CHAPTER 7: REFLECTION OF LIGHT

EXERCISE 7(A)

Q. 1.) What do you mean by reflection of light?

Ans. When light returns to the same medium after striking a surface, this process is called reflection.

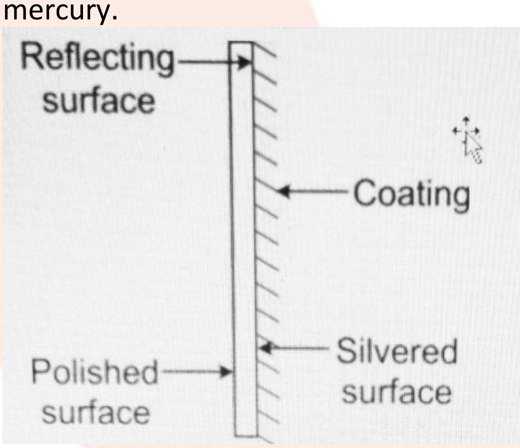
Q. 2.) State which surface of a plane mirror reflects most of the light incident on it: the front smooth surface or the back silvered surface.

Ans. The back silvered surface

Q. 3.) Explain the following term:

a) Plane mirror
b) Incident ray
c) Reflected ray
d) Angle of incidence, and
e) Angle of reflection

Ans. (a) Plane mirror: A highly polished, smooth reflective surface made up of clear plane glass sheet is called a plane mirror. The coating is abrasive made mostly of silver or mercury.

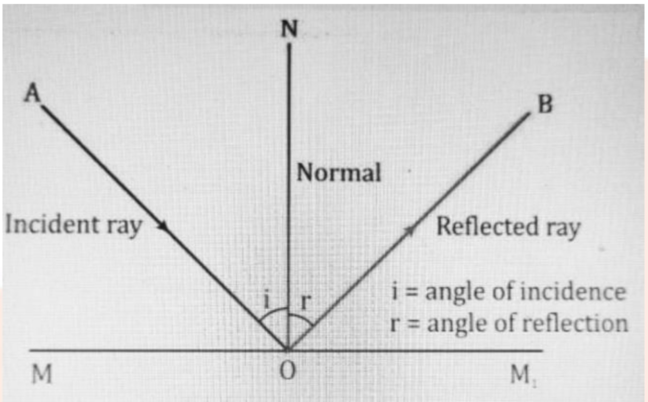


(b) Incident ray: The striking ray on the reflective surface is called incident ray.

(c) Reflected ray: When incident ray strikes a reflective surface, the ray returned to the same medium is called the reflected ray.

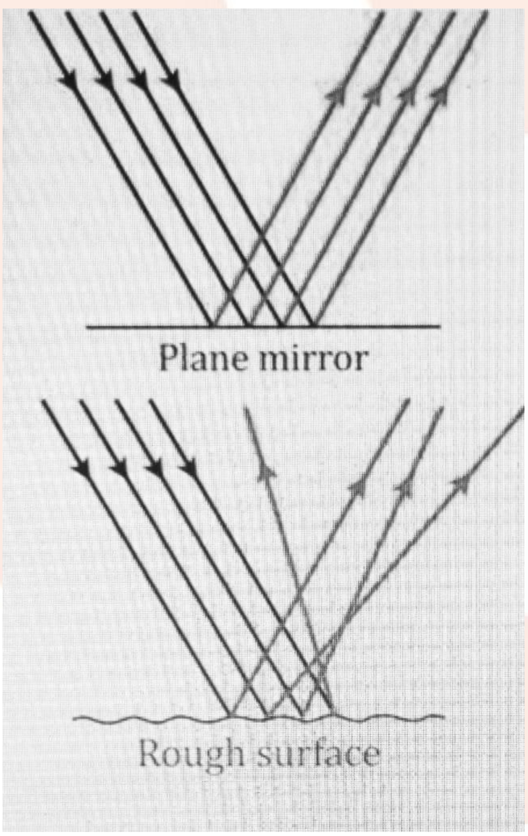
(d) Angle of incidence: The angle between the incident ray with the normal to the reflecting surface is called as angle if incidence.

(e) Angle of reflection: The angle between the reflected ray and the normal at the point of incidence is known as the Angle of reflection. Angle of reflection is denoted by the letter ‘r’.



Q. 4.) With the help of diagram, explain the difference between the regular and irreregular reflection.

Ans.



Regular reflection	Irregular reflection
When a light beam is incident of a smooth even reflective surface, they have an even reflective point with same angle of incidence and angle of reflection. This is called regular reflection.	Unlike regular reflection, in irregular the incident rays have different angle of incidence and thus different angle of reflection as they fall on an uneven surface.

Q. 5.) Differentiate between the reflection of light from a plane mirror and that from a plane sheet of paper.

Ans. Reflection from a plane mirror will be a regular reflection while that from a paper sheet will be irregular

Q. 6.) State the two laws of reflection of light.

Ans. Laws of reflection:

1. **First law:** Angle of reflection is equal to as angle of incidence
2. **Second law:** The incident ray, reflected ray and normal at the point of incidence all lie in the same plane.

Q. 7.) State the laws of reflection and describe an experiment to verify them.

Ans. Laws of reflection:

1. **First law:** Angle of reflection is equal to as angle of incidence
2. **Second law:** The incident ray, reflected ray and normal at the point of incidence all lie in the same plane.

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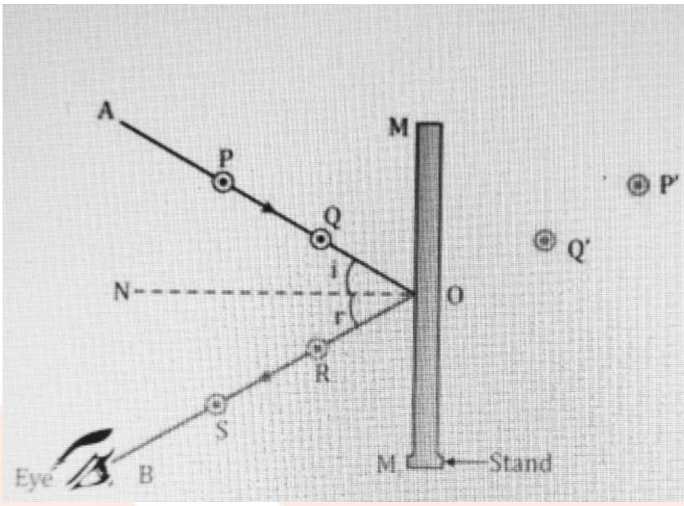
<u>Experiment to verify the laws of reflection:</u>

A white paper is fixed on drawing board and a line MM_1 is drawn.

A point O is taken on this line, nearly in the middle and line OA is drawn such that $\angle MOA < 90^o$

A normal ON is drawn and a small mirror is vertically placed with polished surface along MM_1 .



Now take two pins and fix them at points P and Q on line OA. Now with an eye on the other side of normal ON try to look at the images of pins and fix pins R and S in line with the image.

Next, try fixing pins P' and Q' behind the mirror where the images seem to be coming in line from.

Using a pen, join ORS.

Now you will see $\angle AON = \angle SON$. Repeat this experiment with different angles of incidence.

This proves first law of reflection.

Also it's observed that lower tips of all pins P,Q, R and S and also the normal ON

Next, at some distance (likely ≈5 cm) apart vertically on line OA, fix two pins P and Q on the board. Try to see clearly, images P' and Q' of the pins P and Q by keeping an eye on the other side of normal (but on the same side of mirror). As observed in the mirror, next fix a pin R such that the pin R is in the line with the images of pins P and Q. Next, fix another pin S in such a way that the pin S will be in line with the pin R as well as images P' and Q' of pins P and Q.

As shown in figure, draw small circles around the positions of pins on the paper. Then remove the pins and draw a line OB which joins the pin points S and R, which eventually meets the surface of mirror at O. Then, the angles BON and AON are measured and recorded.

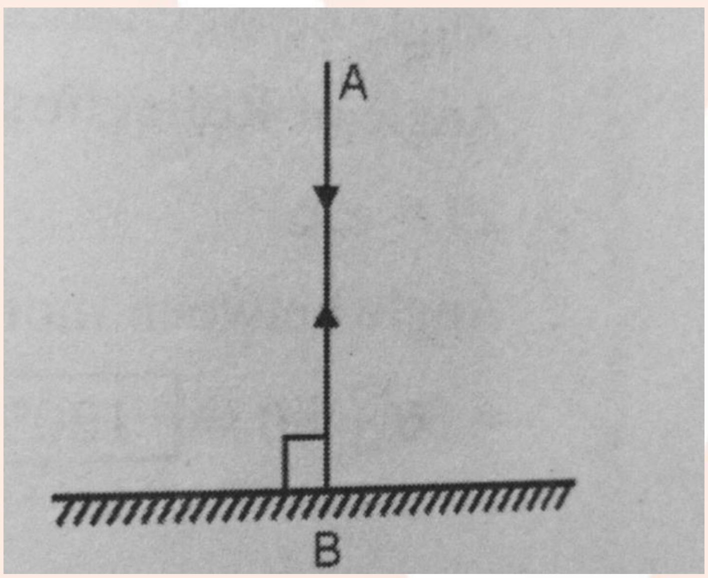
The experiment is then repeated for the angle of incidence ∠AON equal to 40°, 50°, 60°. It is observed from results of repeated experiments that angle of incidence is equal to the angle of reflection. Consequently, This verifies the first law of reflection.

The experiment should be performed on a flat drawing board, which has the mirror normal to the plane of board on which white sheet of paper is being fixed. Because the lower tips of all the pins lie on the same plane (i.e., the plane of paper) too, therefore it proves the second law of reflection.

Q. 8.) A light ray is incident normally on a plane mirror. (a) What is its angle of incidence? (b) What is the direction of the reflected ray? Show it on diagram.

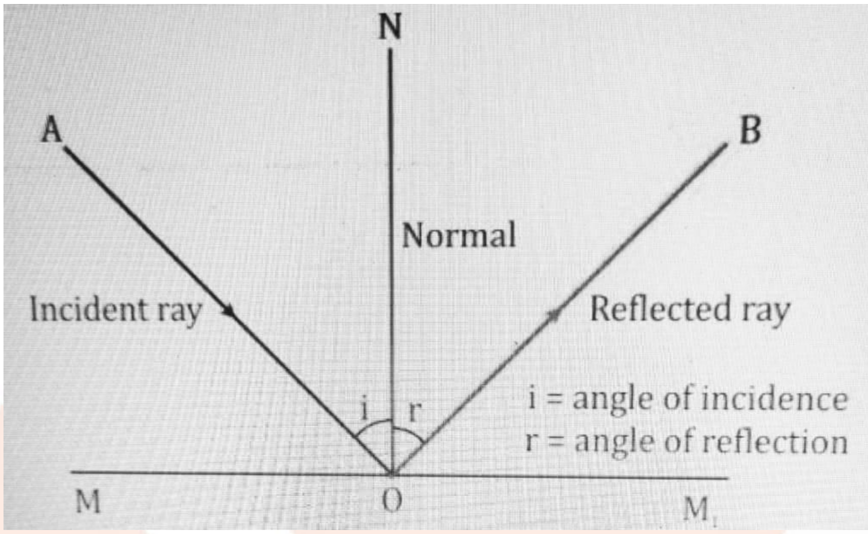
Ans. (a) 0°

(b) The reflected ray is opposite normally to the incident ray.



