Physicsaholics

DPP – 9 (Geometrical Optics & Dispersion)

Q 1. A bi-convex lens is formed with two thin plano-convex lenses as shown in the figure. Refractive index n of the first lens is 1.5 and that of the second lens is 1.2. Both the curved surfaces are of the same radius of curvature R = 14 cm. For this bi-convex lens, for an object distance of 40 cm, the image distance will be

n =1.5   **n =1.2**

R =14 cm
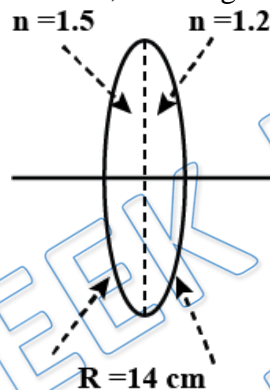
(a) -28 cm
(b) 27.5 cm
(c) 10 cm
(d) 40 cm

Q 2. A convex lens of focal length f is cut into two halves each of which is displaced equally from the axis as shown an object O is kept at a distance 2f on the axis of the original lens. Distance between the images formed is
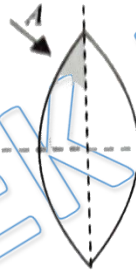
O
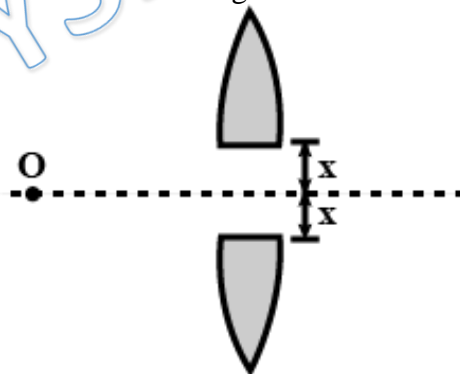
(a) x
(b) zero
(c) 4x
(d) 2x

Q 3. 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
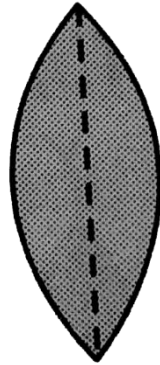
(a) $\frac{f}{2}$ (b) f

(c) $\frac{3}{2}f$ (d) $2f$

Q 4.   A convex lens of focal length f cut into parts first horizontally and then vertically. Find the focal length of part A of the lens, as shown:

(a) $\frac{f}{2}$ (b) $4f$

(c) $\frac{3}{2}f$ (d) $2f$

Q 5.   What is the focal length of a convex lens of focal length 30cm in contact with a concave lens of focal length 20cm. This combination of lenses is: (Ignore thickness of the lenses)

(a) -60 cm, diverging   (b) 60 cm, converging

(c) Can not say anything   (d) none of these

Q 6.   A converging lens has a focal length of 50cm. The power of this lens is :

(a) 0.2 D   (b) -2 D

(c) 2 D   (d) -0.2 D

Q 7.   A convex lens of focal length 25cm is placed co-axially in contact with a concave lens of focal length 20cm. Determine the power of the combination

(a) 1 D   (b) -1 D

(c) 7 D   (d) -7 D

Q 8.   A converging lens of focal length 50cm is placed co-axially in contact with another lens of unknown focal length. If the combination behaves like a diverging lens of focal length 50cm, find the power and nature of second lens

(a) -4D, converging   (b) 2D converging
(c) -4D, diverging   (d) 4D, converging

Q 9.   A screen is placed 90 cm from an object. The image of an object on the screen is formed by a convex lens two different locations separated by 20 cm. The focal length of the lens is
(a) 16 cm   (b) 50 cm
(c) 21.4 cm   (d) 83.6 cm

Q 10.   A convex lens of focal length 15 cm is placed on a plane mirror. An object is placed 20 cm from the lens. The image is formed

O

20 cm

$f = 15$ cm
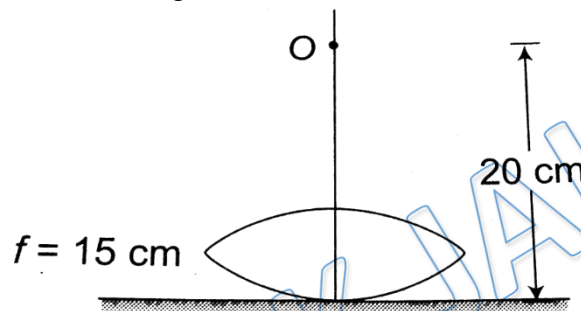
(a) 12 cm in front of the mirror
(b) 60 cm behind the mirror
(c) 60 cm in front of the mirror
(d) 30 cm in front of the mirror

Q 11.   A plano-convex lens is silvered on its plane side. The radius of curvature of the other face is 12cm and the refractive index of the material of the lens is 1.5. An object is placed 24 cm in front of the silvered lens. Where will the image be formed?

