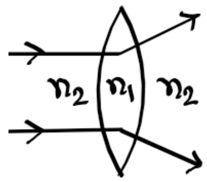
LENS M.C.Q. CLASS - X

1. Observe the behaviour of the light rays as shown in the figure. The relation of n_1 and n_2 is

A. $n_2 > n_1$ B. $n_1 \gg n_2$ C. $n_1 > n_2$ D. $n_1 = n_2$



1. The parallel rays after refraction from a convex lens becomes diverging. Therefore the refractive index of lens is less than the refractive index of medium. So, $n_2 > n_1$.

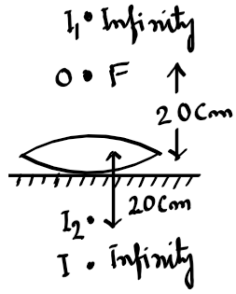
Answer - A

2. A convex lens of focal length 20 cm is placed on a plane mirror. A point object is placed at a distance of 20 cm above the lens along its axis. What will be the final image distance from the lens?

A. 10 cm B. infinity C. 20 cm D. 0

2. As the object is placed at the focus of the convex lens, then real image is formed at infinity (point I). This image is the virtual object for plane mirror. Therefore real image is formed at infinity (point I_1) due to reflection through plane mirror. Point I_1 is the object for lens which is placed at Infinity. Therefore, the image is formed at secondary principal focus of the lens i.e. 20 cm from the lens.

Answer - C



3. If an object is placed at the focus of a concave lens, the image will be formed

A. at infinity B. at the mid-point of the optical centre and the focus

C. at the optical centre D. at the focus

3. If an object is placed at the focus of a concave lens, the image will be formed at the mid-point of the optical centre and the focus.

Answer - B

4. The focal length of a convex lens is f. If an object be placed at a distance u from the lens, the condition of formation of an inverted image of equal size as the object is

A. u = 2f B. u > 2f C. f < u < 2f D. 0 < u < f

4. When an object is placed at a distance of 2f then the image is real inverted and same size of object.

Answer - A

5. The focal length of a convex lens is f. If an object be placed at a distance u from the lens, the condition of formation of a diminished inverted image is

A. u = 2f B. u > 2f C. f < u < 2f D. 0 < u < f

5. When an object is placed at a distance greater than twice of focal length of a convex lens then the image is real inverted and diminished.

Answer - B

6. The focal length of a convex lens is f. If an object be placed at a distance u from the lens, the condition of formation of an image at infinity is

A. u = f B. u > 2f C. f < u < 2f D. 0 < u < f

6. When the object is placed at focus of a convex lens, the image is formed at infinity.

Answer – A

7. The focal length of a convex, lens is f. If an object be placed at a distance u from the lens, the condition of formation of an inverted magnified image is

A. u = f B. u > 2f C. f < u < 2f D. 0 < u < f

7. When object is placed in between f and 2f of a convex lens then the image is formed real inverted and magnified.

Answer - C

8. The focal length of a convex lens is f. If an object be placed at a distance u from the lens, the condition of formation of a magnified virtual image is

A. u = f B. u > 2f C. f < u < 2f D. 0 < u < f

8. When an object is placed in between focus and optical centre of convex lens, the image is formed virtual erect and magnified.

Answer - D

9. The focal length of a concave lens is f. If an object be placed at a distance u from the lens, the condition of formation of a diminished image is

A. u = 0 B. 0 < u < ∞ C. u < 0 and $|u| < |f|$ D. diminished image will not be formed under any condition

9. A concave lens produces virtual erect and diminished image of an object which is placed at any position between infinity and lens.

Answer - B

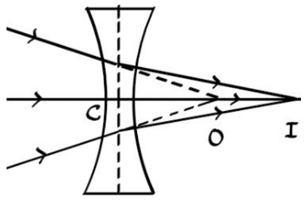
10. The focal length of a concave lens is f. If an object is placed at a distance u from the lens, the condition of formation of a real image is

A. u = 0 B. 0 < u < ∞ C. u < 0 and $|u| < |f|$ D. real image will not be formed under any condition

10. After refraction through the concave lens a converging beam of rays becomes less convergent i.e., the convergent beam meets farther away from the lens. In this case image distance CI is greater than object distance CO.

If the virtual object distance is greater than the focal length of the concave lens, then the image formed by the concave lens becomes virtual.