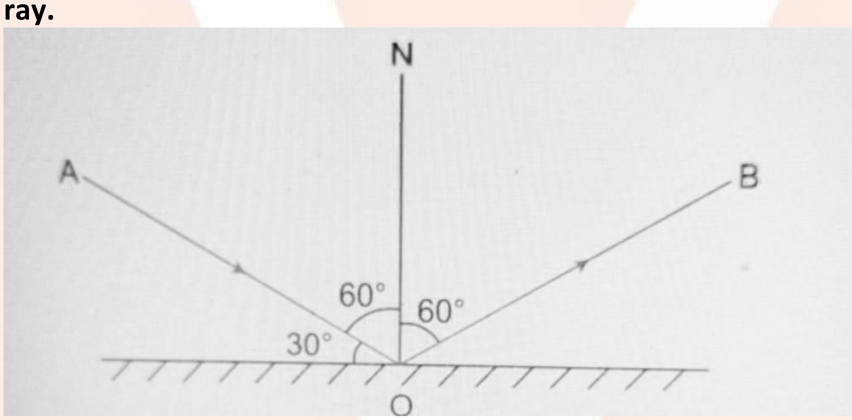
Q. 9.) Draw a diagram to show the reflection at a ray of light by a plane mirror. In the diagram, label the incident ray, the reflected ray, he normal ray, angle of incidence and angle of reflection.

Ans.



Q. 10.) Fig. shows an incident ray AO and the normal ray ON on a plane mirror. The angle which the incidence ray OA makes with the mirror is 30^o.

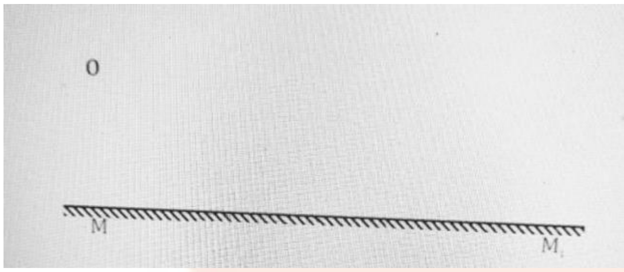
a) Find the angle of incidence
b) Draw the reflected ray and then find the angle between the incident and reflected ray.



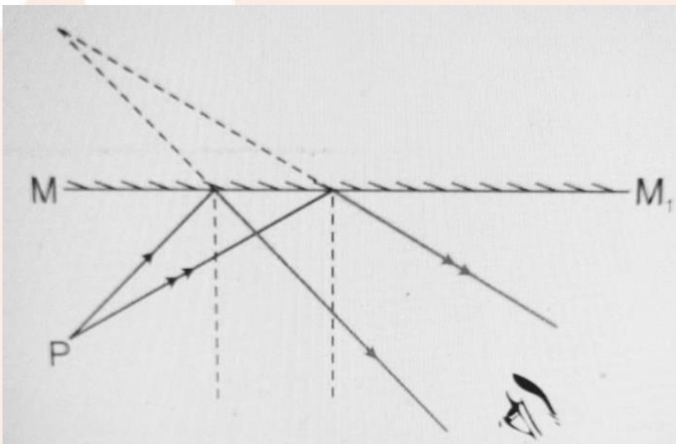
Ans. (a) Angle of incidence = angle AON=90^o – 30^o = 60^o
(b) Angle between the incident and reflected ray = Angle of incidence + Angle of reflection= 2X (angle of incidence) *<Using first law of reflection>*

=2 X 60^o = 120^o

Q.11.) The diagram in fig. shows a point object P in front of a plane mirror MM_1. (a) Complete the diagram by taking two rays from the point P to show the formation of its image. (b) In the diagram, mark the position of eye to see the image. (c) Is the image formed real or virtual? Explain why?



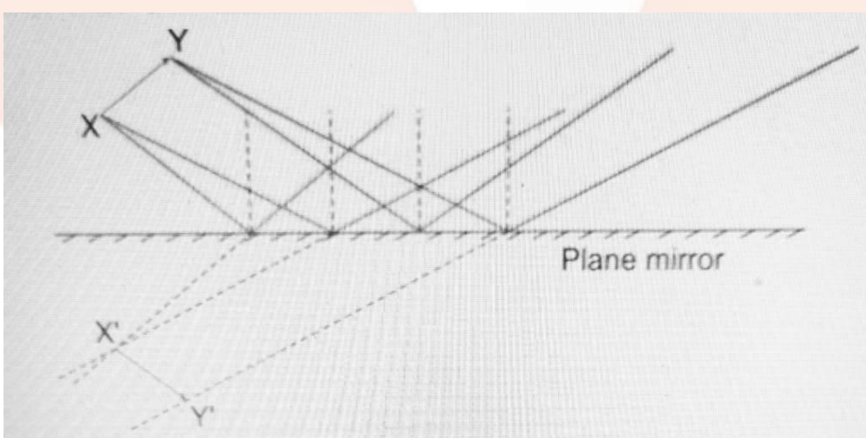
Ans. (a) and (b)



(c) The image formed is a virtual image as on extending the rays behind the mirror, it appears to be converging at a point.

Q. 12.) The diagram below in figure, shows an object XY in front of plane mirror MM_1. Draw the diagram, path of two rays from each point X and Y of the object to show the formation of its image.

Ans.



Q. 13.) (a)Write three characteristics of the image formed by a plane mirror? (b) How is the position of image related to the position of the object?

Ans. (a) The image formed by plane mirror is virtual, same sized and erect.

(b) The image formed is at the same perpendicular distance from the mirror as the object is

Q. 14.) Differentiate between a real and a virtual image.

Ans.

Real Image	**Virtual image**
Can be obtained on a sceen	Cannot be obtained on a screen
It is inverted w.r.t. object	It is erect w.r.t object

Q. 15.) Write down the letters of the word POLEX as seen in a plane mirror held perpendicular to the plane of the paper.

Ans. The interchange of the left and right sides of an object in a plane mirror is said to be lateral inversion.

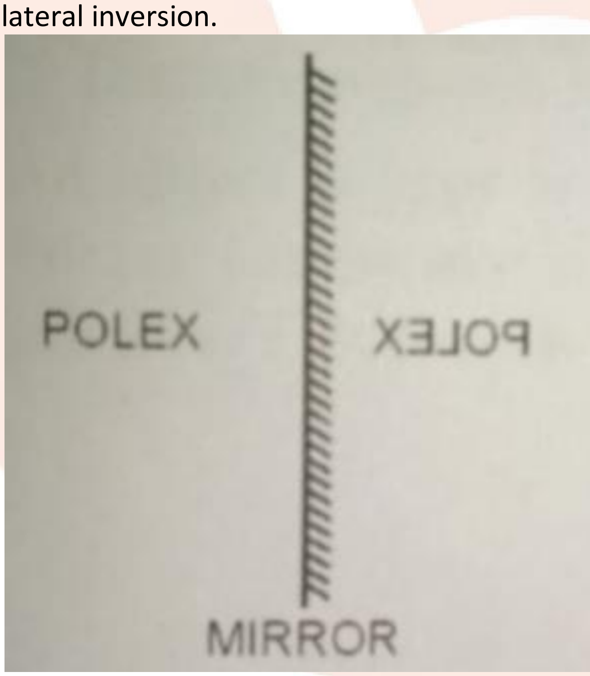
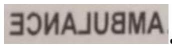


Figure above shows the image formation of a POLEX in a plane mirror.

Q. 16.) The letters on the front of an ambulance are written laterally inverted like . Give reason.

Ans. Because the driver of the vehicle which is moving ahead of the ambulance can read in his rear view mirror, these words laterally inverted as AMBULANCE, and gives side to pass the ambulance

Q. 17.) Why is it difficult to read the image of the text of a page formed due to reflection by a plane mirror?

Ans. It is difficult to read the image of the text of a page formed due to reflection by a plane mirror is due to lateral inversion.

MULTIPLE CHOICE TYPE

Q. 1.) According to the law of reflection:

a) i/r = constant
b) sin i/sin r = constant
c) i + r = constant
d) i = r

Ans. d

Q. 2.) The image formed by a plane mirror is:

a) Erect and diminished
b) Erect and enlarged
c) Inverted and of same size
d) Erect and of same size

Ans. d

Q. 3.) The image formed by a plane mirror is:

a) Real
b) Virtual
c) Virtual with lateral inversion
d) Real with lateral inversion

Ans. c

NUMERICALS

Q. 1.) A ray is incident on a plane mirror. Its reflected ray is perpendicular to the incident ray. Find the angle of incidence.

Ans. Given, the Angle of incidence (i) + Angle of reflection(r) = 90^o
using first law of reflection; i = r
=> 2 i = 90^o
=> i = r = 45^o

Q. 2.) A man standing in front of a plane mirror finds his image at a distance 6 metre from himself. What is the distance of man from the mirror?

Ans. Dist. b/w man and image = 6m
=>distance between man and mirror (d1) + distance between mirror and image(d2) = 6m
As we know that d1=d2
=>2d1 =6

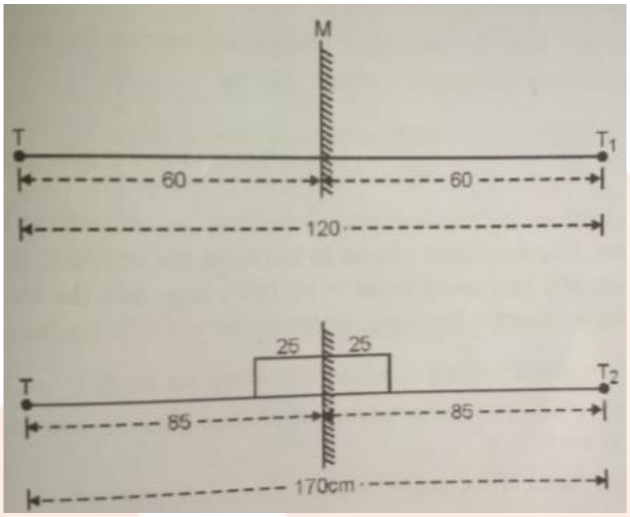
=>d1= 6/2 = 3m

Q. 3.) An insect is sitting in front of a plane mirror at a distance 1 m from it.

a) Where is the image of insect formed?
b) What is the distance between the insect and its image?

Ans. (a) 1m behind the mirror.
(b) The distance will be = 1 + 1 = 2 m

Q. 4.) An object is kept at 60 cm in front of a plane mirror. If the mirror is now moved 25 cm away from the object, how does the image shift from its previous position?



Ans. If the mirror is shifted back by 25 cm, the image will also shift back by 25 cm. Therefore, the image shifts 50 cm away from the object. The depiction is in the diagram above.

Q. 5.) An optician while testing the eyes of a patient keeps a chart of letter 3 m behind the patient and asks him to see the letters on the image of chart formed in a plane mirror kept at distance 2 m in front of him. At what distance is the chart seen by the patient?

Ans. Given that the distance between chart and man(d1) = 3m
Also given, the distance between mirror and man (d2) = 2m
Thus, the distance between chart and mirror = d1+d2= 3+2= 5 m
So, the distance of final image is formed on the mirror, is seen by the patient at (5m + 2m =) 7m from himself.

EXERCISE 7(B)

Q. 1.) Two plane mirrors are placed making an angle ϴ in between them. Write an expression for the number of images formed if an object is placed in between the mirrors. State the condition, if any?

Ans. **First we calculate** $n = 360^o / \theta^o$.

Now, the no. of image formed if an object is kept between two mirrors will be n or (n – 1) if n is odd or even .

Conditions:

(a) If n is odd,
(i) If the object is asymmetrically placed between the mirrors, the number of images formed is n.
(ii) If object is symmetrically placed between the mirrors, the number of images formed is n-1.

(b) If n is even, the number of images formed is n-1 always.