O
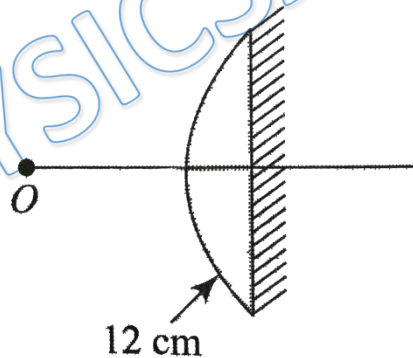
12 cm

(a) 24 cm in front of mirror
(b) 12 cm in front of mirror
(c) 18 cm in front of mirror
(d) 18 cm in behind of mirror

Q 12.   One side of the bi-concave lens is silvered. Now it will behave like
(R = radius of curvature of curved surface), μ = refractive index of lens material)
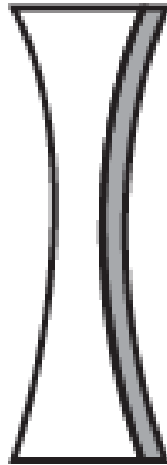
(a) Convex mirror of $f_{eq} = \frac{R}{2\mu}$

(b) Concave mirror of $f_{eq} = \frac{R}{2\mu}$

(c) Convex mirror of $f_{eq} = \frac{R}{4\mu - 2}$

(d) Concave mirror of $f_{eq} = \frac{R}{4\mu - 2}$

Q 13. Two identical glass $(\mu_g = 3/2)$ equiconvex lenses of focal length f each are kept in contact. The space between the two lenses is filled with water $(\mu_W = 4/3)$. The focal length of the combination is

(a) $\frac{4f}{3}$ (b) $\frac{3f}{4}$

(c) $\frac{f}{3}$ (d) f

Q 14. Two symmetrical double convex lenses A and B have same focal length, but the radii of curvature differ so that $R_A = 0.9 R_B$. If $\mu_A = 1.63$ find the μ_B

(a) 1.7   (b) 1.2

(c) 2.1   (d) 2.7

Answer Key

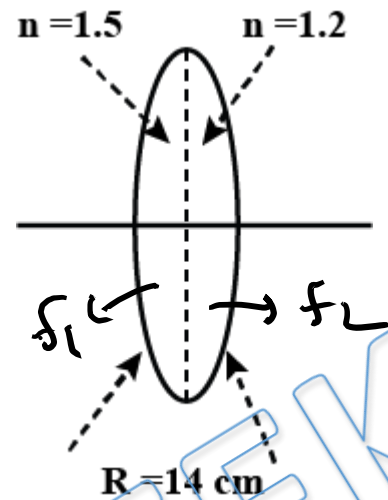| Q.1 d	Q.2 c	Q.3 d	Q.4 d	Q.5 a
Q.6 c	Q.7 b	Q.8 c	Q.9 c	Q.10 a
Q.11 a	Q.12 c	Q.13 b	Q.14 a	

Use code PHYSICSLIVE to get 10% OFF on Unacademy PLUS.

