



(a) $x = 40cm$
(b) $x = \frac{40}{3}cm$
(c) $x = -\frac{40}{3}cm$
(d) $x = \frac{180}{7}cm$

Q 2. An air bubble in glass (μ = 1.5) is situated at a distance 3 cm from a spherical surface of diameter 10 cm as shown in Figure. At what distance from the spherical surface will the bubble appear:



(a) 2.5 cm
(b) 2 cm
(c) 4 cm
(d) 4.5cm

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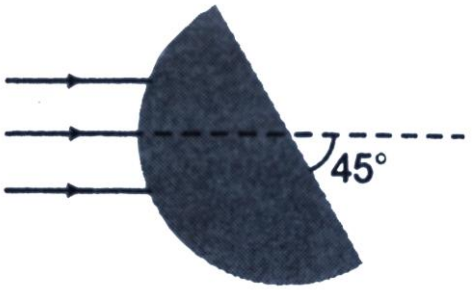
Q 3. The diameter of glass sphere is 15cm . A beam of light strikes the sphere which converges at a point 30 cm behind the pole of spherical surface. Find position of image after first refraction if μ equals to 1.5:
(a) $v = 40cm$ (b) $v = 30cm$ (c) $v = 15cm$ (d) $v = 10cm$

Q 4. A small point object is placed at O, at a distance of 0.60 metre in air from a convex spherical surface of refractive index 1.5. If the radius of the curvature is 25 cm, then what is the position of the image on the principal axis ?
(a) 4.5 m (b) 2.5 m
(c) 1.5 m (d) 5.5 m

Q 5. A point object is placed at the centre of a glass sphere of radius 6 cm and refractive index 1.5. The distance of the virtual image from the surface of the sphere is :
(a) $2cm$ (b) $4cm$ (c) $6cm$ (d) $12cm$

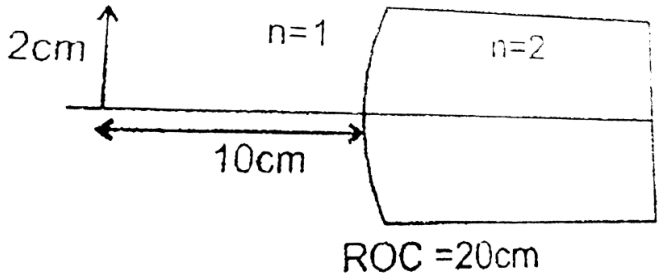
Q 6. A parallel narrow beam of light is incident on the surface of a transparent hemisphere of radius R and refractive index $\mu = 1.5$ as shown. The position of the image formed by refraction at the spherical surface only as



(a) $\frac{R}{2}$ (b) $3R$
(c) $\frac{R}{3}$ (d) $2R$

Q 7. A concave spherical surface of radius of curvature 10 cm separates two medium x (in concave side) & y (in convex side) of refractive index 4/3 & 3/2 respectively. If the object is placed along principal axis in medium x then:
(a) Image is always real
(b) Image is real if the object distance is greater than 90cm
(c) Image is always virtual
(d) Image is virtual if the object distance is less than 90cm

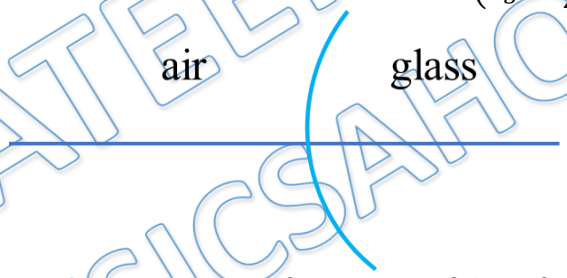
Q 8. An extended object of size 2cm is placed at a distance of 10cm in air (n=1) form pole, on the other side of refracting surface has refractive index n=2. Find the position, nature and size of image formed after single refraction through the curved surface:



