CHAPTER:9

OPEN STUDENT FOUNDATION
STD 10 : SCIENCE
IMPORTANT QUESTION DAY 9

Date : 26/02/24

Section A

● **Write the answer of the following questions. [Each carries 1 Mark]** **[20]**

1. When the ray of light passes from one medium to another, its …….. and …….. get changed
2. To repair clocks …….. lens is used.
3. Light is the …… radiation.
4. The velocity of light in vacuum is ..... m/s.
5. The magnification of plane mirror is always .....
6. Large image of object can be obtain by convex mirror.
7. If the power of the corrective lens used by an optician in a pair of spectacles is –0.4D then the type of lens used is convex.
8. The ratio of sine of angle of incident and angle of reflection remains constant for all types of colour.
9. Magnification is +ve for real image.
10. The formula of mirror is $\frac{2}{R} = \frac{1}{u} + \frac{1}{v}$.
11. What is the angle of refraction of the ray of light incident perpendicular to the surface of the medium ?
    (A) 0° (B) 30° (C) 60° (D) 90°
12. What is the focal length of a lens if it has power P = –4D ?
    (A) 4 m (B) – 40 cm (C) –0.25 m (D) –25 m
13. Where should an object be placed in front of concave mirror so as to obtain an image which is real, inverted and same size of object ?
    (A) At F (B) At infinite distance (C) At C (D) Away from C
14. What is called in optics an object which has higher refractive index ?
    (A) Optically rarer (B) Optically denser (C) Optically density (D) Refractive index
15. The power of a lens is + 1.6 D. The nature of lens is .....
    (A) convex (B) concave
    (C) both concave and convex (D) none of these
16. Define optical density.
17. What is the angle of incident of light incident normally to the mirror ?
18. What is the speed of light in water ? For water $n = \frac{4}{3}$
19. Is refractive index dependent on wavelength ?
20. Write the SI unit of power of lens and define it.

Section B

● **Write the answer of the following questions. [Each carries 2 Marks]** **[18]**

21. An object of size 7.0 cm is placed at 27 cm in front of a concave mirror of focal length 18 cm. At what distance from the mirror should a screen be placed, so that a sharp focussed image can be obtained ? Find the size and the nature of the image.

22. An object 5.0 cm in length is placed at a distance of 20 cm in front of a convex mirror of radius of curvature 30 cm. Find the position of the image, its nature and size.

23. One-half of a convex lens is covered with a black paper. Will this lens produce a complete image of the object ? Verify your answer experimentally. Explain your observations.

24. The refractive index of diamond is 2.42. What is the meaning of this statement ?

25. Light enters from air to glass having refractive index 1.50. What is the speed of light in the glass ? The speed of light in vacuum is 3×10^8 ms^{-1}.

26. Draw a ray diagram of position, type and dimension of image formed by concave lens when an object placed between infinite point and optical centre.

27. Draw ray diagram of position and type of image formed by convex lens when an object is placed on the principal focus F_1.

28. Explain by drawing ray diagram of position and type of image formed by convex lens when an object is placed at infinity distance.

29. Explain the laws of refraction.

Section C

● **Write the answer of the following questions. [Each carries 3 Marks]** **[18]**

30. Name the type of mirror used in the following situations.
(A) Headlights of a car.
(B) Side / rear-view mirror of a vehicle.
(C) Solar furnace.
Support your answer with reason.

31. An object 5 cm in length is held 25 cm away from a converging lens of focal length 10 cm. Draw the ray diagram and find the position, size and nature of the image formed.

32. A convex lens forms a real and inverted image of a needle at a distance of 50 cm from it. Where is the needle placed in front of the convex lens if the image is equal to the size of the object ? Also, find the power of the lens.

33. A concave lens has focal length of 15 cm. At what distance should the object from the lens be placed so that it forms an image at 10 cm from the lens ? Also, find the magnification produced by the lens.

34. Write short note on power of a lens.

35. A 2.0 cm tall object is placed perpendicular to the principal axis of a convex lens of focal length 10 cm. The distance of the object from the lens is 15 cm. Find the nature, position and size of the image. Also find its magnification.

