CHAPTERWISE QUESTION ANSWERS

LIGHT - REFLECTION AND REFRACTION

CLASS X

SET A

SECTION - A OBJECTIVE TYPE

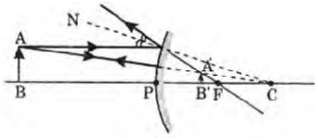
1. d) behind the mirror
2. d) –24 cm
3. c) Three
4. c) equal to 2*f*
5. c) n_m is more than n_a
6. a) magnified and inverted
7. a) Concave mirror as well as convex lens
8. a) A rectangular glass slab
9. d) Assertion is false but reason is true.
10. b) If both the assertion and reason are true but the reason is not a correct explanation of the assertion.

SECTION - B

11. a) (i) Face must be placed in between the pole and focus of the mirror so that enlarged, erect image of face can be formed.
    ii) At focus, because rays coming from the focus after reflection will become parallel.

    b) It is a combination of convex mirror (small head) and plane mirror (legs of normal size).

12. It is a convex mirror. Ray diagram for any position of object.



13. Absolute refractive index of a given medium, w.r.t. air/vacuum is known as absolute refractive index of the medium.

$$n = \frac{Speed\ of\ light\ in\ vacuum\ or\ air}{Speed\ of\ light\ in\ medium}$$

$$n = \frac{c}{v}\ as\ c > v$$

$$n > 1$$

$${}^{b}_{a}n = \frac{Velocity\ of\ light\ in\ B}{Velocity\ of\ light\ in\ A} = \frac{v_b}{v_a} = \frac{n_a}{n_b}$$

Higher the optical density, lesser is the velocity of light in the medium

OR

Radius of curvature of a spherical mirror is the radius of the sphere of which mirror is a part. It is the distance between pole and centre of curvature of a mirror.

The radius of curvature is equal to the twice the focal length.

R = 2f

SECTION - C

14. a) Power of a lens is the ability of a lens to bend a ray of light incident upon it. It is equal to the reciprocal of the focal length of the lens.

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

If *f* is measured in m then unit of power is dioptre (D).

b) v = + 50 cm

m = 1

P = ?

Since, m = 1, $m = \frac{v}{u} = 1$

Or,u = v = 50 cm

i.e., v and u both are at centre of curvatures

C = 2f = 50 or f = 25 cm

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

$P = + \frac{100}{25} D$ or P = + 4D

15. v = –60 cm

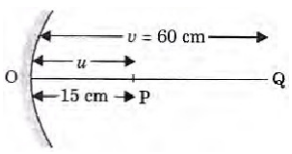
U = –15 cm

a) Since the image is real the minor is concave.

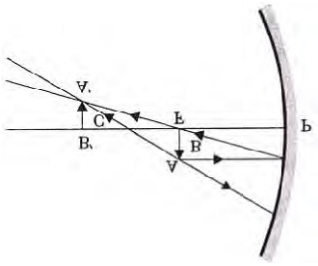
b) $m = -\frac{v}{u} = \frac{-(-60)}{(-15)} = -4$

m = –4

c) Distance between object position and image position = 60 – 15 = 45 cm.



d)



16. Identifying object distance as -2.
Finding out image distance as +1 m using magnification formula.
Using the correct formula (1/u + 1/v = 1/f).
Calculating focal length as +2 m, using the formula.

17. Given f = + 10 cm, u = ?
For virtual image m = +2
As $m = \frac{v}{u}$ or $\frac{v}{u} = 2$

$v = 2u$ .... (1)

$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$ .... (2)

Substituting (1) in (2)

$\frac{1}{2u} - \frac{1}{u} = \frac{1}{10}$

$-\frac{1}{2u} = \frac{1}{10}$

$u = -5$ cm

For real image, f = 10 cm, m = –2

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

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

$\frac{1}{-2u} - \frac{1}{u} = \frac{1}{10}$

$\frac{-3}{2u} = \frac{1}{10}$ or $u = -15$ cm

18. Laws of refraction:

a) The incident ray, refracted ray and normal to the point of incidence, all lie in the same plane.

b) The ratio of sine of incident angle and sine of angle of refraction for a given pair of medium is constant.

$\frac{\sin i}{\sin r}$ = Constant

Absolute refractive index of a medium is the ratio of speed of light in air or vacuum and speed of light in the medium.

Absolute refractive index.

