Light – Reflection of Light

1. *(a) What do you understand by the following terms?*

(i) Light *(ii) Diffused light.*

(b) By giving one example and one use explain or define (i) regular reflection (ii) irregular reflection.

Ans.(a) (i) **Light :** An invisible energy, which causes the sensation of sight.

(ii) **Diffused light :** When light energy spreads over vast space, due to successive reflections from rough surfaces, such that its intensity decreases is called diffused light.

(b) (i) **Regular reflection :** The phenomenon, due to which a parallel from of light, travelling through a certain medium, on striking some smooth polished surface, bounces of from it, as a parallel beam, in same other direction is called regular reflection.

Example : The reflection taking place from a plane mirror.

Use : It is used for seeing one's face in plane mirror.

(ii) **Irregular reflection :** The phenomenon, due to which a parallel beam of light, travelling through some medium, gets reflected in various possible directions, on striking some rough surface is called irregular reflection.

Example : Reflection taking place from irregular surfaces, such as walls, stones, etc.

Use : It cuts the glare and hence, is helpful in seeing things around.

2. *By drawing a neat diagram define the following :*

(i) Mirror (ii) Incident ray (iii) Reflected ray (iv) Angle of incidence (v) Angle of reflection (vi) Normal.

Ans. (i) **Mirror :** A smooth polished surface from which regular reflection takes place is called mirror.

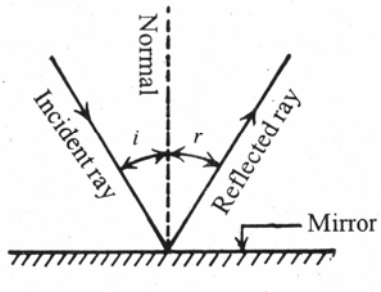
(ii) **Incident ray :** A ray of light, which travels towards mirror is called incident ray.

(iii) **Reflected ray :** A ray of light, which bounces off the surface of mirror.

(iv) **Angle of incidence :** The angle between incident ray and normal.

(v) **Angle of reflection :** The angle between reflected ray and normal.

(vi) **Normal :** The perpendicular drawn on the point of incidence on the surface of mirror is called normal.



3. *State laws of reflection.*

Ans. Laws of reflection :

1. The incident ray, the reflected ray and normal lie in the same plane, at the point of incidence.
2. Angle of incidence is always equal to the angle of reflection.

4. *A ray of light strikes a plane mirror, such that angle with the mirror is* 20°. *What is the value of angle of reflection? What is the angle between incident ray and reflected ray?*

Ans. Angle of reflection = Angle of incidence { By the laws of reflection. }

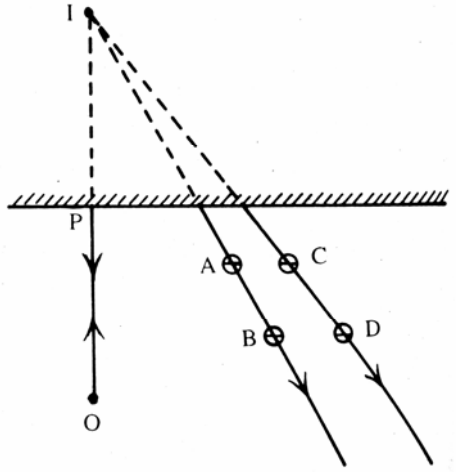
Angle of incidence = (90 – 20)° = 70°

∴ Angle of reflection = **70°**

Angle between incident ray and reflected ray = ∠i + ∠r = 70° + 70° = **140°**.

5. *Prove experimentally that images are formed as far behind in a plane mirror as the object is in front of it.*

Ans. Place a plane mirror strip in an upright position on a white sheet of paper, which is mounted on a wooden board and hold it by a mirror stand.