Section D

● **Write the answer of the following questions. [Each carries 4 Marks]** **[4]**

36. Draw ray diagrams for image formation by a concave mirror for different position of the object and write the type and dimension of each.

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Section [A] : 1 Marks Questions					
No	Ans	Chap	Sec	Que	Universal_QueId
1.	-	Chap 9	S4	17	QP23P11B1012_P1C9S4Q17
2.	-	Chap 9	S4	15	QP23P11B1012_P1C9S4Q15
3.	-	Chap 9	S4	12	QP23P11B1012_P1C9S4Q12
4.	-	Chap 9	S4	7	QP23P11B1012_P1C9S4Q7
5.	-	Chap 9	S4	3	QP23P11B1012_P1C9S4Q3
6.	-	Chap 9	S5	10	QP23P11B1012_P1C9S5Q10
7.	-	Chap 9	S5	13	QP23P11B1012_P1C9S5Q13
8.	-	Chap 9	S5	6	QP23P11B1012_P1C9S5Q6
9.	-	Chap 9	S5	4	QP23P11B1012_P1C9S5Q4
10.	-	Chap 9	S5	3	QP23P11B1012_P1C9S5Q3
11.	A	Chap 9	S6	22	QP23P11B1012_P1C9S6Q22
12.	C	Chap 9	S6	2	QP23P11B1012_P1C9S6Q2
13.	C	Chap 9	S6	1	QP23P11B1012_P1C9S6Q1
14.	B	Chap 9	S6	5	QP23P11B1012_P1C9S6Q5
15.	A	Chap 9	S6	9	QP23P11B1012_P1C9S6Q9
16.	-	Chap 9	S7	2	QP23P11B1012_P1C9S7Q2
17.	-	Chap 9	S7	6	QP23P11B1012_P1C9S7Q6
18.	-	Chap 9	S7	5	QP23P11B1012_P1C9S7Q5
19.	-	Chap 9	S7	12	QP23P11B1012_P1C9S7Q12
20.	-	Chap 9	S7	18	QP23P11B1012_P1C9S7Q18

Section [B] : 2 Marks Questions					
No	Ans	Chap	Sec	Que	Universal_QueId
21.	-	Chap 9	S3	15	QP23P11B1012_P1C9S3Q15
22.	-	Chap 9	S3	14	QP23P11B1012_P1C9S3Q14
23.	-	Chap 9	S3	9	QP23P11B1012_P1C9S3Q9
24.	-	Chap 9	S9	3.5	QP23P11B1012_P1C9S9Q3.5
25.	-	Chap 9	S9	3.2	QP23P11B1012_P1C9S9Q3.2
26.	-	Chap 9	S1	32	QP23P11B1012_P1C9S1Q32
27.	-	Chap 9	S1	29	QP23P11B1012_P1C9S1Q29
28.	-	Chap 9	S1	25	QP23P11B1012_P1C9S1Q25
29.	-	Chap 9	S1	18	QP23P11B1012_P1C9S1Q18

Section [C] : 3 Marks Questions					
No	Ans	Chap	Sec	Que	Universal_QueId
30.	-	Chap 9	S3	8	QP23P11B1012_P1C9S3Q8
31.	-	Chap 9	S3	10	QP23P11B1012_P1C9S3Q10
32.	-	Chap 9	S9	4.2	QP23P11B1012_P1C9S9Q4.2
33.	-	Chap 9	S1	36	QP23P11B1012_P1C9S1Q36
34.	-	Chap 9	S1	38	QP23P11B1012_P1C9S1Q38
35.	-	Chap 9	S1	37	QP23P11B1012_P1C9S1Q37

Section [D] : 4 Marks Questions					
No	Ans	Chap	Sec	Que	Universal_QueId
36.	-	Chap 9	S1	8	QP23P11B1012_P1C9S1Q8

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Section A

● **Write the answer of the following questions.** [Each carries 1 Mark] **[20]**

1. When the ray of light passes from one medium to another, its …….. and ……. get changed

➠ direction, speed

2. To repair clocks …….. lens is used.

➠ convex

3. Light is the …… radiation.

➠ electromagnetic

4. The velocity of light in vacuum is ..... m/s.

➠ 3×10^8

5. The magnification of plane mirror is always .....

➠ +1

6. Large image of object can be obtain by convex mirror.

➠ False

7. If the power of the corrective lens used by an optician in a pair of spectacles is –0.4D then the type of lens used is convex.