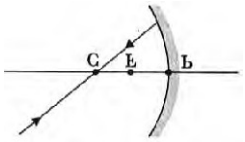
$$= \frac{speed\ of\ light\ in\ air/vacuum}{speed\ of\ light\ in\ medium}$$

SECTION - D

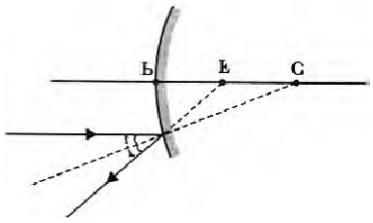
19. a) Use of concave mirrors
    i) Head light of vehicles
    ii) Used by ENT doctors to focus the light.

b) Use of convex mirror: Used as rear view mirrors in vehicles.

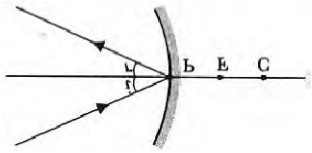
i)



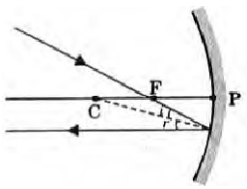
ii)



iii)



iv)



OR

a) Correct completed ray diagram should include the following:
-another correctly drawn incident ray from the pointed end of the pencil.
-two correctly drawn incident rays from the blunt/rear end of the pencil.
- correctly drawn image of the pencil using the point images of the front and rear ends of the pencil.

b) 7.5 cm (with an error margin of 0.5 cm)

c) 3.6 cm (with an error margin of 0.4 cm)

SECTION - E

20. i) Convex lenses

ii) $P_1 = \frac{1}{f_1}$ and $P_2 = \frac{1}{f_2}$

Given $\frac{P_1}{P_2} = \frac{4}{1}$

So, $\frac{f_1}{\frac{1}{f_2}} = \frac{4}{1}$ Hence, $\frac{f_1}{f_2} = \frac{1}{4} \text{ or } 1:4$

iii) magnification (m) = $\frac{h'}{h} = \frac{\upsilon}{u}$

OR

Given m = 3, υ = 24, u = ?

We know, m = $\frac{\upsilon}{u}$

$\Rightarrow 3 = \frac{24}{u}$

Hence, u = 8 cm

SET B

SECTION - A OBJECTIVE TYPE

1. d) centre of curvature of mirror
2. b) 10 cm
3. c) 12 cm
4. b) 2.4
5. a) P is equal to 4.5 D
6. b) infinitely many
7. c) When object is placed between the focus and centre of curvature
8. b) B
9. d) Assertion is false but reason is true.
10. a) If both the assertion and the reason are true and the reason is a correct explanation of the assertion.

SECTION - B

11. The phrase “vehicles in this mirror are closer than they appear” is a safety warning printed on the side view mirror or most vehicles. It is resent because

the side view mirror is a convex mirror and it gives a virtual image of wide field behind the vehicle and appears the objects smaller and farther away than they actually are, and the angular size of the virtual image is also smaller than the angular size of the object. During the lane change, a driver assumes that an adjacent vehicle is at a safe distance behind, serves as a reminder to the driver of this potential problem.

12. As the ray of light comes into air from the different points on the surface of a lemon kept in water in a glass tumbler, it bends away from the normal, ie, there is a change in the direction of propagation of light due to refraction. So, the ray of light appears to come from a point different from that of the actual point. Therefore, the lemon in water appears to be bigger than its actual size, when viewed from the sides of the glass tumbler.
13. Given, concave mirror of f= 15 cm.
    a) When object is placed at a distance 10 cm from mirror (between P and f) image is virtual, enlarged and erected.
    b) For object in between 2F and $\propto$ i.e. 40 cm image is inverted, diminished and real.
    c) For object in between F and C (20 cm), image is inverted, enlarged and real beyond 2F(C).
    d) For object at 2F (30 cm), the image is of same size.

OR

When light enters obliquely from a rarer medium into a denser medium, the speed of light decreases. Also, when light gets into the rarer medium from the denser medium, the speed of light increases.

SECTION - C

14. a) When a ray of light falls normally on a glass slab then i = 0, and r = 0.
    b) $v_m = 1.5 \times 10^8$ m/s

    $c = 3 \times 10^8$ m/s

    We know Refractive index

    $$n = \frac{c}{v_m}$$

    or $$n = \frac{3 \times 10^8}{1.5 \times 10^8} = 2$$

    n = 2
15. Given: $u = -12$ cm

    $f = +15$ cm

    $h_1 = 4.5$ cm

v = ?, m = ?

Mirror formula,

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

$$\frac{1}{v}=\frac{1}{f}-\frac{1}{u}=\frac{1}{15}-\frac{1}{-12}=\frac{1}{15}+\frac{1}{12}$$

v = + 6.6 cm

$$m=-\frac{v}{u}=-\frac{6.6}{-12}=0.55$$

Size of image is smaller than size of object.