(a) −40 cm, 4 cm, erect
(b) 40 cm, 2 cm, erect
(c) 20 cm, 4 cm, inverted
(d) −20 cm, 2cm, inverted

Q 9. The radius of a glass ball is 5 cm. There is an air bubble at 1cm from the centre of the ball and refractive index of glass is 1.5. The position of image viewed from surface near the bubble is:
(a) 3.63 cm
(b) 4.63 cm
(c) 2.12 cm
(d) 5.12 cm

Q 10. Refraction takes place at a convex spherical boundary separating glass-air medium. For the image to be real, the object distance should be $\left(\mu_g = \frac{3}{2}\right)$:



(a) greater than three times the radius of curvature of the refracting surface.
(b) greater than two times the radius of curvature of the refracting surface.
(c) less than two times the radius of curvature of the refracting surface.
(d) independent of the radius of curvature of the refracting surface

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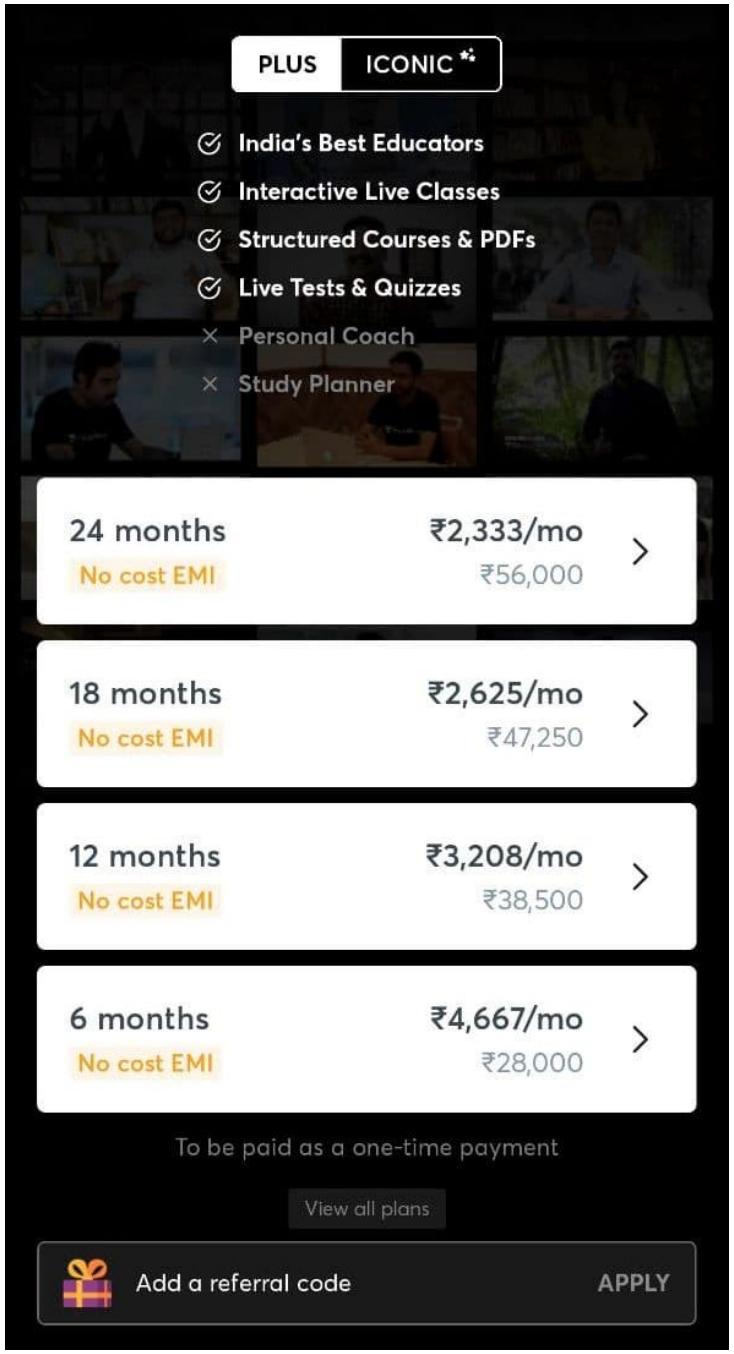
Answer Key