Q. 2.) Two plane mirrors are placed making an angle θ^o in between them. For an object placed between the mirrors, if angle is gradually increased from 0^o to 180^o, how will the number of images change: increases, decreases or remain unchanged?

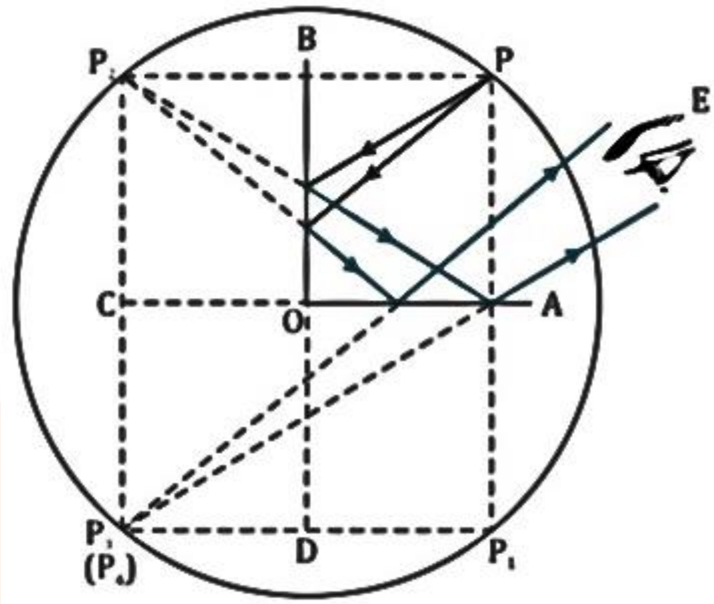
Ans. As we know that

$$n = \frac{360}{\theta}$$

So if the angle is increased, the number of images decreases.

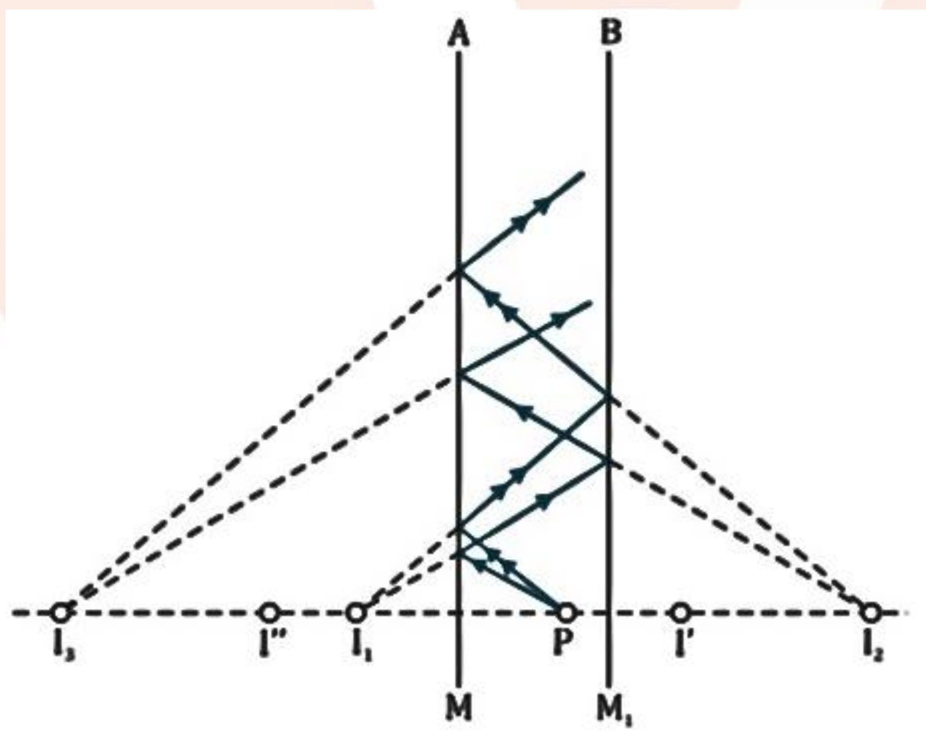
Q. 3.) How many images are formed for a point object kept in between the two plane mirrors at right angles to each other? Show them by drawing a ray diagram.

Ans. 3



Q. 4.) **Two plane mirrors are arranged parallel and facing each other at some separation. How many images are formed for a point object? Show the formation of images with the help of a ray diagram.**

Ans. infinite images



Q. 5.) **State two uses of a plane mirror.**

Ans. Two uses of plane mirror:

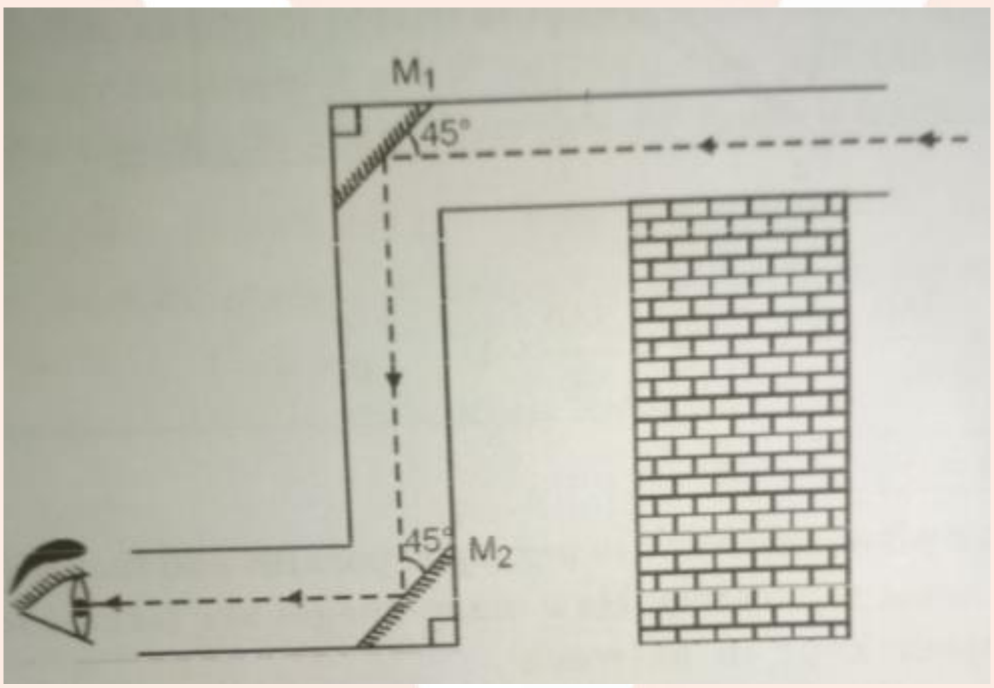
1. Used in home for dressing
2. Used in solar devices like solar cooker etc.

Q. 6.) State one use of periscope.

Ans. It is used in submarines to see above sea level

Q. 7.) Draw a neat labelled diagram to show how a periscope is used to see an object over an obstacle.

Ans.



Q. 8.) How many plane mirror are used in a periscope? How are they arranged relative to each other?

Ans. 2 plane mirrors. They are arranged parallel at a fixed angle of 45°

(Diagram as in Q7)

Q. 9.) Is the image seen by a periscope laterally inverted? Give reason for your answer.

Ans. As the image formation in periscope is done simultaneously by two plane mirrors that cancel out each other's lateral inversion, the final image appears without lateral inversion.

Q. 10.) Is the final image formed in a periscope real?

Ans. No, it's virtual.

MULTIPLE CHOICE TYPE

Q. 1.) Two plane mirrors are placed making an angle 60^o in between them. For an object placed in between the mirrors, the number of images formed will be:

(a) 3 **(b) 6**

(c) 5 **(d) infinite**

Ans. **(c)**

Q. 2.) In the barber's shop, two plane mirrors are placed:

a) **Perpendicular to each other**
b) **Parallel to each other**
c) **At an angle 60^o between them**
d) **At an angle 45^o between them.**

Ans. **(b)**

Q. 3.) The image formed in a periscope is:

a) **Real with lateral inversion**
b) **Virtual with lateral inversion**
c) **Real without lateral inversion**
d) **Virtual without lateral inversion**

Ans. **(d)**

NUMERICALS

Q. 1.) State the number of images of an object placed between the two plane mirrors, formed in each case when the mirrors are inclined to each other at (i) 90^o, and (ii) 60^o.

Ans. (a) Given that $\theta = 90^o$

Now as we know $n = 360^o / \theta^o = 360^o / 90^o = 4$, which is even.

Therefore, the number of images formed will be $(n-1)= 4-1 = 3$ images

(b)Given that $\theta = 60^o$

As we know that, $n = 360^o / \theta^o = 360^o / 60^o = 6$, which is even.

Therefore, the number of images formed will be $(n-1)=6-1 = 5$ images

Q. 2.) An object is placed (i) asymmetrically (ii) symmetrically, between two plane mirrors inclined at an angle of 50^o. Find the number of images formed.

Ans. Given that $\theta = 50^o$

Now as we know that $n = 360^o / \theta^o = 360^o / 50^o = 7.2$ or 7, i.e. odd.

(i) If object is asymmetrically placed, then the number of images formed = n=7.

(ii) If object is symmetrically placed, then the number of images formed = $(n-1)=7-1 = 6$

EXERCISE 7(C)

Q. 1.) What is a spherical mirror?

Ans. A spherical mirror is formed of a reflective surface which is a part of the sphere.

Q. 2.) Name the two kinds of spherical mirrors and distinguish between them.

Ans. Concave mirror and convex mirror

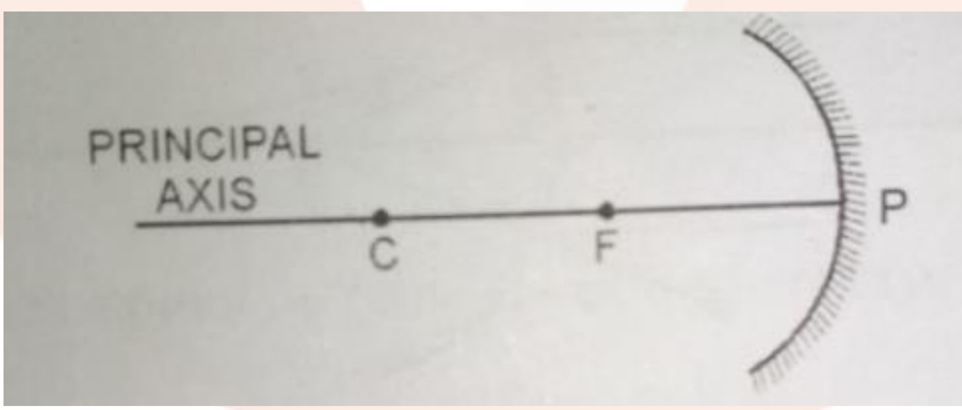
Concave mirror	**Convex mirror**
Spherical mirror in which bulging surface is silvered is a concave mirror	Spherical mirror in which hollow surface is silvered is a convex mirror

Q. 3.) Define the terms pole, principal axis and centre of curvature with reference to a spherical mirror.

Ans. **Pole:** It is defined as the geometric centre of the spherical mirror

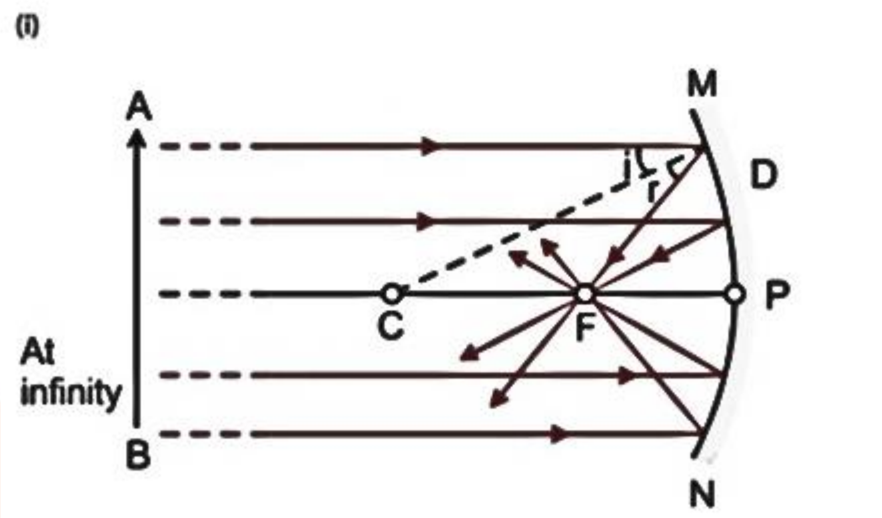
Principal axis: The straight line from the pole to centre of curvature is called principal axis.