Fix a pin at point 'O' in front of mirror and look for its image I. Looking at the image fix two pins A and B, such that these pins and the image I are in same straight line. Remove the pins and draw small circles around the pin points A and B. Similarly, fix two pins C and D in line with the image I. Remove the pins and draw small circles around the pin points

C and D. Join AB and CD and produce them backward to meet at I. Thus, I is the image of O. Join OI, such that it cuts the mirror line at P. Measure PO and PI. It is seen that PO = PI. Thus, in a plane mirror, image is formed as far behind the mirror as the object in front of it.

6. *(a) What do you understand by the term lateral inversion?*

(b) A printed card has letters PHYSICS. Show how it would appear in a mirror without showing ray diagram.

Ans. (a) The phenomenon due to which the image of the object turns through angle of 180º through a vertical axis, such that right side of object appears as left side of object and vice-versa is called lateral inversion.

(b) 

7. *(a) State the mirror formula for the formation of total number of images formed in two plane mirrors, held at an angle* θ.

(b) Calculate the number of images formed in two plane mirrors, when they are held at angle of (i) 72° *(ii)* 36°.

Ans. (a) No image formed in two plane mirrors inclined at angle θ is given by

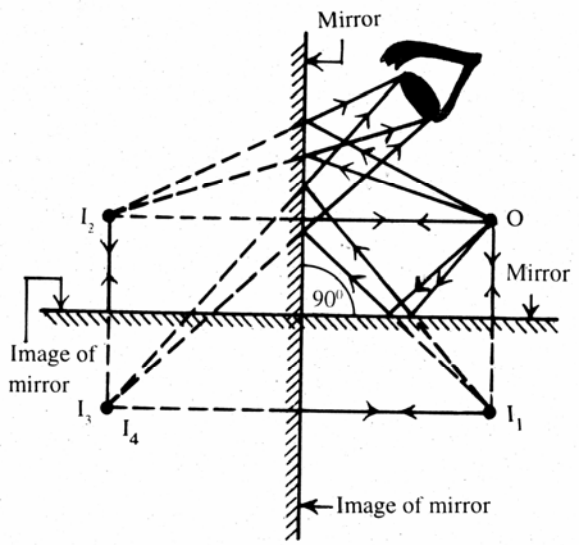
$n = \frac{360}{\theta} - 1$ where n is a number of images and θ the angles of inclination between mirrors.

(b) (i) When θ = 72°, No. of images (n) $= \frac{360°}{\theta} - 1 = \frac{360}{72} - 1 = 5 - 1 =$ **4.**

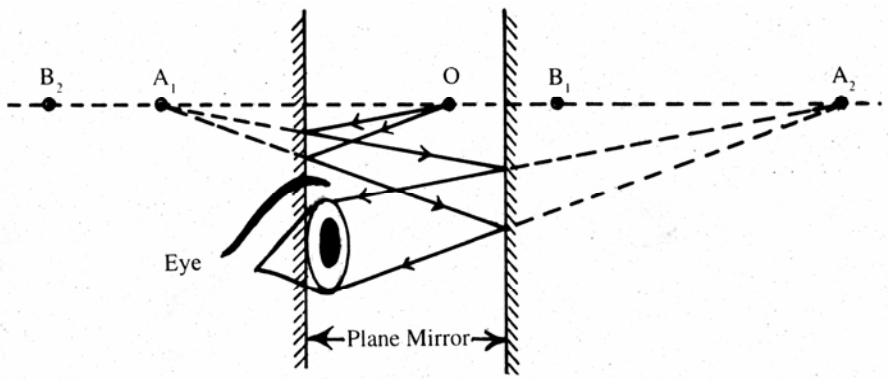
(ii) When θ = 36° No. of images (n) $= \frac{360°}{\theta} - 1 = \frac{360}{36} - 1 = 10 - 1 =$ **9.**

8. *Draw a neat two ray diagram for the formation of images in two plane mirrors, when mirrors are (i) at right angles to each other (ii) facing each other.*

Ans. (a)



(b)



9. *Why are infinite images not seen when two plane mirrors are facing each other?*

Ans.(i) Due to successive reflections the images become very faint and are hardly visible.

