**Light: Reflection and refraction**

1. How is the refractive index of a medium related to the speed of light? Obtain an expression for refractive index of a medium with respect to another in terms of speed of light in these two media?

   **Ans. RI =** $\frac{\text{Speed of light in vacuum}}{\text{Speed of Light in medium}}$ $\mu\,(\text{RI}) = \frac{\frac{c}{v_1}}{c/v_2} = v_2/v_1$

2. Refractive index of diamond with respect to glass is 1.6 and absolute refractive index of glass is 1.5. Find out the absolute refractive index of diamond.

   Ans.

   $n_{dg} = \frac{v_g}{v_d} = 1.6,\ n_g = \frac{c}{v_g},$ and $n_d = \frac{c}{v_d}$

   Therefore, $\frac{v_g}{v_d} \times \frac{c}{v_g} = n_d = 1.6 \times 1.5 = 2.40.$

3. A convex lens of focal length 20 cm can produce a magnified virtual as well as real image. Is this a correct statement? If yes, where shall the object be placed in each case for obtaining these images?

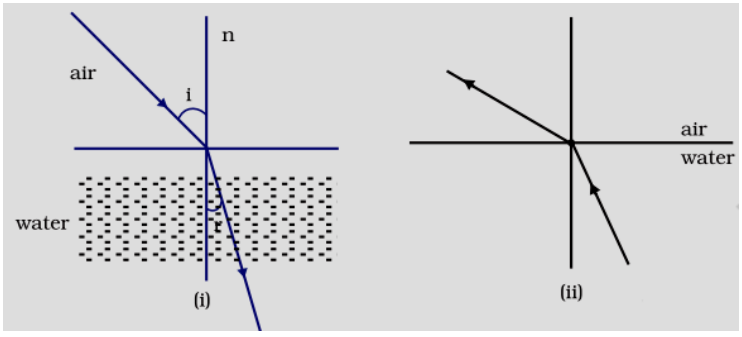
   **Ans. Yes, it is correct. If the object is placed within 20 cm from the lens in the first case and between 20 cm and 40 cm in the second case.**

4. Sudha finds out that the sharp image of the window pane of her science laboratory is formed at a distance of 15 cm from the lens. She now tries to focus the building visible to her outside the window instead of the window pane without disturbing the lens. In which direction will she move the screen to obtain a sharp image of the building? What is the approximate focal length of this lens?

**Ans. Sudha should move the screen towards the lens so as to obtain a clear image of the building. The approximate focal length of this lens will be 15 cm.**

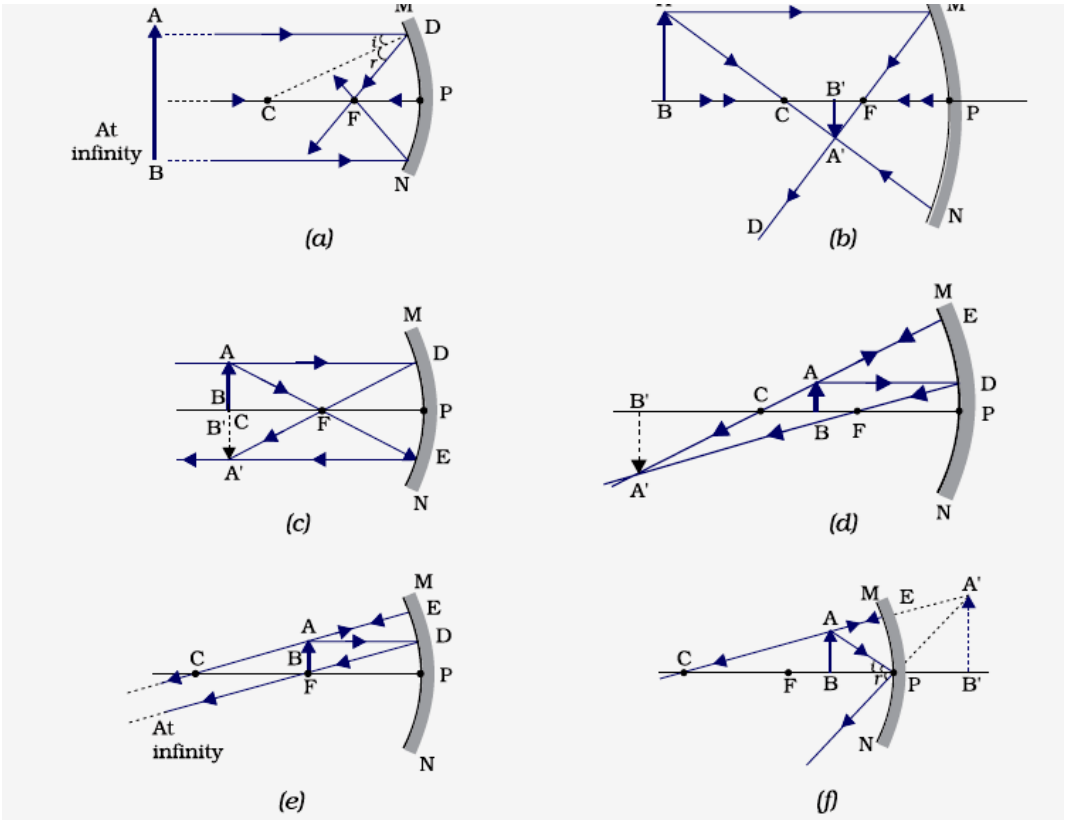
5. Draw a ray diagram showing the path of rays of light when it enters with oblique incidence (i) from air into water; (ii) from water into air.