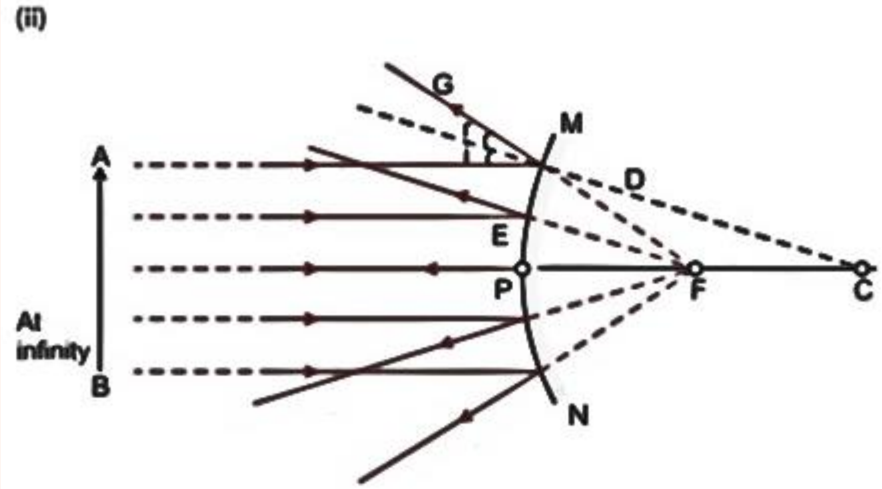
Centre of curvature: The centre of the sphere of which the mirror is a part is called the centre of curvature.



Q. 4.) Draw suitable diagram to illustrate the action of (i) concave mirror, and (ii) convex mirror, on a beam of light incident parallel to the principal axis.

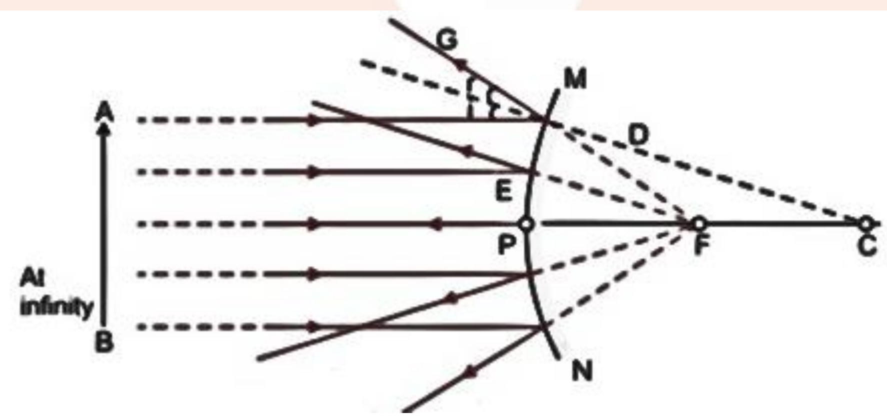
Ans. Concave mirror is converging while convex mirror is diverging



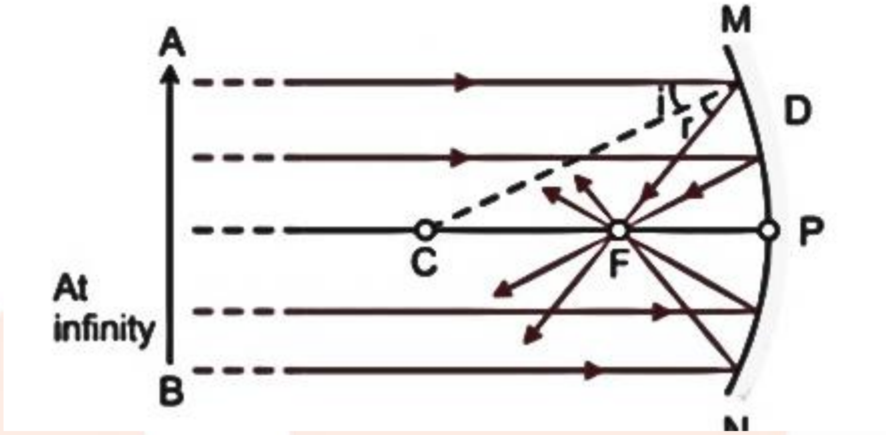


Q. 5.) **Name the spherical mirror which (i) diverges (ii) converges the beam of light incident on it. Justify your answer by drawing a ray diagram in each case.**

Ans. i) Convex mirror



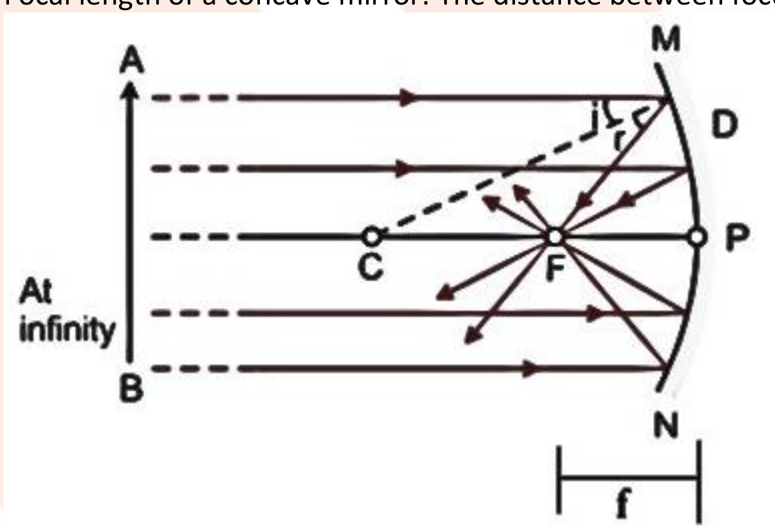
(ii) Concave mirror



Q. 6.) **Define the terms focus and focal length of a concave mirror. Draw diagram to illustrate your answer.**

Ans. Focus of a concave mirror: A point on the principal axis on which the incident rays converge after reflection from the mirror is known as focus.

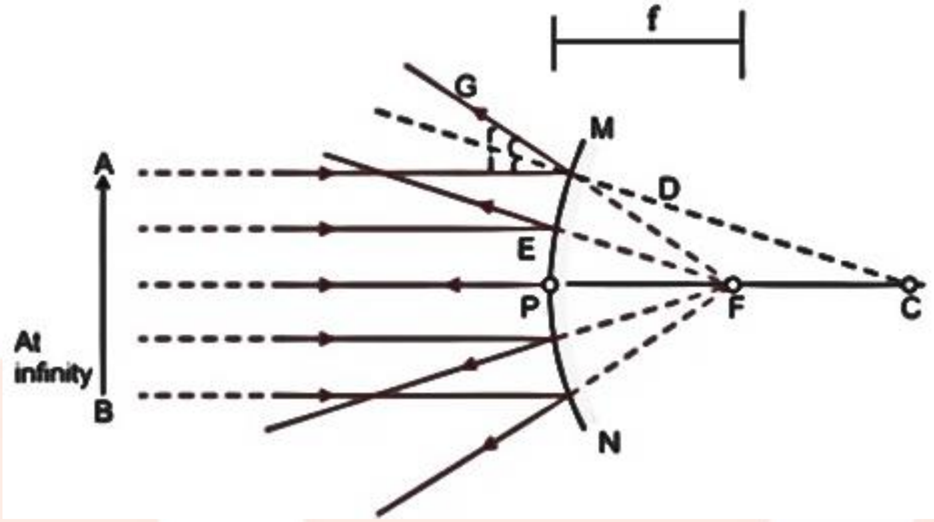
Focal length of a concave mirror: The distance between focus and the pole.



Q. 8.) **Explain the meaning of the terms focus and focal length in case of convex mirror, with the help of suitable ray diagrams.**

Ans. Focus of a convex mirror: A point on the principal axis from which the parallel incident rays, after reflecting from the mirror appear to be diverging from

Focal length of a convex mirror: The distance between focus and the pole.



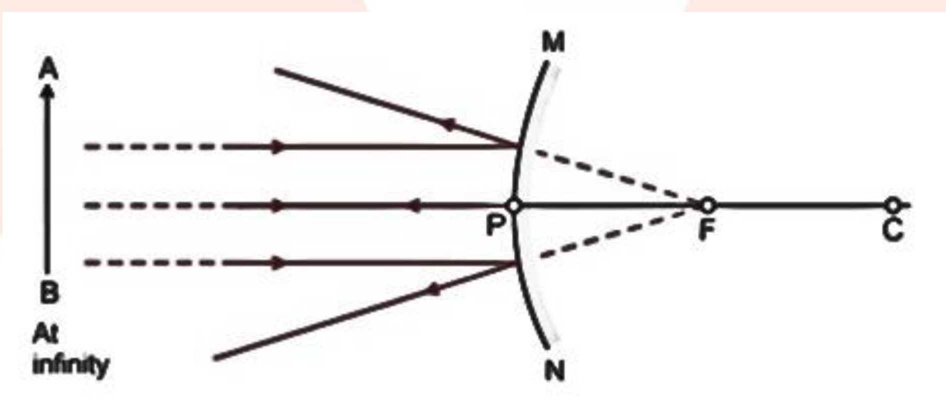
Q. 8.) State the direction of incident ray which after reflection from a spherical mirror retraces its path. Give a reason in your answer.

Ans. Any ray incident on the center of curvature will retrace its path as it will be normal to the mirror, so $\angle i = \angle r = 0$.

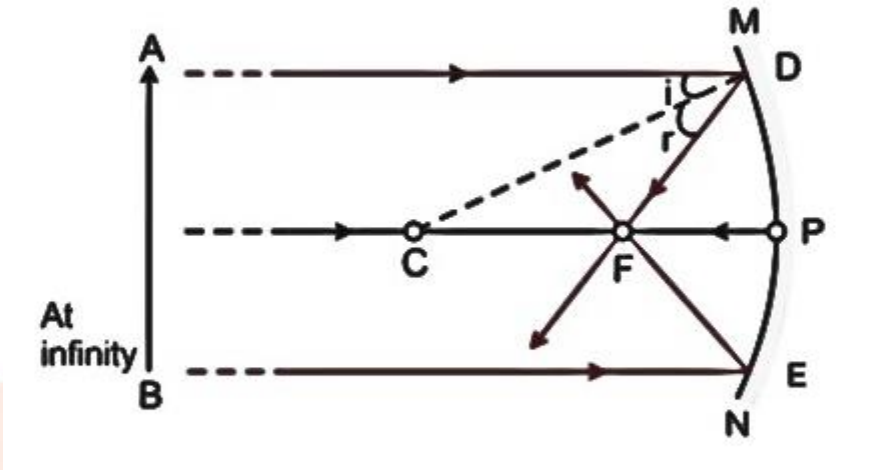
Q. 9.) (i) Name the mirrors shown in fig. (a) and (b). (ii) in each case (a) and (b), draw the reflected rays for the given incident rays and mark the focus by the symbol F.