Q.1 a	**Q.2 a**	**Q.3 c**	**Q.4 a**	**Q.5 c**
Q.6 b	**Q.7 c**	**Q.8 a**	**Q.9 a**	**Q.10 b**



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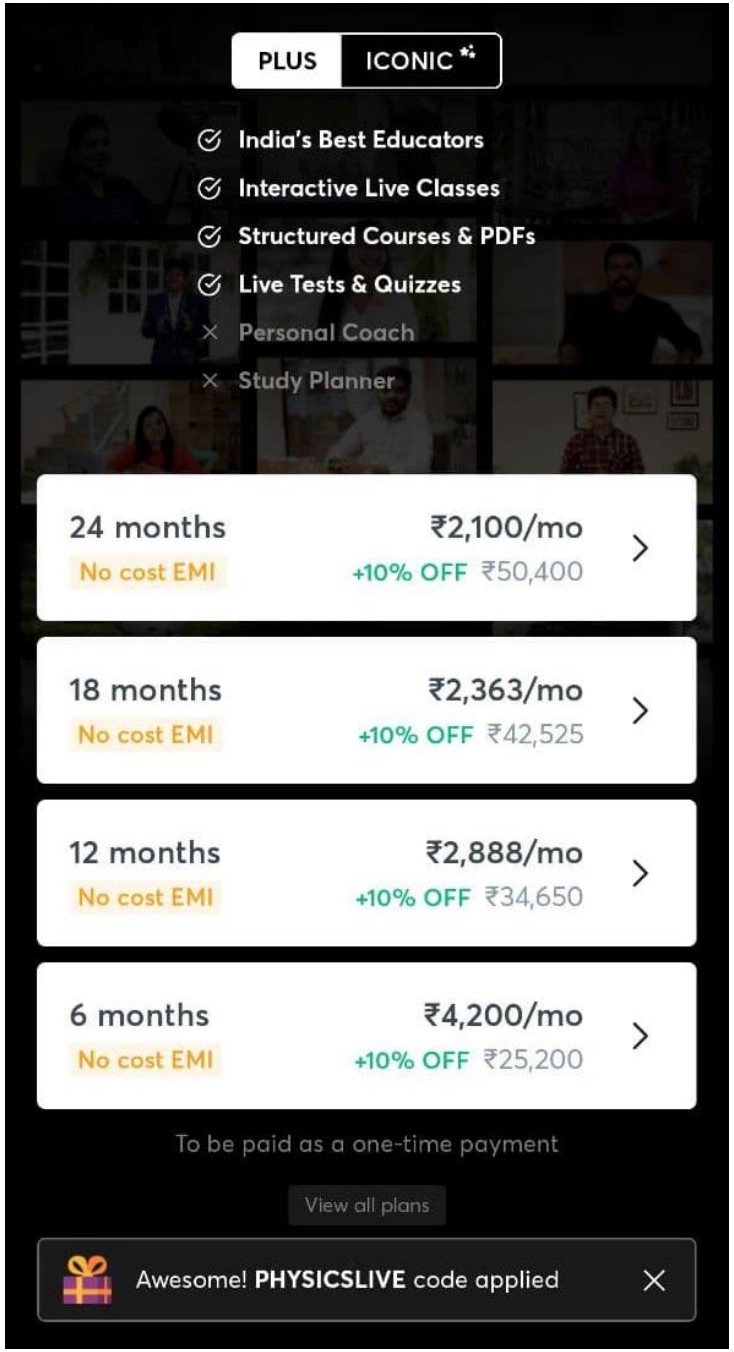
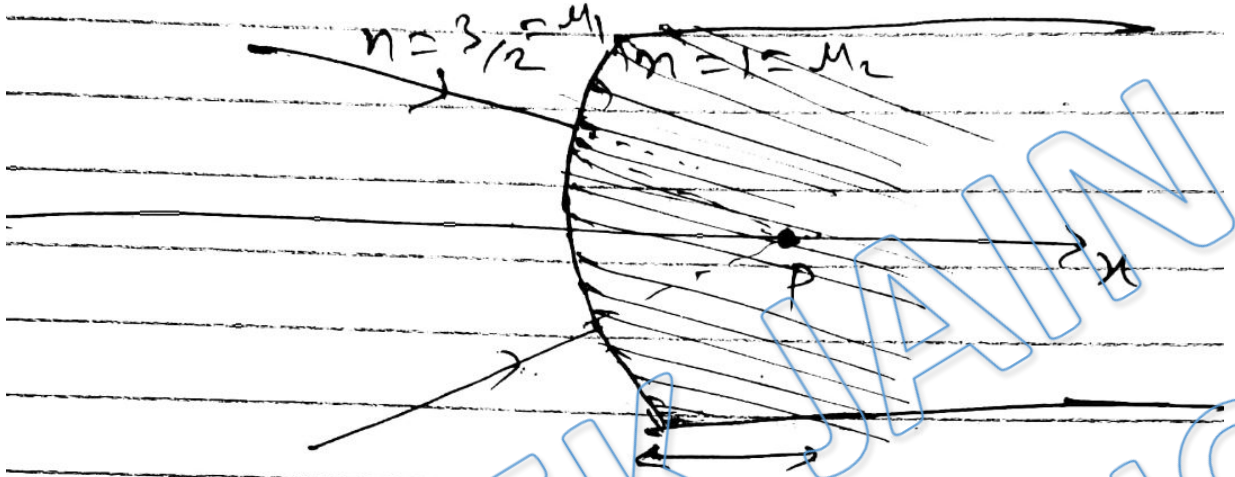