(ii) The eye cannot resolve very far off images as the angle subtended by them on the eye is very small.

10. *(a) State five characteristics of image formed in plane mirror.*

(b) State three ways, in which image formed in plane mirror differs from image formed in pin hole camera.

Ans. (a) **Characteristics of image formed in plane mirror :**

1. Image is virtual
2. Image is erect
3. Image is of same size as object.
4. Image is laterally inverted.
5. Image is formed as far behind the mirror, as the object is in front of it.

(b) (i) Image formed in plane mirror is virtual, but image formed in pin hole camera is real.

(ii) Image formed in plane mirror is laterally inverted but erect, but image formed in pin hole camera is inverted.

(iii) Image formed in plane mirror is of the same size as object, but image formed in pin hole camera is diminished.

11. *A boy stands 4 m away from plane mirror. If the boy moves ½ m towards mirror, what is the distance between the boy and his image? Give a reason for your answer.*

Ans. Distance of object from plane mirror = Distance of image from plane mirror.

∴ Initial distance between boy and plane mirror = 4 m.

Final distance between boy and his image = $3\frac{1}{2}$ m.

Distance between boy and his image = $3\frac{1}{2} \times 2 =$ **7 m.**

12. *Copy the figure* 1 *and* 2 *and complete them by drawing two ray diagram.*

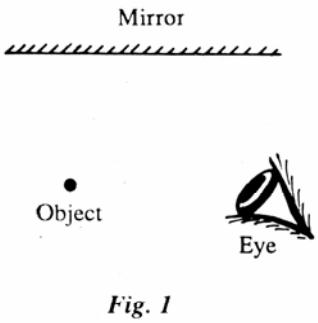


Fig. 1

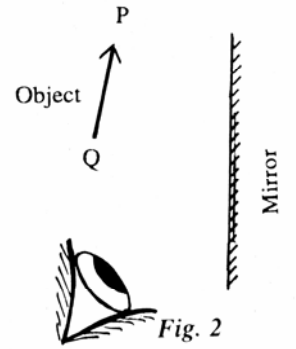


Fig. 2

Ans.

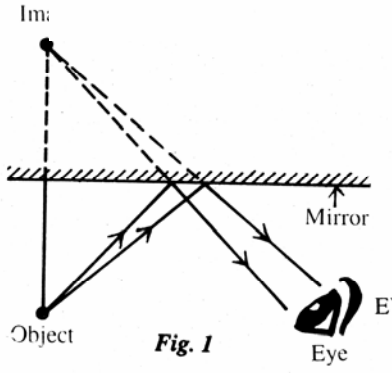


Fig. 1

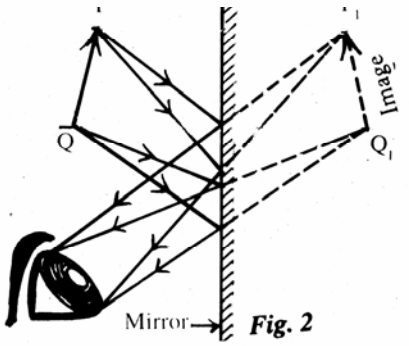


Fig. 2

13. *State four uses of plane mirror.*

Ans. Four uses of plane mirrors are :

(i) As looking glass

(ii) For making periscope

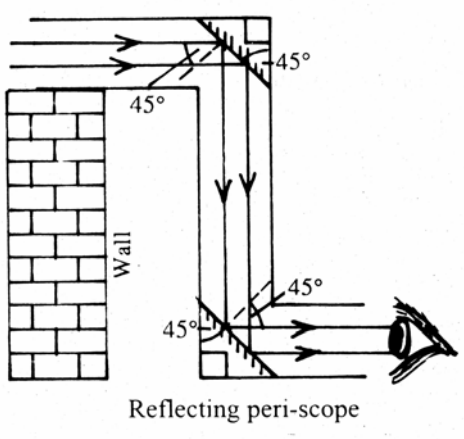
(iii) In solar cookers

(iv) For signalling purposes.

