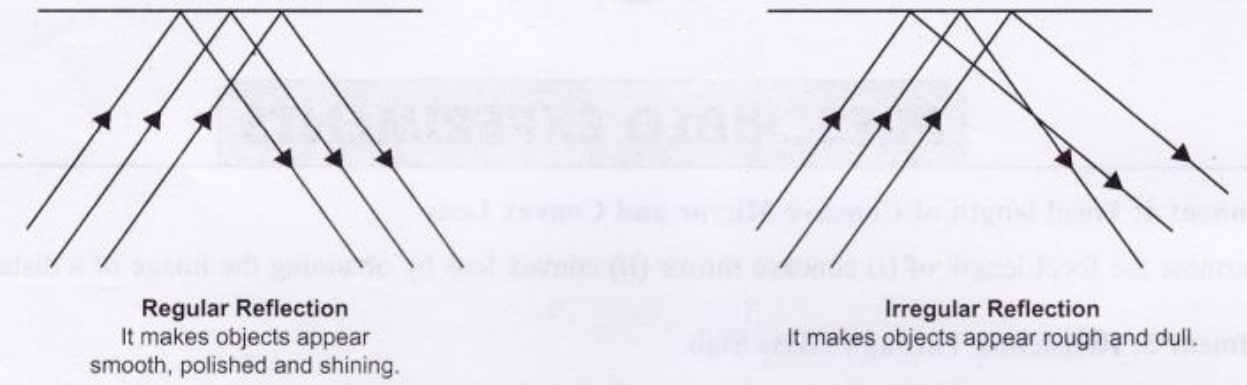
Focal Length of Concave Mirror and Convex Lens

Introduction

Light shows the property of reflection and refraction.
Reflection: The bouncing back of light on hitting any medium/surface is called reflection of light.

Types of Reflection

Regular reflection: When beam/rays of light fall on highly polished and smooth surface, then all the rays bounce back in definite direction.
Irregular reflection: When light rays fall on the rough and irregular surface, the reflection takes place in different directions and gets diffused.



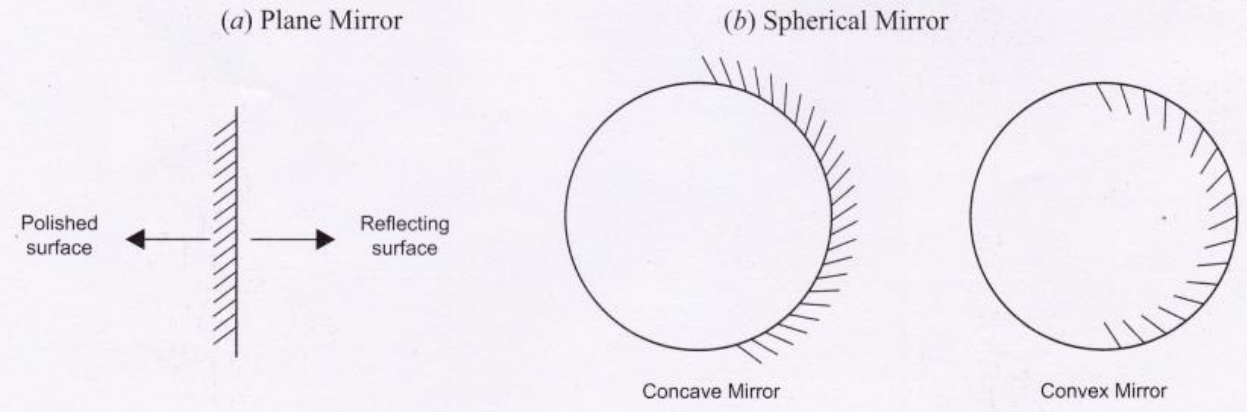
Laws of Reflection:

1. The angle of incidence is equal to the angle of reflection.
2. The incident ray, the reflected ray and the normal ray lie in the same plane. > Mirrors: A smooth, silver surface which reflects light regularly is called a mirror.

Types of mirror

(a) Plane mirror: When the polished surface is plane and the reflection is regular then it is called as a plane mirror.
(b) Spherical mirror: When the polished surface from where the light reflects is a part of a sphere, then it is called as spherical mirror. Spherical minors are of two types,

concave minor and convex minor.