Written Solution

DPP-7 Refraction Through Curved Surface

By Physicsaholics Team

Solution: 1



$u = +30\,cm,$

$R = +20\,cm,$

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

$$\frac{1}{v} - \frac{3/2}{30} = \frac{1 - 3/2}{20}$$

$$\frac{1}{v} - \frac{1}{20} = \frac{-1}{40}$$

$$\frac{1}{v} = \frac{1}{20} - \frac{1}{40}$$

$$\boxed{v = +40\,cm,}$$

Ans. a

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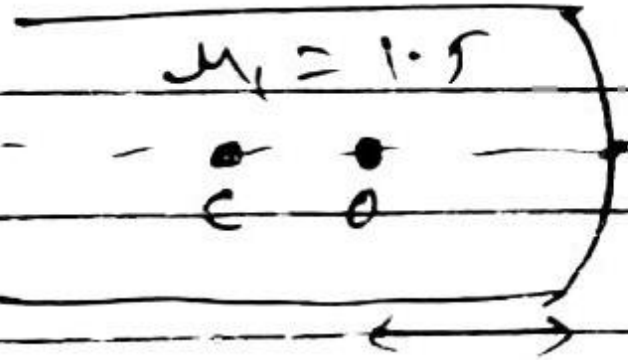
Solution: 2



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

$$\frac{1}{v} - \frac{1.5}{(-3)} = \frac{1 - 1.5}{-5}$$

$$\frac{1}{v} + \frac{1}{2} = \frac{1}{10}$$

$$\Rightarrow \frac{1}{v} = \frac{1}{10} - \frac{1}{2} \Rightarrow \frac{1}{10} - \frac{5}{10} = -\frac{4}{10}$$