Ans.




6. Draw ray diagrams showing the image formation by a concave mirror when an object is placed (a) between pole and focus of the mirror (b) between focus and centre of curvature of the mirror (c) at centre of curvature of the mirror (d) a little beyond centre of curvature of the mirror (e) at infinity

   Ans.

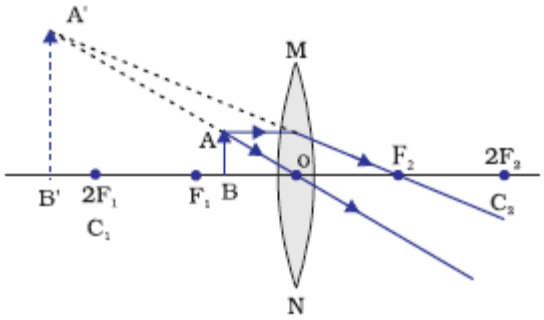



*Ray diagrams for the image formation by a concave mirror*

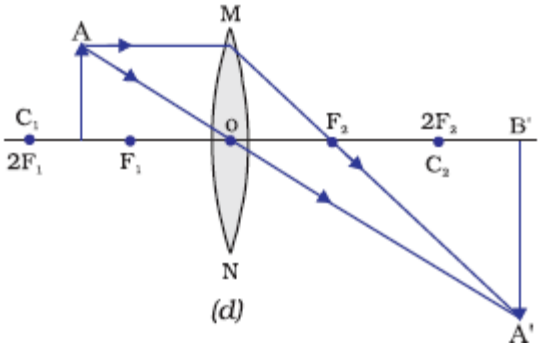
7. Draw ray diagrams showing the image formation by a convex lens when an object is placed (a) between optical centre and focus of the lens (b) between focus and twice the focal length of the lens (c) at twice the focal length of the lens (d) at infinity (e) at the focus of the lens

Ans.