Written Solution

DPP-9 Geometrical Optics: Power, Cutting, Silvering & Combination of lenses

By Physicsaholics Team

Solution: 1

$n = 1.5$ $n = 1.2$

R = 14 cm

$$\frac{1}{f_1} = (1.5 - 1)\left(\frac{1}{14} - \frac{1}{\infty}\right)$$

$$\frac{1}{f_1} = \frac{1}{2} \times \frac{1}{14} = \frac{1}{28}$$

$$\boxed{f_1 = 28 \text{ cm}}$$

$$\frac{1}{f_2} = (1.2 - 1)\left(\frac{1}{\infty} - \frac{1}{-14}\right)$$

$$= 0.2\left(\frac{1}{14}\right)$$

$$\boxed{f_2 = 70 \text{ cm}}$$

$$\frac{1}{f_{eq}} = \frac{1}{f_1} + \frac{1}{f_2}$$

$$f_{eq} = \frac{28 \times 70}{28 + 70} = 20 \text{ cm}$$

$$\boxed{f_{eq} = 20 \text{ cm}}$$

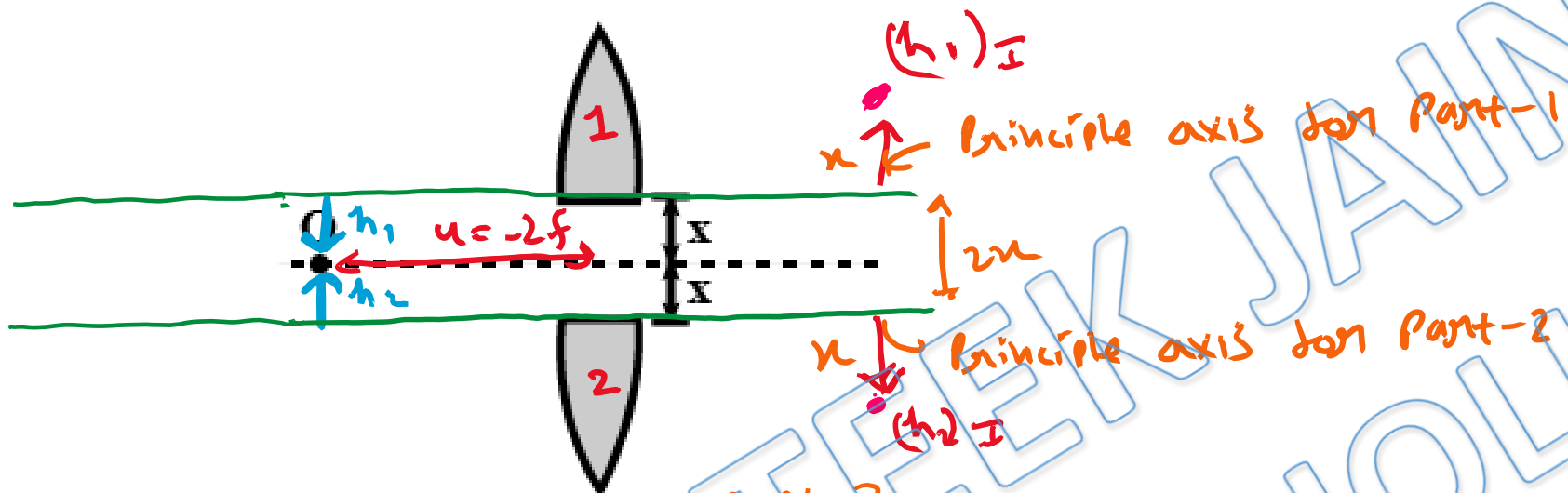$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$$

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

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

$$\boxed{v = 40 \text{ cm}} \text{ Ans.}$$

Ans. d

Solution: 2

$(h_1)_I$

Principle axis for Part-1

$u = -2f$

$2x$

Principle axis for Part-2

$(h_2)_I$

for Part-1

$m_1 = \dfrac{f}{f+u}$

$m_1 = \dfrac{f}{f-2f}$

$\boxed{m_1 = -1} \Rightarrow -ve$

$h_1 = x$

so; $(h_1)_I = -x$

for Part-2

$m_2 = \dfrac{f}{f+u}$

$\boxed{m_2 = -1} \Rightarrow -ve$

$h_2 = x$

$(h_2)_I = -x$

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

$\dfrac{1}{v} - \dfrac{1}{-2f} = \dfrac{1}{f}$

$\dfrac{1}{v} + \dfrac{1}{2f} = \dfrac{1}{f}$

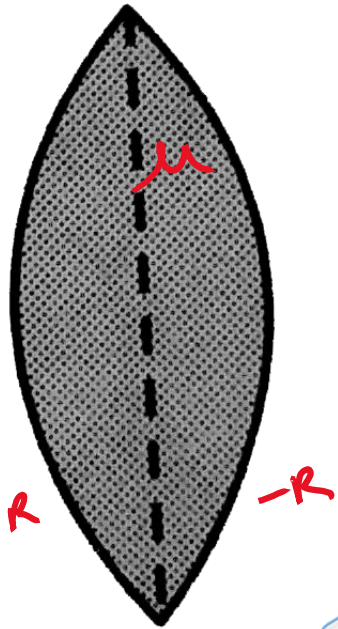$\dfrac{1}{v} = \dfrac{1}{f} - \dfrac{1}{2f} = \dfrac{1}{2f}$

$\boxed{v = 2f}$

$v = +ve \Rightarrow Real$

so; distances between Images from diagram

$= 2x + 2x = 4x$

Ans.