$$v = -\frac{10}{4}\text{ cm} \Rightarrow \boxed{v = -2.5\text{ cm}}$$

$\therefore$ 2.5 cm from spherical surface

Ans. a

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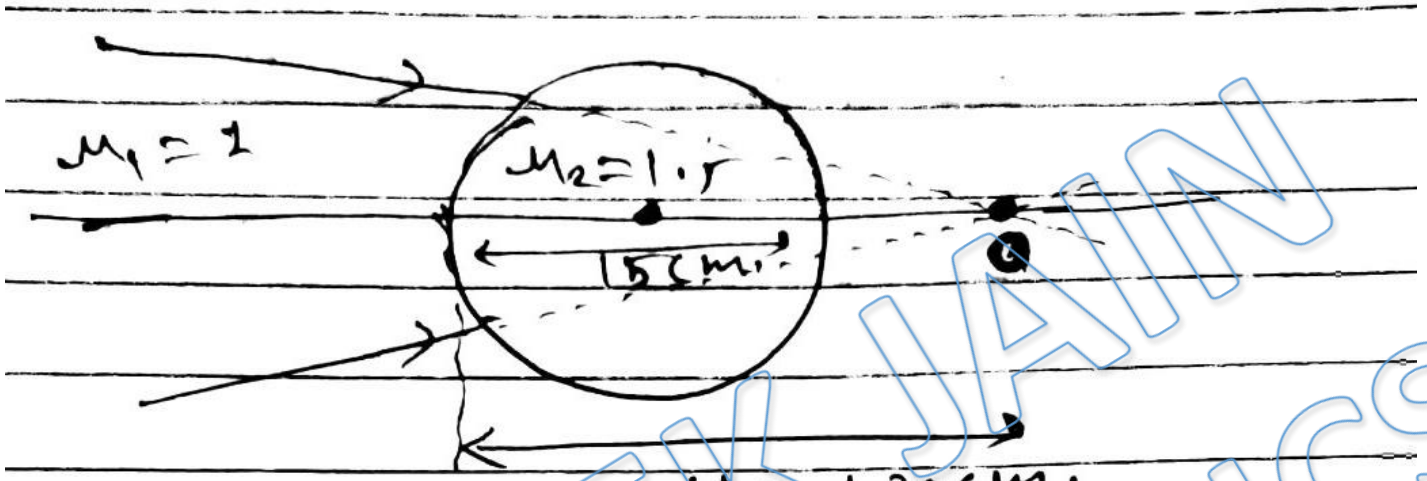
Solution: 3



$u = +30\,cm.$

$d = 15\,cm$, $R = \frac{15}{2}\,cm.$

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

$$\frac{1.5}{v} - \frac{1}{30} = \frac{1.5-1}{(15/2)}$$

$$\frac{1.5}{v} = \frac{1}{30} + \frac{1}{15} = \frac{3}{30}$$

$$\boxed{v = 15\,cm}$$

Ans. c

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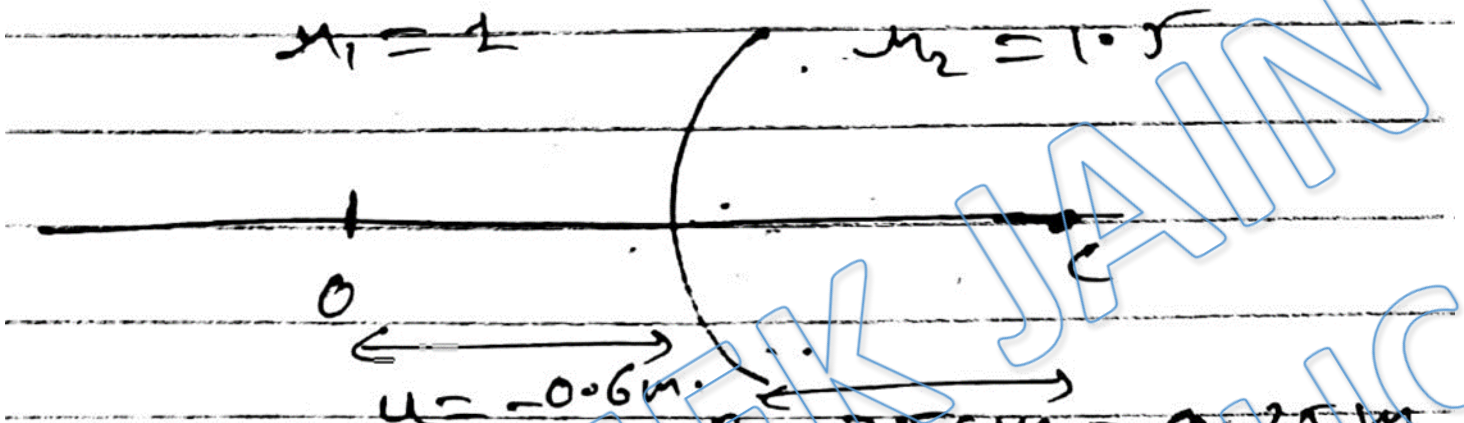
Solution: 4



