Q-1 - 13397326

A ray of light makes an angle of 10 with the horizontal and strikes a plane mirror which is inclined at an angle θ to the horizontal. The angle θ for which the reflected ray becomes vertical, is

(A) 40

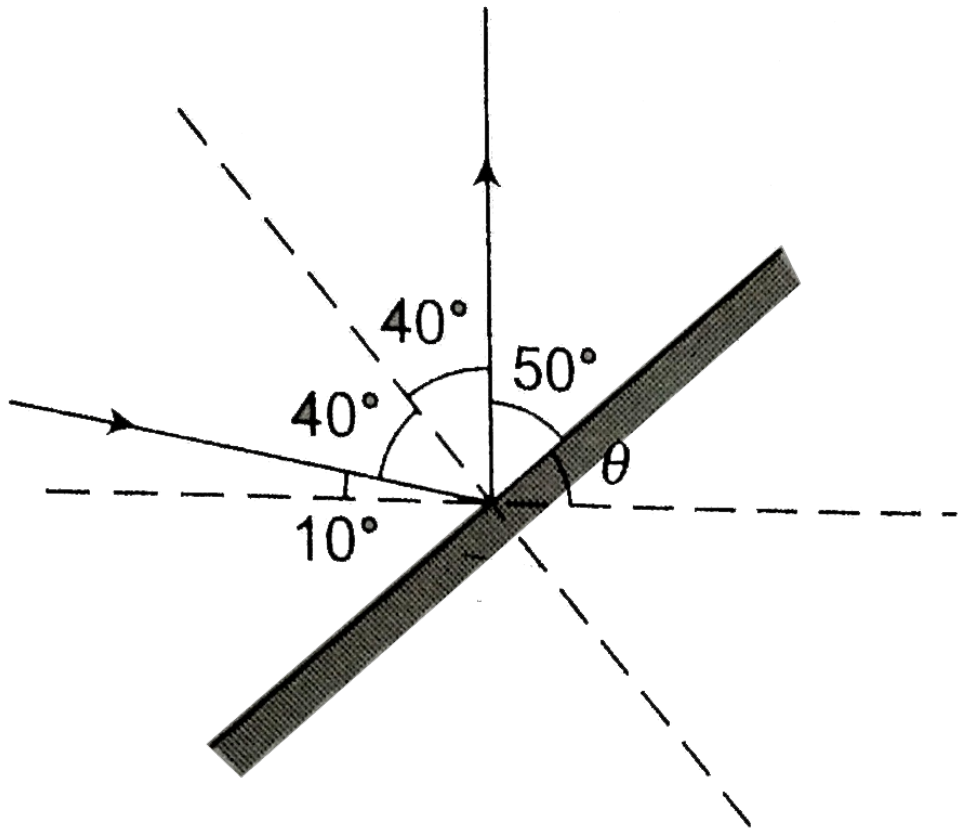
(B) 50°

(C) 80°

(D) 100°

CORRECT ANSWER: A

SOLUTION:



Refer to diagram,

$$50^{+}\theta = 90$$

$$\theta = 40$$

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Q-2 - 10968315

Two plane mirrors are inclined at 70 . A ray incident on one mirror at incidence angle θ after reflection falls on the second mirror and is reflected from there parallel to the first mirror, The value of θ is

(A) 50°

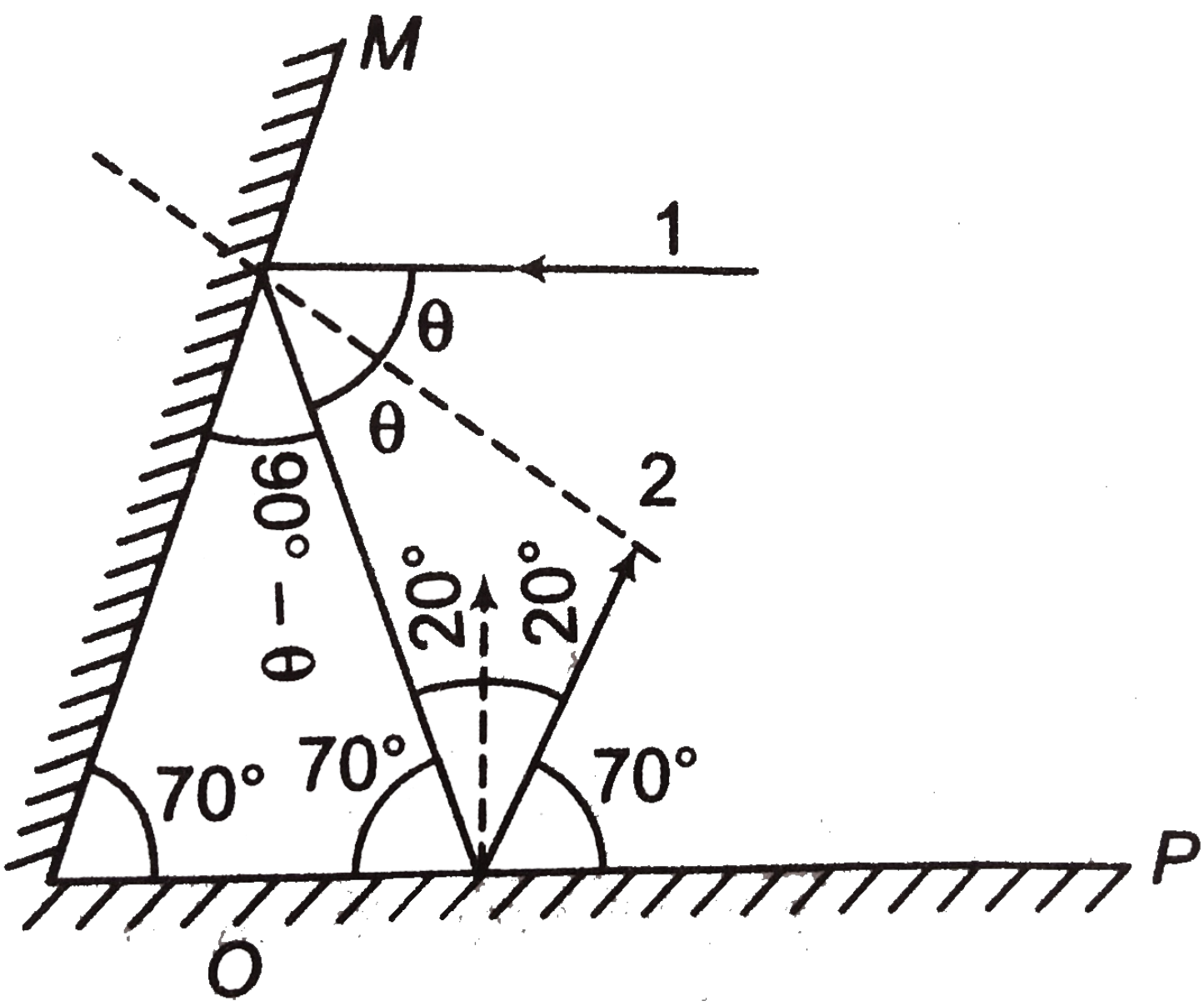
(B) 45°

(C) 30°

(D) 25°

CORRECT ANSWER: A

SOLUTION:



$$90 - (\theta) + 70 + 70$$

$$= 180$$

$$\therefore (\theta) = 50.$$

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Q-3 - 16412667

When a plane mirror is rotated through an angle θ then the reflected ray turns through the angle 2θ then the size of the image

(A) Is doubled

(B) Is halved

(C) Remins the same

(D) Becomes infinite

CORRECT ANSWER: C

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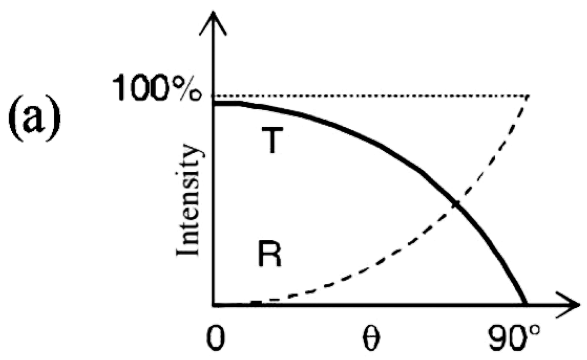
Q-4 - 10060183

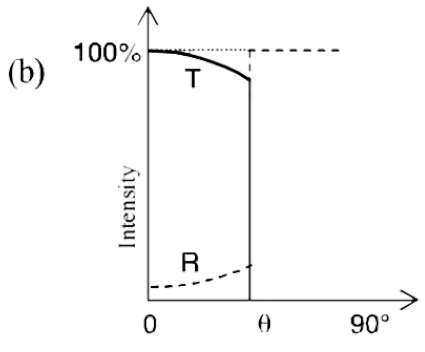
A light ray travelling in glass medium is incident of glass- air

interface at an angle of incidence θ. The reflected (R) and transmitted (T) intensities, both as function of θ, are plotted The correct sketch is

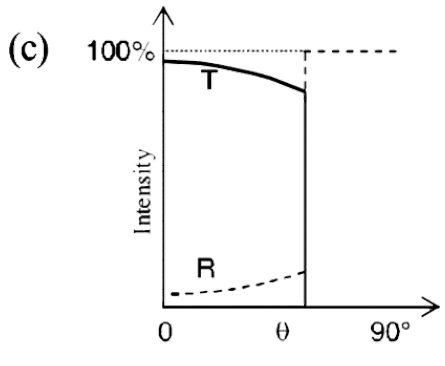
(A)



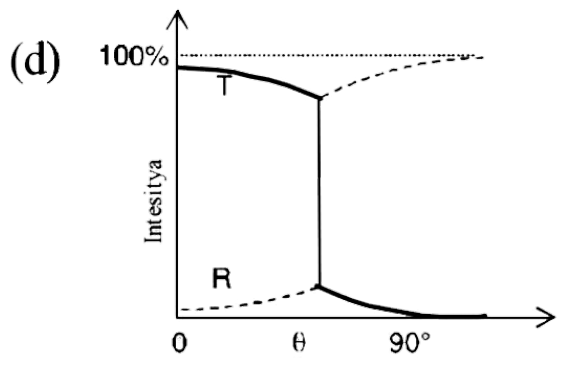
(B)



(C)



(D)



CORRECT ANSWER: C

SOLUTION:

When the light is incident on glass - an interface at an angle less than critical angle a small part of light will be reflected and most part will be transmitted.

When the light is incident greater than the critical angle, it gets completed reflected (total internal reflection)

These characteristics are depicted in option (c).

Q-5 - 16413188

A ray of light is incident at an angle of 60 on one face of a prism of angle 30. The ray emerging out of the prism makes an angle of 30 with the incident ray. The emergent ray is

(A) Normal to the face through which it emerges

(B) Inclined at 30° to the face through which it emerges

(C) Inclined at 60° to the face through which it emerges

(D) None of these

CORRECT ANSWER: A

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Q-6 - 15282382

While looking at her face in a mirror, Hema notes that her face is highly magnified when she is close to the mirror. As she backs away from the mirror, her image first gets blurry, then disappears when she is at a distance of 45 cm from the mirror. Explain the happenings? What will happen if she moves beyond 45 cm distance from the mirror?

CORRECT ANSWER: IMAGE GETS INVERTED

BEYOND 45 CM

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Q-7 - 18254459

A beautiful girl with two normal eye wants to see full width of her face by a plane mirror. The eye to eye and ear to ear distances of her face are 4 inch and 6 inch respectively. Fine the minimum width of the required mirror.

(A) 1 inch

(B) 2 inch

(C) 3 inch

(D) 4 inch

SOLUTION:

(a) Here the minimum size of mirror

$$= \frac{b-a}{2} = \frac{6-4}{2}$$

$$= 1$$

inch

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Q-8 - 12230623

A man of height $170cm$wants to see his complete image in a plane mirror(while standing).His eyes are at a height of $160cm$from the ground.

(A) minimum length of the mirror $= 80cm$

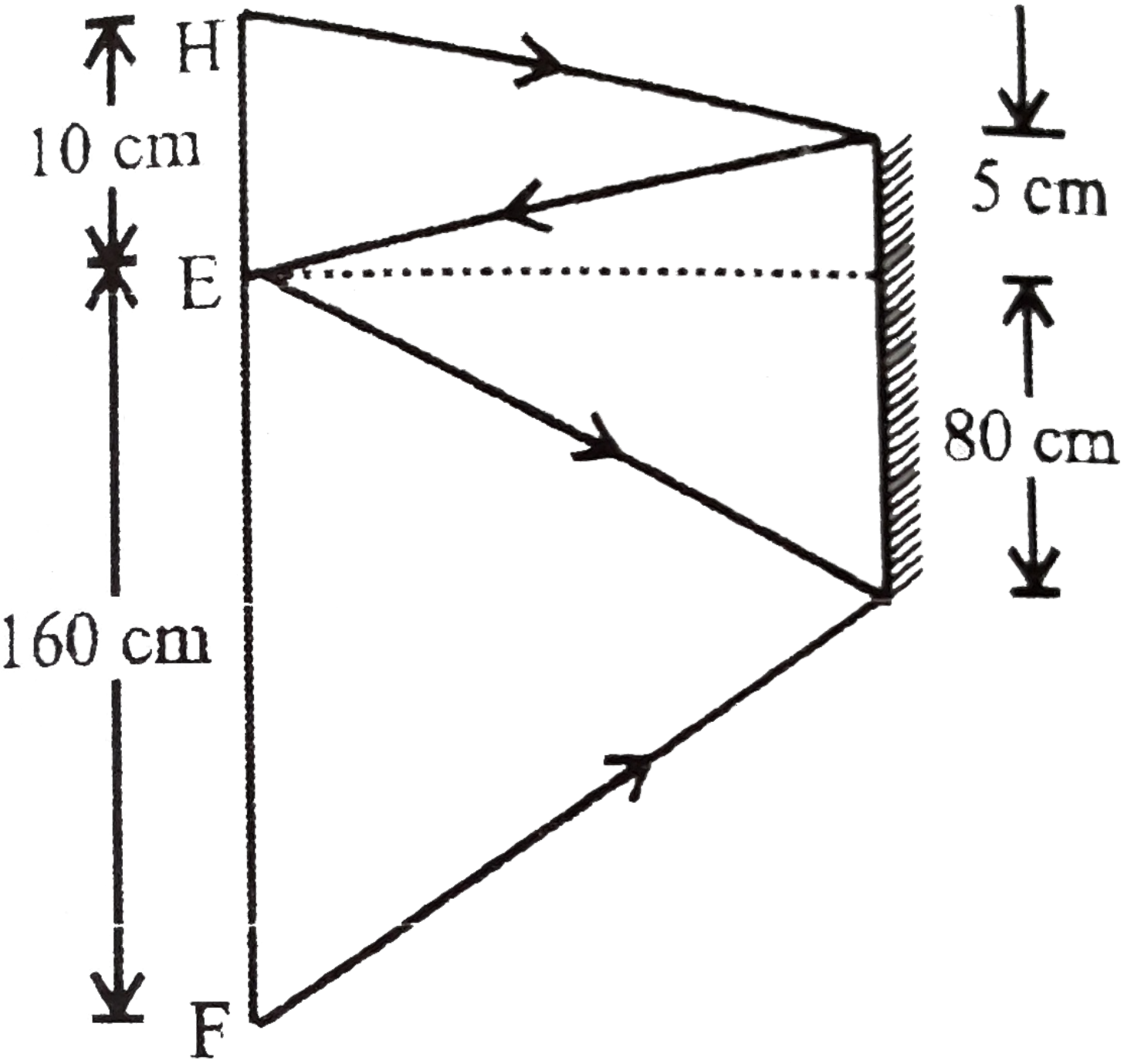
(B) Minimum length of the mirror=$85cm$

(C) Bottoms of the mirror should be at a height $80cm$

(D) Bottoms of the mirror should be at a height $85cm$

CORRECT ANSWER: B,C

SOLUTION:



Q-9 - 11760148

The near point of a defective eye is $25cm$ from the eye. Calculate focal length of the lens required by her to read a book placed at $20cm$.