Answer - C



11. An object is placed at a distance of 20 cm from a convex lens of focal length 10 cm. The image distance is

A. 20 cm B. 6.67 cm C. 10 cm D. 30 cm

11. Object distance u = - 20 cm, focal length f = 10 cm, image distance v = ?

Using lens formula we get, $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$

Or, $\frac{1}{v} - \frac{1}{-20} = \frac{1}{10}$

Or, $\frac{1}{v} = \frac{1}{10} - \frac{1}{20} = \frac{1}{20}$

$\therefore$ v = 20 cm

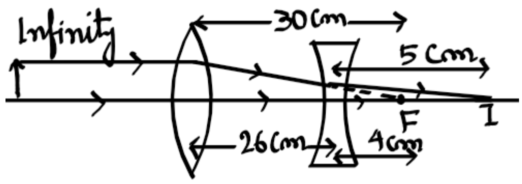
Answer – A

12. The size of the image of an object which is at infinity, as formed by a convex lens of focal length 30 cm is 2 cm. If a concave lens of focal length 20 cm is placed between the convex lens and the image at a distance at 26 cm from the convex lens, the real size of the image would be

A. 1.25 cm B. 2.5 cm C. 1.05 cm D. 2 cm

12. The size of image formed by convex lens is 2 cm and it is at the focus of the lens. When a concave lens is placed in between convex lens and the image, then that image behaves as the object for concave lens. For concave lens, object distance u = + 4 cm, focal length f = - 20 cm, image distance v = ?

Using lens formula we get, $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$



Or, $\frac{1}{v} - \frac{1}{4} = \frac{1}{-20}$

Or, $\frac{1}{v} = \frac{1}{4} - \frac{1}{20} = \frac{1}{5}$

$\therefore$ v = 5 cm

Magnification of the image by concave lens is m = $\frac{\text{size of image}}{\text{size of object}} = \frac{v}{u}$

Or, $\frac{5}{4} = \frac{\text{size of image}}{2}$

$\therefore$ size of image = 2.5 cm.

Answer - B

13. A convex lens of focal length 30 cm produces 5 times magnified real image of an object. What is the object distance?

A. 36 cm B. 25 cm C. 30 cm D. 150 cm

13. The relation between magnification of convex lens and object distance is $m = \frac{f}{u+f}$.

Here, m = -5 (for real image), focal length f = + 30 cm

Therefore, - 5 = $\frac{30}{u+30}$

Or, u +30 = -6

∴ u = -36 cm.

Answer – A

14. The focal length of a lens made of glass in air is 10 cm. What will be the focal length of the lens in water? Refractive index of glass = 1.51 and refractive index of water = 1.33.

A. 18.84 cm B. 36 cm C. 18 cm D. 37.7 cm

14. Let focal length of the lens in air = f_a and radii of curvature of the two surfaces are respectively r_1 and r_2.

$\therefore \frac{1}{f_a} = ({}_a\mu_g - 1)\left[\frac{1}{r_1} - \frac{1}{r_2}\right]$

Or, $\frac{1}{10} = (1.51 - 1)\left[\frac{1}{r_1} - \frac{1}{r_2}\right]$

Or, $\left[\frac{1}{r_1} - \frac{1}{r_2}\right] = \frac{1}{10\times 0.51} = \frac{1}{5.1}$

If the focal length of the lens in water is f_w, then $\frac{1}{f_w} = ({}_w\mu_g - 1)\left[\frac{1}{r_1} - \frac{1}{r_2}\right]$

Or, $\frac{1}{f_w} = \left[\frac{{}_a\mu_g}{{}_a\mu_w} - 1\right] \times \frac{1}{5.1}$

Or, $\frac{1}{f_w} = \left[\frac{1.51}{1.33} - 1\right] \times \frac{1}{5.1} = \frac{0.18}{1.33} \times \frac{1}{5.1}$

$\therefore f_w = \frac{1.33\times 5.1}{0.18} = 37.68 \approx 37.7$ cm.

Answer – D

15. If a lens is surrounded by a medium denser than air, the focal length of the lens

A. decreases B. increases C. remains same D. cannot be determined

15. Let focal length of the lens in air = f_a and radii of curvature of the two surfaces are respectively r_1 and r_2.

$\therefore \frac{1}{f_a} = ({}_a\mu_g - 1)\left[\frac{1}{r_1} - \frac{1}{r_2}\right]$

Or, $\frac{1}{f_a} = \left(\frac{\mu_g}{\mu_a} - 1\right)\left[\frac{1}{r_1} - \frac{1}{r_2}\right]$

If the focal length of the lens in a medium is f_m, then $\frac{1}{f_m} = ({}_m\mu_g - 1)\left[\frac{1}{r_1} - \frac{1}{r_2}\right]$

Or, $\frac{1}{f_m} = \left[\frac{\mu_g}{\mu_m} - 1\right]\left[\frac{1}{r_1} - \frac{1}{r_2}\right]$

As, $\mu_m > \mu_a$ so, $f_m > f_a$.