➠ False

8. The ratio of sine of angle of incident and angle of reflection remains constant for all types of colour.

➠ False

9. Magnification is +ve for real image.

➠ False

10. The formula of mirror is $\frac{2}{R} = \frac{1}{u} + \frac{1}{v}$.

➠ True

11. What is the angle of refraction of the ray of light incident perpendicular to the surface of the medium ?

(A) 0° (B) 30° (C) 60° (D) 90°

Ans. (A) 0°

➠ The angle of incident of a ray of light perpendicular to the surface of the medium is zero and such a ray does not bend, so the angle of refraction is also zero.

12. What is the focal length of a lens if it has power P = –4D ?

(A) 4 m (B) – 40 cm (C) –0.25 m (D) –25 m

Ans. (C) – 0.25 m

➠ $f = \frac{1}{P} = \frac{1}{-4} = -0.25$ m

13. Where should an object be placed in front of concave mirror so as to obtain an image which is real, inverted and same size of object ?

(A) At F (B) At infinite distance (C) At C (D) Away from C

Ans. (C) At C

➠ Knowledge based

14. What is called in optics an object which has higher refractive index ?

(A) Optically rarer (B) Optically denser (C) Optically density (D) Refractive index

Ans. (B) Optically denser

➠ Knowledge based

15. The power of a lens is + 1.6 D. The nature of lens is .....

(A) convex (B) concave

(C) both concave and convex (D) none of these

Ans. (A) convex

16. Define optical density.

➠ The ability of the medium to refract light is called optical density.

17. What is the angle of incident of light incident normally to the mirror ?

➠ $\angle i = 0$

18. What is the speed of light in water ? For water $n = \frac{4}{3}$

➠ $v = \frac{c}{n} = \frac{3 \times 10^8}{4/3}$

$\therefore \quad v = \frac{9}{4} \times 10^8 = 2.25 \times 10^8$ m/s

19. Is refractive index dependent on wavelength ?

➠ Yes, $n = \frac{c}{v} = \frac{\lambda f}{\lambda' f} = \frac{\lambda}{\lambda'}$

where, λ = wavelength of light in vacuum

λ' = wavelength of light in medium

20. Write the SI unit of power of lens and define it.

➠ SI unit of power is "D" (dioptre). 1 dioptre is the power of a lens whose focal length is 1 metre.

Section B

● **Write the answer of the following questions.** [Each carries 2 Marks] **[18]**

21. An object of size 7.0 cm is placed at 27 cm in front of a concave mirror of focal length 18 cm. At what distance from the mirror should a screen be placed, so that a sharp focussed image can be obtained ? Find the size and the nature of the image.

➠ Nature of mirror = concave

Focal length f = –18 cm,

Object distance u = –27 cm,

Image distance v = ?

Object height h = +7.0 cm,

Nature of image and size h = ?

➠ **Mirror formula :** $\frac{1}{f} = \frac{1}{u} + \frac{1}{v} \Rightarrow \frac{1}{v} = \frac{1}{f} - \frac{1}{u}$

$= \frac{1}{-18} - \frac{1}{-27}$

$\therefore \frac{1}{v} = -\frac{1}{18} + \frac{1}{27}$

$= \frac{-3+2}{54} = -\frac{1}{54}$

$\therefore v = -54$ cm

➠ The image is formed in front of the mirror at distance of 54 cm.

➠ Magnification $m = -\frac{v}{u}$

$\frac{h'}{h} = -\frac{(-54)}{(-27)} = -2$

$\therefore \quad h' = h \times (-2) = 7 \times (-2)$

$= -14$ cm

➠ Image will be real, inverted and enlarged.

22. An object 5.0 cm in length is placed at a distance of 20 cm in front of a convex mirror of radius of curvature 30 cm. Find the position of the image, its nature and size.