- **Concave mirror:** The spherical part of the sphere which is painted from the outer side is called concave mirror.
- The concave mirrors are used as shaving mirrors as they magnify objects placed close to them.
- These mirrors form real image as they have real focus and are called converging mirrors.

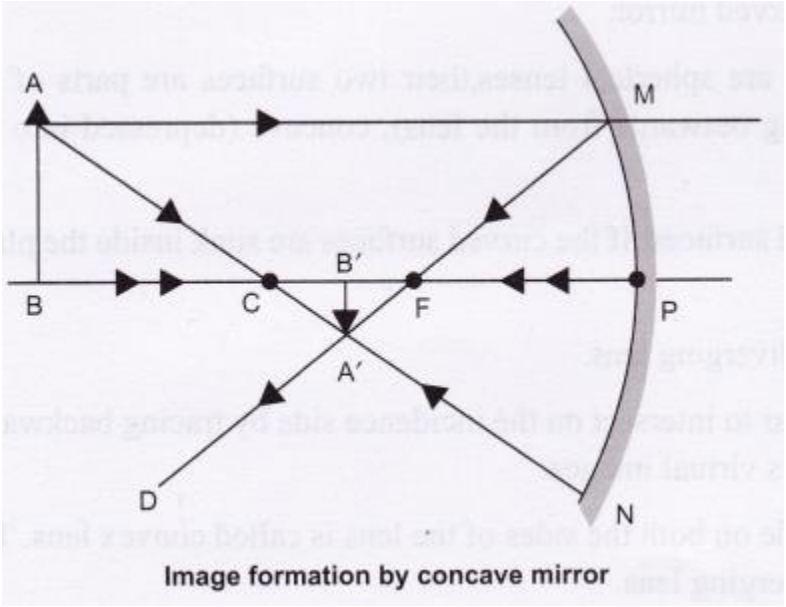


Image formation by concave mirror

- **Convex mirror:** The spherical part of the mirror which is painted from the inner side is called convex mirror.
- The convex mirrors are the side view mirrors of cars. These types of mirrors have wider fields of view than flat mirrors, but objects appear smaller in them.

- These mirrors always form a virtual image because the focus is virtual. They are also called as diverging mirrors.

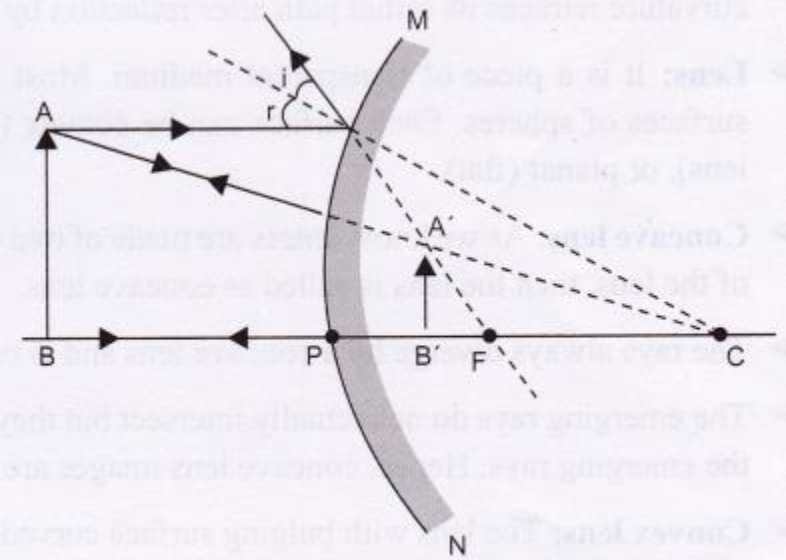
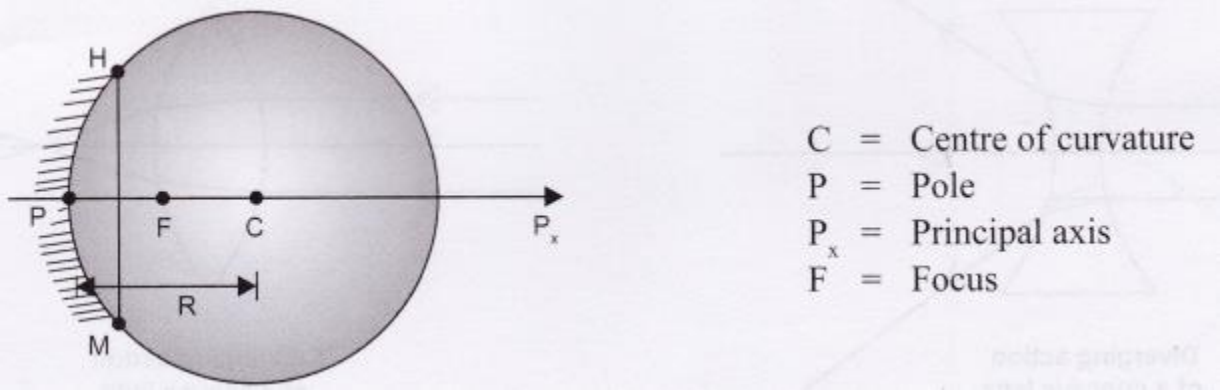