Ans. c

Solution: 3

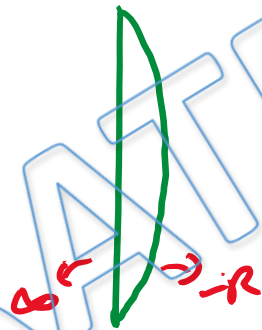$$\frac{1}{f} = (\mu - 1)\left(\frac{1}{R} - \frac{1}{-R}\right)$$

$$\frac{1}{f} = (\mu - 1)\left(\frac{2}{R}\right) \longrightarrow \text{①}$$

Now;

$$\frac{1}{f_2} = (\mu - 1)\left(\frac{1}{\infty} - \frac{1}{-R}\right)$$

$$\frac{1}{f_2} = (\mu - 1)\left(\frac{1}{R}\right) \longrightarrow \text{②}$$

① ② $\quad \dfrac{f_2}{f} = \dfrac{2/R}{1/R} = 2$

$$\boxed{f_2 = 2f} \quad \text{Ans.}$$
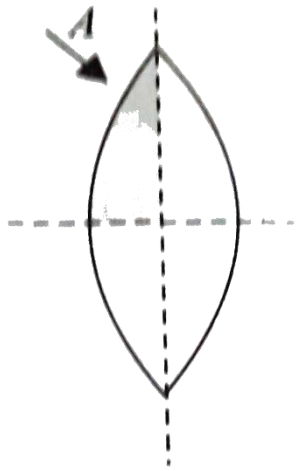
Ans. d