SOLUTION:

Here,

$u = -20cm, v = -25cm, f = ?$

From

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u} = \frac{1}{-25} + \frac{1}{20} = \frac{-4+5}{100} = \frac{1}{100}, f = 100$$

.

The lens must be convex, as focal length is positive.

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Q-10 - 12015464

Assertion : A normal human eye can clearly see all the objects beyond a certain minimum distance.

Reason : The human eye has the capacity to suitable adjust the focal

length of its lens to a certain extent.

(A) If both, Assertion and Reason are true and the Reason is the correct explaination of the Assertion.

(B) If both, Assertion and Reason are true but Reason is not a correct explaination of the Assertion.

(C) If Assertion is true but the Reason is false.

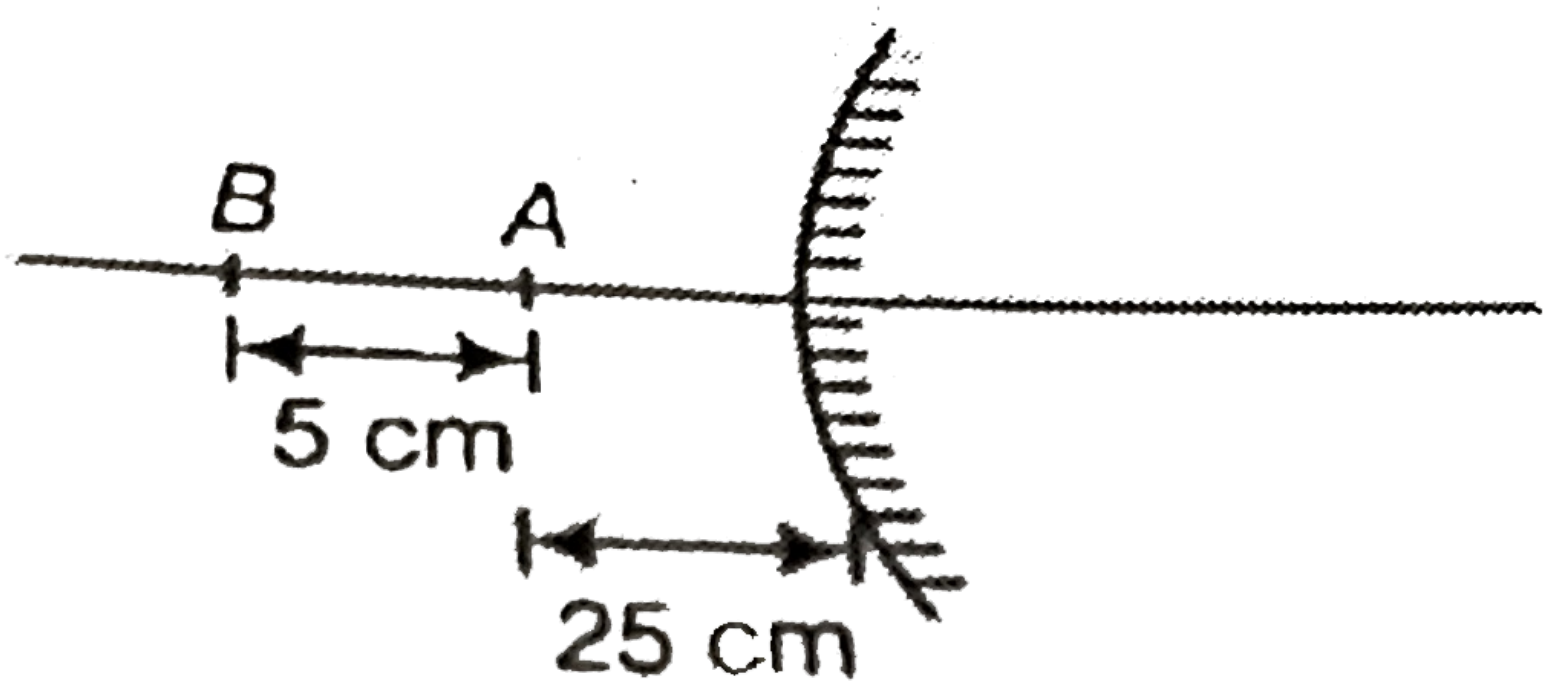
(D) If both, Assertion and Reason are false.

CORRECT ANSWER: A

SOLUTION:

Both, the assertion and reason are correct and the latter is correct explaination of the former.

A convex mirror of focal length $10cm$ is shown in figure. A linear object $AB = 5cm$ is placed along the optical axis. Point B is at distance $25cm$ from the pole of mirror. The size of image of AB is



(A) $2.5cm$

(B) $0.64cm$

(C) $0.36cm$

(D) none of these

SOLUTION:

(c) For point A, $u = \ -25cm$

$f = \ +10cm$

$$\therefore \frac{1}{v}+\frac{1}{u}=\frac{1}{f}$$

or $\frac{1}{v}-\frac{1}{25}=\frac{1}{10}$

or $\frac{1}{v}=\frac{1}{10}+\frac{1}{25}$ or $\frac{1}{v}=\frac{5+2}{50}$

$$\therefore v=\frac{50}{7}=7.14cm$$

For point B, $u'=-30cm$

$f'=10cm$

$$\frac{1}{v'}+\frac{1}{u'}=\frac{1}{f'}$$

or $\frac{1}{v'}-\frac{1}{30}=\frac{1}{10}$ or

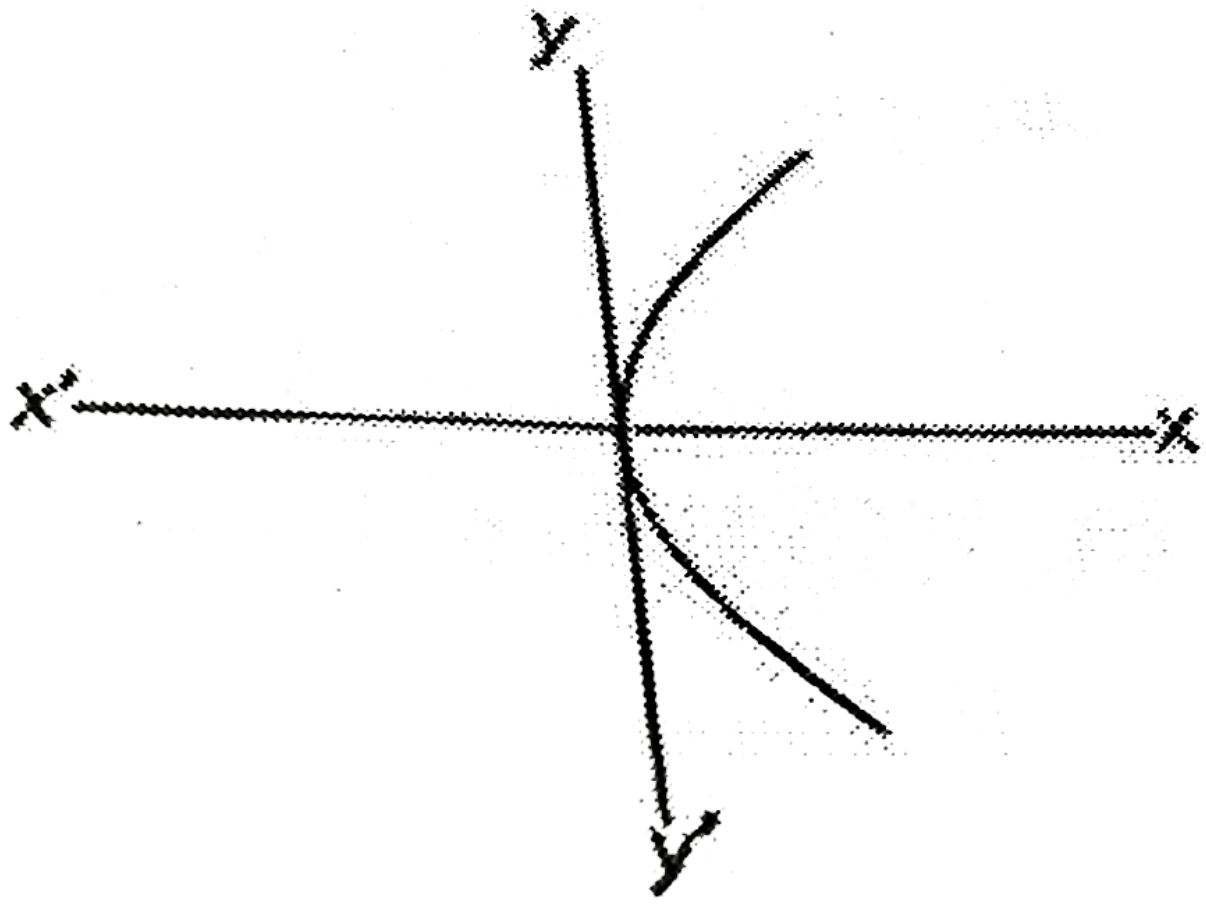
$$\frac{1}{v'}=\frac{1}{30}+\frac{1}{10}$$

$$=\frac{1+3}{30}=\frac{4}{30}$$

$$\therefore v'=\frac{30}{4}=7.5cm$$

$$\therefore A'B'=|v'-v|$$

$$=|7.5-7.14|=0.36$$



Q-12 - 10060314

A car is fitted with a convex side-view mirror of focal length 20 cm.

A second car 2.8m behind the first car is overtaking the first car at a relative speed of 15 $\frac{m}{s}$. The speed of the image of the second car as seen in the mrror of the first one is:

(A) $\frac{1}{15}\frac{m}{s}$

(B) $10\frac{m}{s}$

(C) $15\frac{m}{s}$

(D) $\frac{1}{10}\frac{m}{s}$

CORRECT ANSWER: A

SOLUTION:

From mirror formula

$$\frac{1}{v}+\frac{1}{u}=\frac{1}{f} \text{ so }, \frac{dv}{dt}=-\frac{v^2}{u^2}\left(\frac{du}{dt}\right)$$

$$\Rightarrow \frac{dv}{dt}=$$

$$-\left(\frac{f}{u-f}\right)^2\frac{du}{dt}$$

$$\Rightarrow \frac{dv}{dt}=\frac{1}{15}\frac{m}{s}$$

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Q-13 - 12014047

How many images of himself can a person see in a room whose

ceiling and two adjacent walls are mirrors ?

SOLUTION:

six images. This is because two adjacent walls are at 90. They will produce 3 images $\left(= \frac{360}{90} - 1 \right)$. The ceiling mirror will repeat the three images taking the total to six images.

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Q-14 - 11759965

An object is placed at a large distance in front of a convex mirror of radius of curvature 40 cm. How far is the image behind the mirror?

CORRECT ANSWER: 20 CM

SOLUTION:

Here,

$R = 40cm, u = \infty, v$

$= ?$

As

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

$$\frac{1}{\infty} + \frac{1}{v} = \frac{2}{40}$$

or $v = 20cm.$

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Q-15 - 12230651

An object is present on the principal axis of a concave mirror at a

distance $30cm$from it.Focal length of mirror is$20cm$

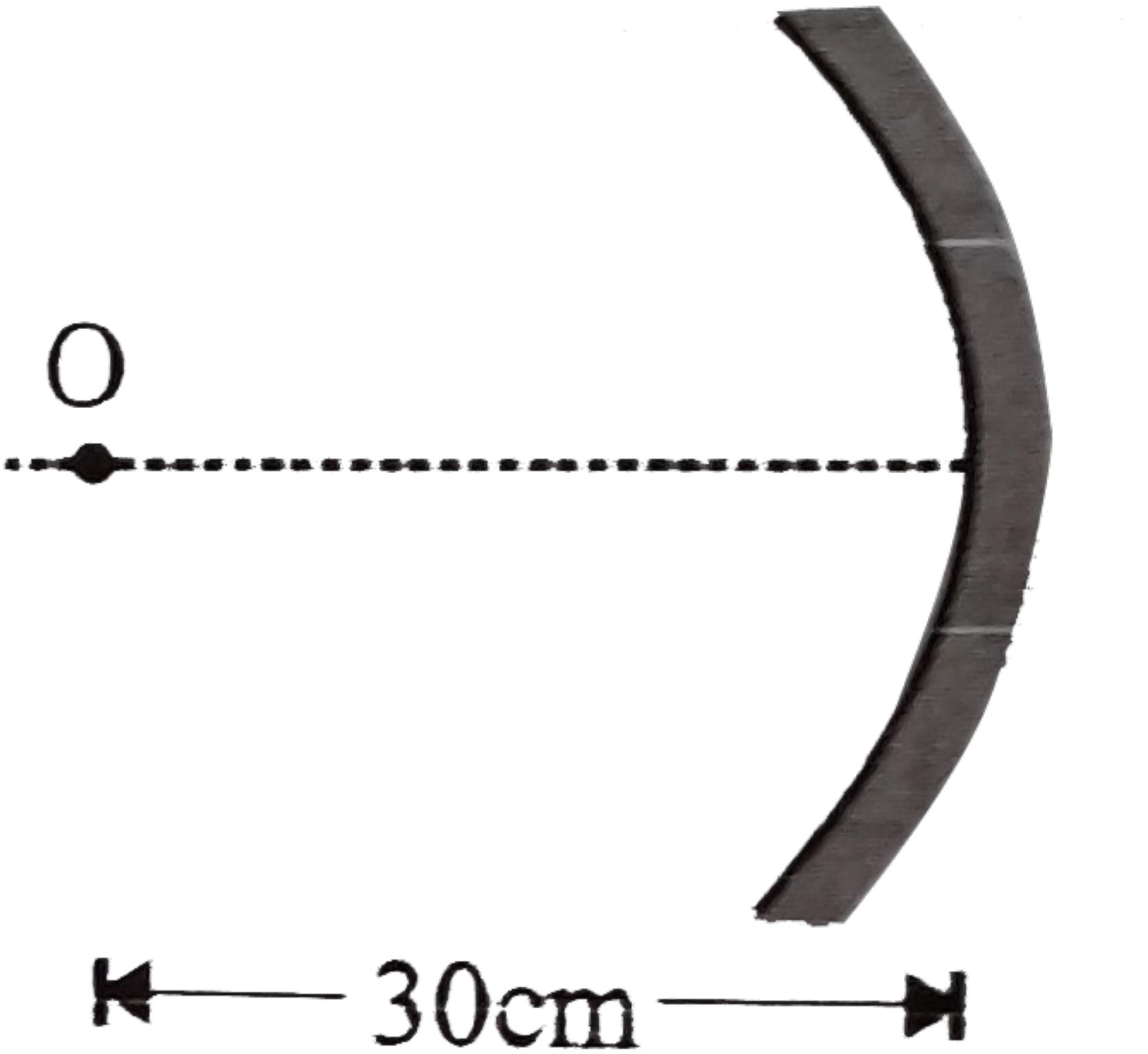


Image formed by mirror is

(A) At a distance $60cm$in front of mirror.

(B) At a distance $60cm$behind of mirror.

(C) At a distance $12cm$in front of mirror.

(D) At a distance $12cm$behind of mirror.