Ans. (i) (a) Convex mirror (b) concave mirror

(ii) (a)

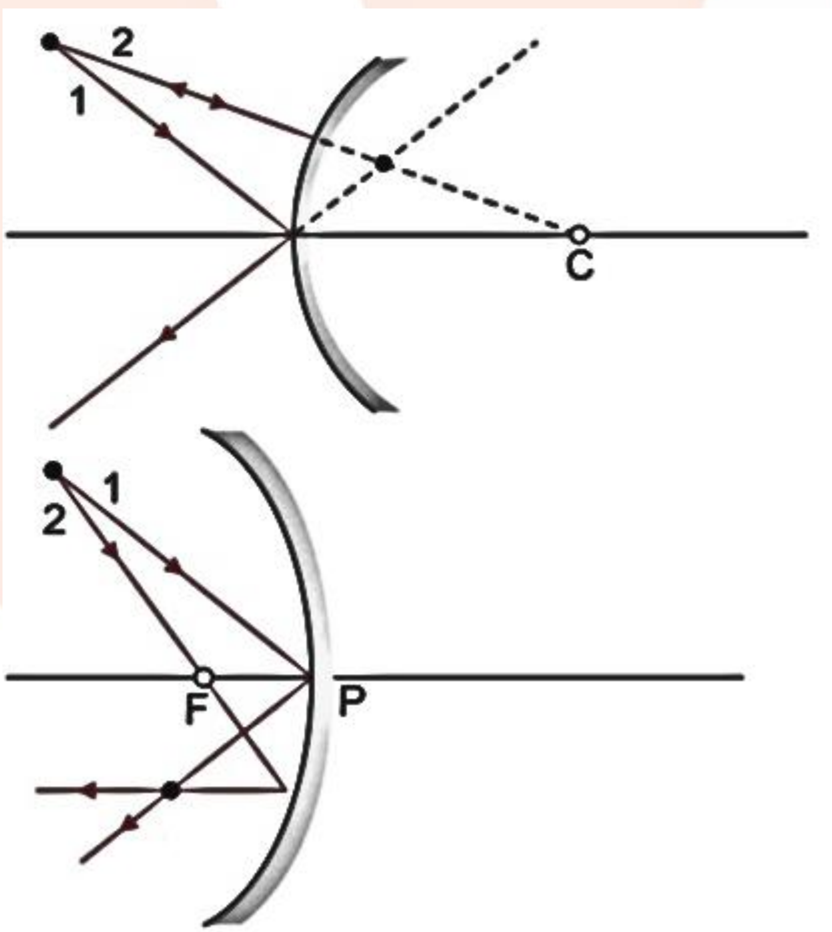


(b)



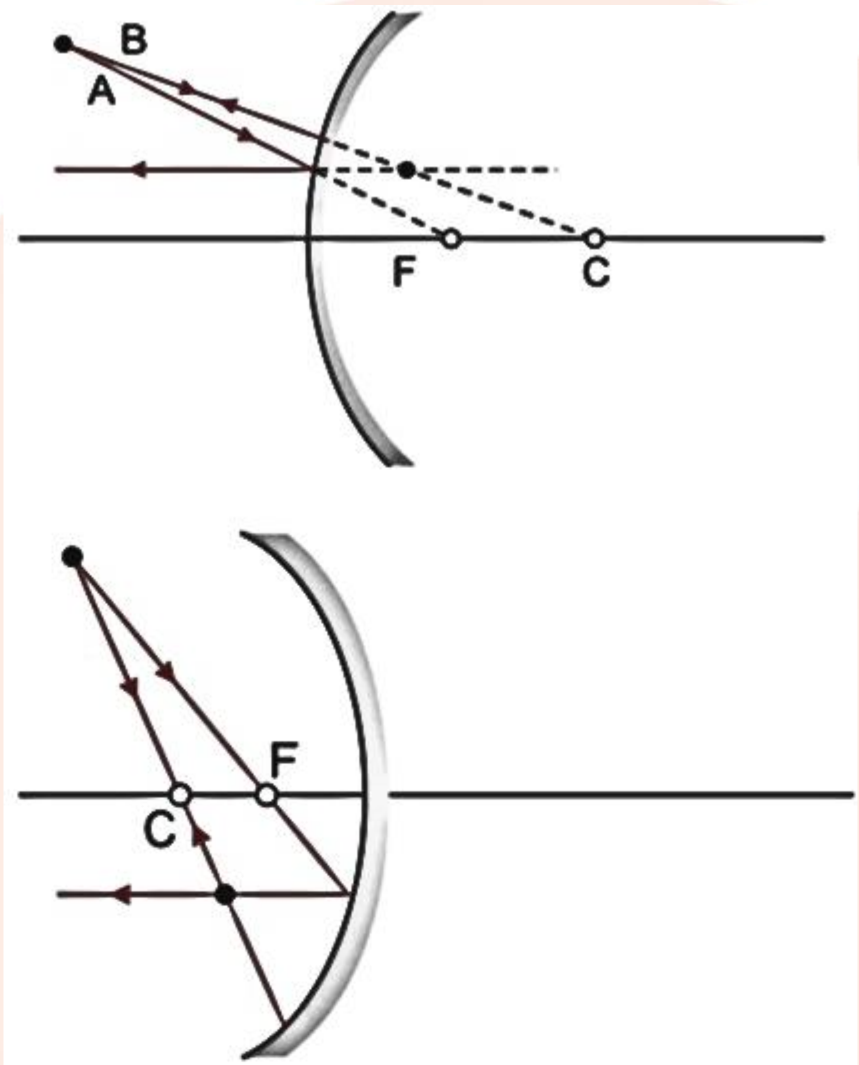
Q. 10.) Complete the following diagrams in fig. by drawing the reflected rays for the incident ray 1 and 2.

Ans.



Q. 11.) Complete the following diagrams shown in fig. by drawing the reflected ray for each of the incident ray A and B.

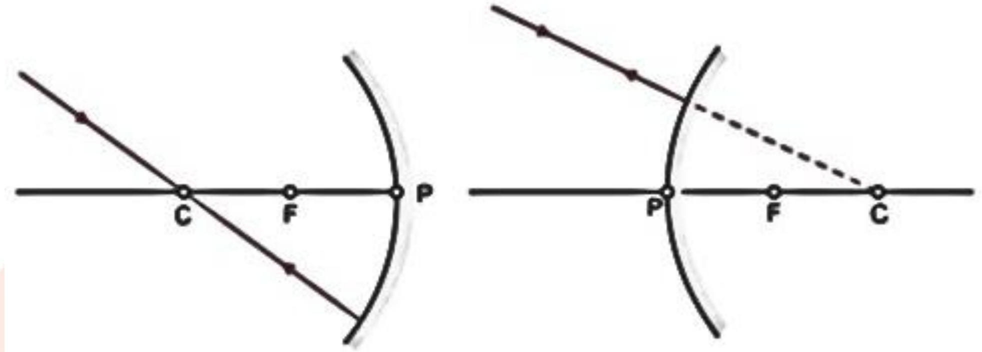
Ans.



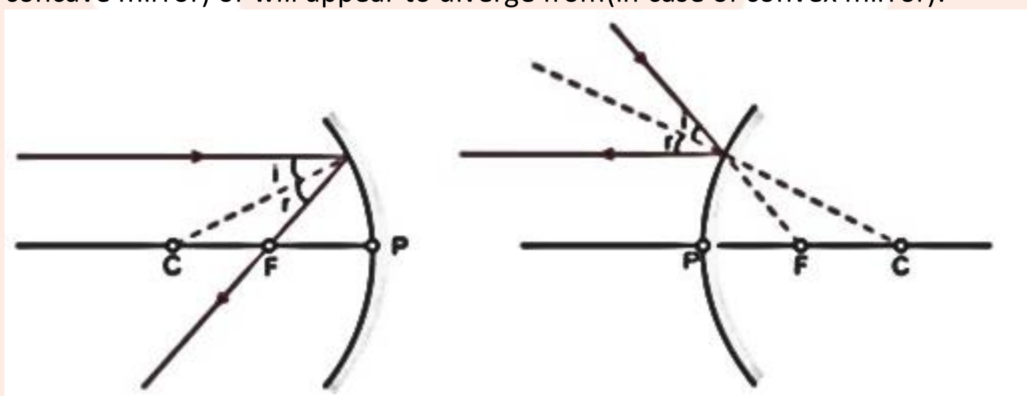
Q. 12.) State the two convenient rays that are chosen to construct the image by a spherical mirror for a given object? Explain with the help of suitable ray diagram.

Ans. Two convenient rays that are chosen to construct the image by a spherical mirror for a given object:

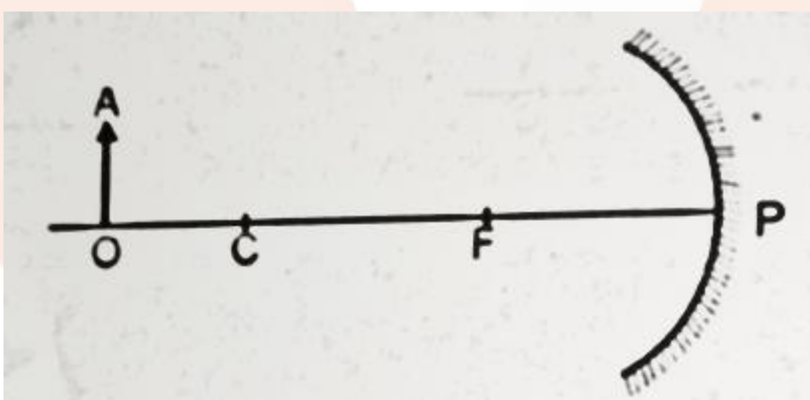
1. **A ray incident on the Centre of curvature:** Any ray incident on the center of curvature will retrace its path as it will be normal to the mirror.



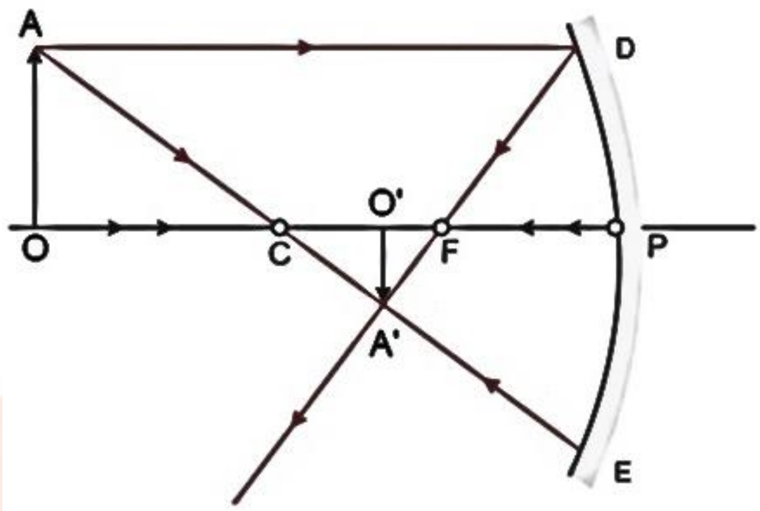
2. **A ray parallel to the principal axis:** After reflection this ray will pass through focus(in concave mirror) or will appear to diverge from(in case of convex mirror).