Solution: 4

Initially Focal length = f

Now; First cutted horizontally $\Rightarrow f_2 = f$

Now cutted vertically $\Rightarrow f_3 = 2f_2 = 2f$

$$f_3 = f_A = 2f$$

$$\boxed{f_p = 2f} \quad \text{Ans.}$$

Ans. d

Solution: 5

$$f_1 = 30 \, cm$$

$$f_2 = -20 \, cm$$

$$\frac{1}{f_{eq}} = \frac{1}{f_1} + \frac{1}{f_2}$$

$$f_{eq} = \frac{f_1 f_2}{f_1 + f_2} = \frac{30 \times (-20)}{30 + (-20)}$$

$$f_{eq} = \frac{-600}{10}$$

$$\boxed{f_{eq} = -60 \, cm}$$

$$\therefore f_{eq} = -ve \Rightarrow \text{diverging lens.}$$

Ans. a

Solution: 6

$f = 50 \, cm$

$P = \dfrac{100}{f(in\,cm)}$

$P = \dfrac{100}{50}$

$\boxed{P = +2 \, D}$

Ans. c

Solution: 7

$$f_1 = 25\,cm \Rightarrow P_1 = \frac{100}{25} = +4D$$

$$f_2 = -20\,cm \Rightarrow P_2 = \frac{100}{-20} = -5D$$

$$P = P_1 + P_2$$

$$P = 4 - 5$$

$$\boxed{P = -1\,D} \quad As$$

Ans. b

Solution: 8

$f_1 = 50\,cm$
$\Rightarrow P_1 = \dfrac{100}{50} = 2\,D$

$f_i = ?$
$P_2 = ?$

$f_{eq} = -50\,cm$

$P_{eq} = \dfrac{100}{-50} = -2D$

$\therefore P_{eq} = P_1 + P_2$

$-2D = 2D + P_2$

$\boxed{P_2 = -4D}$

Power $-ve \Rightarrow$ Diverging

Concave lens

Ans. c

Solution: 9

$d = 20\,cm$

$L = 90\,cm$

Object

screen.
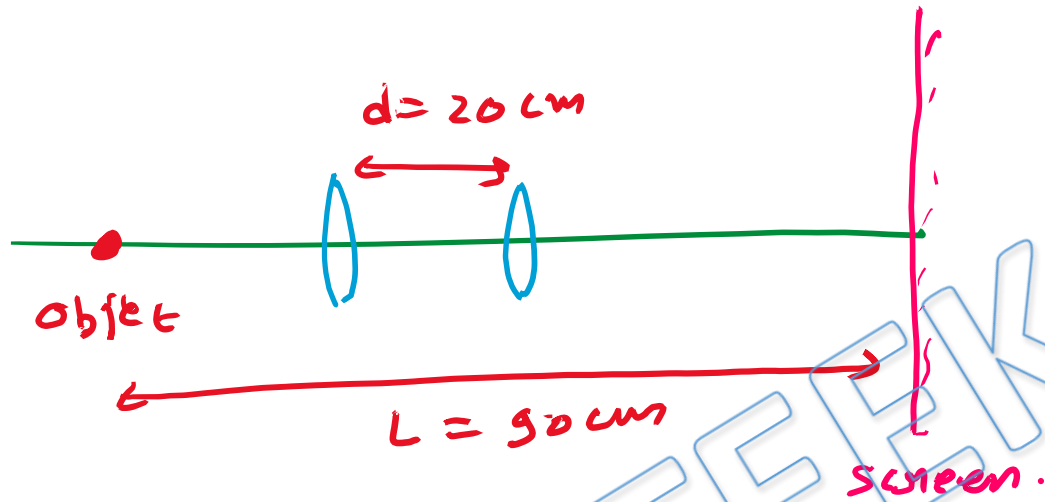
$f = \dfrac{L^2 - d^2}{4L}$

$f = \dfrac{(90)^2 - (20)^2}{4(90)}$

$f = \dfrac{8100 - 400}{360}$

$f = \dfrac{7700}{360}$

$\boxed{f = 21.39\ cm}$ As.