➠ Nature of mirror = convex

Radius of curvature R = + 30 cm,

Focal length f = +15 cm,

Object distance u = –20 cm,

Height of object h = 5.0 cm,

Nature and size of image h' = ?

➠ **Formula of mirror :** $\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$

$\therefore \frac{1}{v} = \frac{1}{f} - \frac{1}{u} = \frac{1}{15} - \frac{1}{-20} = \frac{1}{15} + \frac{1}{20}$

$\therefore \frac{1}{v} = \frac{4+3}{60} = \frac{7}{60}$

$\therefore v = \frac{60}{7} = 8.57$ cm

➠ The image is formed behind the mirror at a distance of 8.57 cm.

➠ Magnification $m = -\frac{v}{u} \Rightarrow \frac{h'}{h} = -\frac{v}{u}$

$\therefore h' = h \times \left(-\frac{v}{u}\right) = 5 \times \left(-\frac{60}{7} \times \frac{1}{(-20)}\right)$

$\therefore h' = \frac{5 \times 60}{7 \times 20} = \frac{15}{7}$

$\therefore h' = 2.14$ cm

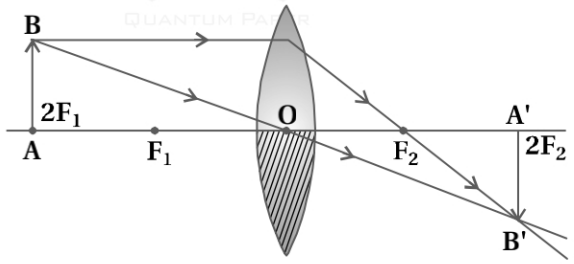
➠ The image formed is virtual, erect with 2.14 cm height.

23. One-half of a convex lens is covered with a black paper. Will this lens produce a complete image of the object ? Verify your answer experimentally. Explain your observations.

➠ Yes, one-half of a convex lens when covered with a black paper, the lens produces a complete or full

image of an object.

➠ To verify experimentally, take a convex lens cover half part of it as shown in the figure, with a paper.



➠ Now place it on a stand. Focus a distant object on a screen.

➠ **Observation and conclusion :** Image formed on the screen does not depend on the size of the lens. The brightness of the image decreases as less number of rays pass through the lens.

24. The refractive index of diamond is 2.42. What is the meaning of this statement ?

➠ Absolute refractive index = $\frac{\text{speed of light in vacuum}}{\text{speed of light in diamond}}$

➠ Hence, the ratio of speed of light in vacuum to the speed of light in diamond is 2.42.

25. Light enters from air to glass having refractive index 1.50. What is the speed of light in the glass ? The speed of light in vacuum is 3×10^8 ms^{-1}.

➠ Here $n_{(g)} = 1.50$

The velocity of light in vacuum $c = 3 \times 10^8$ ms^{-1}

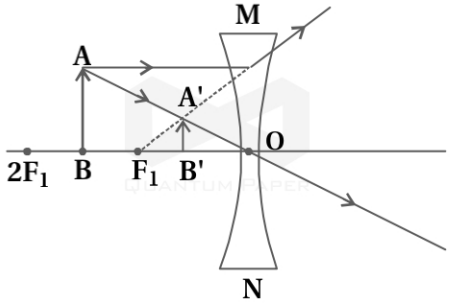
The velocity of light in glass v_g = ?

$$\therefore n_g = \frac{c}{v_g}$$

$$\therefore v_g = \frac{c}{n_g} = \frac{3 \times 10^8}{1.5} = 2 \times 10^8 \text{ ms}^{-1}$$

26. Draw a ray diagram of position, type and dimension of image formed by concave lens when an object placed between infinite point and optical centre.

➠ When an object AB is placed between infinite point and optical centre of concave lens, a ray coming out from point A goes parallel to principal axis and refracted through lens, this emergent ray and an another ray passing through optical centre without refraction. Both ray are diverging. So they do not cross each other. These two rays are extended backward by dotted lines on extending back, these rays appear to intersect at point A'. Hence A' is the image of A. Now perpendicular point B' on principal axis from A' is the image of B.



