O P JINDAL SCHOOL, SAVITRINAGAR

ASSIGNMENT

CLASS X PHYSICS

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81 The image of an object formed by a mirror is real, inverted and is of magnification –1. If the image is at a distance of 40 cm from the mirror, where is the object placed? Where would the image be if the object is moved 20 cm towards the mirror? State reason and also draw ray diagram for the new position of the object to justify your answer. 1

ANS: Given: Magnification of spherical mirror = –1, Image distance, v = –40 cm

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

$u = -\frac{v}{m} = -\frac{-40}{-1} = -40 \text{ cm}$

Therefore, the object is placed at a distance of 40 cm in front of the spherical mirror.

Case I: when u = – 40 cm and v = – 40 cm,

Using mirror formula, we get

$$\frac{1}{f} = \frac{1}{v} + \frac{1}{u} \Rightarrow \frac{1}{f} = \frac{1}{-40} + \frac{1}{-40} = -\frac{2}{40}$$

$$f = -\frac{40}{2} = -20 \text{ cm}$$

Hence the focal length of the mirror is 20 cm, and the negative focal length shows that it is a concave mirror.

The new position of the object when it moves 20 cm towards the concave mirror, u' = – (40 – 20) = –20 cm.

Case II: u' = –20 cm, f = – 20 cm, v' = ?

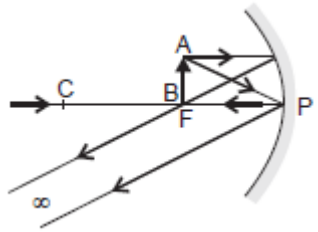
From mirror formula,

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

$$\Rightarrow \quad \frac{1}{-20} = \frac{1}{v'} + \frac{1}{-20}$$

$$\Rightarrow \quad \frac{1}{v'} = -\frac{1}{20} + \frac{1}{20} = -\left(\frac{1}{20} - \frac{1}{20}\right) = -\frac{0}{20}$$

$$\Rightarrow \quad v' = -\frac{20}{0} = -\infty \text{ (infinity)}$$



Thus, the image is formed at infinity.

Hence when the object is moved 20 cm towards the mirror, a real, inverted and highly enlarged image is formed at infinity.

82 A spherical mirror produces an image of magnification –1 on a screen placed at a distance of 50 cm from the mirror.

(a) Write the type of mirror.

(b) Find the distance of the image from the object. 1

(c) What is the focal length of the mirror?

(d) Draw the ray diagram to show the image formation in this case.

ANS: (a) As magnification is negative, the image formed is real. Hence, it is a concave mirror.

(b) $\because \; m = \frac{-v}{u} = -1$

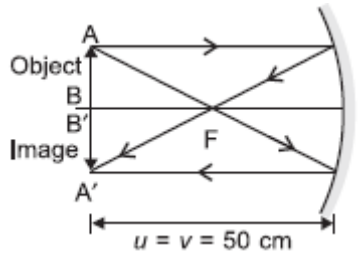
$\therefore \quad u = v = -50$ cm

$\therefore$ Distance of the image from the object = $|u| + |v| = 100$ cm

(c) Using mirror formula, $\frac{1}{f} = \frac{1}{v} + \frac{1}{u} = \frac{1}{(-50)} + \frac{1}{(-50)} = \frac{-1}{25}$

$\therefore$ $f = -25$ cm

(d)



83 A student wants to project the image of a candle flame on a screen 80 cm in front of a mirror by keeping the candle flame at a distance of 20 cm from its pole.

(i) Which type of mirror should the student use?

(ii) Find the magnification of the image produced.

(iii) Find the distance between the object and its image.

(iv) Draw a ray diagram to show the image formation in this case and mark the distance between the object and its image. 1

ANS: (i) Concave mirror

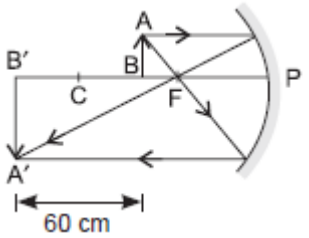
(ii) Magnification, $m = -\frac{v}{u} = -\frac{-80}{-20} = -4$

(iii) Distance between the object and its image = 80 – 20 = 60 cm.