Answer – B

16. What type of lens is used in sunglass?

A. A concavo-convex lens whose radii of curvature of two surfaces are equal

B. A biconcave lens whose radii of curvature of the two surfaces are equal

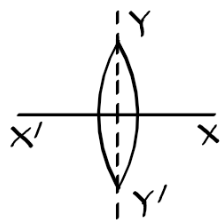
C. A biconcave lens whose radii of curvature of the two surfaces are unequal

D. Plano-concave lens

16. In sunglass concavo-convex lens whose radii of curvature of two surfaces are equal are used.

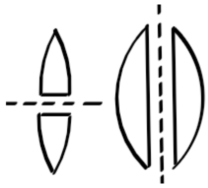
Answer - A

17. An equi-convex lens is divided into two halves along (i) XX' and (ii) YY' as shown in the figure. Suppose f, $f^{/}$, $f^{//}$ are the focal lengths of the complete lens, of each half portion of case (i) and of each half portion of case (ii), respectively. In this case the correct statement is



A. $f^{/} = 2f$; $f^{//} = f$ B. $f^{/} = f$; $f^{//} = f$ C. $f^{/} = 2f$; $f^{//} = 2f$ D. $f^{/} = f$; $f^{//} = 2f$

17. If a lens is cut horizontally into two equal halves as shown in figure, the focal length of the lens remained unchanged. So, $f^{/} = f$.



If the lens is cut vertically into two equal halves as shown in figure, the focal length becomes two times of initial value. Initial focal length of equi-convex lens is f.

Therefore, $\frac{1}{f} = (\frac{\mu_2}{\mu_1} - 1)(\frac{1}{r_1} - \frac{1}{r_2}) = (\mu - 1)\frac{2}{r}$. Here $r_1 = +r$, $r_2 = -r$, $\mu_2 = \mu$ and $\mu_1 = 1$.

The focal length of plano-convex lens is $f^{//}$. Therefore, $\frac{1}{f^{//}} = (\frac{\mu_2}{\mu_1} - 1)(\frac{1}{r_1} - \frac{1}{r_2}) = (\mu - 1)\frac{1}{r}$.

Here $r_1 = +r$, $r_2 = \infty$. Hence, $f^{//} = 2f$.

Answer – D

18. Which of the following is true for rays coming from infinity incident on the lens shown in figure?

A. Two images are formed B. Continuous image is formed between focal points of upper and lower lens C. One image is formed D. none of the above

18. The upper half and lower half of the lens have two medium of different refractive indices, then after refraction through lens two images are produce.

Answer - A

19. A beam of parallel rays after refraction in a convex lens converges at a point. If a concave lens of same focal length be placed in contact with the convex lens where will the image be shifted?

A. at infinity B. at 2f C. between 0 and f D. between f and 2f

19. If a convex lens (focal length $f_1 = +f$), in contact with a concave lens of same focal ($f_2 = -f$), then the combination will act as a plane transparent plate. $\frac{1}{f^{/}} = \frac{1}{f_1} + \frac{1}{f_2} = +\frac{1}{f} - \frac{1}{f} = 0$.

$\therefore f^{/} = \infty$. A beam of parallel rays after refraction through combination forms image at infinity.

Answer – A

20. The ratio of powers of a thin convex and a thin concave lens is $\frac{3}{2}$. When they are in contact, the equivalent focal length is 30 cm. Their individual focal lengths are

A. 75 cm, - 50 cm B. 10 cm, - 15 cm C. 15 cm, - 10 cm D. 50 cm, - 75 cm

20. When a convex lens and concave lens of power p_1 and p_2 respectively are in contact, the effective power of the combination is $p = \frac{1}{f} = \frac{100}{30} = p_1 + p_2$ ---- (i)

Again $\frac{p_1}{p_2} = \frac{3}{2}$ or, $p_1 = \frac{3p_2}{2}$ ---- (ii)

From equations (i) and (ii) we get, $\frac{100}{30} = \frac{3p_2}{2} - p_2 = \frac{p_2}{2}$ [focal length of concave lens is negative]

The focal length of concave lens is $f_2 = -\frac{1}{p_2} = -\frac{30}{200} = -0.15$ m = - 15 cm.

The focal length of convex lens is $f_1 = \frac{1}{p_1} = \frac{1}{10} = 0.1$ m = 10 cm [$\because \frac{p_1}{\frac{200}{30}} = \frac{3}{2} \therefore p_1 = 10$ D].