CORRECT ANSWER: A

Q-16 - 16412727

Match List I with List II and select the correct answer using the codes given below the lists :

List I (Position of the object)	List II (Magnification)
(I) An object is placed at focus before a convex mirror	(A) Magnification is $-\infty$
(II) An object is placed at centre of curvature before a Concave mirror	(B) Magnification is 0.5
(III) An object is placed at focus before a concave mirror	(C) Magnification is $+1$
(IV) An object is placed at centre of curvature before a convex mirror	(D) Magnification is -1
	(E) Magnification is 0.33

(A) I-B, II-D, III-A, IV-E

(B) I-A, II-D, III-C, IV-B

(C) I-C, II-B, III-A, IV-E

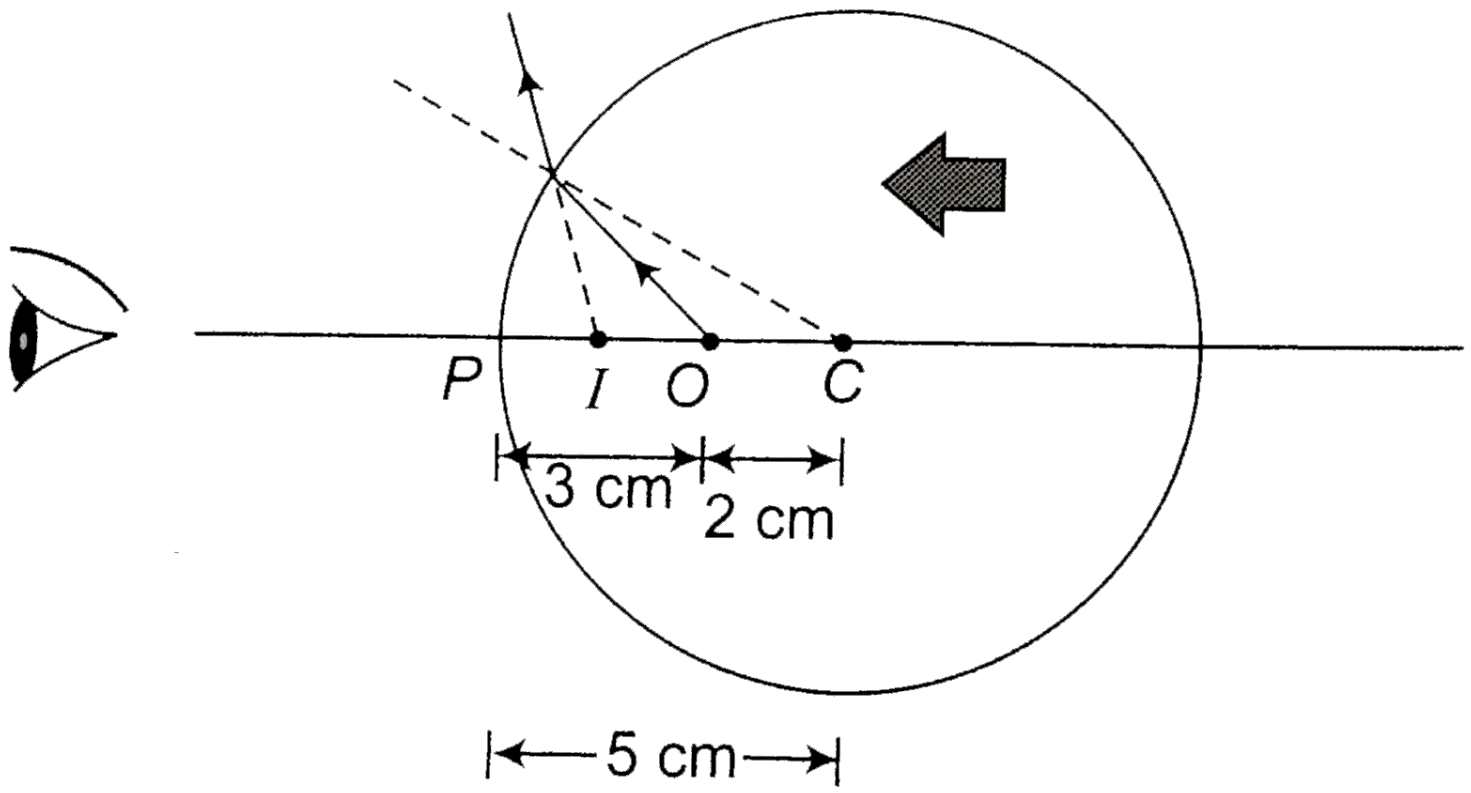
(D) I-B, II-E, III-D, IV-C

CORRECT ANSWER: A

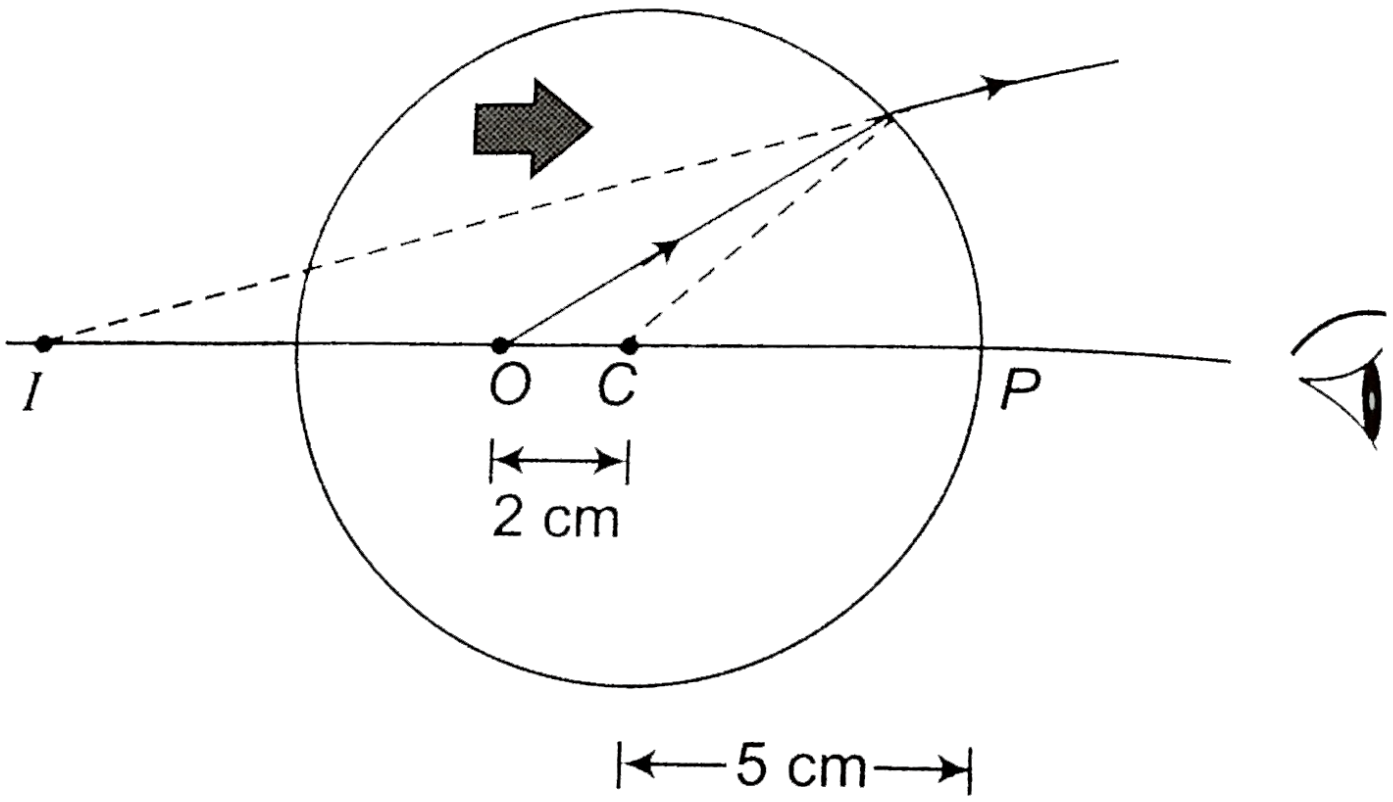
Q-17 - 14156624

An air bubble in glass $(\mu = 3/2)$ is situated at a distance of 2 cm from centre of sphere of diameter 10 cm. Locate the image of bubble from (a) nearer surface and (b) farther surface.

SOLUTION:



It brgt



(a). From nearer surface:

$$\mu_1 = \frac{3}{2}, \mu_2 = 1.0, u = -3cm, R = -5cm, v = ?$$

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

$$\frac{1}{v}-\frac{\frac{3}{2}}{-3}=\frac{1-\frac{3}{2}}{-5}$$

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

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

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

$$-2.5cm$$

The bubble appears nearer from the nearer surface.

(b) From farther surface:

$$\mu_1=\frac{3}{2},\mu_2=1,u=$$

$$-(2+5)=7cm$$

$$R=-5cm,v=?$$

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

$$\Rightarrow \frac{1}{v} - \frac{1}{-7}$$

$$= \frac{1 - \frac{3}{2}}{-5}$$

$$\frac{1}{v} = \frac{1}{10} - \frac{1}{7} = \frac{-3}{70}$$

$$v = \frac{-70}{3} =$$

$$-23.3cm$$

The bubble appears farther from the farther surface. If bubble is at centre, it will appear at centre.

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Q-18 - 12014974

An air bubble in a glass sphere $(\mu = 1.5)$ is situated at a distance

$3cm$ from a convex surface of diameter $10cm$. At what distance from the surface will be the bubble appear ?

CORRECT ANSWER: $-2.5CM$

SOLUTION:

Here,

$\mu_2 = 1.5, \mu_1 = 1, u = -3, v = ?$

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

.

As refraction occurs from denser to rarer medium,

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

$$-\frac{3}{2(-3)}+\frac{1}{v}$$

$$=\frac{1-3/2}{-5}=\frac{1}{10}$$

or

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

$$=-2.5cm$$

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Q-19 - 18252618

A compound microscope has a magnification f 30. the focal length of its eyepiece is 5 cm. assuming the final image to be formed at least distance of distinct vision (25 cm), calculate the magnification produced by the objective.

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Q-20 - 18254511

An object appraches a convergent lens from the left of the lens with a uniform speed $5m / s$ and stops at the focus. The image

(A) moves away from the lens with a uniform speed $5m / s$

(B) moves away from the lens with a uniform acceleration

(C) moves away from the lens with a non-uniform acceleration

(D) moves towards the lens with a non-uniform acceleration

SOLUTION:

(c)

Q-21 - 11759636

A $4.5cm$ needle is placed 12 cm away from a convex mirror of focal length 15 cm. Give the location of the image and the magnification. Describe what happens as the needle is moved farther from the mirror.

SOLUTION:

Here, object size, $h_1 = 4.5cm$

object distance, $u = -12cm$

focal length, $f = +15cm$

image distance, $v = ?$ (to be calculated)

magnification,$m = ?$

As $\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$, $\frac{1}{v} = \frac{1}{f} - \frac{1}{u}$

Putting $u = -12cm$ and $f = +15cm$, we get

$$\frac{1}{v} = \frac{1}{15} - \frac{1}{-12}$$

$$= \frac{4+5}{60}$$

$$= \frac{60}{9}$$

or $v = \frac{60}{9} = 6.7cm$

i.e., image is formed $6.7cm$ behind the convex mirror. It must be virtual and erect.

If h_2 is size of the image, then $m = \frac{h_2}{h_1} = \frac{-v}{u}$ or

$$m = \frac{h_2}{h_1} = \frac{-(6.7)}{-12}$$

$$= 0.558$$

i.e.,

$$h_2 = 0.558h_1 = 0.558$$

$$\times 4.5 = 2.5cm$$

As the needle is moved farther from the mirror, image moves away from the the mirror till it is at focus F of the mirror. The size of the image goes on decreasing.

Q-22 - 12014186

An object is placed at the focus of a concave lens. Where will be image ?

SOLUTION:

The image will be formed at infinity. (Use this formula, taking $u = -f$).

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Q-23 - 11971487

A wire mesh consisting of very small squares is viewed at a distance of $8cm$ through a magnifying converging lens of focal length $10cm$, kept close to the eye. The magnification produced by the lens is:

(A) 5

(B) 8

(C) 10

(D) 20

CORRECT ANSWER: A

SOLUTION:

Lens formula is given by

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$ ...(i)

where f is focal length of lens, v is image distance and u is object distance.

Given, $f = 10cm$ (as lens is converging)

$u = -8cm$ (as object is placed on left side of the lens)

Substituting these values in Eq.(i), we get,

$$\frac{1}{10} = \frac{1}{v} - \frac{1}{-8} \Rightarrow \frac{1}{v}$$

$$= \frac{1}{10} - \frac{1}{8}$$

$$\frac{1}{v} = \frac{8-10}{80} \Rightarrow v$$

$$= \frac{80}{-2} = -40cm$$

Hence, magnification produced by the lens

$$m = \frac{v}{u} = \frac{-40}{-8} = 5$$

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Q-24 - 16758123

A screen beaming areal image of magnification formed by a convex lens is moved through a distance x. The objectis the moved until a new image of magnification is formedon the screen. The focal length of the lens is :

(A) $\frac{x}{m_1 - m_2}$

(B) $\frac{x}{m_1 - m_2}$

(C) $\frac{x}{\sqrt{m_1 m_2}}$

(D) None of these

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Q-25 - 14527906

A plano convex lens is made of glass of refractive index 1.5. The radius of curvature of its convex surface is R. Its focal length is

(A) $\frac{R}{2}$

(B) R

(C) 2R

(D) 1.5R

CORRECT ANSWER: C

SOLUTION:

$$\frac{1}{f(1.5-1)}\left[\frac{1}{R}-\frac{1}{\infty}\right]$$

$$f=\frac{R}{0.5}$$

f=2R

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Q-26 - 16412940

If in a plano-convex lens, the radius of curvature of the convex surface is 10 cm and the focal length of the lens is 30 cm , then the refractive index of the material of lens will be

(A) 1.5

(B) 1.66

(C) 1.33

(D) 3

CORRECT ANSWER: C

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Q-27 - 15705795

Focal length of a convex lens of refractive index 1.5 is 2 cm. Focal length of lens when immersed in a liquid of refractive index 1.25 will be

(A) $10cm$

(B) $2.5cm$

(C) $5cm$

(D) $7.5cm$

CORRECT ANSWER: C

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Q-28 - 14156702

The radius of curvature of the convex surface of a thin plano-convex lens is 15 cm and the refractive index of its material is 1.6. The power of the lens is