(iv) The focal length of the concave mirror is given by $\frac{1}{f} = \frac{1}{v} + \frac{1}{u} = \frac{1}{-80} + \frac{1}{-20} = -\frac{5}{80} = -\frac{1}{16}$

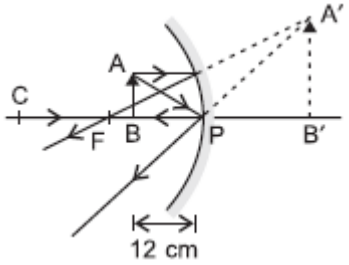
$\therefore$ $f = -16$ cm, $R = 2f = -32$ cm

Since $u = -20$ cm, it implies that the object lies between F and C.



84 A student wants to obtain an erect image of an object using a concave mirror of 12 cm focal length. What should be the range of distance of the object from the mirror? State the nature and size of the image he is likely to observe. Draw a ray diagram to justify your answer. 1

ANS: If a student wants to obtain an erect image of an object using a concave mirror of 12 cm focal length, he should keep the object between the pole and the focus of the mirror, therefore, a virtual, erect and enlarged image will be formed behind the mirror.

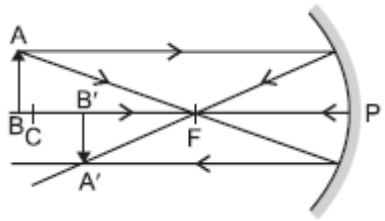


85 For the given data showing the focal lengths of three concave mirrors A, B and C, and the respective distances of different objects from these mirrors. 1

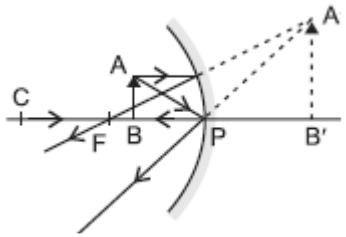
S.No.	Object distance (cm)	Focal length (cm)
A	45	20
B	30	15
C	20	30

Answer the following questions:
(i) In the given position of object from the mirrors, which mirror will form a diminished image of the object. Draw a ray diagram for image formation by this mirror.
(ii) Which mirror can be conveniently used as a make-up mirror? Draw a ray diagram to illustrate this function.

ANS: (i) Concave mirror A will form the diminished image of the object as the object is placed beyond the centre of curvature (> 2*f*) of the mirror.



(ii) Concave mirror 'C' can be used as a make-up mirror as the object distance is less than the focal length of concave mirror, i.e. when the object is placed between the focus '*F*' and the pole '*P*' of the concave mirror, a virtual, erect and enlarged image is formed.



86 Name the type of mirror used (i) by dentists and (ii) shaving mirrors. Give two reasons why such mirrors are used in each case. 1

ANS: (i) Dentists use a concave mirror because it converges the light and when the object lies between its pole and principal focus, it forms a virtual, erect and enlarged image behind it. Hence they use the concave mirror so that they could see the cavity or plaque clearly, which is inside the teeth.
(ii) When the object lies between the pole and the principal focus of a concave mirror, it forms a virtual, erect and enlarged image behind it. So, the concave mirror can be used as a shaving mirror to see a larger image of the face.