Answer – B

21. Two thin lenses of focal length f_1 and f_2 are kept in contact coaxially. The power of the combination is given by

A. $\sqrt{\frac{f_1}{f_2}}$ B. $\sqrt{\frac{f_2}{f_1}}$ C. $\frac{f_1+f_2}{2}$ D. $\frac{f_1+f_2}{f_1 f_2}$

21. If two lenses of focal length f_1 and f_2 are kept in contact coaxially, then the equivalent focal length of the combination of lenses is given by $\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2} = \frac{f_1+f_2}{f_1 f_2} = P$ [power of the combination]

Answer – D

22. Convex lens is cut into two equal parts by a plane perpendicular to principal axis. If the power of the original lens is 4D. The power of the halved portion will be

A. 2 D B. 3 D C. 4 D D. 5 D

22. If the lens is cut vertically into two equal halves, the focal length becomes two times of initial value. So, power becomes half [as $p = \frac{1}{f}$]. The power of the halved portion will be 2 D.

Answer – A

23. An air bubble in water will behave as a

A. converging lens B. diverging lens C. Plane glass slab D. concave mirror

23. When light travels from water to air then the air bubble behaves as a lens.

The focal length of the lens is $\frac{1}{f} = (\frac{\mu_a}{\mu_w} - 1)(\frac{1}{r_1} - \frac{1}{r_2})$. As $\mu_w > \mu_a$, f is negative. Therefore, air bubble in water will behave as a diverging lens.

Answer – B

24. The radii of curvature of a double convex lens are 10 cm and 15 cm. If the refractive index of the material of the lens is 1.5, its focal length is

A. 12 cm B. 24 cm C. 30 cm D. 24 m

24. The focal length of the lens is $\frac{1}{f} = (\frac{\mu_g}{\mu_a} - 1)(\frac{1}{r_1} - \frac{1}{r_2}) = (1.5-1)(\frac{1}{10} - \frac{1}{-15}) = \frac{1}{12}$

∴ f = 12 cm

Answer – A

25. Two lenses of power 2 D and - 3.5 D are placed in contact. The power of the combination will be

A. 1D B. – 1.5 D C. 2 D D. -3.5 D

25. The effective power of the combination is $p = p_1 + p_2 = 2 + (-3.5) = -1.5$ D

Answer – B

26. A convex lens of focal length f forms an image which is m times magnified on a screen. If the distance between the object and the screen is x, then f is

A. $\frac{mx}{(m-1)^2}$ B. $\frac{mx}{(1+m)^2}$ C. $\frac{(1+m)^2}{mx}$ D. $\frac{(m-1)^2}{mx}$

26. Since the image is formed on a screen, it is real. So the image distance is positive. The focal length is also positive and magnification m is negative. Let us consider object distance is u = - a.

Magnification, $-m = \frac{v}{u} = \frac{v}{-a}$

Or, v = ma

Here, u + v = x

Or, a + ma = x

Or, $a = \frac{x}{1+m}$

∴ $u = -\frac{x}{1+m}$

∴ $v = \frac{mx}{1+m}$

Using lens formula we get, $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$

Or, $\frac{1+m}{mx} + \frac{1+m}{x} = \frac{1}{f}$

Or, $\frac{1+m+m(1+m)}{mx} = \frac{1}{f}$

Or, $f = \frac{mx}{(1+m)^2}$.

Answer - B

27. A luminous object and a screen are placed 60 cm apart. To cast an image magnified twice the size of the object on the screen, what type of lens is required and what will be its focal length?

A. convex, 10.33 cm B. concave, 10.33 cm C. convex, 13.33 cm D. concave, 13.33 cm

27. Since the image is formed on a screen, it is real. Hence the lens to be used should be convex.

$\frac{v}{u} = -2$ or, $v = -2u$

In this case, u + v = 60 cm

Or, -3u = 60 cm

∴ u = -20 cm

∴ v = 60 – 20 = 40 cm

Substituting in lens formula, $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$

Or, $\frac{1}{40} - \frac{1}{-20} = \frac{1}{f}$ [u = - 20 cm, as the object is real]

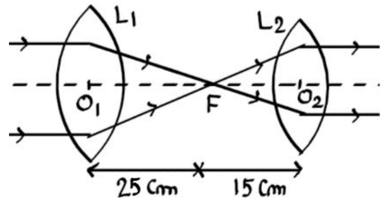
Or, f = 13.33 cm

∴ Focal length of the lens is 13.33 cm.

Answer - C

28. Two convex lenses of focal length 25 cm and 15 cm are placed coaxially. A ray of light parallel to the principal axis of a lens is incident on it and emerges from the other lens parallel to the same axis. What is the distance of separation between the lenses?