14. *(a) Draw a neat diagram of reflecting periscope.*

(b) State two advantages and two disadvantages of reflecting periscope.

Ans. (a)



Reflecting peri-scope

(b) **Advantages of periscope :**

1. It can be used to see above the heads of crowd.
2. It can be used by soldiers in trench warfare.

Disadvantages of periscope :

1. Final image is not brightly illuminated as some amount of light energy is absorbed by two successive reflections.

2. Any deposition of dust or moisture on mirror, reduces regular reflection almost to nil and hence, it stops working.

15. *Define the following terms :*

(i) Spherical mirror(ii) Convex mirror (iii) Concave mirror.

Ans. (i) **Spherical mirror :** A mirror, which is made from a part of hollow sphere is called spherical mirror.

Concave mirror : A mirror, which is polished form outer side of hollow sphere, such that its reflecting surface is towards hollow side is called concave mirror.

Convex mirror : A mirror, which is polished from hollow side of sphere, such that the reflecting surface is towards outside of hollow sphere is called convex mirror.

16. *Define the following terms in relation to concave mirror.*

(i) Pole (ii) Centre of curvature (iii) Principal axis

(iv) Principal focus (v) Focal length (vi) Radius of curvature

(vii) Linear aperture.

Ans. (i) **Pole (P) :** The mid-point of spherical mirror is called pole.

(ii) **Centre of curvature (C) :** The centre of the sphere of which spherical mirror is a part, is called centre of curvature.

(iii) **Principal axis :** An imaginary line passing through the pole and centre of curvature of mirror is called principal axis.

(iv) **Principal focus :** It is a point on principal axis, where a parallel beam of light after reflection either actually meets or appears to meet.

(v)**Focal length :** The linear distance between pole and principal focus is called focal length.

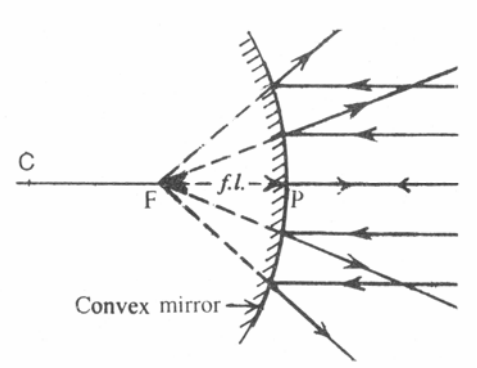
(vi) **Radius of curvature :** The linear distance between pole and centre of curvature is called radius of curvature.

(vii) **Linear aperture :** The diameter of spherical mirror is called linear aperture.

17. *(a)Define the term principal focus in case of convex mirror. Draw a convex mirror and show its principal focus and focal length clearly.*

(b)What is the relation between focal length and radius of curvature of concave mirror?

Ans. (a) A point on the principal axis of a convex mirror, where a beam of light travelling parallel to principal axis after reflection appears to meet is called principal focus of convex mirror.



(b) Radius of curvature = 2 × focal length.

18. *(a) What do you understand by the term real image?*

(b) What type of mirror is used to obtain real image?

(c) Does the mirror named by you forms real image for all locations? Give reason for your answer.

(d) Is real image always inverted?

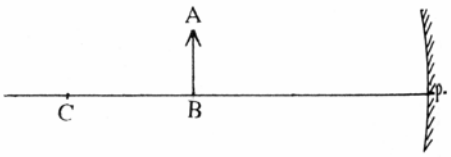
Ans.(a) When the rays of light diverging from a point after reflection or refraction actually converge at some other point, then that point is called real image of object.

(b) A concave mirror is used to obtain real image.