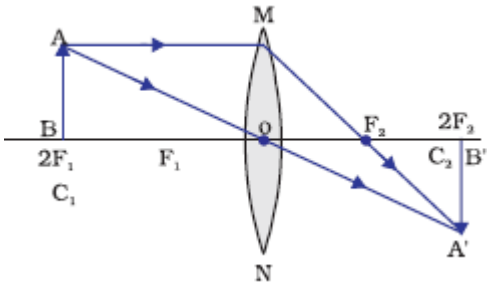
a. Ray Diagram



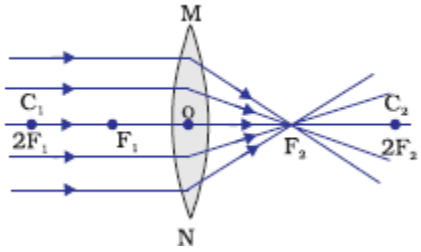

b. Ray Diagram



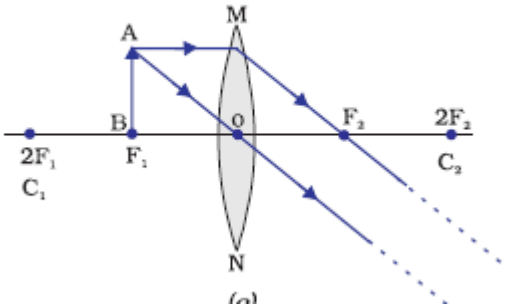
c. Ray Diagram




d. Ray Diagram

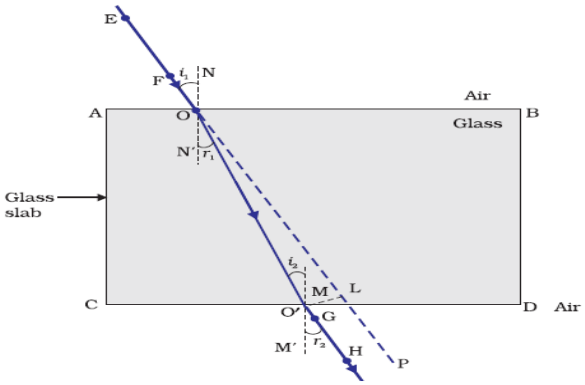



e. Ray Diagram




8. Write laws of refraction. Explain the same with the help of ray diagram, when a ray of light passes through a rectangular glass slab.

**Ans.**



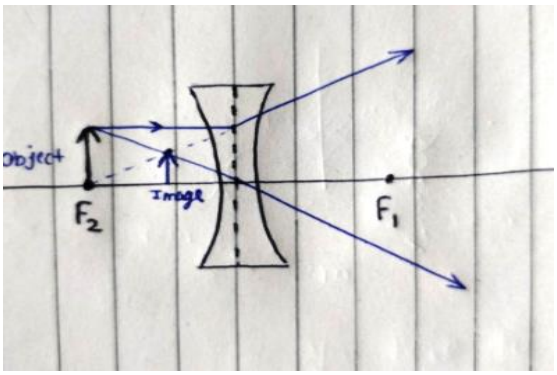

*Refraction of light through a rectangular glass slab*

**Explanation:-1. Incident ray, Refracted ray and normal live in the same plane.**

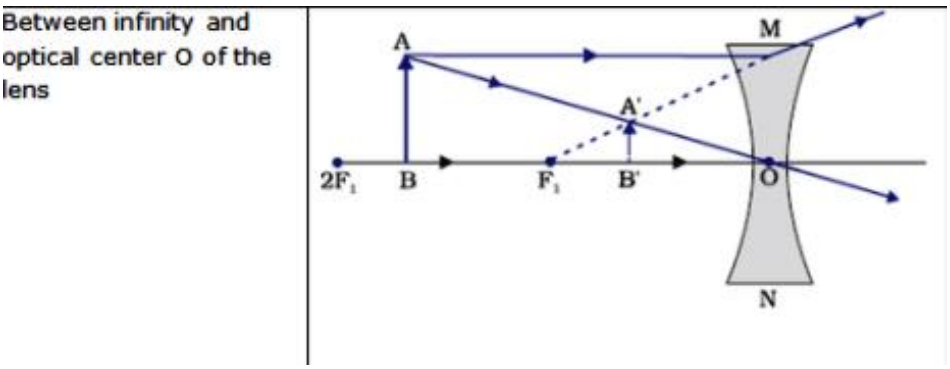
**2.** $\frac{Sin\ i}{Sin\ r}$ **= constant ( refractive index =μ)**

**When ray goes from rare to denser medium it bends towards the normal and when denser to rarer, it does from away from the normal.**
**Incident ray and emergent ray are parallel to each other.**