A. 30 cm B. 35 cm C. 40 cm D. 45 cm



28. The ray incident on the lens L_1 passes through the second principal focus (F) of this lens after refraction. As the ray after refraction through the lens L_2 moves parallel to the principal axis of this lens, F is the first principal focus of the lens L_2.

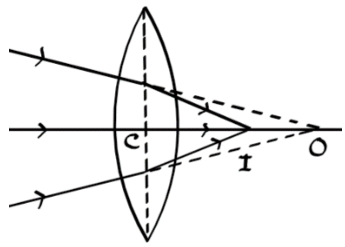
So, O_1F = 25 cm, O_2F = 15 cm

∴ Distance of separation between the lenses = 25 + 15 = 40 cm.

Answer – C

29. If a convex lens of focal length 20 cm is placed in the path of a convergent beam of rays, the beam meets at I. In absence of the lens the beam would meet at O. If the distance of O from the centre of lens is 30 cm, the distance of I from the centre of lens is

A. 10 cm B. 12 cm C. 16 cm D. 20 cm



29. From diagram, O is the virtual object and I is its real image.

Object distance CO = u = + 30 cm, focal length of lens f = + 20 cm,

Image distance CI = v = ?

The equation of lens is $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$

Or, $\frac{1}{v} - \frac{1}{30} = \frac{1}{20}$

Or, $\frac{1}{v} = \frac{1}{30} + \frac{1}{20} = \frac{1}{12}$

∴ v = 12 cm

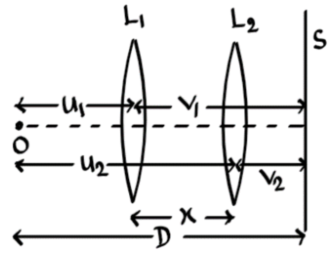
The distance of I from the lens is CI = 12 cm.

Answer – B

30. The object and screen position remain fixed and separated by a distance D. A convex lens of focal length f can be placed in two such positions that in each position, a distinct image of the object is formed on the screen. It is possible when

A. $D = 4f$ B. $D < 4f$ C. $D > 2f$ D. $D > 4f$

30. A convex lens is placed in between the object and screen forms real images on the screen for two positions of lens L_1 and L_2.



Let us consider, object distance = u, image distance = v.

Here, D = u + v

The equation of convex lens for real image is $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$

Or, $\frac{1}{D-u} + \frac{1}{u} = \frac{1}{f}$

Or, $\frac{D}{(D-u)u} = \frac{1}{f}$

or, $u^2 - Du + Df = 0$

On solving the equation, we get the following two values of u i.e. $u_1 = \frac{D-\sqrt{D^2-4Df}}{2}$

And $u_2 = \frac{D+\sqrt{D^2-4Df}}{2}$ [taking, $u_1 < u_2$]

When $D^2 > 4Df$ i.e., $D > 4f$, the values of u_1 and u_2 are real and different.

So, if the distance between the object and the screen is greater than 4 times the focal length of the lens, then for two different positions of the lens (L_1 and L_2), two real images of the object O are formed on the screen.

Answer – D

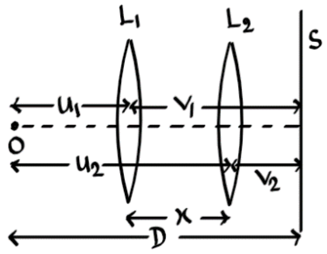
31. A convex lens is placed between an object and a screen. If d_1 and d_2 are the height of two real images formed for two positions of the lens and d be the height of the object, then d is equal to

A. $\sqrt{\frac{d_1+d_2}{d_1d_2}}$ B. $\sqrt{\frac{d_1d_2}{d_1+d_2}}$ C. $\sqrt{d_1d_2}$ D. $\sqrt{2d_1d_2}$

31. For the first position of the lens L_1, the height of the image is d_1 and for the second position of the lens L_2, the height of the image is d_2.

If u_1 and v_1 be the object distance and image distance respectively for the first position of the lens, then magnification, $m_1 = \frac{d_1}{d} = \frac{v_1}{u_1} = \frac{D-u_1}{u_1}$ [$\because D = u_1 + v_1$].

If u_2 and v_2 be the object distance and image distance for the second position of the lens, then magnification, $m_2 = \frac{d_2}{d} = \frac{v_2}{u_2} = \frac{D-u_2}{u_2}$ [$\because D = u_2 + v_2$].