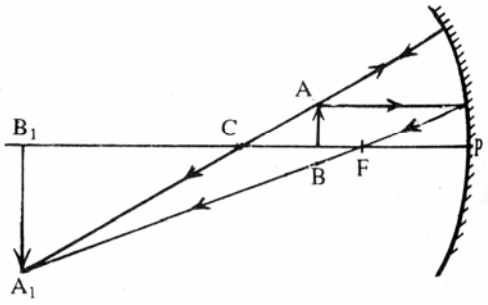
(c) No. It forms virtual image when object is between principal focus and pole.

(d) Yes. Real image is always inverted.

19. *Copy the figure. By taking two rays from point A, show the formation of image. State four characteristics of image.*



Ans. Characteristics of image :



(i) Image is real

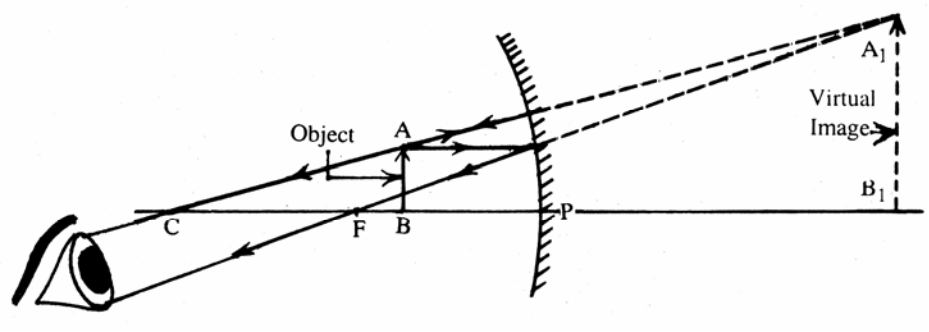
(ii) Image is inverted

(iii) Image is magnified

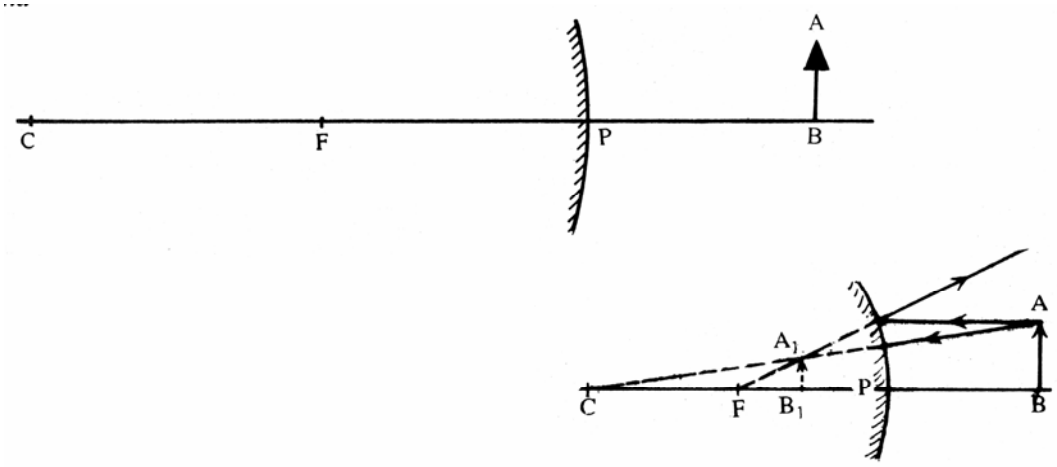
(iv) Image is formed between infinity and centre of curvature.

20. *Draw a neat two ray diagram to illustrate, how a concave mirror is used as a shaving mirror.*

Ans.



21. *Copy the figure. By taking two rays from point A, show the formation of image. State four characteristics of image.*



Ans. Characteristics of Image.