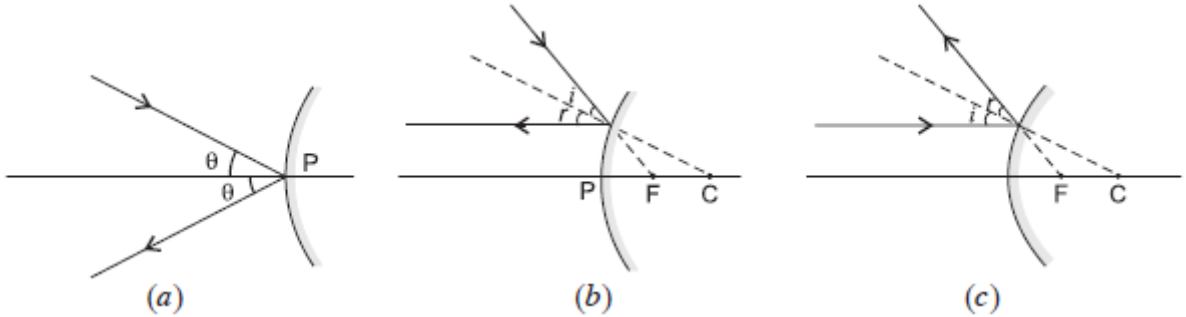
87 Draw a ray diagram to show the path of the reflected ray in each of the following cases. A ray of light incident on a convex mirror.

(a) strikes at its pole making an angle θ from the principal axis. 1

(b) is directed towards its principal focus.

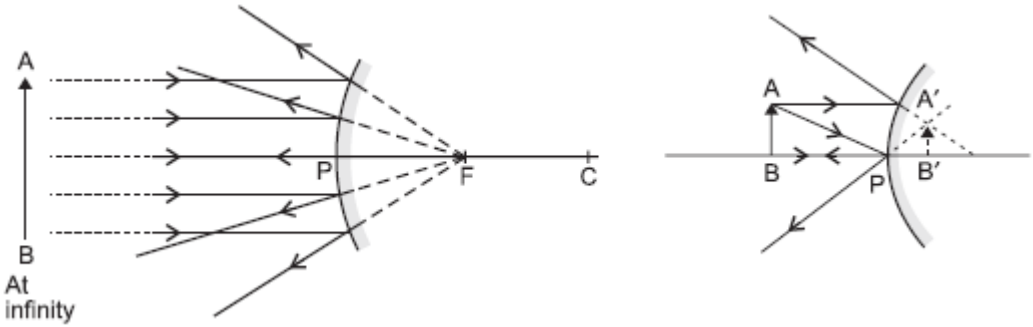
(c) is parallel to its principal axis.

ANS:



88 If the image formed by mirror for all positions of the object placed in front of it is always virtual and diminished, state the type of the mirror. Draw a ray diagram in support of your answer. Where are such mirrors commonly used and why? 1

ANS: Convex Mirror



A convex mirror is commonly used as a rear-view mirror in vehicles because it always produces a virtual and erect image whose size is smaller than the object. Therefore, it enables the driver to see a wide field of view of the traffic behind the vehicle in a small mirror.

89 A 4.5 cm needle is placed 12 cm away from a convex mirror of focal length 15 cm. Give the location of the image and magnification. Describe what happens as the needle is moved farther from the mirror? 1

ANS: Given: $h_o = +4.5$ cm, $u = -12$ cm, $f = +15$ cm

From mirror equation, $\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$

$$\frac{1}{v} = \frac{1}{f} - \frac{1}{u} = \frac{1}{+15} - \frac{1}{-12} = \frac{1}{15} + \frac{1}{12} = \frac{3}{20}$$

$$v = +\frac{20}{3} = +6.7 \text{ cm}$$

Also, magnification, $m = \frac{h_i}{h_o} = -\frac{v}{u} = -\frac{(20/3)}{-12}$

$$\frac{h_i}{h_o} = \frac{20}{3 \times 12} \Rightarrow h_i = \frac{20 \times h_o}{3 \times 12}$$

$$h_i = \frac{20 \times 4.5}{3 \times 12} = \frac{5}{2} = 2.5 \text{ cm}$$

- A virtual and diminished image is formed by a convex mirror at a distance of 6.7 cm behind the mirror and the size of image is reduced to 2.5 cm.

As the needle is moved farther from the mirror, the image moves towards the focus and will gradually reduce in size further.

90 (a) "The refractive index of diamond is 2.42". What is the meaning of this statement? 1
(b) Name a liquid whose mass density is less than that of water but it is optically denser than water.

ANS: (a) This means that the ratio of speed of light in air and the speed of light in diamond is equal to 2.42.
(b) Kerosene