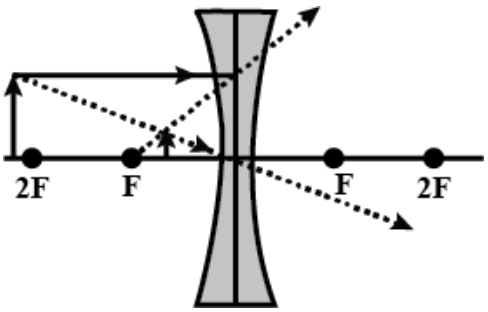
9. Draw ray diagrams showing the image formation by a concave lens when an object is placed (a) at the focus of the lens (b) between focus and twice the focal length of the lens (c) beyond twice the focal length of the lens.
**Ans. a).**



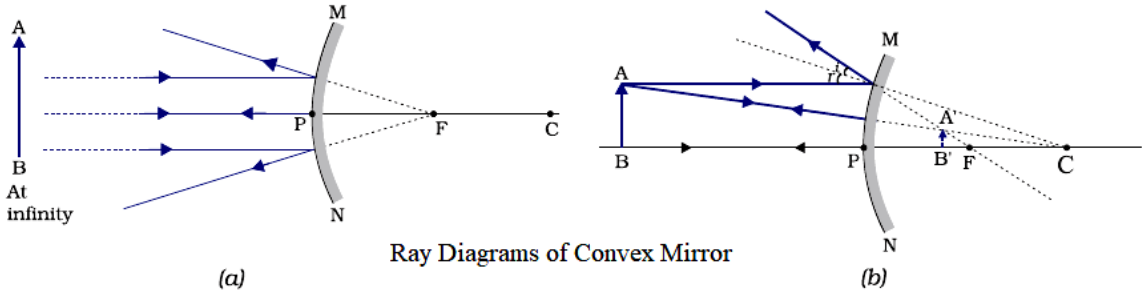

**b).**




**c).**




10. Draw ray diagrams showing the image formation by a convex mirror when an object is placed (a) at infinity (b) at finite distance from the mirror.
**Ans.**



Ray Diagrams of Convex Mirror

11. The image of a candle flame formed by a lens is obtained on a screen placed on the other side of the lens. If the image is three times the size of the flame and the distance between lens and image is 80 cm, at what distance should the candle be placed from the lens? What is the nature of the image at a distance of 80 cm and the lens?

**Ans.** $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$ **& m = -v/u = -3, so v = -3u, v = 80 cm; so u = -80/3 cm.**

**Image is real and inverted. The lens is convex**

12. Size of image of an object by a mirror having a focal length of 20 cm is observed to be reduced to 1/3rd of its size. At what distance the object has been placed from the mirror? What is the nature of the image and the mirror?

**Ans. m = 1/3 .** $\frac{v}{u} = -m$ **; Using** $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$ **; v = -(1/3)u;** $\frac{-3}{u} - \frac{1}{u} = \frac{1}{20}$

**calculate u; u = – 80 cm. Image is real and inverted. Mirror is concave.**

13. Define power of a lens. What is its unit? One student uses a lens of focal length 50 cm and another of –50 cm. What is the nature of the lens and its power used by each of them?

**Ans. P = 1/f where f is in metre. Its unit is Dioptre. Lens is convex in the first case and concave in the second case. Power is equal to 2 dioptre in the first case and –2 dioptre in the second case.**

14. A student focussed the image of a candle flame on a white screen using a convex lens. He noted down the position of the candle screen and the lens as under Position of candle = 12.0 cm Position of convex lens = 50.0 cm Position of the screen = 88.0 cm

(i) What is the focal length of the convex lens?

(ii) Where will the image be formed if he shifts the candle towards the lens at a position of 31.0 cm?

(iii) What will be the nature of the image formed if he further shifts the candle towards the lens? (iv) Draw a ray diagram to show the formation of the image in case (iii) as said above.

**Ans. (i) Focal length = 38/2 = 19 cm**

**(ii) The image will be formed at infinity**

**(iii) Virtual and erect**

**(iv)**