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

$$\frac{1.5}{v} - \frac{1}{-0.6} = \frac{1.5 - 1}{0.25}$$

$$\frac{1.5}{v} = 2 - \frac{1}{0.6}$$

$$\boxed{V = 4.5\,(m)}$$

Ans. a

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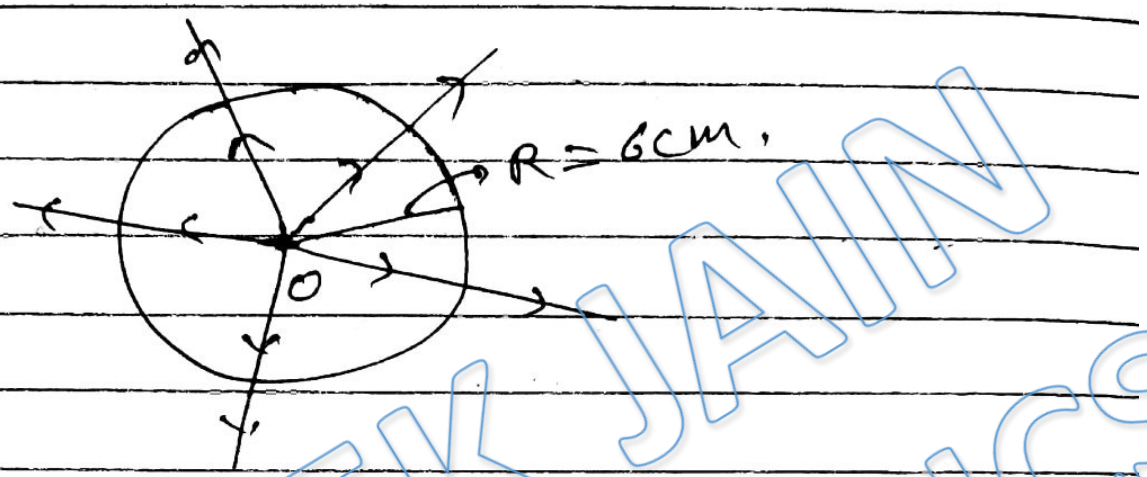
Solution: 5



The object is kept at the centre of the sphere. All the rays coming from it are normal to the surface of the sphere or to the tangent of sphere at the point of incidence,

Therefore the will pass through it withought deviating.

So, Image will appear at the same place.

⇒ 6 cm from the surface,

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Ans. c

Solution: 6

$\mu = 1.5$, Radius of curvature $= R$

$u = -\infty$ [$\because$ Parallel beam of light]