Therefore, $m_1 \times m_2 = \frac{d_1}{d} \times \frac{d_2}{d} = \frac{(D-u_1)(D-U_2)}{u_1u_2}$

Or, $\frac{d_1d_2}{d^2} = \frac{D^2-(u_1+u_2)D+u_1u_2}{u_1u_2}$

Or, $\frac{d_1d_2}{d^2} = \frac{D^2-(u_1+v_1)D+u_1u_2}{u_1u_2}$ [$\because u_2 = v_1$]

Or, $\frac{d_1d_2}{d^2} = \frac{D^2-D^2+u_1u_2}{u_1u_2}$ [$\because u_1 + v_1 = D$]

Or, $\frac{d_1d_2}{d^2} = \frac{u_1u_2}{u_1u_2}$

Or, $\frac{d_1d_2}{d^2} = 1$

$\therefore$ d = $\sqrt{d_1d_2}$.

Answer – C

32. A student obtained a sharp image of the grill of a window on a screen using a convex lens. For getting better results, the teacher suggested focusing of a distant tree instead of the grill. In which direction should the lens be moved for this purpose?

A. Away from the screen B. Very far away from the screen
C. Behind the screen D. Towards the screen

32. To focus the distant tree instead of window grill, the object distance is increased. Therefore the image distance is decreased. Hence the lens should move towards the screen.

Answer - D

33. Given below are few steps (not in proper sequence) following in the determination of focal length of a given convex lens by obtaining a sharp image of a distant object.

a. Measure the distance between the lens and the screen
b. Adjust the position of the lens to form a sharp image
c. Select a suitable distant object
d. Hold the lens between the object and the screen with its face parallel to the screen

A. c, a, d, b B. c, d, b, a C. c, a, b, d D. a, b, c, d

33. The proper sequence to get the focal length of a convex lens is

1. Select a suitable distant object
2. Hold the lens between the object and the screen with its face parallel to the screen
3. Adjust the position of the lens to form a sharp image
4. Measure the distance between the lens and the screen

Answer - B

34. Four students A B C and D did their experiment on finding the focal length of a convex lens by obtaining the image of a distant object as follows:

Student A: Use the window grill in the laboratory as the object, and a white paper sheet held in hand as the screen

Student B: Use a distant tree in the shade as the object, and a white thick board, held in stand as the screen

Student C: Use a well illuminated laboratory window grill as the object, and a white paper sheet, held in a stand as the screen

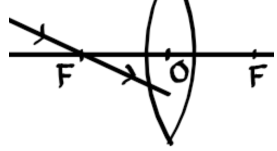
Student D: Use a well illuminated distant tree as the object, and a white thick board, held in a stand as the screen

Which one of the four sequences of above setup represents the decreasing order of preference for performing the experiment?

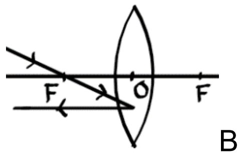
A. D, B, C, A B. C, D, A, B C. D, C, A, B D. B, D, C, A

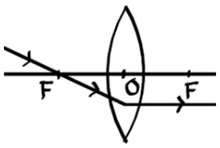
34. To find the focal length of a convex lens, an illuminated object should be taken at infinity. Therefore, the four sequences of above setup are respectively, D, B, C, A.

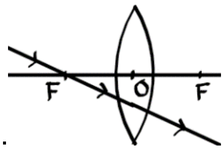
Answer – A

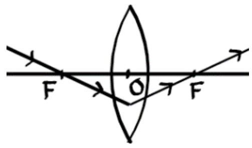


35. A ray of light falls on a convex lens as shown in figure. 4 Students traced the ray of light after refraction from the lens. Which is correct?

A. 

B. 

C. 

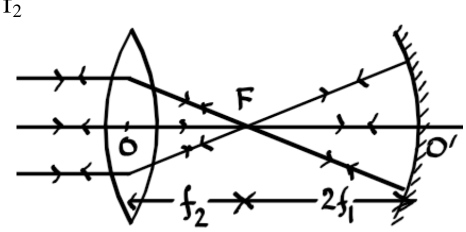
D. 