Object position : Between infinite point and optical centre

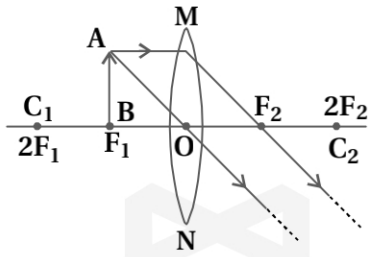
Image position : Between principal focus F_1 in same side of object and optical centre

Type of image : Virtual and erect

Dimension : Diminished

27. Draw ray diagram of position and type of image formed by convex lens when an object is placed on the principal focus F_1.

➠ When an object AB is placed at principal focus F_1 of convex lens a ray coming out from point A goes parallel to principal axis and refracted through lens and passes through principal focus. Whereas an another ray passing through optical centre without refraction. Both these rays are parallel, hence they do not cross each other. So image is formed at infinity distance.



Object position : At principal focus F_1

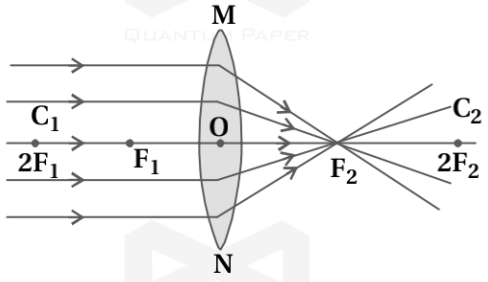
Image position : At infinity

Type of image : Real and inverted

Dimension : Highly enlarged

28. Explain by drawing ray diagram of position and type of image formed by convex lens when an object is placed at infinity distance.

➠ When the object is placed at infinity from convex lens, the image is formed at focus on the other side of lens and it is real, inverted and highly diminished.



Object position : At infinity

Image position : On the other side of lens at F

Type of image : Real and inverted

Dimension : Highly diminished

29. Explain the laws of refraction.

➠ Laws of refraction are as follow :

(i) The incident ray, the refracted ray and the normal to the interface of two transparent media at the point of incidence, all lie in the same plane.

(ii) The ratio of sine of angle of incidence to the sine of angle of refraction is a constant, for the light of a given colour and for the given pair of media. This law is known as Snell's law of refraction.

$\therefore \frac{\sin i}{\sin r}$ = constant

➠ This constant value is called the refractive index of the second medium with respect to the first.

Section C

● **Write the answer of the following questions. [Each carries 3 Marks]** **[18]**

30. Name the type of mirror used in the following situations.

(A) Headlights of a car.

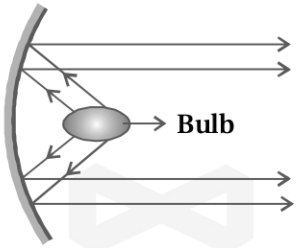
(B) Side / rear-view mirror of a vehicle.

(C) Solar furnace.

Support your answer with reason.

➠ **(A)** For headlight of a car-concave mirror is used to get a powerful beam of light after reflection.

➠ Because the light source is placed at their principal focus and rays coming from it becomes parallel after the reflection from mirror.



➠ **(B)** Convex mirror is used in the headlight of a vehicle because it gives a virtual, erect and diminished image and it enables the driver to see the most of traffic behind him.

➠ **(C)** In solar furnace concave mirror is used as a reflector, it concentrates sunlight at a point where the temperature increases sharply to 180°C to 200°C.

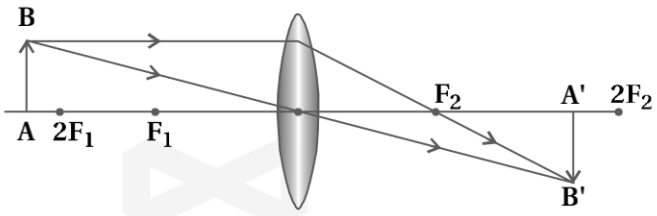
31. An object 5 cm in length is held 25 cm away from a converging lens of focal length 10 cm. Draw the ray diagram and find the position, size and nature of the image formed.