16. a) 17 mm

b) - Substituting correct values into lens formula

- Calculating focal length as 18.6 mm using lens formula

c) because the location of the image moves behind the retina.

17. Given, object height h = +5 cm for a concave lens.

u = –20 cm, f = –10 cm

v = ?

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

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

$$\frac{1}{v}=\frac{1}{-10}+\frac{1}{-20}=-\frac{3}{20}$$

$$v=-\frac{20}{3}cm = -6.66 \text{ cm}$$

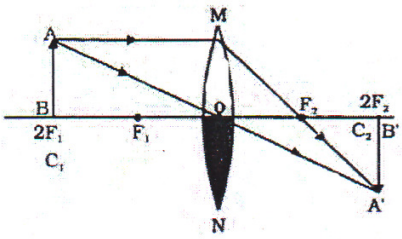
Image formed is virtual, erect

$$m=\frac{h'}{h}=\frac{v}{u}$$

$$h'=h\times\frac{v}{u}=5\times\left(-\frac{20}{3}\times\frac{1}{-20}\right)cm$$

$$= 5\times\frac{1}{3}cm=\frac{5}{3}cm = 1.66 \text{ cm}$$

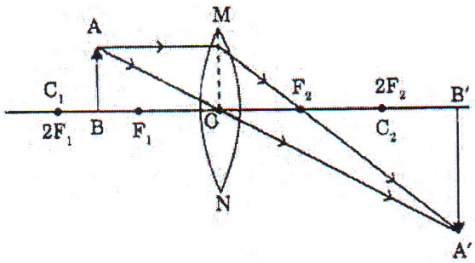
18. a) If the lower half of the lens is covered even then it will form a complete real, inverted image of same size at $C_2(2F_2)$ with reduced intensity of image.



b) There will be no change in the nature and position of the object except in later case the image will be brighter.

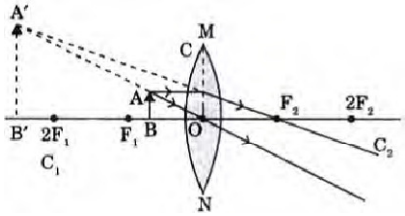
SECTION - D

19. a) When object is placed in between F and 2F(C) of a converging lens it will form a real magnified image.



When object is placed in between F_1 and optical centre O of a converging lens, it will form a virtual magnified image of the object.

b)



c) When lens is cut along the principal axis its focal length remains same but intensity is reduced.

OR

Object distance u = Position of the convex lens – Position of candle

$= 50 - 12 = 38$ cm

By sign convention, $u = -38$cm

Similarly, image distance, v = position of the screen – position of convex lens

$= 88 - 50 = 38$ cm

By sign convention, $v = +38$ cm

(i) Using lens formula, $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$

$$\frac{1}{f} = \frac{1}{38} - \frac{1}{-38} = \frac{2}{38} = \frac{1}{19}$$

$f = 19$ cm

The focal length of the convex lens is 19 cm.

(ii) After shifting the candle towards the lens at a position of 31.0 cm, then

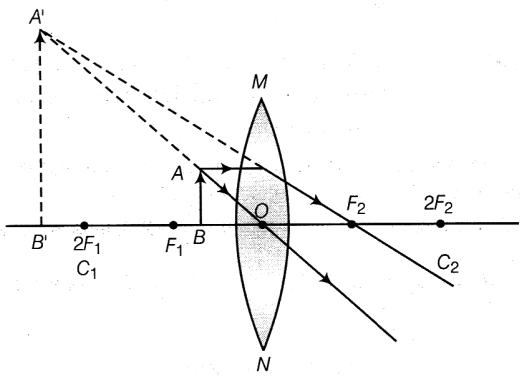
object distance u = position of convex lens – position of candle

$= 50 - 31 = 19$

By sign convention, $u = -19$ cm, but here focal length of the convex lens is also 19 cm. So, the candle lies at the focus of lens, hence its image forms at infinity.

(iii) When student further shifts the candle towards the lens *i.e.,* candle lies between optical centre and focus of convex lens, then lens forms enlarged, virtual and erect image of the candle.

(iv) The ray diagram showing the formation of image



SECTION - E

20. i) convex lenses

ii) The image when passed through the lens was inverted and then it gets reflected on the mirror to be obtained on the screen.

iii) Because concave mirror can give real image.

iv) We know that f = R/2 = 12/2 = 6 cm

But the sign of focal length of concave mirror is negative.

Therefore f = –6 cm.