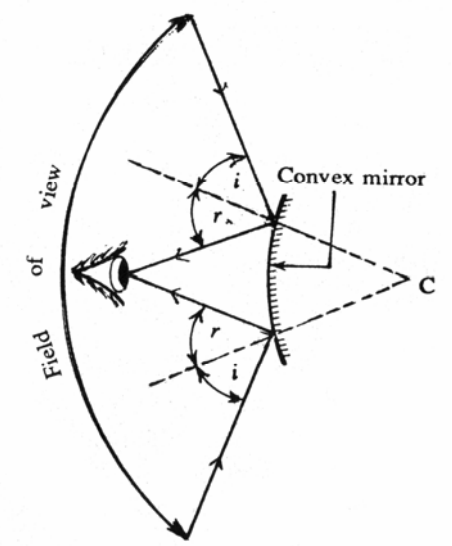
(i) Image is virtual

(ii) Image is erect

(iii) Image is diminished

(iv) Image is formed between pole and principal focus of spherical mirror.

22. *Why do automobile drivers prefer convex mirror as a rear view mirror? Illustrate your answer.*



Ans. It is because, it can cover a very wide field behind the driver and hence enables him to see the traffic behind him without turning his head backward.

23. *Give two uses of (i) convex mirrors (ii) concave mirrors.*

Ans. (i) **Uses of convex mirror :**

1. They are used as rear view mirror in automobiles.
2. They are used as reflectors for street light bulbs as they diverge rays of light over wide area.

(ii) **Uses of concave mirror :**

1. They are used as shaving glass, as they form an enlarged and virtual image when face is between pole and principal focus.
2. They are used as reflectors in automobile head lights.

24. *You are provided a convex mirror, a concave mirror and a plane mirror. How will you distinguish between them, without touching or using any other apparatus?*

Ans. Hold an object say pencil close to each mirror and look for its image.

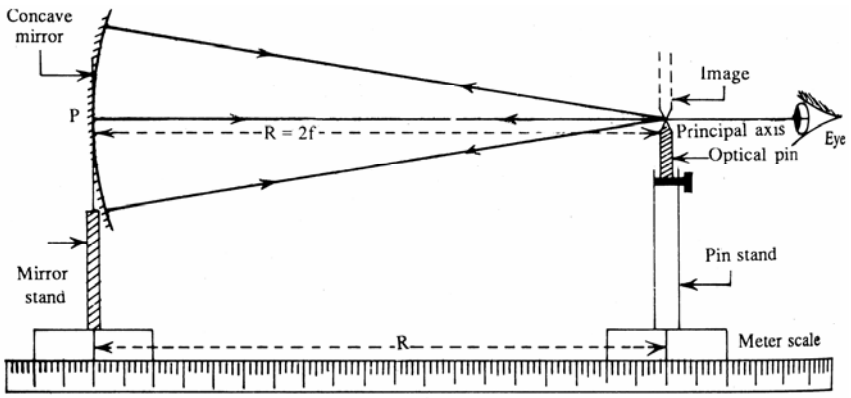
(i) If the image is erect and diminished, the mirror is convex.

(ii) If the image is erect and enlarged, the mirror is concave.

(iii) If the image is erect and same size as object, the mirror is plane.

25. *Describe briefly, how you will determine focal length of a concave mirror, using a single optical pin.*

Ans. Support a concave mirror on a mirror stand and in front of it mount an optical pin in another stand, such that tip of optical pin is in line with the pole of concave mirror. Look for the image of pin. Move the optical pin backward or forward, till parallax between optical pin and its image is removed. Measure the distance between the optical pin and concave mirror. This distance is equal to radius of curvature R. The focal length of concave mirror f = R/2.

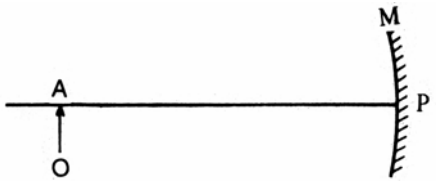


26. *Compare the characteristics of an image formed by a convex mirror and a concave mirror, when object is beyond centre of curvature, but not at infinity in case of concave mirror and in between pole and infinity in case of convex mirror.*

Ans.