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

$$\frac{1.5}{v} - \frac{1}{-\infty} = \frac{1.5 - 1}{R}$$

$$\boxed{v = 3R}$$

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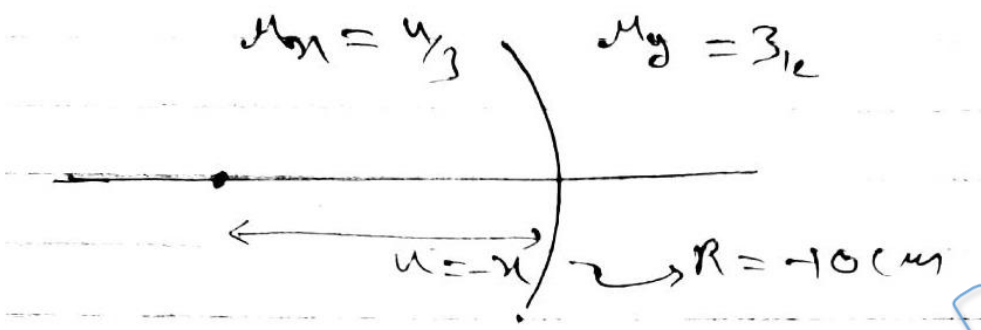
Ans. b

Solution: 7



$$\frac{\mu_y}{v} - \frac{\mu_x}{u} = \frac{\mu_y - \mu_x}{R}$$

$$\frac{3/2}{v} - \frac{4/3}{-x} = \frac{3/2 - 4/3}{+10}$$

$$\frac{3}{2v} + \frac{4}{3x} = \frac{1/6}{10}$$

$$\frac{3}{2v} = -\frac{4}{3x} - \frac{1}{60} = -\left(\frac{240+3x}{180x}\right)$$

$$v = -\frac{540x}{2(240+3x)} = -ve$$

$$\boxed{v < 0} \quad (always)$$

$\Rightarrow$ virtual Image, always.

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Ans. c

Solution: 8

$h_o = 2$ cm

$u = -10$ cm

$R = +20$ cm

$\mu_2 = 2, \quad \mu_1 = 1$

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

$$\frac{2}{V} + \frac{1}{10} = \frac{2-1}{20}$$

$$\frac{2}{V} = \frac{1}{20} - \frac{1}{10} = \frac{-1}{20}$$

$V = -40$ cm

$$m = \frac{\mu_1 V}{\mu_2 u} = \frac{1}{2}\left(\frac{-40}{-10}\right)$$

$m = +2$ (erect Image)