(A) $+1D$

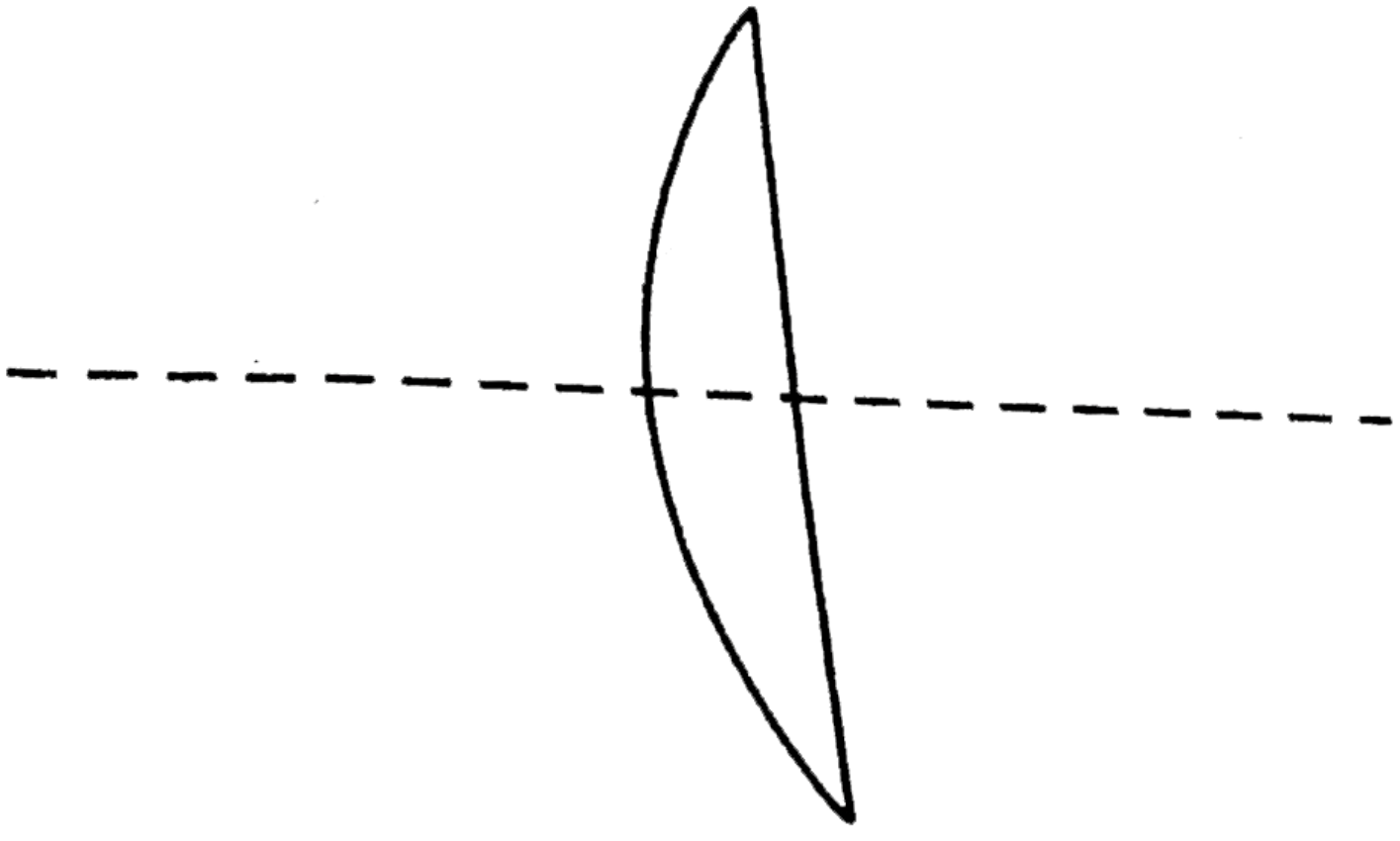
(B) $-2D$

(C) $+3D$

(D) $+4D$

CORRECT ANSWER: D

SOLUTION:



$$\frac{1}{f} = ($$

$$- a\mu_g - 1\Big)\Big(\frac{1}{R}$$

$$- \frac{1}{\infty}\Big)$$

$$= (1.6 - 1)\Big(\frac{1}{15}\Big)$$

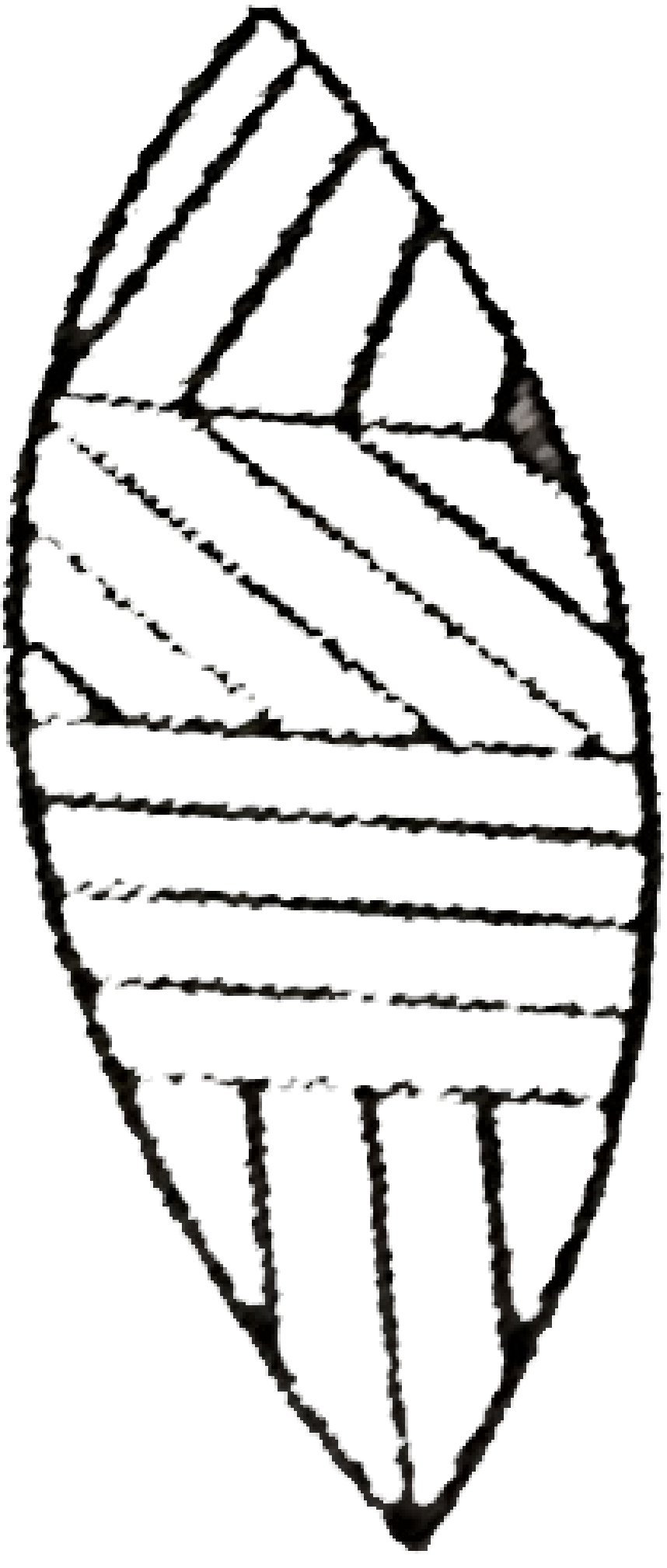
$$= \frac{6}{150}$$

$$P = \frac{100}{f(cm)}D = 100$$

$$\times \frac{6}{150} = 4D$$

Q-29 - 18254525

A layered lens is made of materials indicated by shades in the figure. The number of images formed is



(A) 1

(B) 2

(C) 3

(D) 4

SOLUTION:

(d)

Q-30 - 10968486

Assertion:Image formed by concave lens is not always virtual.

Reason:Image formed by a lens is real if the image is formed in the direction of ray of light with respect to the lens.

(A) If both Assertion and Reason are true and the Reason is correct explanation of the Assertion.

(B) If both Assertion and Reason are true but Reason is not the correct explanation of the Assertion.

(C) If both Assertion is true, but the Reason is false.

(D) If both Assertion is false but the Reason is true.

CORRECT ANSWER: B

SOLUTION:

For virtual object a concave lens can form a real

.

image.

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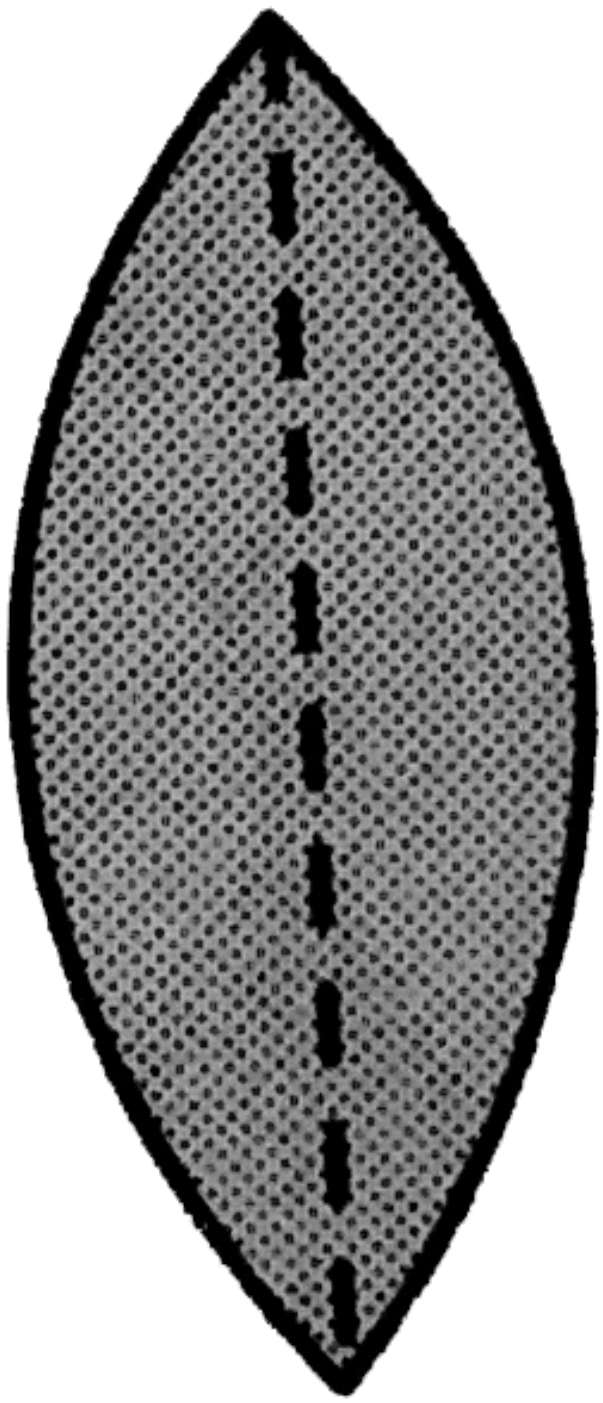
Q-31 - 11968723

A convex lens has a focal length f. It is cut into two parts along the

dotted line as shown in figure. The focal length of each part will be



(A) $\frac{f}{2}$

(B) f

(C) $\frac{3}{2}f$

(D) $2f$

CORRECT ANSWER: D

SOLUTION:

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

$$f' = \frac{R}{(\mu - 1)}$$

$$\Rightarrow f' = 2f$$

Q-32 - 18254526

Resolving power of a telescope will be more, fi the diameter (a) of the objective is

(A) larger

(B) smaller

(C) resolving poer does not depend on a

(D) None of the above

SOLUTION:

(a)

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Q-33 - 13397432

Electromagnetic radiation of frequency n, wavelength λ, travelling with velocity v in air, enters a glass slab of refractive index μ. The frequency, wavelength and velocity of light in the glass slab will be respectively

(A) $\frac{n}{\mu}, \frac{\lambda}{\mu}, \frac{v}{\mu}$

(B) $n, \frac{\lambda}{\mu}, \frac{v}{\mu}$

(C) $n, \lambda, \frac{v}{\mu}$

(D) $\frac{n}{\mu}, \frac{\lambda}{\mu}, v$

CORRECT ANSWER: B

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Q-34 - 11761286

The refractive index μ of a medium is found to vary with wavelength λ as $\mu = A + \frac{B}{\lambda^2}$. What are the dimensions of A and B?

SOLUTION:

mu =

$$\frac{\text{velocity of light in vacuum}}{\text{velocity of light in medium}}$$

$$=\text{dimensionless number}$$

A$\mu = A + \frac{B}{\lambda^2}$, $\therefore$, A must be dimensionless, and $B = \mu\lambda^2 = \left[L^2\right]$

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Q-35 - 18254524

When a glass slab is placed on a cross made on a sheet, the cross appears to be raised by $1cm$. The thickness of the glass is $3cm$. The critical angle for glass is

(A) $\sin^{-1}(0.33)$

(B) $\sin^{-1}(0.5)$

(C) $\sin^{-1}(0.67)$

(D) $\sin^{-1}\left(\frac{\sqrt{3}}{2}\right)$

SOLUTION:

(c) We can write shift $1 = 3\left(1 - \frac{1}{\mu}\right)$

$$\Rightarrow 1 - \frac{1}{\mu} = \frac{1}{3}$$

or

$$\frac{1}{\mu} = 1 - \frac{1}{3} = \frac{2}{3}$$

$$\Rightarrow \mu = \frac{3}{2}$$

Now,

$$\frac{1}{\sin i_c} = \frac{3}{2}$$

$$\Rightarrow \sin i_c = \frac{2}{3}$$

or

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

$$= \sin^{-1}(0.67)$$

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Q-36 - 12015447

A simple microscope consists of a concave lens of power of $-10D$ and a convex lens of power $+30D$ in contact. If the image formed is at infinity, what is the magnifying power of microscope ? Take distance of distinct vision $= 25cm$.

CORRECT ANSWER: 5

SOLUTION:

Here,

$$P = P_1 + P_2 = \ -10 \ + 30 = 20D$$

$$F = \frac{100}{P} = \frac{100}{20} \ = 5cm$$

As final image is at infinity, therefore,

$$M = \frac{D}{F} = \frac{25}{5} = 5$$

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Q-37 - 18252958

Ray coming from an object situated at infinity, fall on a convex lens and an image is formed at a distance of 16 cm from the lens. When

a concave lens is kept in contact with the convex lens, the image is formed at a distance of 20 cm from the lens combination. Calculate the focal length of the concave lens.

CORRECT ANSWER: $-80CM$

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Q-38 - 16978939

A lens of power $16D$ is used as a simple microscope. In order to obtain maximum magnification, at what distance from the lens

(A) $5cm$

(B) $10cm$

(C) $16cm$

(D) $25cm$

CORRECT ANSWER: A

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Q-39 - 16412913

Critical angle for light going from medium (i) to (ii) is θ . The speed of light in medium (i) is v then speed in medium (ii) is

(A) $v(1-\cos\theta)$

(B) $v/\sin\theta$

(C) $v/\cos\theta$

(D) $v(1-\sin\theta)$

CORRECT ANSWER: B

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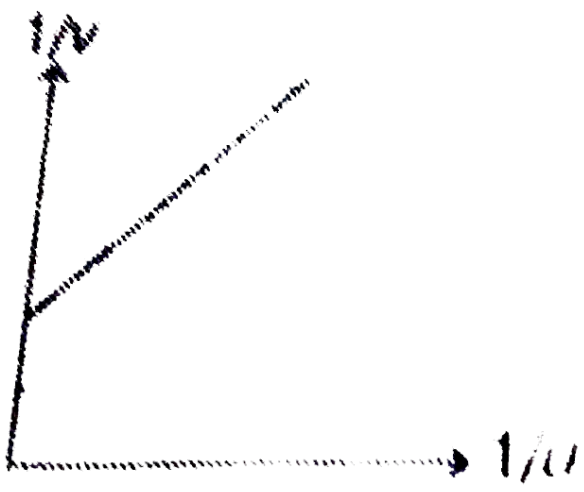
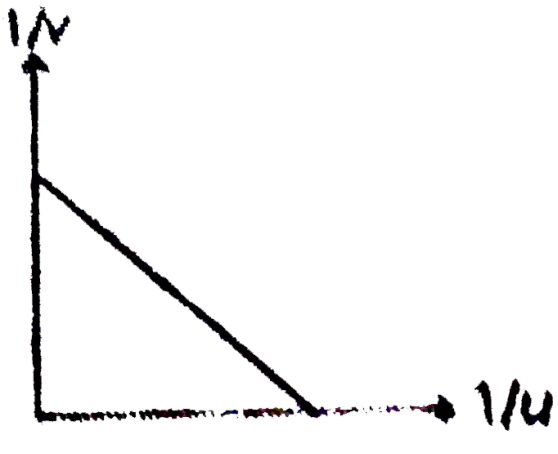
Q-40 - 17816806

An object is placed at a distance u from a concave mirror and its real image is received on a screen placed at a distance of v from the mirror. If f is the focal length of the mirror, then the graph between 1/v versus 1/u is