Convex mirror	Concave mirror
1. Image is virtual 2. Image is erect 3. Image is diminished 4. Image is formed between pole and principal focus.	1. Image is real. 2. Image is inverted. 3. Image is diminished. 4. Image is formed between principal focus and centre of curvature.

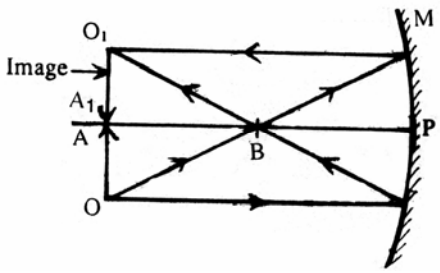
27. *In the diagram a concave mirror of focal length 2.15 cm is shown. A is a point on the principal axis. If an object O is kept at A, image is formed on A itself. Draw the image in the diagram. Is the image real or virtual? Measure the distance PA and write it in the diagram. What is the distance PA called? Mark a point B on the principal axis, at which, if a point source of light is kept, the rays travel parallel to principal axis after reflection from M. What is the point B called?*



Ans. **PA** = 4.3 cm

PA is called radius of curvature.

Point B is called principal focus.



28. *An insect is sitting in front of a plane mirror at a distance of one metre from it.*

(i) Where is the image of insect formed?

(ii) What is the distance between insect and its image?

(iii)State any two characteristics of image formed in a plane mirror.

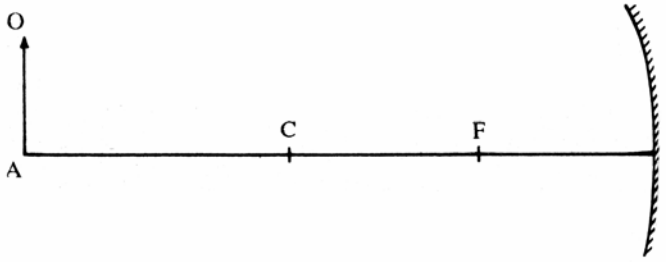
Ans. (i) Image of insect is formed 1 m behind the plane mirror.

(ii) The distance between insect and its image is 2m.

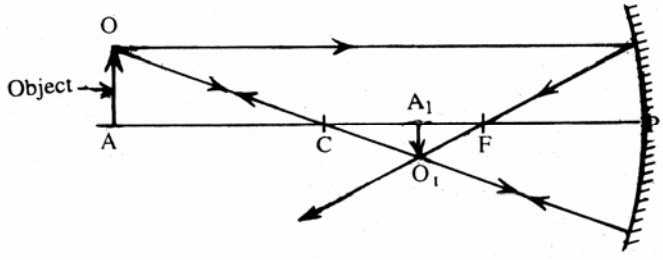
(iii) (a) Image is virtual.

(b) Image is erect.

29. *An object OA is placed on the principal axis of a concave mirror as shown in diagram. Copy the diagram and complete to show the formation of image.*



Ans.



30. *(i) Parallel rays are incident*

(a) on polished surface and

(b) on rough surface.

In what respect do reflected rays in (a) differ from those of (b)?

(ii) Write down four characteristics of image formed in a plane mirror.

Ans. (i) (a) On polished surface, the parallel beam is reflected as parallel beam.

(b) On rough surface, the reflected rays travel in various directions and not as a parallel beam.

(ii) (a) Image is virtual

(b) Image is erect

(c) Image is formed as far behind the mirror as object is in front of it.

(d) Image is laterally inverted.

31. *How many images will be formed when an object is placed between two parallel plane mirrors with their reflecting surfaces facing each other?*

Why do more distant images appear fainter?

Ans. Infinite images are formed.

On every successive reflection, some amount of light is absorbed by mirror.

Thus, the distant images tend to get fainter.

32. *(a)Write down the letters of the word 'POLEX' as seen in a plane mirror, held parallel to the plane of this paper.*

(b) Name a mirror which always produces an erect and virtual image.

(c)Distinguish between real and virtual image.