Image formation by convex mirror

- **Pole:** The pole is defined as the geometric center of the curved mirror.
- **Centre of curvature:** The centre of curvature of a curved mirror is defined as the center of the hollow glass sphere of which the curved mirror was a part. It is denoted by C.



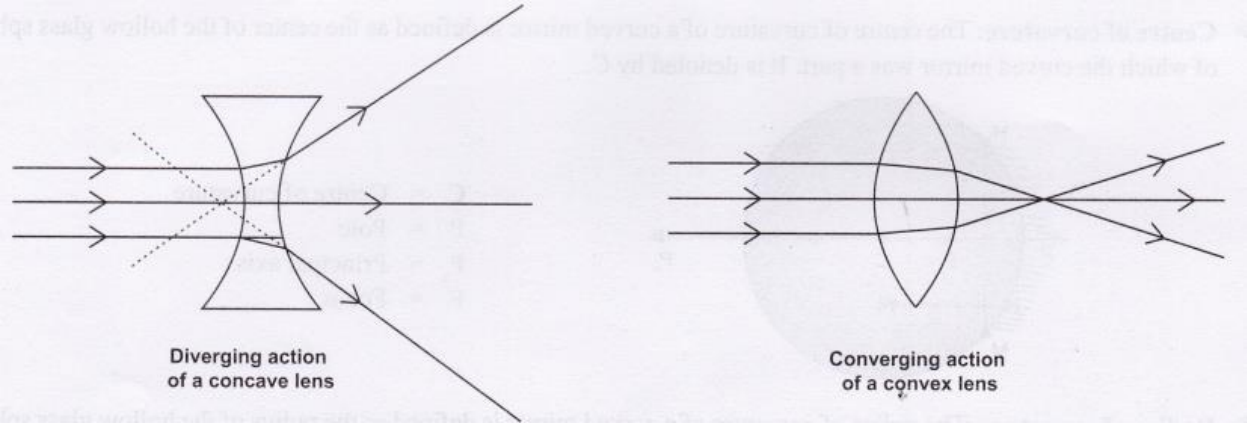
- **Radius of curvature:** The radius of curvature of a curved mirror is defined as the radius of the hollow glass sphere of which the spherical mirror was a part. In the figure given above, the distance between ‘P’ and ‘C’ is the radius of curvature ‘R’.
- **Principal axis:** The principal axis of a curved mirror is defined as the imaginary line passing through its pole P and centre of curvature C.
- **Principal focus:** The principal focus (denoted by F in the figure) is defined as the point on the principal axis where the light rays traveling parallel to the principal axis after reflection actually meet (for a concave mirror) or appear to meet (for a convex mirror).
- The principal focus is in front of the concave mirror and is behind the convex mirror.
- **Focal length:** The focal length (denoted by FP in the fig.) is the distance between the pole P and the principal focus F of a curved mirror.

- The focal length is half the radius of curvature.
  Focal length = Radius of curvature/2 .

Rules for constructing ray diagrams

1. Any light ray traveling parallel to the principal axis is reflected by the curved mirror through the principal focus.
   It either actually passes (for a concave mirror) or appears to pass (for a convex mirror) through the principal focus.
2. Any light ray that passes (for a concave mirror) or appears to pass (for a convex mirror) through the principal focus is reflected by the curved mirror parallel to the principal axis.
3. Any light ray that passes (for a concave mirror) or appears to pass (for a convex mirror) through the center of curvature retraces its initial path after reflection by the curved mirror.