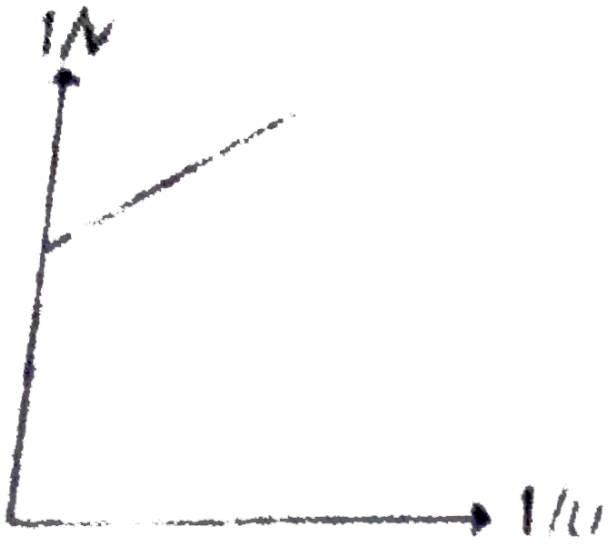
(A)

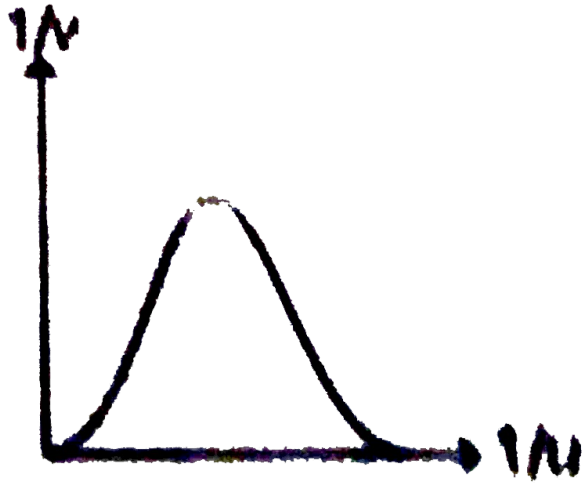


(B)



(C)



(D) 

CORRECT ANSWER: B

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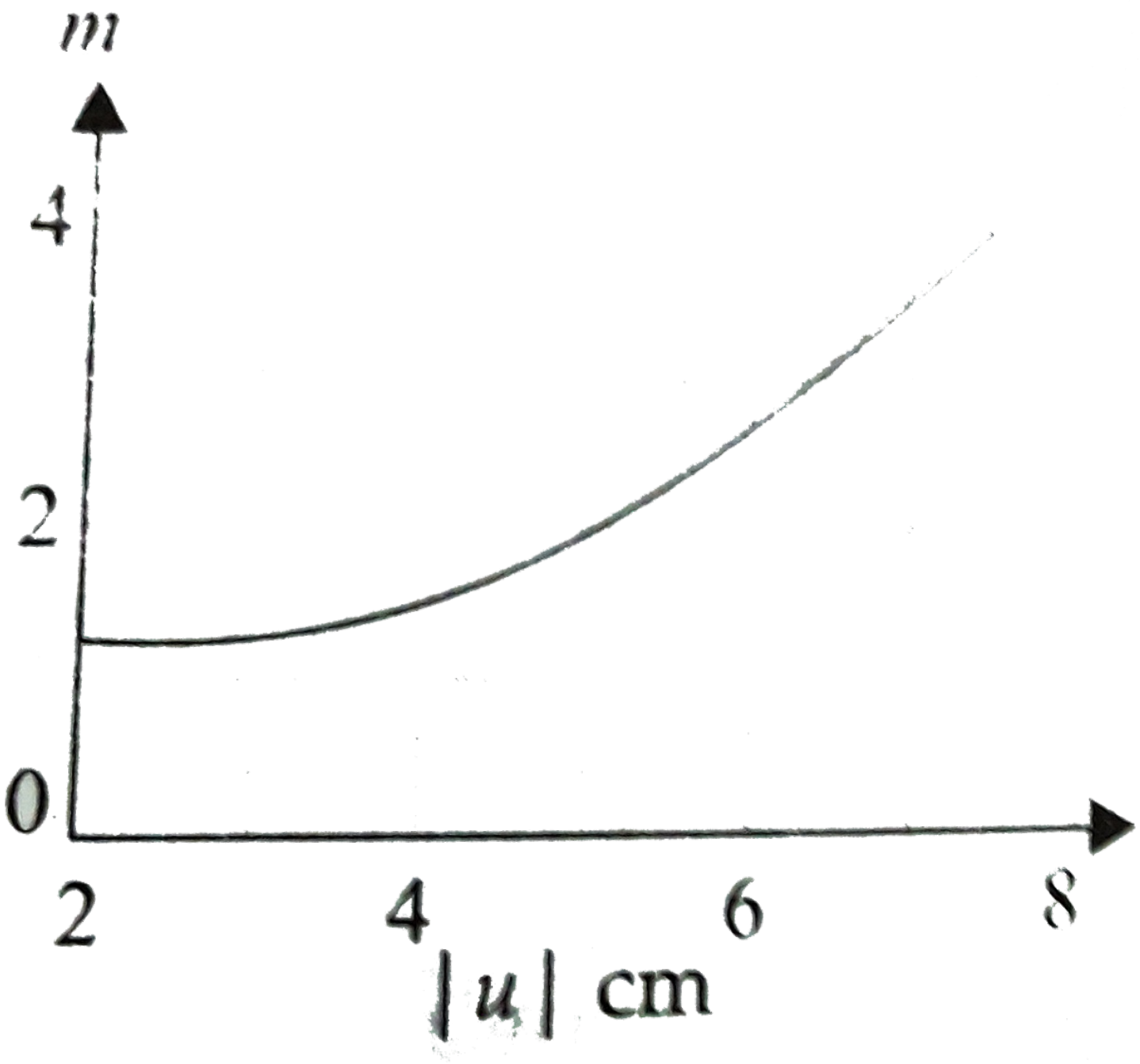
Q-41 - 11311575

An object kept on the principal axis and infront of a spherical mirror, is moved along the axis itself. Its lateral magnification m is measured, and plotted versus object distance $|u|$ for a range of u, as shown in figure. The magnification of the object when it is placed at a distance 20cm in front of the mirror is



(A) -1

(B) 1

(C) 8

(D) 20

CORRECT ANSWER: A

SOLUTION:

When $m = 2, u = \ -5cm$

$$2 = \ -\frac{v}{-5} \Rightarrow v$$

$$= 10cm$$

$$\frac{1}{f} = \frac{1}{10} + \frac{1}{-5} \Rightarrow f$$

$$= \ -10cm$$

Now when $u = \ -20cm$

$$-\frac{1}{10} = \frac{1}{v} + \frac{1}{-5}$$

$$\Rightarrow v = \ -20cm, m$$

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

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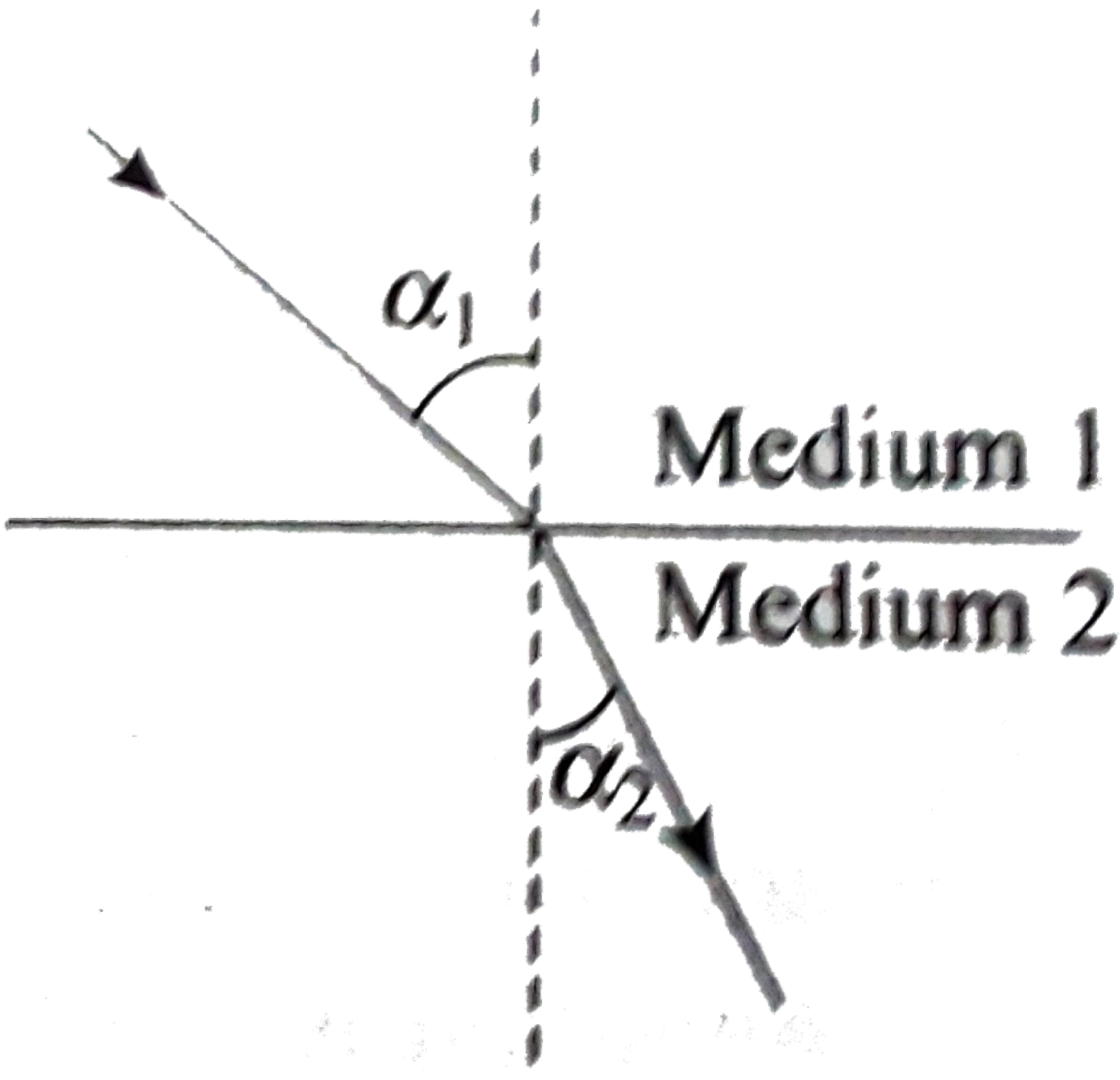
Q-42 - 11311427

A beam of light propagates through a medium 1 and falls onto another medium 2, at an angle α_1 as shown in figure. After that, it

propagates in medium 2 at an angle α_2 as shown. The light's wavelength in medium 1 is λ_1. What is the wavelength of light in medium



(A) $\dfrac{\sin\alpha_1}{\sin\alpha_2}\lambda_1$

(B) $\dfrac{\sin\alpha_2}{\sin\alpha_1}\lambda_1$

(C) $\dfrac{\cos\alpha_1}{\cos\alpha_2}\lambda_1$

(D) $\dfrac{\cos\alpha_2}{\cos\alpha_1}\lambda_1$

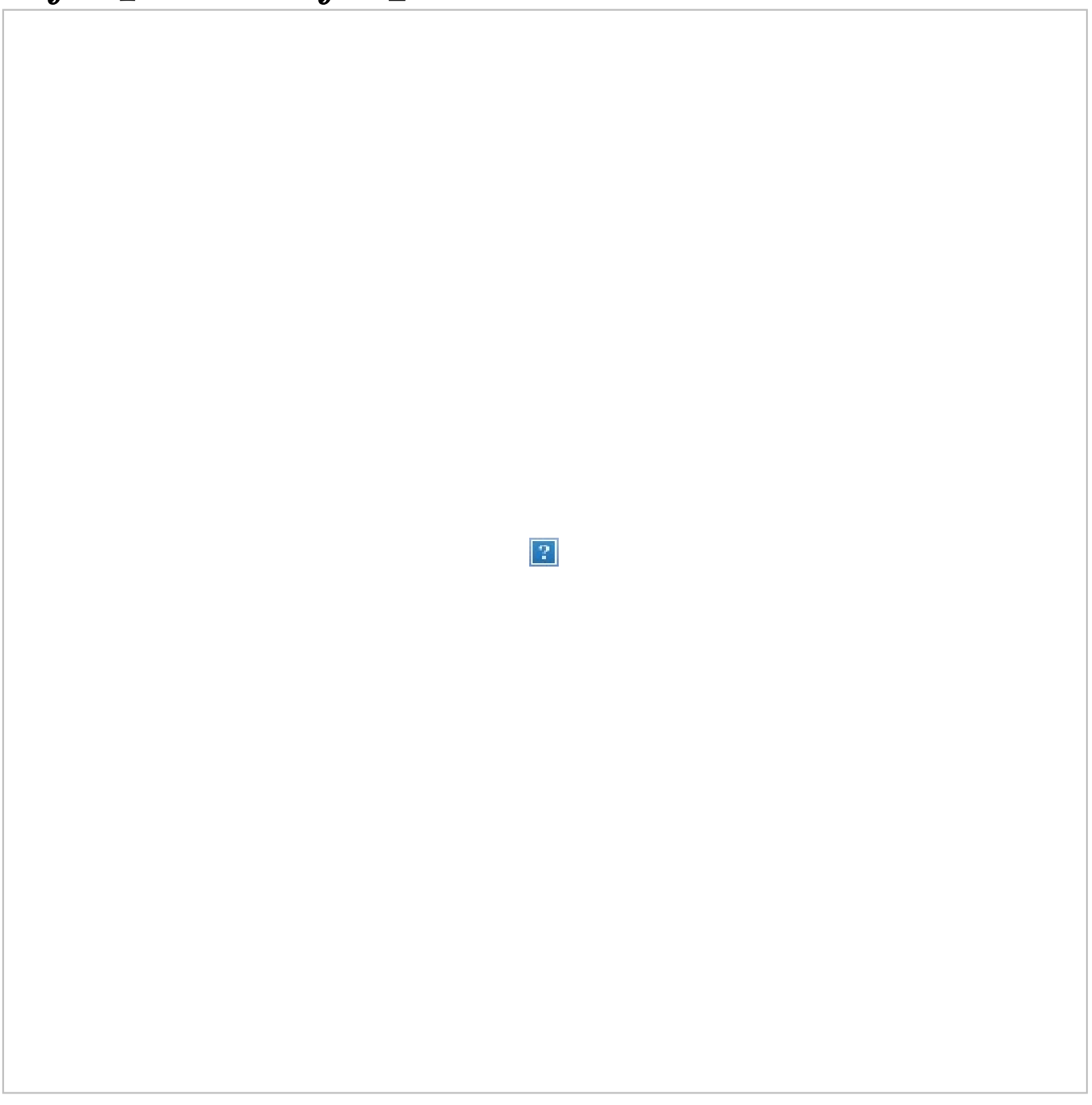
CORRECT ANSWER: B.

SOLUTION:

$$\mu_1 \sin \alpha = \mu_2 \sin \alpha_2$$

$$\frac{c}{v_1} \sin \alpha_1 = \frac{c}{v_2} \sin \alpha_2$$

$$\frac{\sin \alpha_1}{f\lambda_1} = \frac{\sin \alpha_2}{f\lambda_2}$$



Q-43 - 12010698

The near vision of an average person is $25cm$. To view an object with an angular magnification of 10, what should be the power of the microscope ?