Ans. c

Solution: 10

$V_2 \bullet -60\ cm$

O

$V_3 \bullet 12\ cm$

20 cm

$f = 15\ cm$
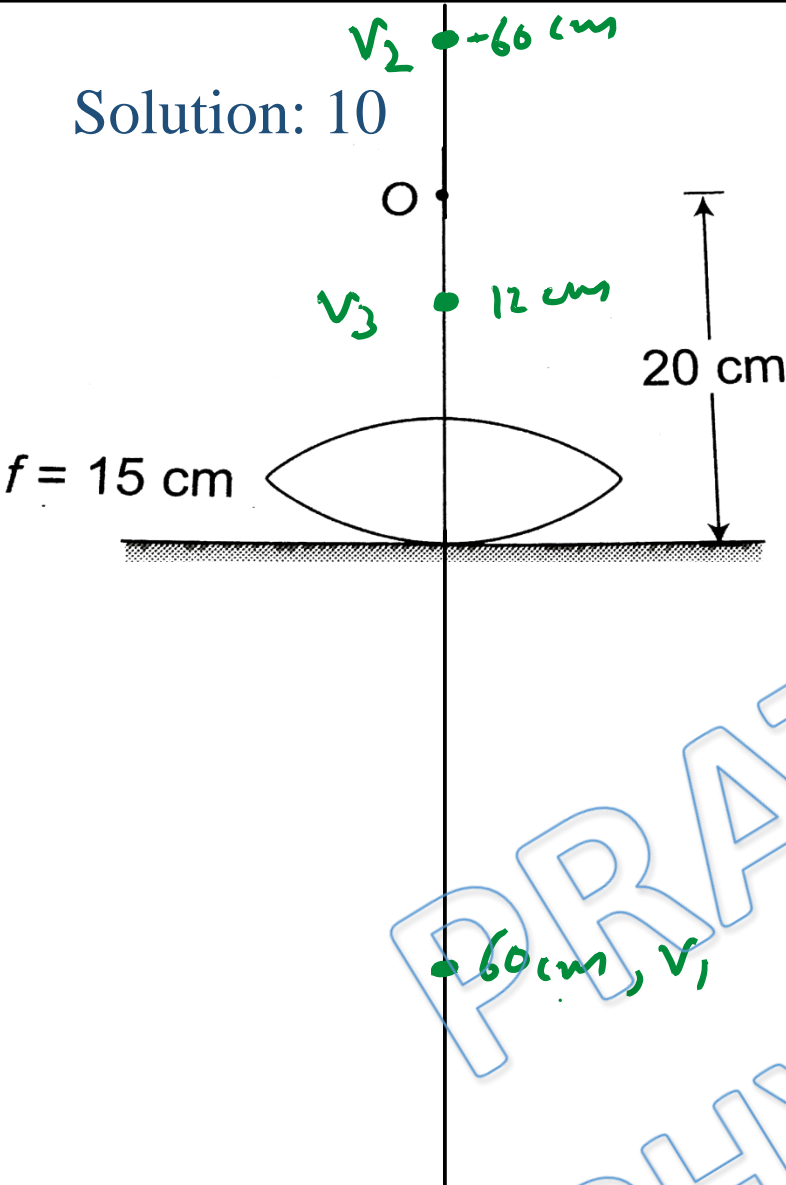
$\bullet 60cm, V_1$

1st refraction on lens

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

$$\frac{1}{v_1} - \frac{1}{-20} = \frac{1}{15}$$

$$\frac{1}{v_1} = \frac{1}{15} - \frac{1}{20}$$

$$v_1 = \frac{15 \times 20}{5}$$

$$\boxed{V_1 = 60\ cm}$$

2nd → Reflection on mirror

$$u = V_1 = 60cm$$

So) $V_2 = -60cm$.

3rd → again refraction on lens.

$$u = V_2 = 60cm$$

$$\frac{1}{v_3} - \frac{1}{60} = \frac{1}{15}$$

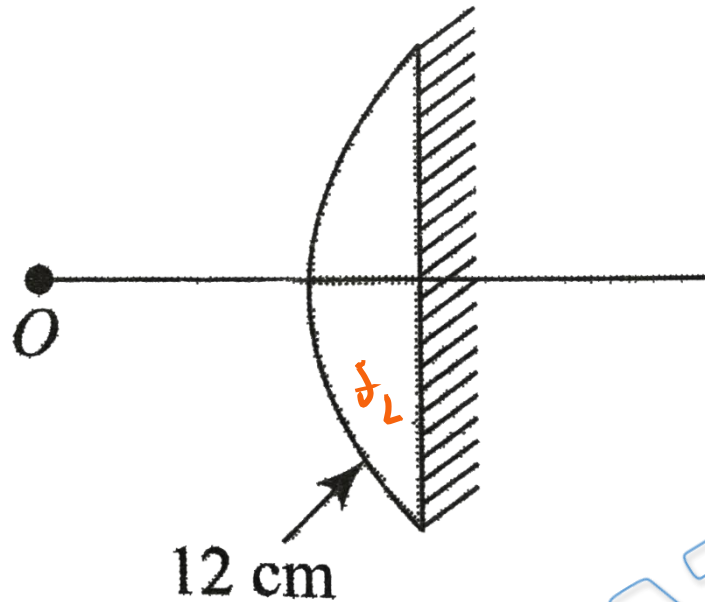$$\frac{1}{v_3} = \frac{1}{15} + \frac{1}{60} = \frac{5}{60}$$