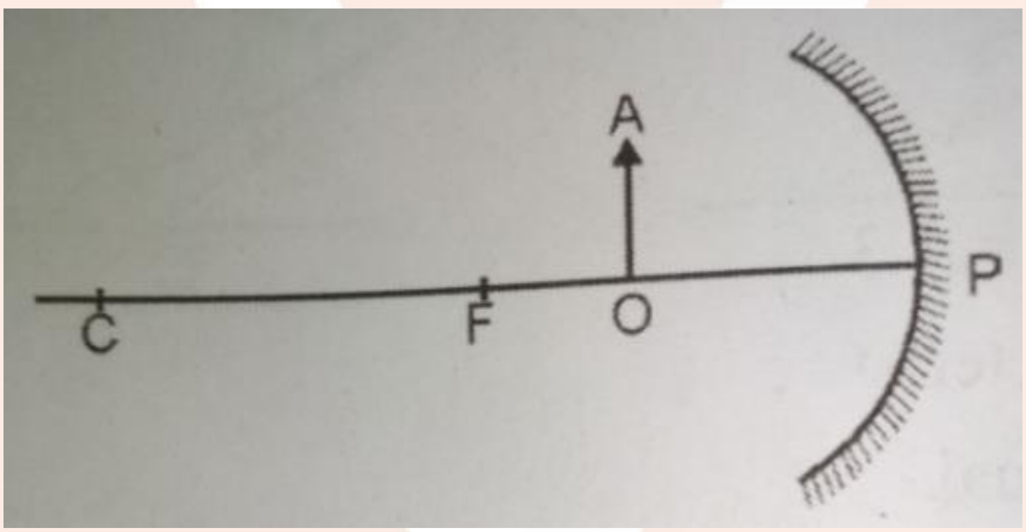
Q. 13.) Fig show as a concave mirror with its pole at P, focus F and centre of curvature C. Draw a ray diagram to show the formation of image of an object OA.



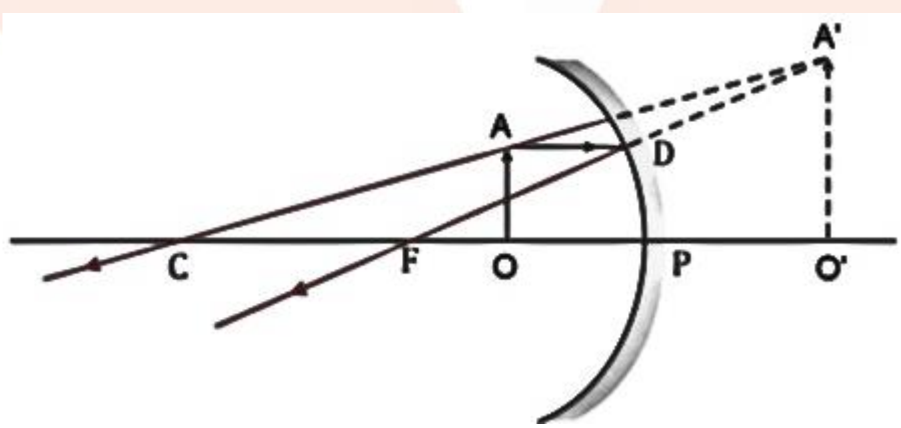
Ans.



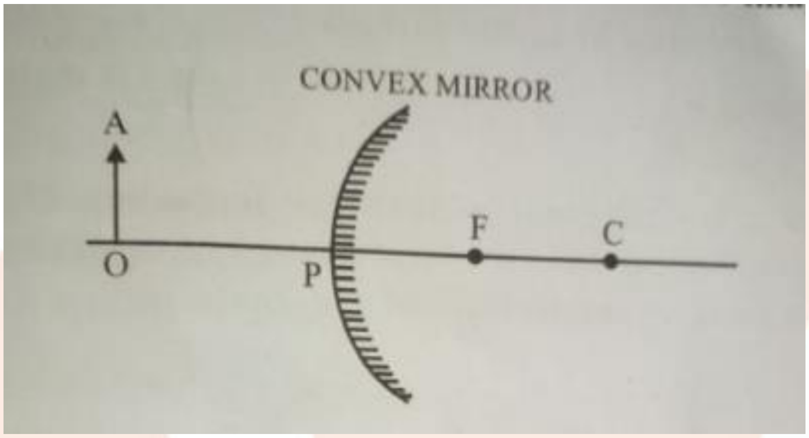
Q. 14.) Fig. shows a concave mirror with its pole at P, focus F and centre of curvature C. Draw ray diagram to show the formation of image of an object OA.



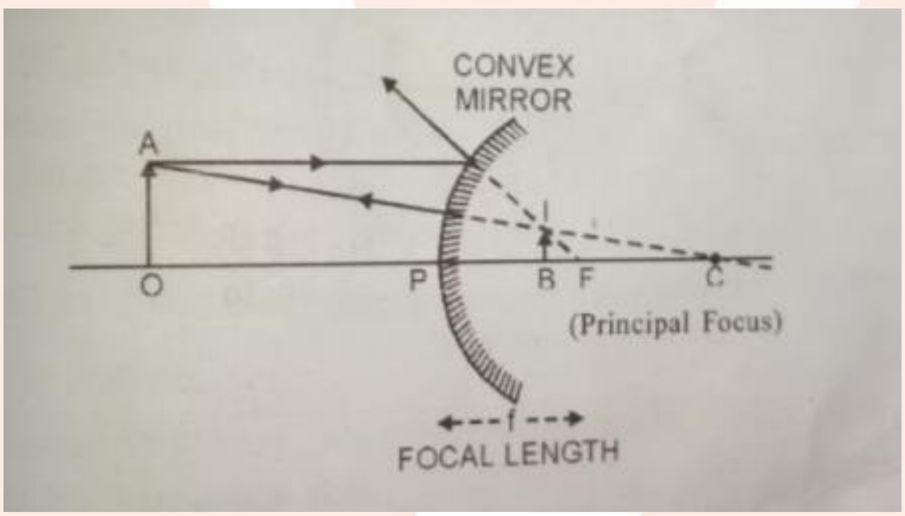
Ans.



Q. 15.) **The diagram below in fig. shows a convex mirror. C is its centre of curvature and F is its focus. (i) Draw two rays from A and hence locate the position of the image of object OA. Label image IB. (ii) State three characteristics of the image.**



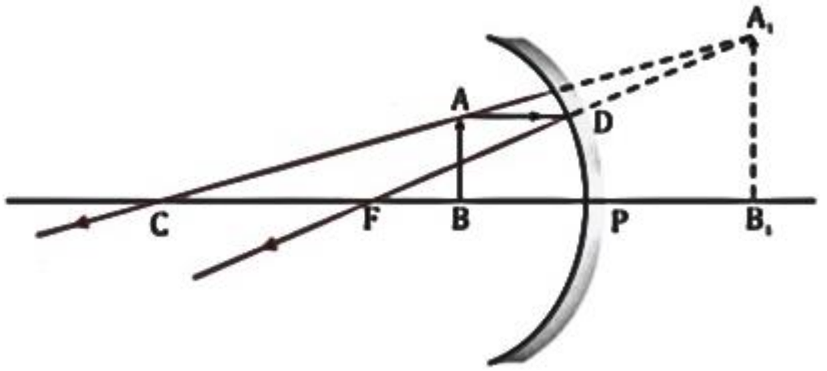
Ans.



ii.) Three characteristics of the image formed : Virtual, Erect and Diminished

Q. 16.) Draw a ray diagram to show the formation of image by a concave mirror for an object placed between its pole and focus. State three characteristics of the image.

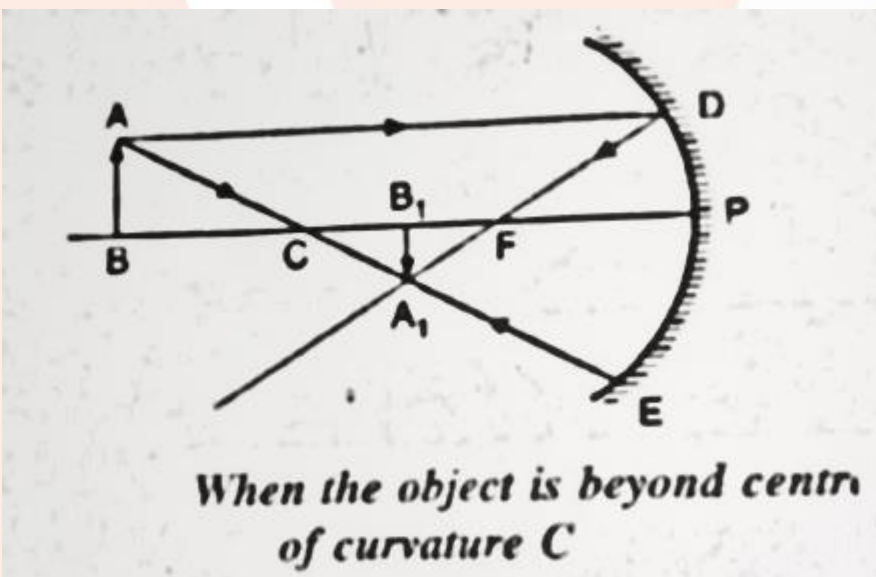
Ans.



The 3 characteristics of the image: Virtual, Erect and Magnified.

Q. 17.) Draw a ray diagram to show the formation of image by a concave mirror for the object beyond its centre of curvature, State three characteristics of the image.

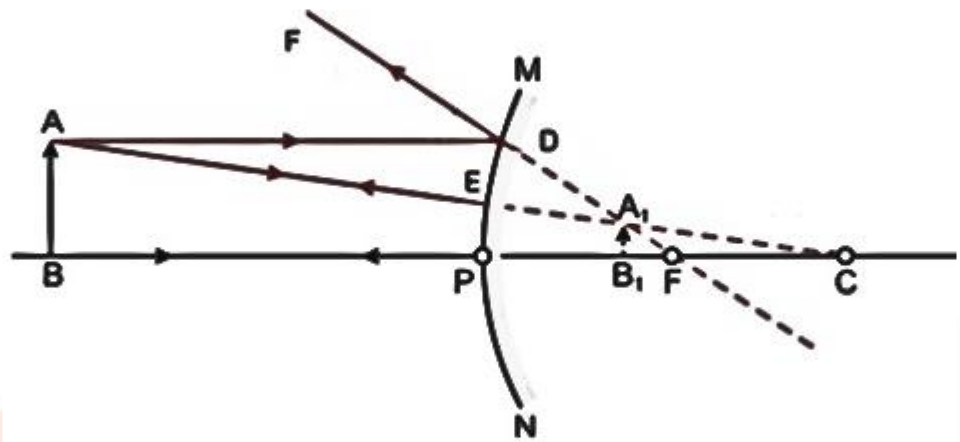
Ans.



The 3 characteristics of the image: Real, Inverted and Magnified.

Q. 18.) Draw a ray diagram to show the formation of image of an object kept in front of a convex mirror. State three characteristics of the image.

Ans.



The 3 characteristics of the image: Virtual, Erect and Diminished.

Q. 19.) Name the mirror which always produces an erect and virtual image. How is the size of image related to the size of object?

Ans. Convex mirror. It always produces an image smaller (or diminished) as compared to size of object.

Q. 20.) (a) For what position of object, the image formed by a concave mirror is magnified and erect? (b) State whether the image in part (a) is real or virtual?

Ans. (a) between pole and focus
(b) virtual

Q. 21.) (a) State the position of object for which the image formed by a concave mirror is of same size. (b) Write two more characteristics of the image.

Ans. (a) at centre of curvature
(b) image is real and inverted

Q. 22.) (a) What is real image? (b) What type of mirror can be used to obtain a real image of an object? (c) Does the mirror mentioned in part (b) form real image for all locations of the object?