SOLUTION:

Here,

$d = 25cm, m = 10, P = ?$

Angular magnification,

$m = \frac{d}{f} \therefore f = \frac{d}{m}$

$= \frac{25}{10} = 2.5cm$

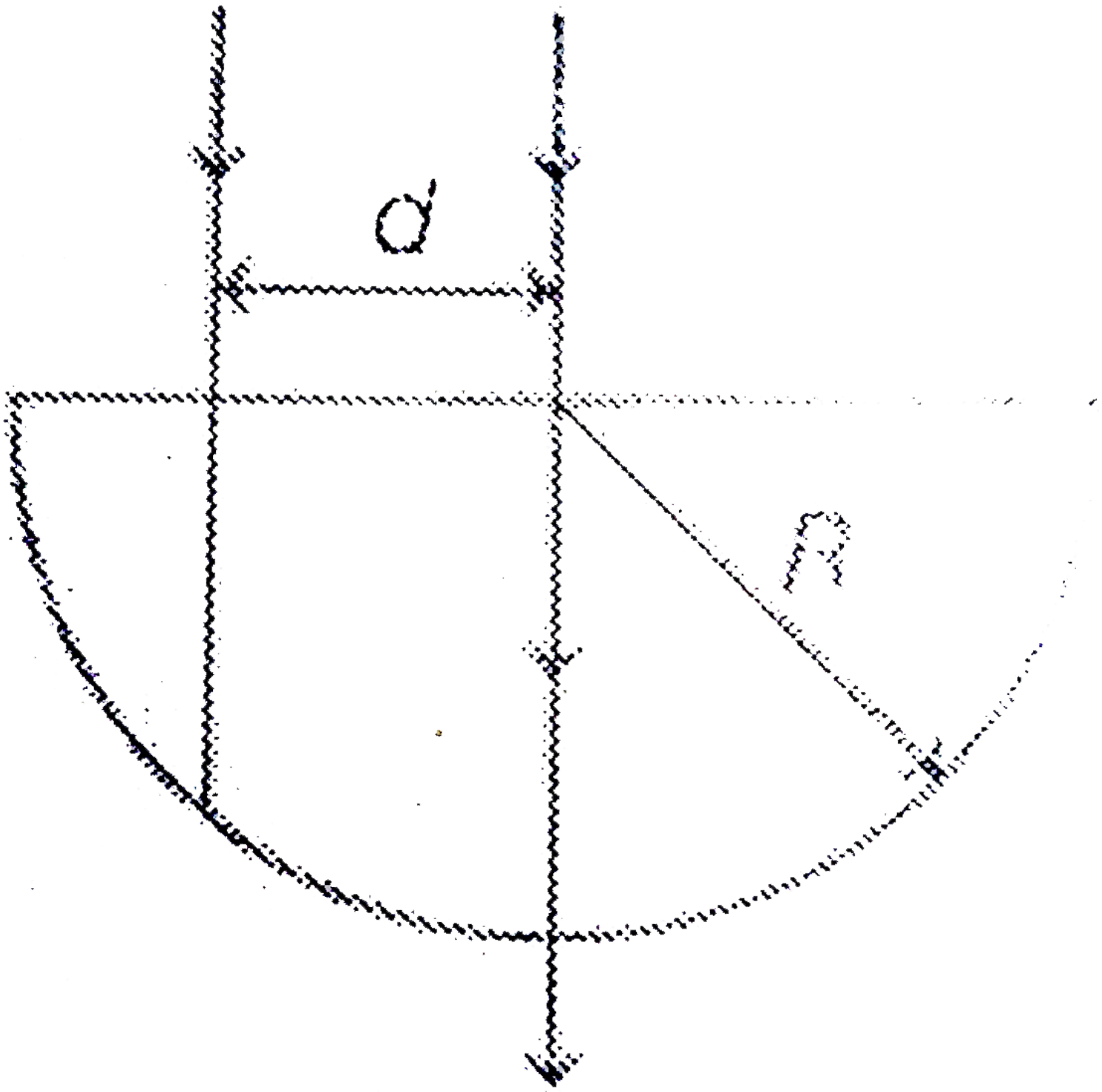
$P = \frac{100}{f} = \frac{100}{2.5}$

$= 40D$

.

Q-44 - 17816860

As shown, a narrow beam of light is incident onto a semi-circular glass cylinder of radius R. Light can exit the cylinder when the beam is at the centre. When the beam is moved parallel to a maximum distance d from the central line, no light can exit the cylinder from its lower surface. Find the refractive index of the glass.



(A) $\frac{R}{d}$

(B) $\frac{d}{R}$

(C) $\frac{R}{\sqrt{R^2 - d^2}}$

(D) $\frac{\sqrt{R^2 - d^2}}{R}$

CORRECT ANSWER: A

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Q-45 - 17816866

For an equilateral prism, it is observed that when a ray strikes grazingly at one face, it emerges grazingly at the other face, its refractive index will be

(A) $\frac{\sqrt{3}}{2}$

(B) $\frac{2}{\sqrt{3}}$

(C) 2

(D) $\frac{4}{3}$

CORRECT ANSWER: C

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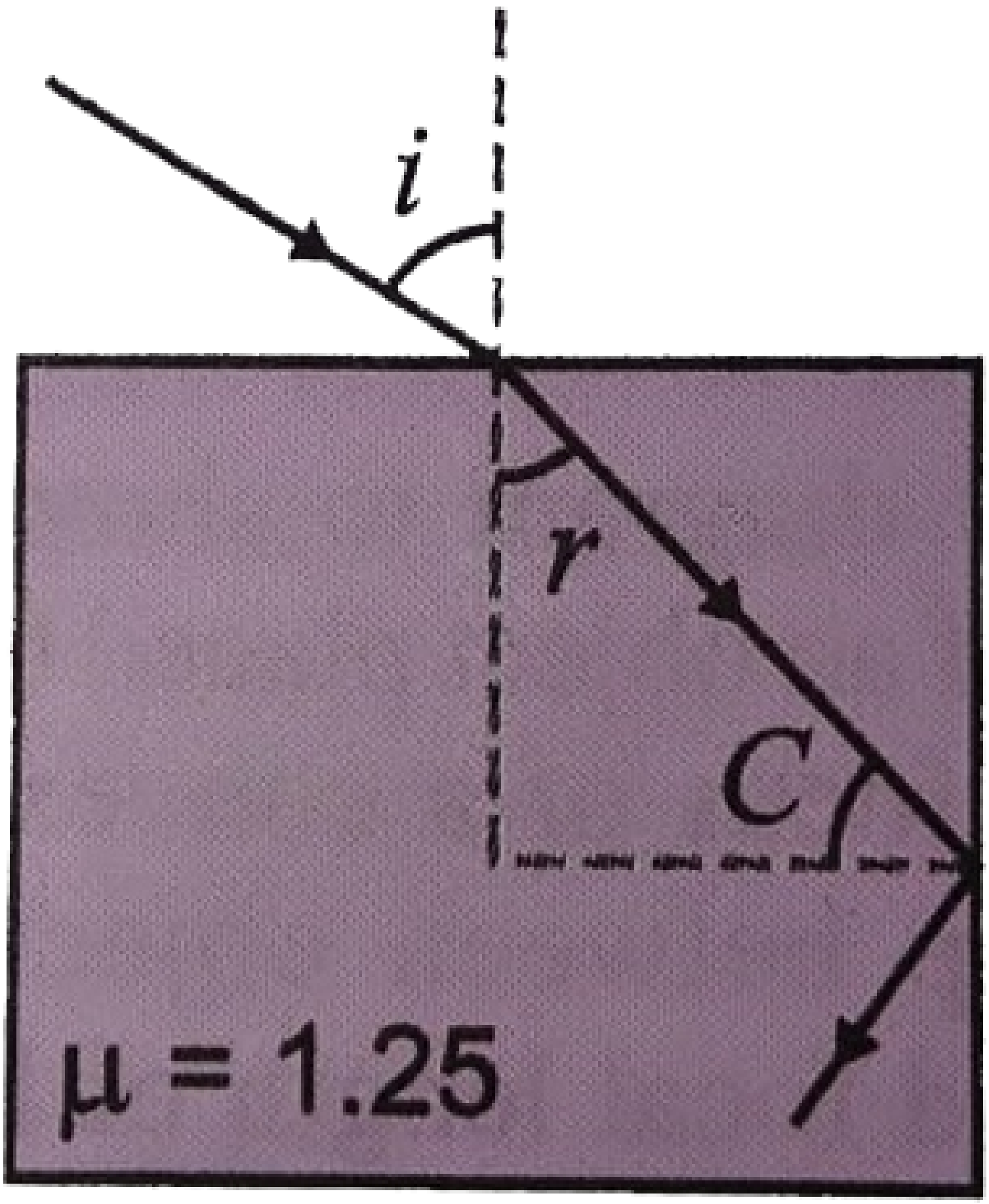
Q-46 - 12014961

In Fig. find the maximum angle i for which light suffers total internal reflection at the vertical surface.



CORRECT ANSWER: 48.6°

SOLUTION:

$$\sin C = \frac{1}{\mu} = \frac{1}{1.25}$$

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

As $C + r = 90$ or $r = 90 - C$

$$\therefore \sin r = \sin(90 - C)$$

$$= \cos C$$

$$= \sqrt{1 - \sin^2 C}$$

$$= \sqrt{1 - \left(\frac{4}{5}\right)^2} = \frac{3}{5}$$

From Snell's Law, $\frac{\sin i}{\sin r} = \mu = 1.25$

$$\sin i = 1.25 \sin r$$

$$= 1.25 \times \frac{3}{5} = 0.75$$

$$i = \sin^{-1}(0.75)$$

$$= 48.6$$

This is the maximum value of i, for which Total Internal

Reflection would occur at the vertical surface.

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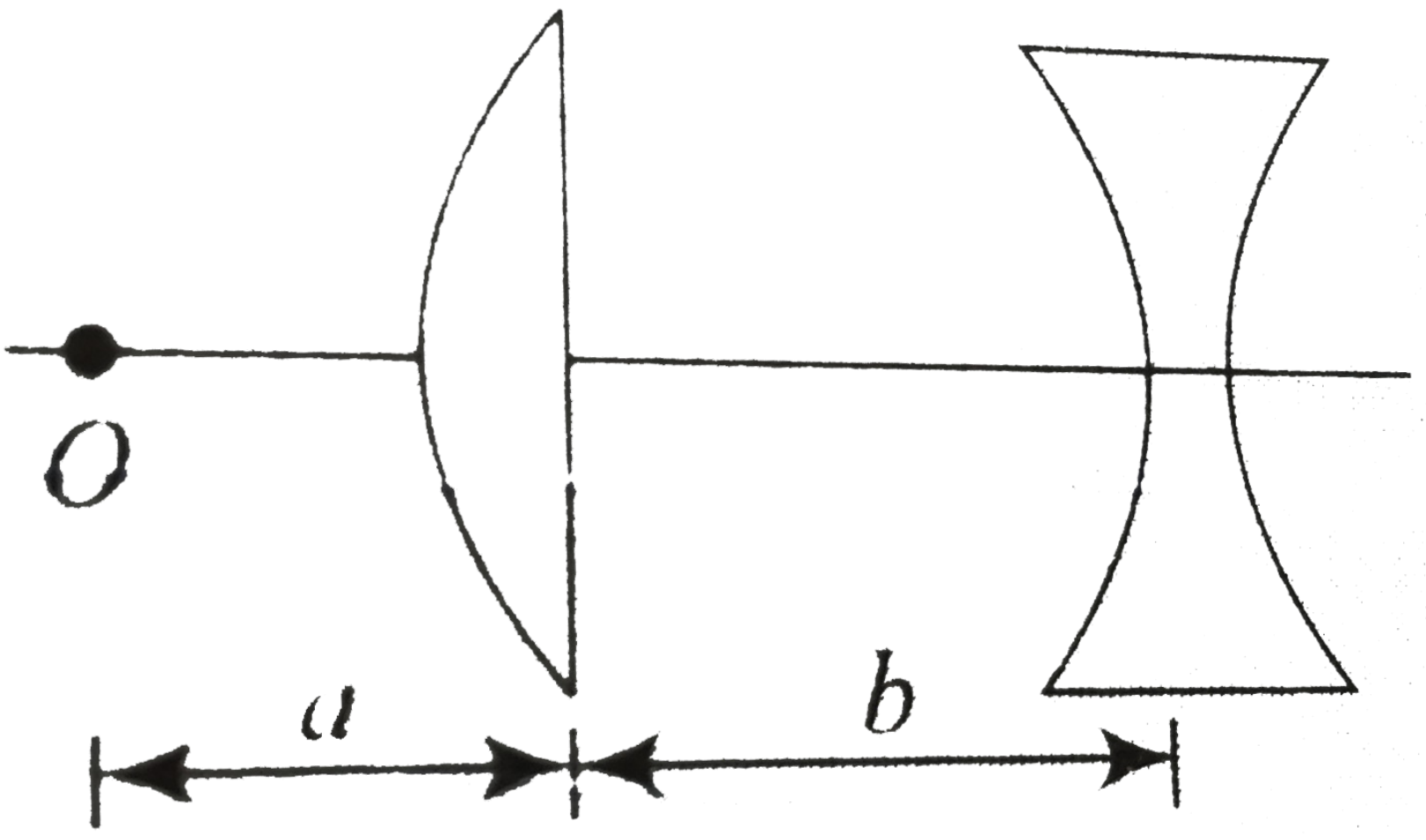
Q-47 - 11311394

A plano-convex glass lens $\left(\mu_g = 3/2\right)$ of radius of curvature $R = 10cm$ is placed at a distance of b from a concave lens of focal length 20cm. What should be the distance a of point object O from the plano-convex lens so that position of final image is independent of b?



SOLUTION:

Focal length of the plano-convex lens is

$$\frac{1}{f} = \left(\frac{3}{2} - 1\right)\left(\frac{1}{10} - \frac{1}{\infty}\right)$$

or $f = 20cm$

If point object Ois placed at a distance os 20 cm from the plano-convex lens, rays becme parallel and final image is formed at second focus or 20 cm from concave lens which is independent of b.

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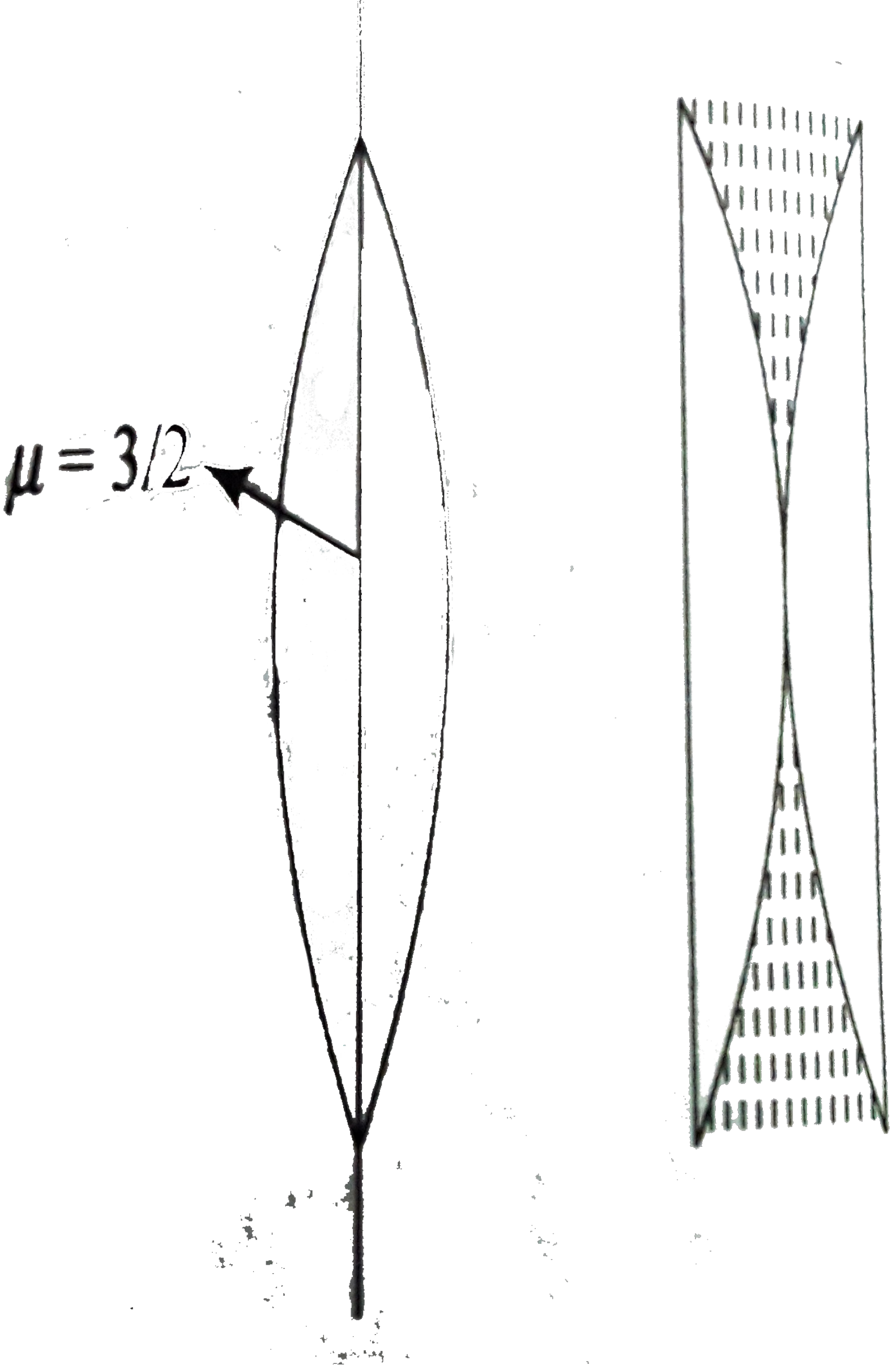
Q-48 - 11311432

A thin equiconvex lens $(\mu = 3/2)$ of focal length 10cm is cut and separated and a material of refractive index 3 is filled between them. What is the focal length of the combination?