➠ Nature of lens = convex,

Focal length f = + 10 cm

Object distance u = – 25 cm

Height of object h = + 5 cm



➠ Lens formula, $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

$\therefore \quad \frac{1}{v} = \frac{1}{f} + \frac{1}{u} = \frac{1}{10} + \frac{1}{-25}$

$\therefore \quad \frac{1}{v} = \frac{5-2}{50} = \frac{3}{50}$

$\therefore \quad v = \frac{50}{3} = 16.67$ cm

➠ Magnification $\frac{h'}{h} = \frac{v}{u} = \frac{16.67}{-25}$

$\therefore \quad h' \times h \times (-0.6668)$

$\therefore \quad h' = 5 \times (-0.6668)$

$= -3.334$ cm

➠ Hence, the image formed at 16.67 cm from the lens on the other side and size of the image is reduced and inverted.

32. A convex lens forms a real and inverted image of a needle at a distance of 50 cm from it. Where is the needle placed in front of the convex lens if the image is equal to the size of the object ? Also, find the power of the lens.

➠ Type of lens = Convex

Type of image = Real and inverted

Image distance $v = +50$ cm

Magnification $m = -1$

Object distance u = ?

Magnification $m = +\frac{v}{u}$

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

$\therefore \quad -u = +50$

$\therefore \quad u = -50$ cm

➠ Now lens formula

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

$$= \frac{1}{50} - \frac{1}{-50}$$

$$= \frac{1}{50} + \frac{1}{50} = \frac{2}{50} = \frac{1}{25}$$

$\therefore \quad 2f = +25$ cm $= +0.25$ m

and power $P = \frac{1}{f} = \frac{1}{+0.25} = +4D$

33. A concave lens has focal length of 15 cm. At what distance should the object from the lens be placed so that it forms an image at 10 cm from the lens ? Also, find the magnification produced by the lens.

➠ A concave lens always form a virtual, erect image on the same side of the object.

➠ Image distance $v = -10$ cm

Focal length $f = -15$ cm

Object-distance u = (?)

Now, $\frac{1}{v} - \frac{1}{u} = \frac{1}{f} \Rightarrow \frac{1}{u} = \frac{1}{v} - \frac{1}{f} = \frac{1}{-10} - \frac{1}{(-15)} = \frac{1}{10} + \frac{1}{15}$

$\therefore \quad \frac{1}{u} = \frac{-3+2}{30} = \frac{1}{-30}$

$\therefore \quad u = -30$ cm

Thus, the object distance is 30 cm.

➠ Magnification $m = \frac{v}{u}$

$$m = \frac{-10\,\text{cm}}{-30\,\text{cm}} = \frac{1}{3} \approx +0.33$$

➠ The positive sign shows that the image is erect and virtual. The image is one-third of the size of the object.

34. Write short note on power of a lens.

➠ The ability of a lens to converge or diverge light rays depends on its focal length.

➠ A convex lens of short focal length bends the light rays through large angles, by focussing them closer

to the optical centre. Similarly, concave lens of very short focal length causes higher divergence than one with longer focal length.

➠ The degree of convergence or divergence of light rays achieved by a lens is expressed in terms of its power.

➠ The power of a lens (P) is the reciprocal of its focal length.

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

➠ The SI unit of power of a lens is Dioptre. It is denoted by the letter D.

➠ 1 dioptre is the power of a lens whose focal length is 1 metre.

➠ The power of a convex lens is positive and that of a concave lens is negative.

➠ Opticians prescribe corrective lenses indicating their powers.

➠ The lens prescribed has power equal to + 2.0 D. This means the lens prescribed is convex. The focal length of the lens is + 0.50 m. Similarly, a lens of power – 2.5 D has a focal length of – 0.40 m. The lens is concave.

➠ The instrument used to measure the power of the lens is called dioptre meter. Unit of dioptre is m^{-1}.

➠ Note : When an eye doctor writes a prescription of lens of +2.0 D. What does that mean ?

It means that $f = \frac{1}{p} = \frac{1}{+2} = 0.5$ m

$\therefore$ $f = 50$ cm

➠ That means, person should wear a glass of convex lens of focal length 50 cm.