Ans. (a)

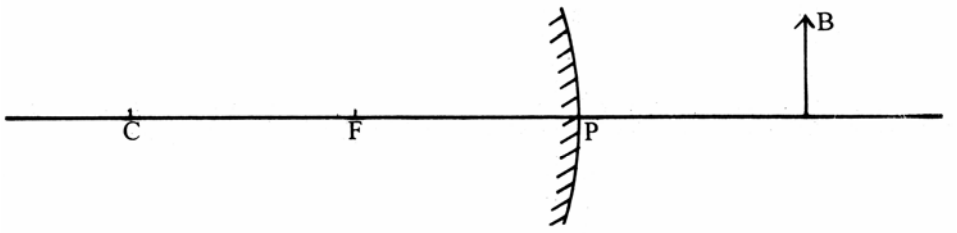
(b) Convex mirror always produces erect and virtual image.

(c) (i) Real image can be taken on screen, but virtual image cannot be taken one screen.

(ii) Real image is always inverted, but virtual image is always erect.

33. *(a) On what factors does the size of an image formed by a pin hole camera depend?*

(b)



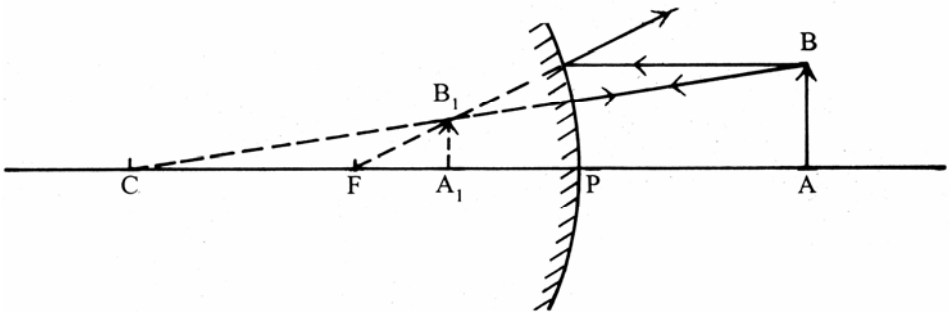
Copy the above diagram and complete it by drawing two rays to show the formation of the image of the object AB. State the size, position and nature of image formed.

Ans. (a) Size of image in pin hole camera ∝ size of object.

∝ 1/Distance of object from pin hole.

∝ Distance of image from pin hole.

(b)



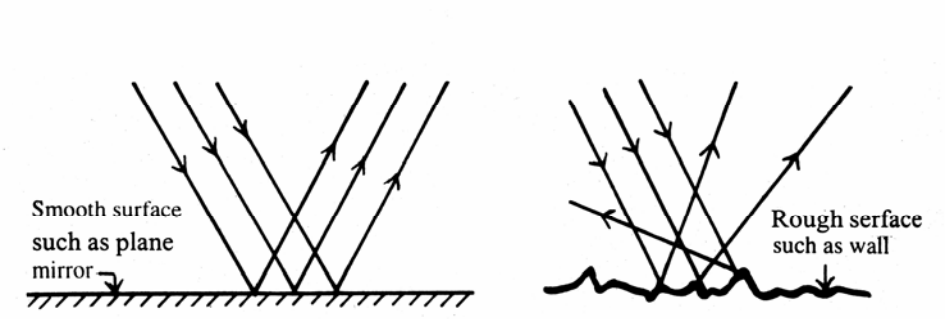
Size : Image is diminished.

Position : Image is formed between P and F, behind the mirror.

Nature : Image is virtual and erect.

34. *Draw diagrams to show difference between regular and irregular reflection.*

Ans.



35. *An object is placed 2 cm from a plane mirror. If the object is moved by 1 cm towards the mirror, what will be the new distance between object and image?*

Ans. New distance of object from plane mirror = (2–1) cm = 1 cm

By the laws of reflection

New distance of image from plane mirror = 1 cm

∴ Total distance between object and image = (1 + 1) cm = **2 cm.**