$h_I = 2 h_o$

$h_I = 2 \times 2$

$h_I = 4$ cm, erect

Ans. a

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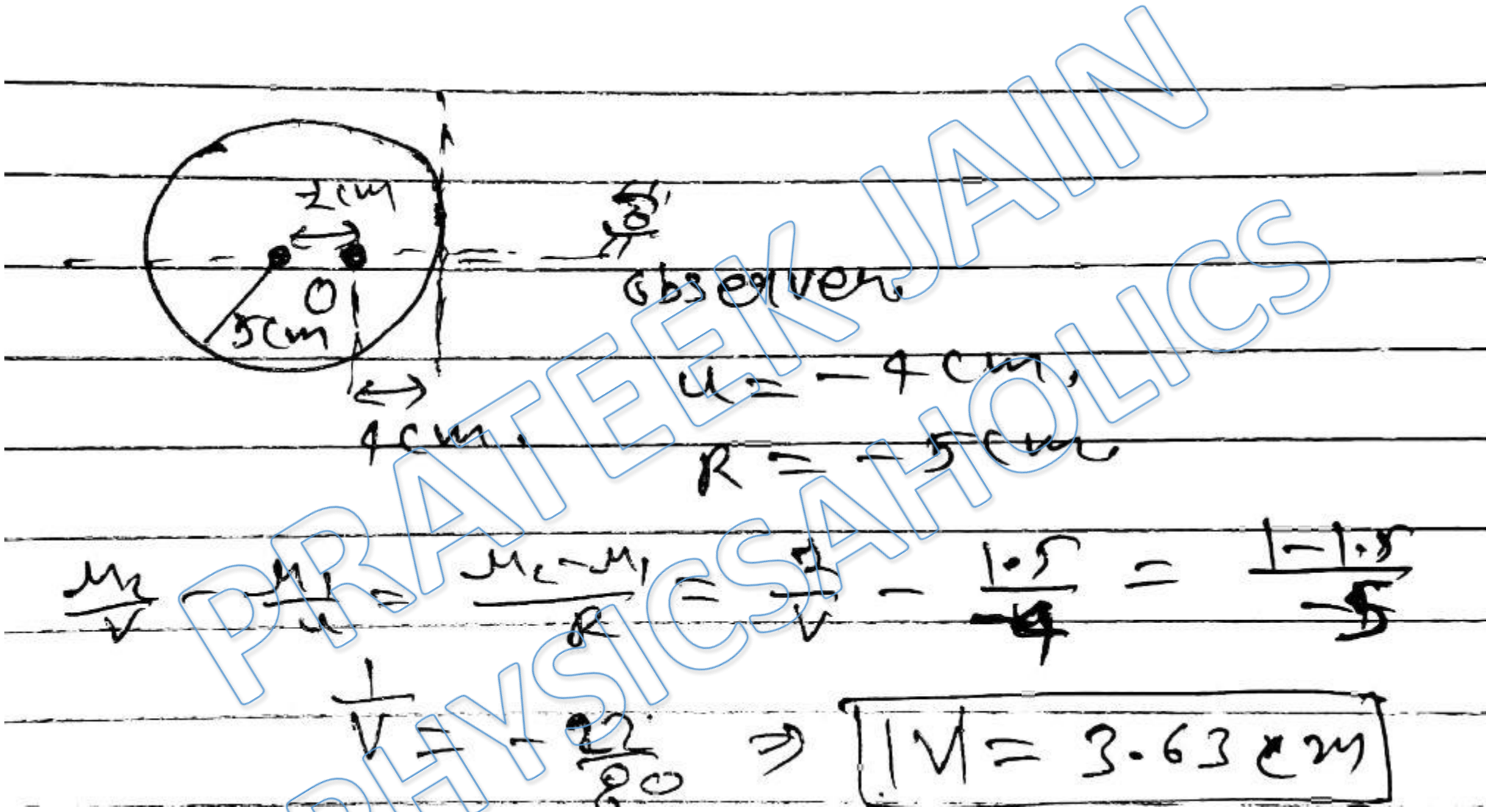
Solution: 9



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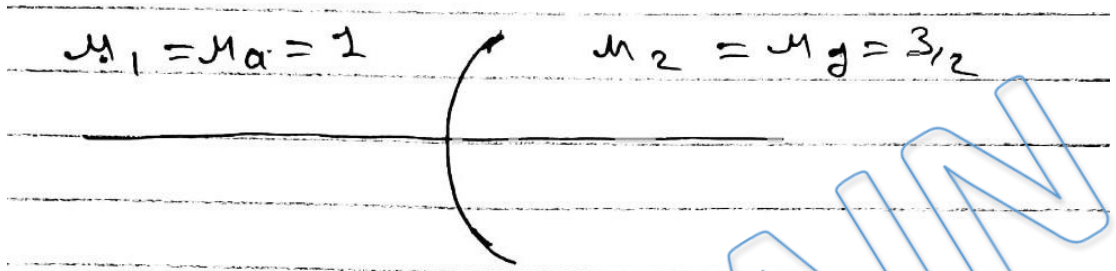
Ans. a

Solution: 10



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

$$\frac{3/2}{v} - \frac{1}{u} = \frac{3/2 - 1}{R}$$

$$\frac{3}{2v} = \frac{1}{2R} + \frac{1}{u}$$

for Image to be real

$\Rightarrow v = +ve$

$$\therefore \frac{3}{2v} > 0 \Rightarrow \frac{1}{2R} + \frac{1}{u} > 0$$

$$\frac{1}{2R} > -\frac{1}{u}$$

$$2R < -u$$

$$-u > 2R$$

for object distance

$$\boxed{|u| > |2R|}$$

Ans. b

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