35. When ray of light passes through the primary principal focus of a convex lens then after refraction it moves parallel to the principal axis.
Answer - B

36. A student has to determine the focal length of a convex lens by focusing the image of a distant object on the screen. For conducting this experiment, he wants to use the minimum material. Out of the following four sets A, B, C and D the best choice for him is:
Set A: convex lens, lens holder, candle, screen with stand
Set B: convex lens, lens holder, screen with stand, measuring scale
Set C: convex lens, lens holder, concave lens, measuring scale
Set D: convex lens, burning candle, screen with stand, lens holder
36. To calculate the focal length of a convex lens we can focus a distant object (tree) on a screen using a convex lens. The measured distance between the length and the screen by a measuring scale give the approximate focal length of the lens. Therefore, the best choice is set B.
Answer – B

37. When a biconvex lens of glass having refractive index 1.47 is dipped in a liquid, it acts as a plane sheet of glass. This implies that the liquid must have refractive index
A. equal to that of glass B. less than one C. greater than that of glass
D. less than that of glass
37. When the refractive index of glass of the lens is same as that of the liquid, then when the lens is immersed in the liquid it acts as a plane sheet of glass.
Answer - A

38. A concave mirror of focal length f_1 is placed at a distance of d from a convex lens of focal length f_2. A beam of light coming from infinity and falling on that convex lens-concave mirror combination returns to infinity. The distance d must equal
A. $f_1 + f_2$ B. $-f_1 + f_2$ C. $2f_1 + f_2$ D. $-2f_1 + f_2$



38. The ray coming from infinity produce image at the focus of the convex lens. This image is considered as the object for the concave mirror. If the position of object for the mirror is at the centre of curvature of it, then the image also formed on that point due to refraction through the mirror. This image is considered as the object for convex lens which is at the focus of it. Therefore, the final image is formed at infinity after refraction through the lens. Hence the distance $d = 2f_1 + f_2$.
Answer - C

39. A convex lens is dipped in a liquid whose refractive index is equal to the refractive index of the lens. Then its focal length will
A. become zero B. become infinity C. become small, but non zero
D. remain unchanged
39. When a convex lens is immersed in a liquid of same refractive index, then it behaves as a plane glass sheet. Therefore, the focal length of the lens becomes infinity.
Answer - B

40. If f_V and f_R are the focal lengths of a convex lens for violet and red light respectively and F_V and F_R are the focal length of a concave lens for violet and red light respectively, then we must have
A. $f_V > f_R$ and $F_V > F_R$ B. $f_V < f_R$ and $F_V > F_R$ C. $f_V > f_R$ and $F_V < F_R$ D. $f_V < f_R$ and $F_V < F_R$
40. For convex lens, $f_R > f_V$. For concave lens focal length is negative. Therefore, $F_V > F_R$.
Answer - B

41. A lens is placed between a source of light and the wall. It forms images of area A_1 and A_2 on the wall, for its two different positions. The area of the source of light is

A. $\frac{A_1 - A_2}{2}$ B. $\frac{1}{A_1} + \frac{1}{A_2}$ C. $\sqrt{A_1 A_2}$ D. $\frac{A_1 + A_2}{2}$

41. A convex lens is placed between a source and a screen. If d_1 and d_2 are the height of two real images formed for two positions of the lens and d be the height of the object, then d = $\sqrt{d_1 d_2}$.

Therefore, the area of the source of light is $\sqrt{A_1 A_2}$.

Answer - C

42. A convex lens and a concave lens separated by a distance d are then put in contact. The focal length of the combination

A. decrease B. increase C. become zero D. remains the same

42. If a convex lens of focal length f_1 and a concave lens of focal length f_2 are placed co-axially and separation between their optical centres be d, then the expression of equivalent focal length of the combination of lenses is given by $\frac{1}{f} = \frac{1}{f_1} + \frac{1}{-f_2} - \frac{d}{f_1 f_2}$ ----- (i)

When they are in contact then the equivalent focal length of the combination of lenses is $\frac{1}{f^{/}} = \frac{1}{f_1} + \frac{1}{-f_2}$ ------ (ii)

From equations (i) and (ii) the focal length of the combination decreases in second case.

Answer - A

43. A lens behaves as a converging lens in air and diverging lens in water. The refractive index of the material of the lens

A. equal to that of water B. less than that of water C. greater than that of water

D. nothing can be predicted

43. The lens maker formula is $\frac{1}{f} = (\frac{\mu_g}{\mu_m} - 1)(\frac{1}{r_1} - \frac{1}{r_2})$.

When a lens behaves as a converging lens in air, the refractive index of the material of lens is greater than air. As the lens behaves as a diverging lens in water, the refractive index is less than that of water.

Answer - B

44. A lens having focal length f and aperture of diameter d forms an image of intensity I. Aperture of diameter $\frac{d}{2}$ in central region of lens is covered by a black paper. Focal length of lens and intensity of image now will be respectively

A. f and $\frac{I}{4}$ B. $\frac{3f}{4}$ and $\frac{I}{2}$ C. f and $\frac{3I}{4}$ D. $\frac{f}{2}$ and $\frac{I}{2}$

44. The focal length of the lens remain unchanged. The intensity of image depends on the area exposed to the incident light from the object.