Lens: It is a piece of transparent medium. Most lenses are spherical lenses,their two surfaces are parts of the surfaces of spheres. Each surface can be convex (bulging outwards from the lens), concave (depressed into the lens), or planar (flat).
Concave lens: As we know lenses are made of two curved surfaces. If the curved surfaces are sunk inside the plane of the lens, then the lens is called as concave lens. The rays always diverge by a concave lens and is called diverging lens.
The emerging rays do not actually intersect but they appear to intersect on the incidence side by tracing backwards the emerging rays. Hence, concave lens images are always virtual images.
Convex lens: The lens with bulging surface curved outside on both the sides of the lens is called convex lens. The rays always converge by a convex lens and is called converging lens.
The merging rays actually intersect. Hence, it forms a real image.



Important terms related to Lens

- **Principal Axis:** The principal axis is a line that is perpendicular to and passes through the centre of the lens.

- **Principal Focus:** The principal focus, F is the point through which all incident rays travelling parallel to the principal axis after refraction appear to meet.
- **The focal length:** “f ’ is the distance from the centre of the lens, O to the principal focus, F.

Rules for constructing ray diagrams:

- A ray from the top of the object proceeding parallel to the centerline is perpendicular to the lens. It-will pass through the lens and the principal focal point.
- A ray through the center of the lens, will pass straight through the lens.
- A ray passing through the principal focal point of the lens will proceed parallel to the centre line upon exit from the lens.

Science Lab Manual Experiment – 4

Aim

To determine the focal length of (i) concave mirror (ii) convex lens by obtaining the image of a distant object.

Theory

Focal length of Concave Mirror

- A spherical mirror, whose reflecting surface is curved inwards, that is, faces towards the centre of the sphere, is called a concave mirror.
- A concave mirror, like a plane mirror, obeys the laws of reflection of light.
- The rays of light coming from a distant object such as the sun or a distant tree can be considered parallel to each other.

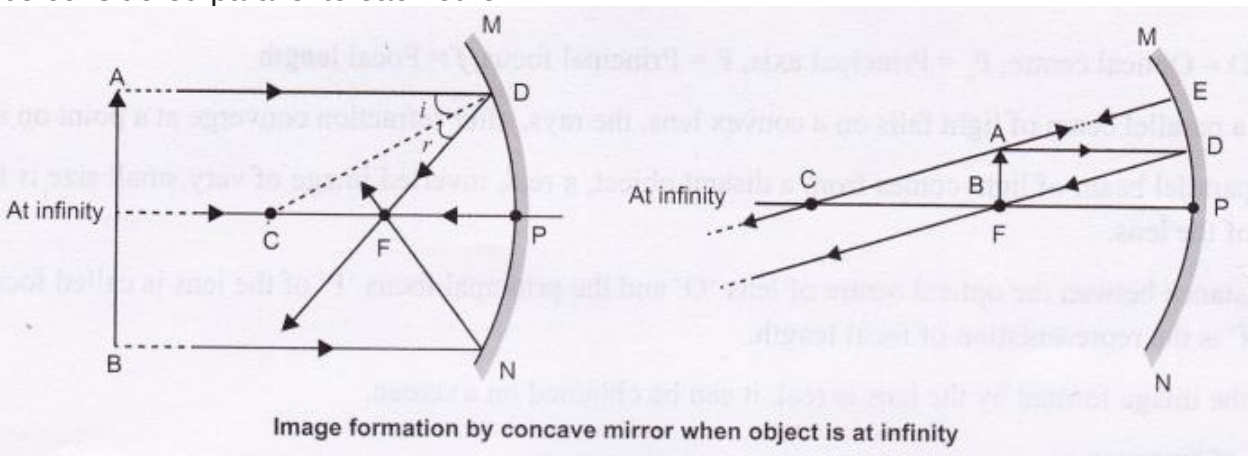
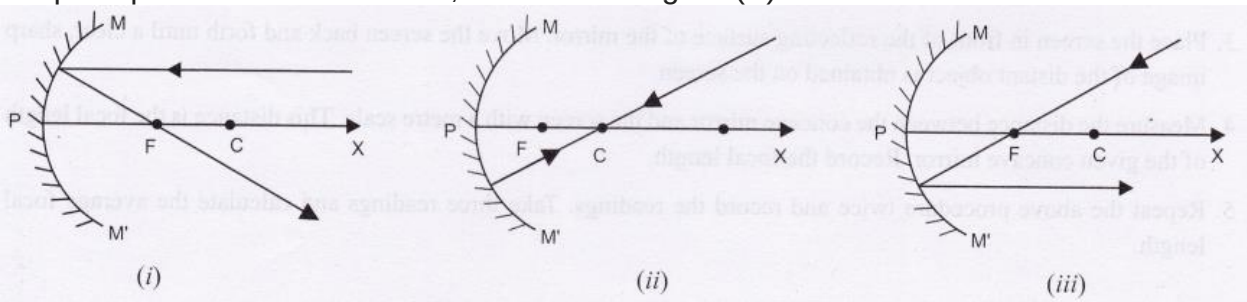