Ans. (a) Real image is the one which can be obtained on a screen
(b) Concave mirror
(c) No

Q. 23.) Discuss the position and nature of image formed by a concave mirror when an object is moved from infinity towards the pole of mirror.

Ans. Real and inverted image is formed and starts to move away from the mirror as an object moves towards the pole from infinity.

Q. 24.) Discuss the position and nature of image formed by a convex mirror when an object is moved from infinity towards the pole of mirror.

Ans. Irrespective of position of object, image is formed between pole and focus. The image will always be virtual, erect and diminished.

Q. 25.) Name the kind of mirror used to obtain:

i. **A real and enlarged image.**
ii. **A virtual and enlarged image**
iii. **A virtual and diminished image**
iv. **A real and diminished image**

Ans. (i) Concave, (ii) Concave, (iii) Convex and (iv) Concave

Q. 26.) How is the focal length of a spherical mirror related to its radius of curvature?

Ans. Focal length is equal to half of the radius of curvature of a spherical mirror.

$$f = \frac{R}{2}$$

Q. 27.) Write the spherical mirror's formula and explain the meaning of each symbol used in it.

Ans. The spherical mirror formula is given as:

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

Where f = focal length, u = distance between the object and the mirror, v = distance between the image and the mirror.

Q. 28.) What is meant by magnification? Write its expression. What is its sign for the (a) real (b) virtual image?

Ans. Magnification is the ratio of the length of image to that of the object.

$$M = \frac{l_i}{l_o}$$

Alternatively, it is given by

$$M = -\frac{v}{u}$$

Where u and v are object and image distance from the mirror respectively.

Hence, we get

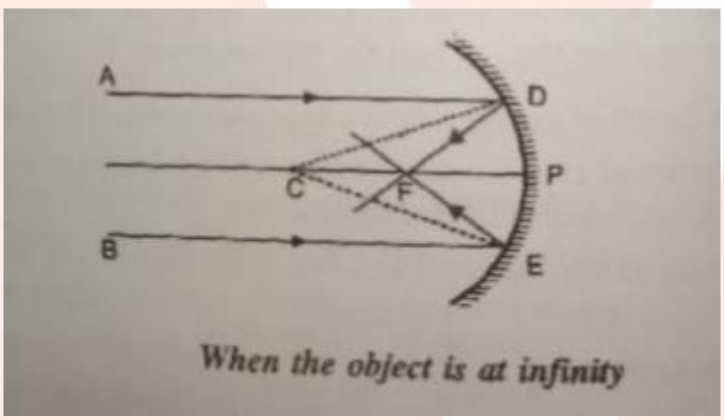
a. M is negative
b. M is positive

Q. 29.) Up to what maximum distance from the pole the image in a convex mirror can be obtained? What will be the location of object then?

Ans. The image in a convex mirror can be obtained maximum upto the Focus. For that, the object needs to be at infinity.

Q. 30.) Up to what maximum distance from a concave mirror, the image can be obtained? What will be the location of object for it?

Ans. The maximum where the image can be obtained in a concave mirror is at infinity. For that, the object has to be at focus.



Q. 31.) How will you distinguish between a plane mirror, a concave mirror and a convex mirror, without touching them?

Ans. Without touching them , to distinguish between the three, we observe the image formed of our face in the mirror.

(i) If the image is erect, same sized and its size does not change on going away from it, the mirror is plane.
(ii) If the image is magnified and erect, and its size increases if we move away from it, the mirror is concave.

(iii) If the image is erect and diminished and its size decreases if we move away from it, the mirror is convex.

Q. 32.) State two uses of a concave mirror.

Ans. Two uses of concave mirror:

1. Used for making reflectors in automobile head lamps
2. Can be used as shaving mirror

Q. 33.) State the kind of mirror used (a) by a dentist, (b) as a search light reflector.

Ans. (a) Concave mirror
(b) Concave mirror

Q. 34.) (a) When a concave mirror is used as a shaving mirror, where is the person's face in relation to the focus of mirror?

(b) State three characteristics of the image seen in part (a).

Ans. (a) between pole and focus
(b) virtual, erect and magnified

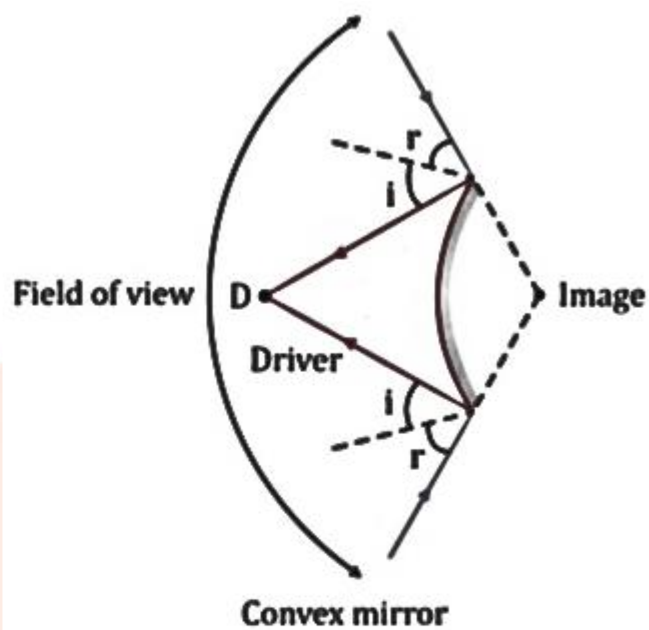
Q. 35.) Which mirror will you prefer to use as a rear view mirror in a car: plane mirror or convex? Give one reason.

Ans. Convex mirror, as it has a larger field of view as compared to plane mirror.

Q. 36.) Why does a driver use a convex mirror instead of a plane mirror as rear view mirror? Illustrate your answer with the help of a ray diagram.

Ans. A convex mirror always form virtual, erect and diminished image. This increases its field of view which enables the driver to see the traffic behind him. So, he uses a convex mirror instead of plane mirror.

This can be well explained by below ray diagram:



MULTIPLE CHOICE TYPE

Q. 1.) **For an incident ray directed towards centre of curvature of a spherical mirror, the reflected ray:**

- **a) Retraces its path**
- **b) Passes through the focus**
- **c) Passes through the pole**
- **d) Becomes parallel to the principal axis.**

Ans. (a)

Q. 2.) **The image formed by a convex mirror is**

- **a) Erect and diminished**
- **b) Erect and enlarged**
- **c) Inverted and diminished**
- **d) Inverted and enlarged**

Ans. (b)

Q. 3.) **A real and enlarged image can be obtained by using a:**

(a) Convex mirror **(b) Plane mirror**

(c) Concave mirror **(d) either convex or plane mirror**

Ans. (c)

Q. 4.) The focal length f and radius of curvature R of spherical mirror are related as:

(a) R = f **(b) R = (1/2) f**

(c) R = 2f **(d) R = (1/4) f**

Ans. (c)

NUMERICALS

Q. 1.) The radius of curvature of a convex mirror is 40cm. Find its focal length.

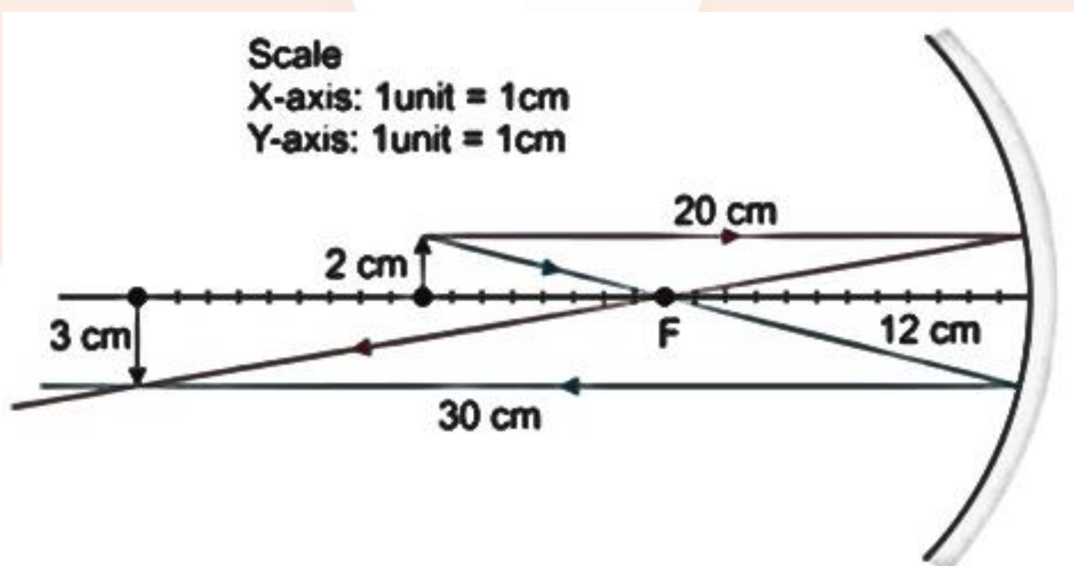
Ans. f=R/2 => f = 40/2 = 20 cm

Q. 2.) The focal length of a concave mirror is 10 cm. Find its radius of curvature.

Ans. R=2f
=2 x 10 = 20 cm

Q. 3.) An object of height 2 cm is placed at a distance 20 cm in front of a concave mirror of focal length 12 cm. Find the position, size and nature of the image.

Ans.



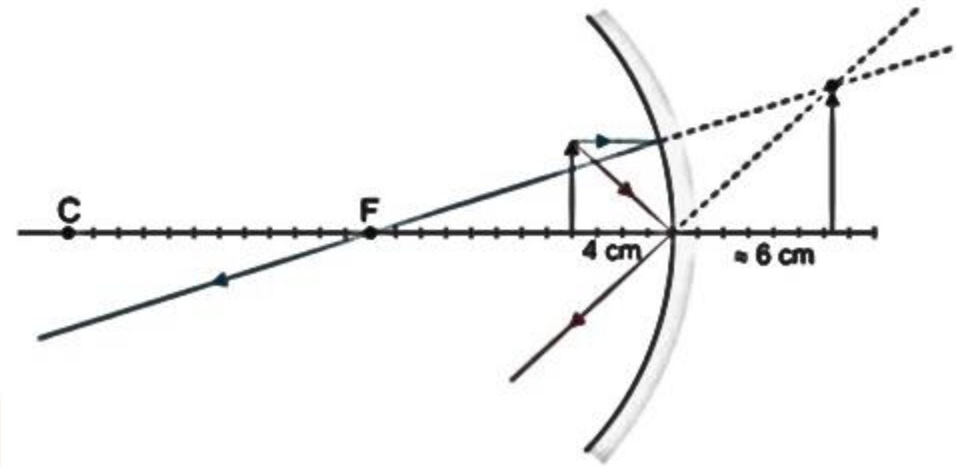
According to question:

$$O = 2cm, I = ?$$
$$u = -20cm, f = -12cm$$
$$By\ mirror\ formula:$$
$$\frac{1}{v} = \frac{1}{f} - \frac{1}{u} = -\frac{1}{12} + \frac{1}{20}$$
$$\Rightarrow \frac{1}{v} = \frac{-5+3}{60} = -\frac{1}{30}$$
$$\Rightarrow v = -30cm$$
$$Also,$$
$$m = \frac{I}{O} = \frac{v}{u}$$
$$\Rightarrow \frac{I}{2} = \frac{-30}{-20} = 1.5$$
$$\Rightarrow I = 3cm$$

Therefore, the real, inverted and magnified image is formed at 30 cm in front of the mirror, and has a height of 3 cm