(A) $-10cm$

(B) $-10/4cm$

(C) $-10/3cm$

(D) None of these

CORRECT ANSWER: C.

SOLUTION:

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

$$R = 10cm$$

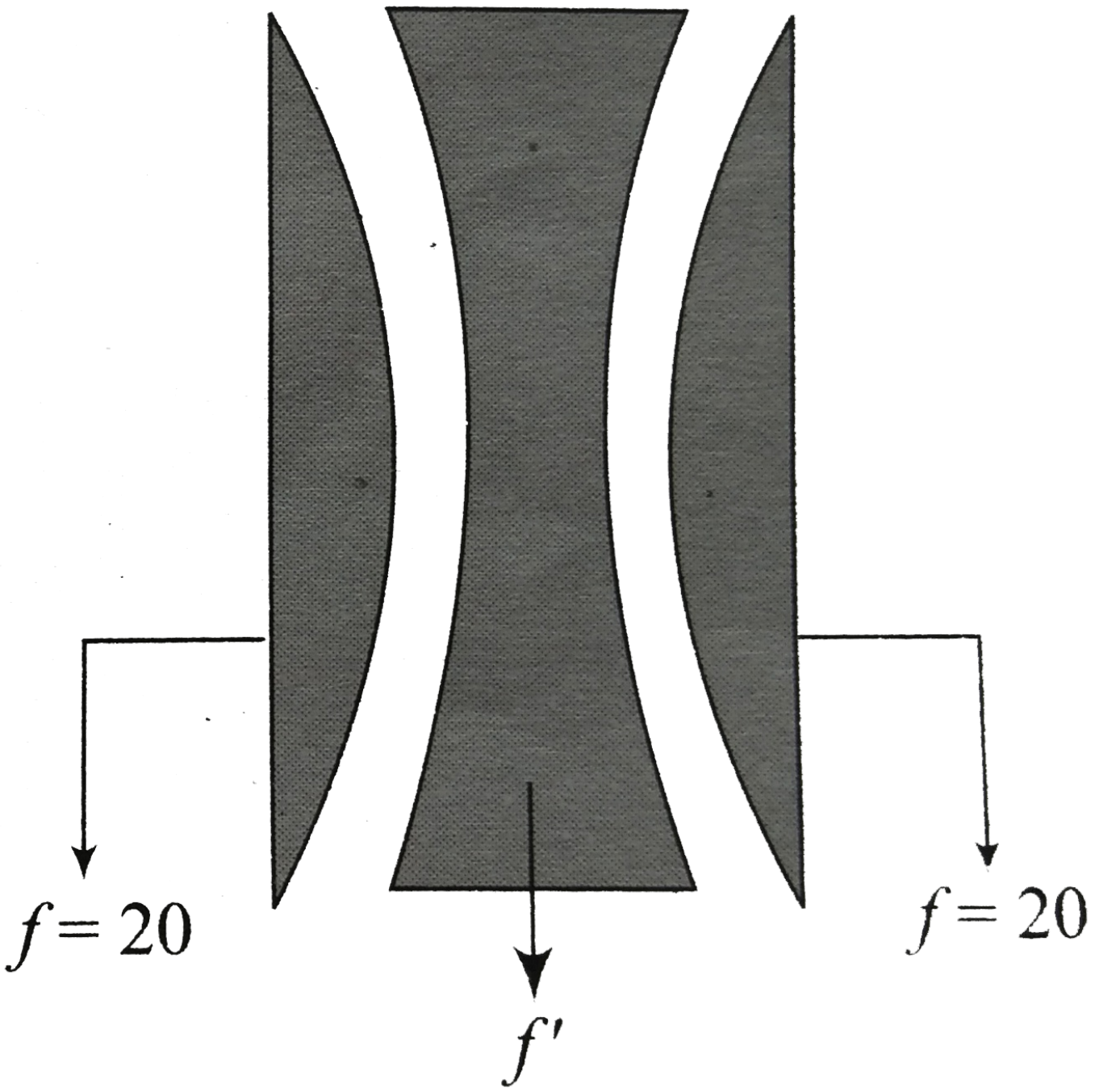
$$f' = (3 - 1)\left(\frac{1}{-10} - \frac{1}{10}\right)$$

$$f' = \frac{-10}{4}$$

$$\frac{1}{f_{eq}} = \frac{1}{20} - \frac{4}{10}$$

$$+ \frac{1}{20} = \frac{2}{20} - \frac{4}{10}$$

$f_{eq} = -10/3cm$



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Q-49 - 11311495

A ray of light traveling in glass $(\mu = 3/2)$ is incident on a horizontal glass-air surface at the critical angle θ_C. If a thin layer of water $(\mu = 4/3)$ is now poured on the glass-air surfac, the angle at

which the ray emerges into air at the water-air surface is

(A) 60°

(B) 45°

(C) 90°

(D) 180°

CORRECT ANSWER: C.

SOLUTION:

$\mu_g \sin\theta_c = \mu_1 \sin 90$

or $\mu_g \sin\theta_c = 1$

When water is poured,

$\mu_w \sin r = \mu_g \sin\theta_c$

or $\mu_w \sin r = 1$

Again, $\mu_a \sin\theta = \mu_w \sin r$

or $\mu_a \sin\theta = 1$

or $\sin\theta = 1$ or $\theta = 90$

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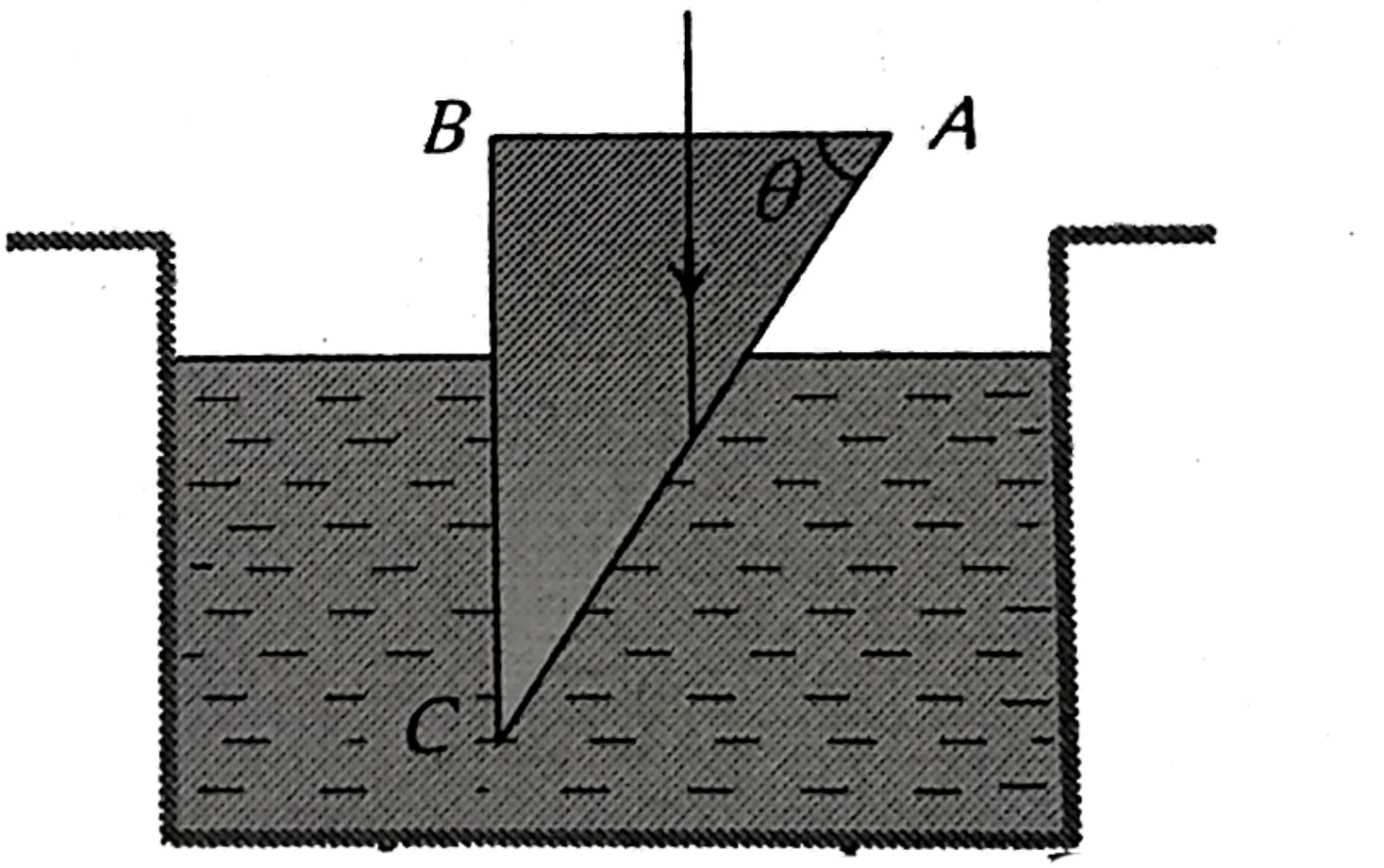
Q-50 - 16413625

A glass prism $(\mu = 1.5)$ is dipped in water $(\mu = 4/3)$ as shown in figure. A light ray is incident normally on the surface AB . It reaches the surface BC after totally reflected, if



(A) $\sin\theta \geq 8/9$

(B) $2/3 < \sin\theta < 8/9$

(C) $\sin\theta \leq 2/3$

(D) It is not possible

CORRECT ANSWER: A

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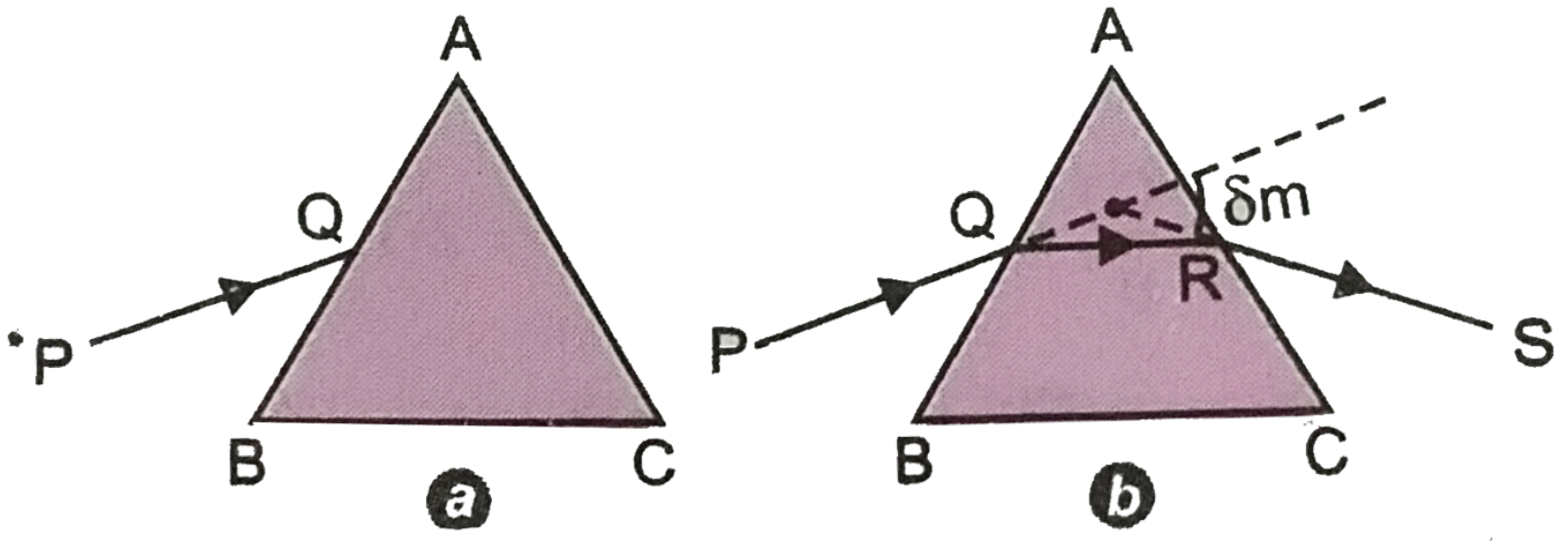
Q-51 - 12010513

A ray PQ incident on face AB of a prism ABC, as shown in Fig., emerges from the face AC such that $AQ = AR$. Draw the ray diagram showing the pasage of the ray through the prism. If the angle of prism is 60° and refractive index of the material of the prism is $\sqrt{3},$ determine the values of angle of incidence and angle of deviation.