Image formation by concave mirror when object is at infinity

- When parallel rays of light fall on a concave mirror along its axis, the rays meet at a point in front of the mirror and the image formed of the object is real, inverted and very small in size.
- As the image formed by concave lens is real it can be obtained on a screen.
- The distance between the principal axis P of the concave mirror and the focus F is the focal length of the concave mirror. It is denoted by letter ‘f’.

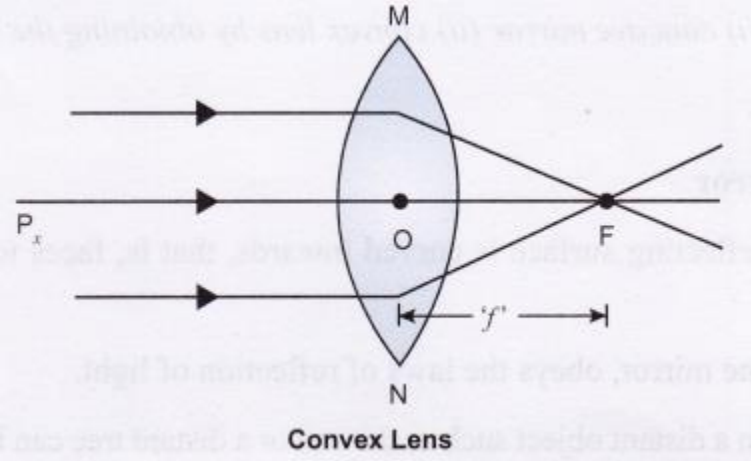
Rules for Obtaining Image Formed By Concave Mirror

1. A ray of light parallel to principal axis of a concave mirror, passes through its focus after reflection from the mirror as shown in figure (i).
2. A ray of light passing through the centre of curvature of a concave mirror is reflected back along the same path as shown in figure (ii).
3. A ray of light passing through the focus of a concave mirror becomes parallel to the principal axis after reflection, as shown in figure (iii).



Focal Length of Convex Lens

- Convex lens is bulge in the centre, i.e,, it is thicker in the middle and thinner at the edges. It is also called converging lens because it converges a beam of light incident on it.



Here, O = Optical centre, P = Principal axis, F = Principal focus,/= Focal length

- When a parallel beam of light falls on a convex lens, the rays, after refraction converge at a point on its other side.
- If the parallel beam of light comes from a distant object, a real, inverted image of very small size is formed at the focus of the lens.
- The distance between the optical centre of lens ‘O’ and the principal focus ‘F’ of the lens is called focal length of a lens, ‘f’ is the representation of focal length.
- Since the image formed by the lens is real, it can be obtained on a screen.
- **Types of Images:**

Real Image		Virtual Image
It can be obtained on the screen.	1.	It cannot be obtained on the screen.
The light rays after reflection, actually meet at a point. E.g. Concave mirror forms such an image. (It is an inverted image)	2.	The light rays after reflection appear to diverge from a point. E.g. Plane and convex mirrors form such a virtual image.