$$\boxed{V_3 = 12\ cm}$$

in front of mirror

Ans. a

Solution: 11

$$\frac{1}{f_{ee}} = \frac{-2}{f_L} + \frac{1}{f_M}$$

$$\frac{1}{f_{ee}} = \frac{-2}{24} + \frac{1}{\infty} = \frac{-1}{12} + 0$$

$$\boxed{f_{ee} = -12 \text{ cm}}$$

$$u = -24 \text{ cm}$$

$$f_L = (1.5-1)\left(\frac{1}{12} - \frac{1}{\infty}\right)$$

$$f_L = \frac{1}{2} \times \frac{1}{12}$$

$$\boxed{f_L = 24 \text{ cm}}$$

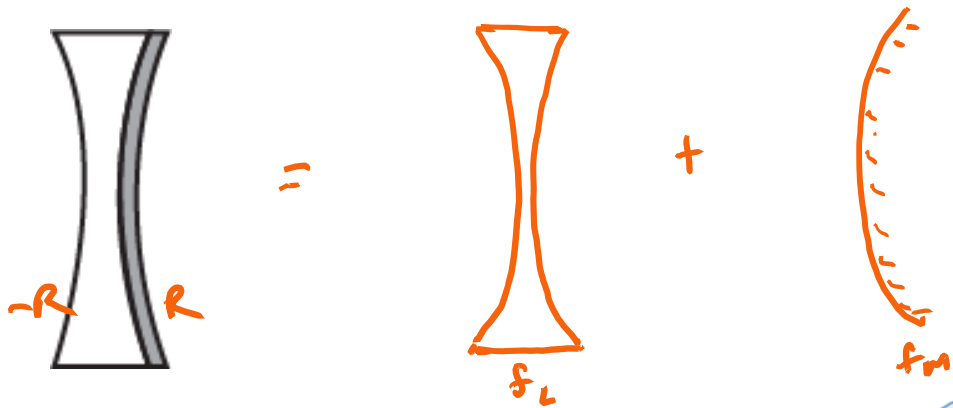$$f_m = \infty$$

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

$$\frac{1}{v} + \frac{1}{-24} = \frac{1}{-12}$$

$$\frac{1}{v} = \frac{-1}{12} + \frac{1}{24}$$

$$\boxed{v = -24 \text{ cm}} \text{ Ans.}$$

Ans. a

Solution: 12

$$\frac{1}{f_L} = (\mu-1)\left(\frac{1}{-R} - \frac{1}{R}\right)$$

$$\frac{1}{f_L} = (\mu-1)\left(\frac{-2}{R}\right)$$

$$f_m = \frac{R}{2}$$

$$\frac{1}{f_{eq}} = \frac{1}{f_m} - \frac{2}{f_L}$$

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

$$\frac{1}{f_{eq}} = \frac{2}{R} + \frac{4(\mu-1)}{R} = \frac{4\mu-2}{R}$$

$$\boxed{f_{eq} = \frac{R}{4\mu-2}}$$

$$\rightarrow \boxed{f_{eq} = +ve}$$
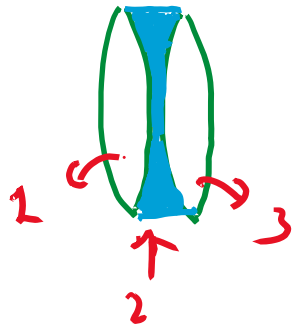
$$\therefore \mu > 1$$

$$\hookrightarrow \text{Convex Mirror}$$

Ans. c

Solution: 13

$$\frac{1}{f_1} = \left(\frac{3}{2} - 1\right)\left(\frac{1}{R} - \frac{1}{-R}\right)$$

$$\frac{1}{f_1} = \left(\frac{1}{2}\right)\left(\frac{2}{R}\right)$$

$$f_1 = f_3 = f$$

$$\frac{1}{f} = \frac{1}{2}\left(\frac{2}{R}\right) \quad —①$$

$$\frac{1}{f_2} = \left(\frac{4}{3} - 1\right)\left(\frac{1}{-R} - \frac{1}{R}\right)$$

$$\frac{1}{f_2} = \left(\frac{1}{3}\right)\left(\frac{-2}{R}\right) \quad —②$$

$$\frac{②}{①} \Rightarrow \frac{f_2}{f} = \frac{\frac{1}{3}\left(\frac{-2}{R}\right)}{\frac{1}{2}\left(\frac{2}{R}\right)}$$

$$\frac{f_2}{f} = -\frac{3}{2}$$

$$\boxed{f_2 = -\frac{3f}{2}}$$

$$\frac{1}{f_{eq}} = \frac{1}{f_1} + \frac{1}{f_2} + \frac{1}{f_3}$$

$$= \frac{1}{f} - \frac{2}{3f} + \frac{1}{f}$$

$$= \frac{2}{f} - \frac{2}{3f}$$

$$\frac{1}{f_{eq}} = \frac{4}{3f}$$

$$\boxed{f_{eq} = \frac{3f}{4}} \quad \text{Ans.}$$

Ans. b

Solution: 14

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

for double convex lens

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

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

$$\therefore f_A = f_B$$

$$\Rightarrow \frac{1}{f_A} = \frac{1}{f_B}$$

$$(\mu_A - 1)\left(\frac{2}{R_A}\right) = (\mu_B - 1)\left(\frac{2}{R_B}\right)$$

$$(\mu_A - 1) \cdot \frac{R_B}{R_A} = \mu_B - 1$$

$$(1.63 - 1)\left(\frac{1}{0.9}\right) = \mu_B - 1$$

$$0.63 / 0.9 = \mu_B - 1$$

$$0.74 = \mu_B - 1$$

$$\boxed{\mu_B = 1.74} \quad \text{Ans}$$

Ans. a

For Video Solution of this DPP, Click on below link

Video Solution on Website:- https://physicsaholics.com/home/courseDetails/31

Video Solution on YouTube:- https://youtu.be/h_-88GaAZxl

Written Solution on Website:- https://physicsaholics.com/note/notesDetalis/58

@Physicsaholics @Physicsaholics_prateek @NEET_Physics
@IITJEE_Physics physicsaholics.com

CLICK

Chalo Niklo