SOLUTION:

As the refracted ray passes such that $AQ = AR$, it must go parallel to the base of the prism suffering minimum deviation.

$$r = A/2 = \frac{60}{2} = 30$$

$$\mu = \frac{\sin i}{\sin r} = \frac{\sin i}{\sin 30^{\square}}$$

$$\therefore \sin i = \mu \sin 30^{=} \sqrt{3} \times \frac{1}{2}$$

$$i = 60$$

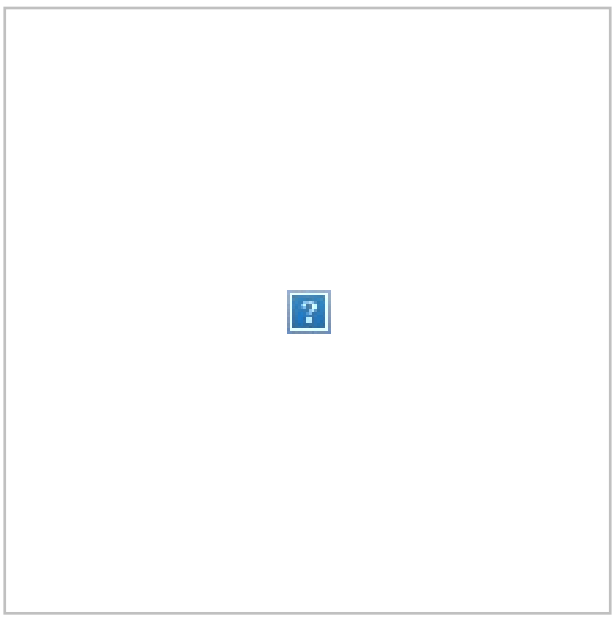
As $i + e = A + \delta_m$

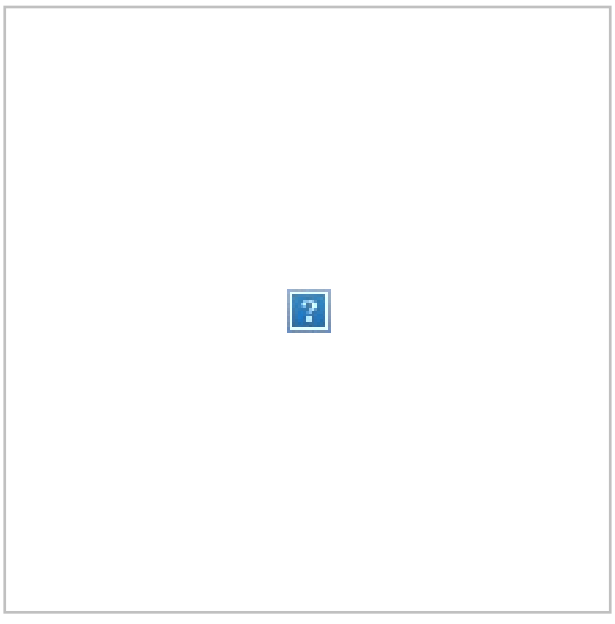
$$2i = 60^{+} \delta_m, \delta_m = 2i - 606 = 120^{-60\wedge}$$

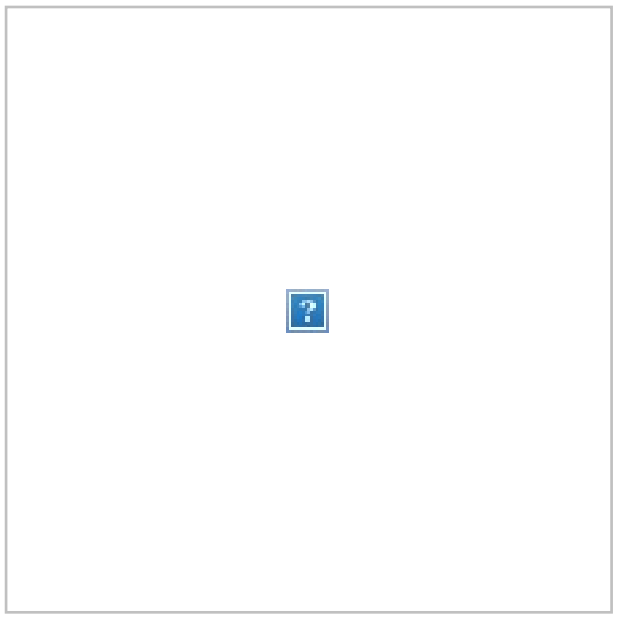
$$\delta_m = 60 \, .$$

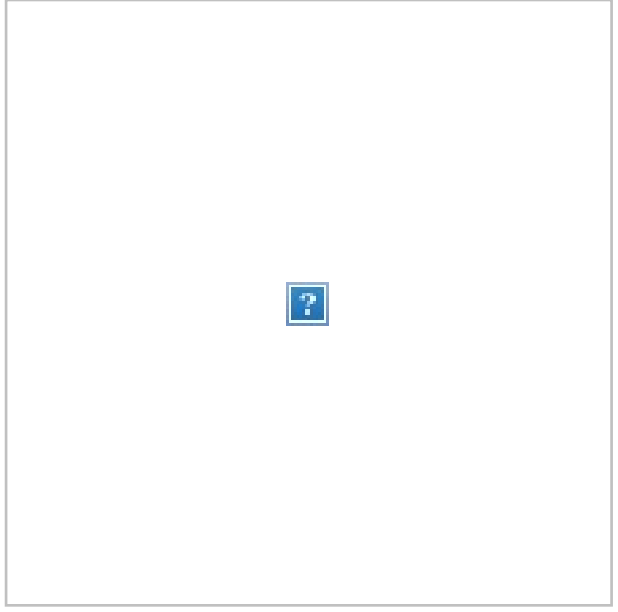
Q-52 - 10955098

The graph between $\frac{1}{v}$ and $\frac{1}{u}$ for a concave mirror looks like.

(A) 

(B) 

(C) 

(D) 

CORRECT ANSWER: B

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Q-53 - 16978986

STATEMENT-1: Real images cannot be formed by reflection of light in a convex mirror.

STATEMENT-2: Parallel rays incident on a convex mirror must diverge after reflection.

(A) Statement-1 is True, Statement-2 is True, Statement-2 is a correct explanation, for Statement-1.

(B) Statement-1 is True, Statement-2 is True, Statement-

2 is not a correct explanation for Statement-1.

(C) Statement-1 is True, Statement-2 is False.

(D) Statement-1 is a False, Statement-2 is True.

CORRECT ANSWER: D

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Q-54 - 11311491

A small piece of wire bent into an L shape, with upright and horizontal portions of equal lengths, is placed with the horizontal portion along the axis of the concave mirror whose radius of curvature is 10cm. I fthe bend is 20cm from the pole of the mirror, then the ration of the lengths of the images of the upright and horizontal portions of the wire is

(A) $1:2$

(B) $3:1$

(C) $1:3$

(D) $2:1$

CORRECT ANSWER: B.

SOLUTION:

For upright portion,

$$m = \frac{f}{f-u}$$

$$= \frac{\frac{-10}{2}}{\frac{-10}{2} - (-20)}$$

$$= \frac{-5}{-5+20} = \frac{-5}{15}$$

$$= -\frac{1}{3}$$

For horizontal portion, magnification is $\left(-\frac{1}{3}\right)^2$ i.e., $\frac{1}{9}$

Required ration is $\frac{-1/3}{1/9} = -3:1$

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Q-55 - 13397451

A slab of glass of refractive index 1.5 and thickness $3cm$ is placed with the faces perpendicular to the principle axis of a concave mirror. If the radius of curvature of the mirror is $10cm$, the distance at which an object must be placed from the mirror so that the image coincides with the object is

(A) $9cm$

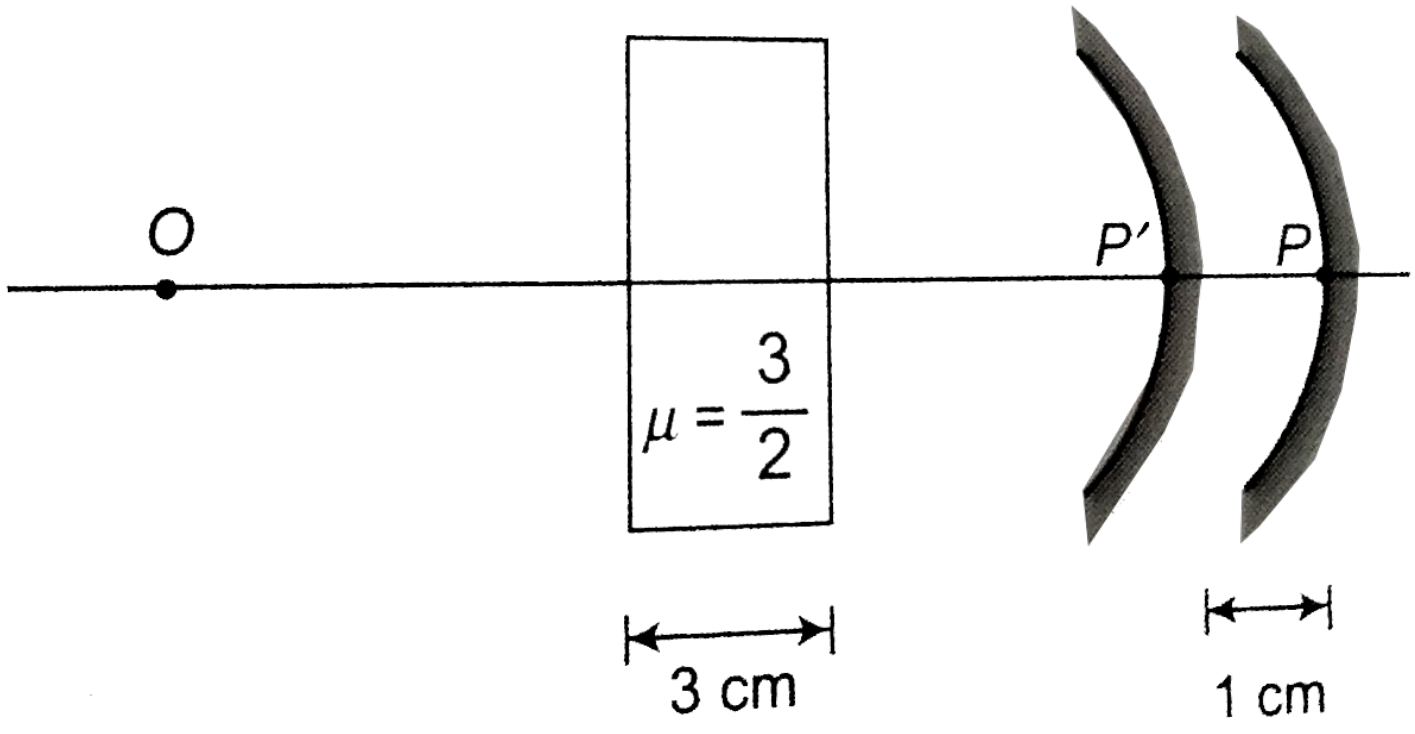
(B) $10cm$

(C) $11cm$

(D) $12cm$

CORRECT ANSWER: C

SOLUTION:



Shift of mirror towards object

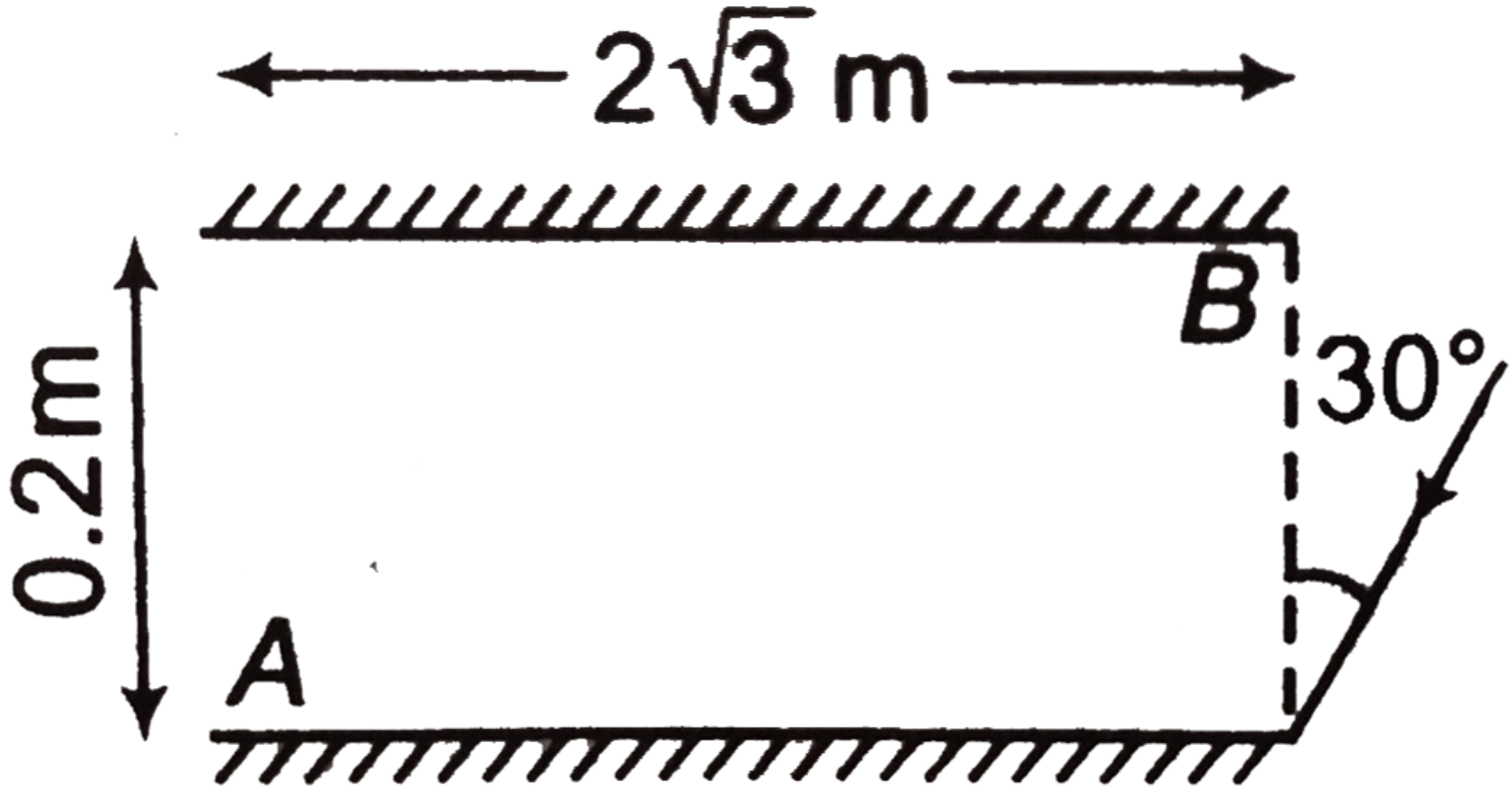
$$= 3\left(1 - \frac{1}{3/2}\right)$$

$$= 1cm$$

If object and image coincides, for this object must be placed at centre of curvature of concave mirror i.e. at distance $10cmP'$.

The distance O from actual mirror i.e. $PO = 11cm$

Two plane mirrors A and B are aligned parallel to each other as shown in the figure. A light ray is incident at an angle of 30 at a point just inside one end of A. The number of times the ray undergoes reflections (including the first one) before it emerges out is



(A) 29

(B) 30

(C) 31

(D) 32

CORRECT ANSWER: C

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Q-57 - 16413188

A ray of light is incident at an angle of 60 on one face of a prism of angle 30. The ray emerging out of the prism makes an angle of 30 with the incident ray. The emergent ray is

(A) Normal to the face through which it emerges

(B) Inclined at 30° to the face through which it emerges

(C) Inclined at 60° to the face through which it emerges

(D) None of these

CORRECT ANSWER: A

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Q-58 - 13397333

A small plane mirror placed at the centre of a spherical screen of radius R. A beam of light is falling on the mirror, If the mirror makes n revolution per second, the speed of light on the screen after reflection from the mirror will be

(A) $4\pi nR$

(B) $2\pi nR$

(C) $\frac{nR}{2\pi}$

(D) $\frac{nR}{4\pi}$

CORRECT ANSWER: A

SOLUTION:

If mirror is turned by θ, reflected ray turned by 2θ

$\omega = 2\pi n, 2\omega = 4\pi n$

$$v = R.2\omega = 4\pi nR$$

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Q-59 - 16413704

The separation between the screen and a plane mirror is 2 r . An isotropic point source of light is placed exactly midway between the mirror and the screen. Assume that mirror reflects 100% of incident light. Then the ratio of illuminances on the screen with and without the mirror is

(A) $10:1$

(B) $2:1$

(C) $10:9$

(D) $9:1$

CORRECT ANSWER: C

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Q-60 - 10968912

A parallel beam of monochromatic light of wavelength 663 nm is incident on a totally reflection plane mirror. The angle of incidence is 60° and the number of photons striking the mirror per second is 1.0×10^{19}. Calculate the force exerted by the light beam on the mirror.

CORRECT ANSWER: A

SOLUTION:

Force = Rate of change of momentum

$$= 2[N]\left[\frac{h}{\lambda}\right].\cos 60$$

N = number of photons striking per second

`(h)/(lambda) = momentum of one photn.