Intensity of image ∝ area

The initial area of the incident light is A = $\frac{d^2}{4}$.

The final area of the incident light is $A^{/} = \frac{d^2}{4} - \frac{d^2}{4\times4} = \frac{3d^2}{16} = \frac{3A}{4}$.

Therefore, the intensity of image when black paper is placed in the central region of the lens is $\frac{3I}{4}$

Answer - C

45. A convex lens forms a real image with magnification m_1 on a screen. Now, the screen is moved by a distance x and the object is also moved so as to obtain a real image with magnification m_2 on the screen. Then, the focal length of the lens is

A. $(\frac{m_1}{m_2})x$ B. $(\frac{m_2}{m_1})x$ C. $x(m_1 - m_2)$ D. $\frac{x}{m_2 - m_1}$

45. The relation between magnification and focal length of a convex lens is m = $\frac{f-v}{f}$.

Where v is the image distance. As the image is real, the magnification is negative. So, $-m_1 = \frac{f-v}{f}$

Or, $m_1 f + f = v$ ----- (i)

When the screen is moved for a distance x then magnification is $-m_2 = \frac{f-(v+x)}{f}$

Or, $m_2 f + f = v + x$ ----- (ii)

From equations (i) and (ii) we get, f = $\frac{x}{m_2 - m_1}$.
Answer - D

46. Assertion: A single lens produces a coloured image of an object illuminated by white light.
Reason: The refractive index of the material of lens is different for different wavelengths of light.
A. Both Assertion and Reason are true and Reason in the correct explanation of Assertion
B. Both Assertion and Reason are true but Reason is not the correct explanation of Assertion
C. Assertion is true but Reasons is false
D. Both Assertion and Reason are false
46. The focal length of a lens varies with the refractive index of a medium. The refractive index of the medium varies for different colour of wavelength of light. As white light is composed of seven colours of light, each colour will produce its own image based on its focal length for that colour.
Answer - A

47. A beam of parallel rays is brought focus by a plano-convex lens. A thin concave lens of same focal length is joined to the first lens. The effect of this is
A. the focus shifts to infinity
B. the focal points towards the lens by a small distance
C. the focal point shift away from the lens by a small distance
D. the focus remains undisturbed
47. The net focal length of the combination is $\frac{1}{f^{/}} = \frac{1}{f} + \frac{1}{-f} = 0$
$\therefore f = \infty$
Answer - A

48. Assertion: The focal length of lens does not change when red light is replaced by blue light
Reason: The focal length of lens does not depends on colour of light used
A. Both Assertion and Reason are true and Reason in the correct explanation of Assertion
B. Both Assertion and Reason are true but Reason is not the correct explanation of Assertion
C. Assertion is true but Reasons is false
D. Both Assertion and Reason are false
48. Focal length of a lens depends on the refractive index of the medium as $\frac{1}{f} = (\frac{\mu_g}{\mu_m} - 1)(\frac{1}{r_1} - \frac{1}{r_2})$. The refractive index of the medium varies for different colour of wavelength of light. Therefore, the focal length of lens depends on the wavelength of incident light.
Answer - D

49. Assassin: A concave mirror and convex lens both have the same focal length in air. When they are submerged in water, they will have same focal length.
Reason: The refractive index of water is smaller than the refractive index of air.
A. Both Assertion and Reason are true and Reason in the correct explanation of Assertion
B. Both Assertion and Reason are true but Reason is not the correct explanation of Assertion
C. Assertion is true but Reasons is false
D. Both Assertion and Reason are false
49. When a concave mirror is immersed in water, the focal length of it does not change. The focal length of mirror depends on the radius of curvature of the mirror which is constant.
When a convex lens is immersed in water, the focal length of it changes as the focal length of lens depends on the refractive index of the medium.
The refractive index of water is greater than that of air.
Answer - D

50. Assertion: A biconvex lens of focal length 10 cm is split into two equal parts by a plane parallel to its principal axis. The focal length of the each part will be 20 cm.
Reason: Focal length does not depends on the radii of curvature of two surfaces.
A. Both Assertion and Reason are true and Reason in the correct explanation of Assertion
B. Both Assertion and Reason are true but Reason is not the correct explanation of Assertion

C. Assertion is true but Reasons is false

D. Both Assertion and Reason are false

50. When a biconvex lens is cut into two equal halves by a plane parallel to its principal axis, the focal length of each part will remain same as the radii of curvature and refractive index remain unchanged.

The focal length of the lens depends on the radius of curvature as $\frac{1}{f} = (\frac{\mu_g}{\mu_m} - 1)(\frac{1}{r_1} - \frac{1}{r_2})$.

Answer - D