Q. 4.) **An object is placed at 4cm distance in front of a concave mirror of radius of curvature 24 cm. Find the position of image. Is the image is magnified?**

Ans.



$$f = \frac{R}{2} = \frac{24}{2} = 12cm$$

$$\frac{1}{v} = \frac{1}{f} - \frac{1}{u} = \frac{1}{-12} - \frac{1}{-4} = \frac{-1+3}{12}$$

$$v = 6cm$$

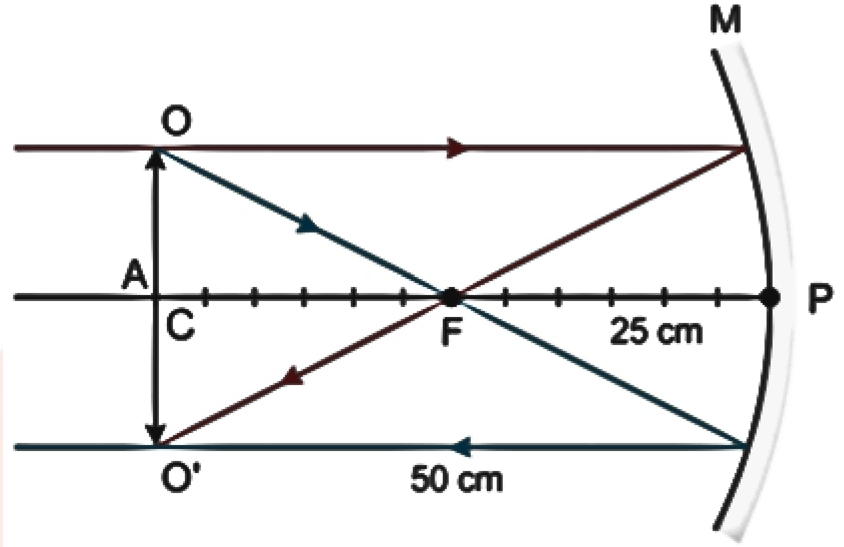
The image will be formed behind the mirror at 6cm from it.
From the ray diagram, we can see that the image is magnified.

Q. 5.) At what distance from a concave mirror of focal length 25cm should an object be placed so that the size of image is equal to the size of the object.

Ans. The size of the image is equal to the size of the object if the object is placed at the centre of curvature of a concave mirror.

Now, given that f=25cm

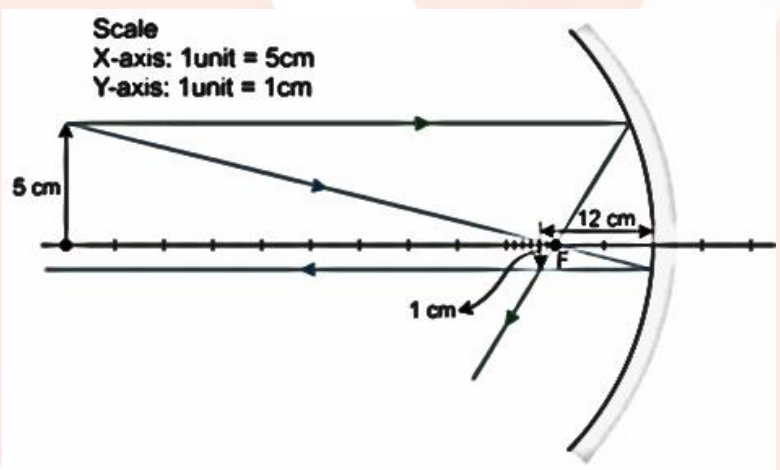
This means C=2f=2 X 25= 50 cm



Hence, the object should be placed at 50 cm.

Q. 6.) An object is 5cm high is placed at a distance 60 cm in front of a concave mirror of focal length 10cm. Find the position and size of the image.

Ans.

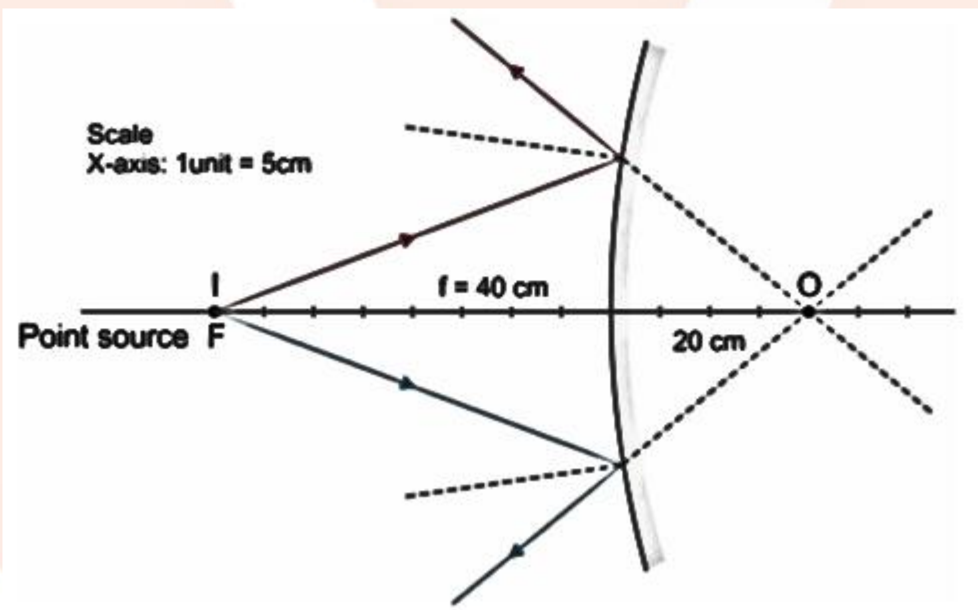


Using mirror formula;

$$\frac{1}{v}=\frac{1}{f}-\frac{1}{u}$$
$$\Rightarrow \frac{1}{v}=-\frac{1}{10}-\left(\frac{-1}{60}\right)=\frac{-1}{10}+\frac{1}{60}=\frac{-1}{12}$$
$$\Rightarrow v=-12cm$$
$$Now$$
$$m=\frac{I}{O}=\frac{v}{u}$$
$$\Rightarrow \frac{I}{5}=\frac{-12}{60}$$
$$\Rightarrow I=-1cm$$

The image will be formed 12cm in front of mirror and is 1 cm in height.

Q. 7.) A point light source is kept in front of a convex mirror at a distance of 40cm. The focal length of the mirror is 40cm. Find the position of the image.

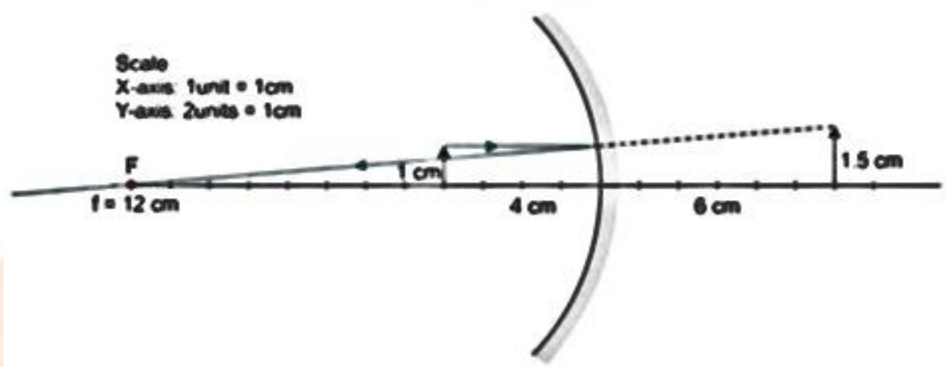


Given, u = -40, f= 40

Using mirror formula; v= 20

Therefore image is formed behind the mirror at a distance 20 cm from it.

Q. 8.) When an object of height 1 cm is kept at a distance 4cm from a concave mirror, its erect image of height 1.5cm is formed at a distance 6cm behind the mirror. Find the focal length of mirror.



Given u = -4, v = 6

Using mirror formula;

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

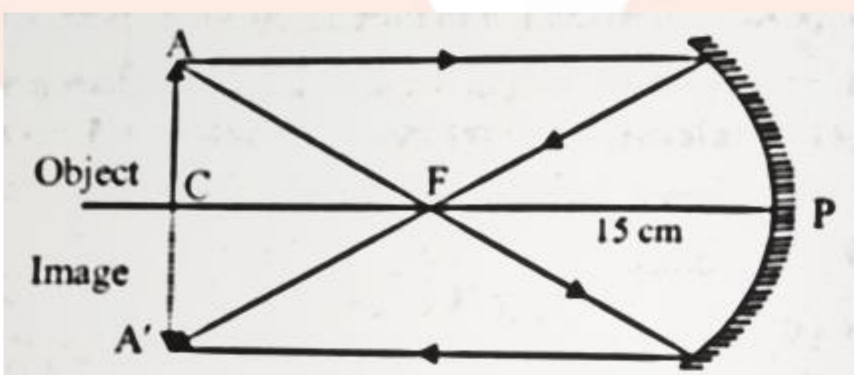
$$\frac{1}{f} = \frac{-1}{4} + \frac{1}{6} = \frac{-1}{12}$$

$$f = -12cm$$

Q. 9.) An object of length 4cm is placed in front of a concave mirror at distance 30cm. The focal length of mirror is 15cm.

a) Where will the image form?
b) What will be the length of the image

Ans.



$$f = 15cm$$
$$\Rightarrow R = 2f = 2 \times 15 = 30cm$$

As object placed at the centre of curvature, then

(a) the image is formed at C also

(b) As m = -v/u, we get m= -1. Thus size of image is same as that of object.

Q. 10.) A concave mirror forms a real image of an object placed in front of it at a distance 30 cm, of size three times the size of object. Find (a) the focal length of the mirror (b) position of image.

Ans.

$$Given\, m = -3$$
$$As\, m = \frac{-v}{u} = \frac{-v}{-30}$$
$$\Rightarrow -3 = \frac{v}{30}$$
$$\Rightarrow v = -90$$

$$Now\ \text{we know,}$$
$$\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$$
$$\frac{1}{f} = \frac{1}{-30} + \frac{1}{-90}$$
$$\frac{1}{f} = \frac{-3-1}{-90} = \frac{1}{22.5}$$
$$f = 22.5cm$$

Q. 11.) A concave mirror forms a virtual image of size twice that of the object placed at a distance 5cm from it. Find: (a) the focal length of the mirror, (b) position of image.

Ans.

$Given,\ u = -5$

$m = 2$

$Now\,as, m = \dfrac{-v}{u},$

$we\ get\ v = 10$

$And\ by\ mirror\ formula$

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

$$\Rightarrow \frac{1}{f} = \frac{1}{-5} + \frac{1}{10}$$

$$\Rightarrow \frac{1}{f} = \frac{-2+1}{-10} = \frac{-1}{-10}$$

$$\Rightarrow \frac{1}{f} = \frac{1}{10}$$

$$\Rightarrow f = 10cm$$

Q. 12.) The image formed by a convex mirror is of size one-third the size of object. How are u and v related?

Ans. Given,

$$m = \frac{1}{3}$$

$$As,\ m = -\frac{v}{u}$$

$$\Rightarrow \frac{1}{3} = \frac{-v}{u}$$

$$\Rightarrow u = -3v$$

Q. 13.) The erect image formed by a concave mirrors is of size double the size of object. How are u and v related?

Ans.

$$m = 2$$

$$As, m = -\frac{v}{u}$$

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

$$\Rightarrow v = -2u$$

Q. 14.) The magnification for a mirror is -3. How are u and v related?

Ans. Given that

$$m = -3$$
$$\therefore m = \frac{v}{u}$$
$$\Rightarrow v = -3u$$