35. A 2.0 cm tall object is placed perpendicular to the principal axis of a convex lens of focal length 10 cm. The distance of the object from the lens is 15 cm. Find the nature, position and size of the image. Also find its magnification.

➠ Height of object $h = +2.0$ cm | Image-distance v = ?

Focal length $f = +10$ cm | Height of the image h' = ?

Object distance $u = -15$ cm

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

$= \frac{1}{(-15)} + \frac{1}{10} = \frac{-2+3}{30} = \frac{+1}{30}$

$\therefore$ $v = +30$ cm

➠ The positive sign of v shows that the image is formed at a distance of 30 cm on the other side of the optical centre. The image is real and inverted.

Magnification $m = \frac{h'}{h} = \frac{v}{u}$ or $h' = h\left(\frac{v}{u}\right)$

The height of image $h' = 2\left(\frac{30\text{ cm}}{-15\text{ cm}}\right) = -4.0\text{ cm}$

Magnification $m = \frac{v}{u}$ or $m = \frac{+30\text{ cm}}{-15\text{ cm}} = -2$

➠ The negative sign of m and h' show that the image is real and inverted. It is formed below the principal

axis. Thus, a real and inverted image 4 cm tall is formed at a distance of 30 cm on the other side of the lens. The image is two times enlarged.

Section D

● **Write the answer of the following questions.** [Each carries 4 Marks] **[4]**

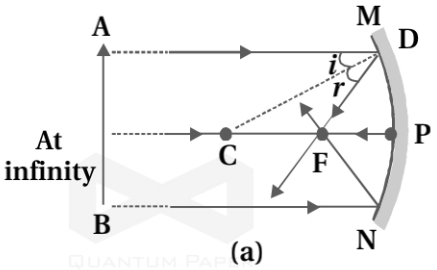
36. Draw ray diagrams for image formation by a concave mirror for different position of the object and write the type and dimension of each.

➠ (a) Object Position : At infinity distance

Image Position : At focus F

Type of image : Real and inverted

Dimension of image : Highly diminished (point size)



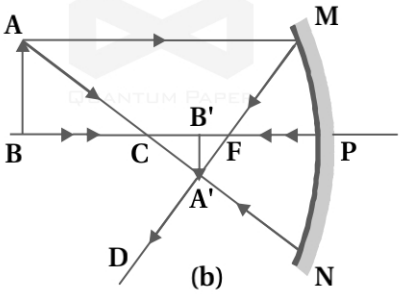
(a)

(b) Object Position : Little away from centre of curvature (C)

Image Position : Between C and F

Type of Image : Real and inverted

Dimension of image : Diminished



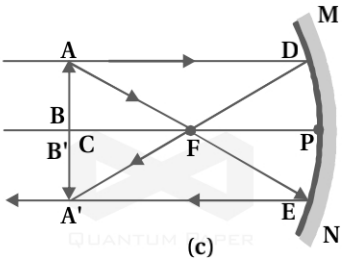
(b)

(c) Object Position : At centre of curvature (C)

Image Position : At C

Type of image : Real and inverted

Dimension of image : Same size as object



(c)

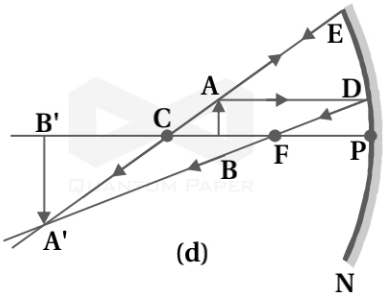
(d) Object Position : Between F and C

Image Position : Beyond C

Type of image : Real and inverted

Dimension of image : Enlarged

M

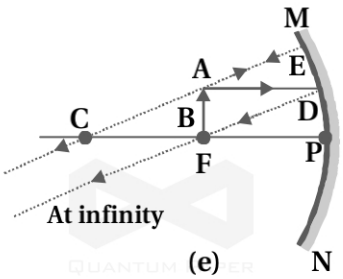


(e) Object Position : At F

Image Position : At infinity

Type of image : Real and inverted

Dimension of image : Highly enlarged



(f) Object Position : Between P and F

Image Position : Behind the mirror

Type of image : Virtual and erect

Dimension of image : Enlarged