(i) To determine focal length of a given concave mirror:

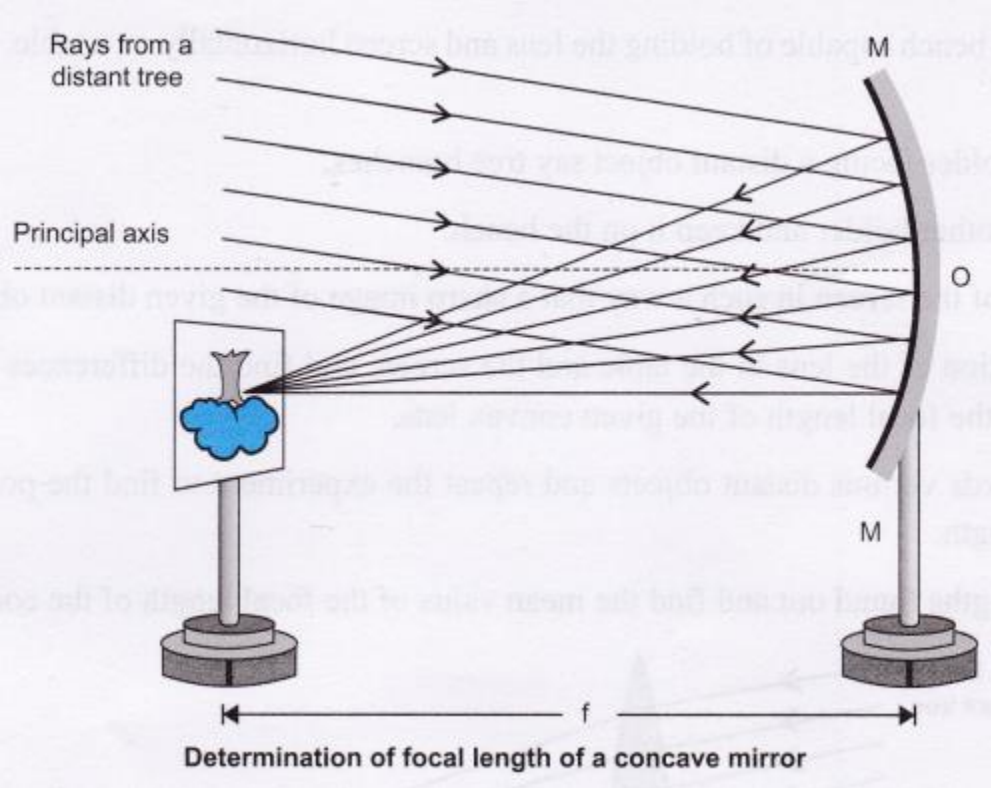
Materials Required

A concave mirror, a measuring scale, a screen a mirror holder and mirror stand.

Procedure

1. Select a distant object from the laboratory window (distance should be more than 50 ft).
2. Fix the concave mirror on the mirror stand placed on the table, facing the distant object.
3. Place the screen in front of the reflecting surface of the mirror. Move the screen back and forth until a clear, sharp image of the distant object is obtained on the screen.
4. Measure the distance between the concave mirror and the screen with a metre scale. This distance is the focal length of the given concave mirror. Record the focal length.

5. Repeat the above procedure twice and record the readings. Take three readings and calculate the average focal length.



Determination of focal length of a concave mirror

Observation Table

S.No.	Position of concave mirror (M)	Position of screen (S)	Focal length/ = (M – S) cm
1.	60 cm	50 cm	10 cm
2.	60 cm	50 cm	10 cm
3.	60 cm	50 cm	10 cm

Calculation

Mean value of focal length of concave mirror =

$$\frac{f_1+f_2+f_3}{3}\ \text{cm} = 10\ \text{cm}$$

Result

The focal length of the given concave mirror = 10 cm

Precautions

1. The distant object must be well illuminated to produce a well illuminated and distinct image.
2. Always place the concave mirror near an open window.
3. The polished surface of the concave mirror must face the distant object.
4. There should be no obstacle or hurdle in the path of rays of light from the distant object, incident on the concave mirror.
5. The base of the stands of the concave mirror and screen should be parallel to the measuring scale.
6. The mirror holder along with the mirror should be kept perpendicular to the measuring scale for precise measurements.

(ii) To determine focal length of a given convex mirror:

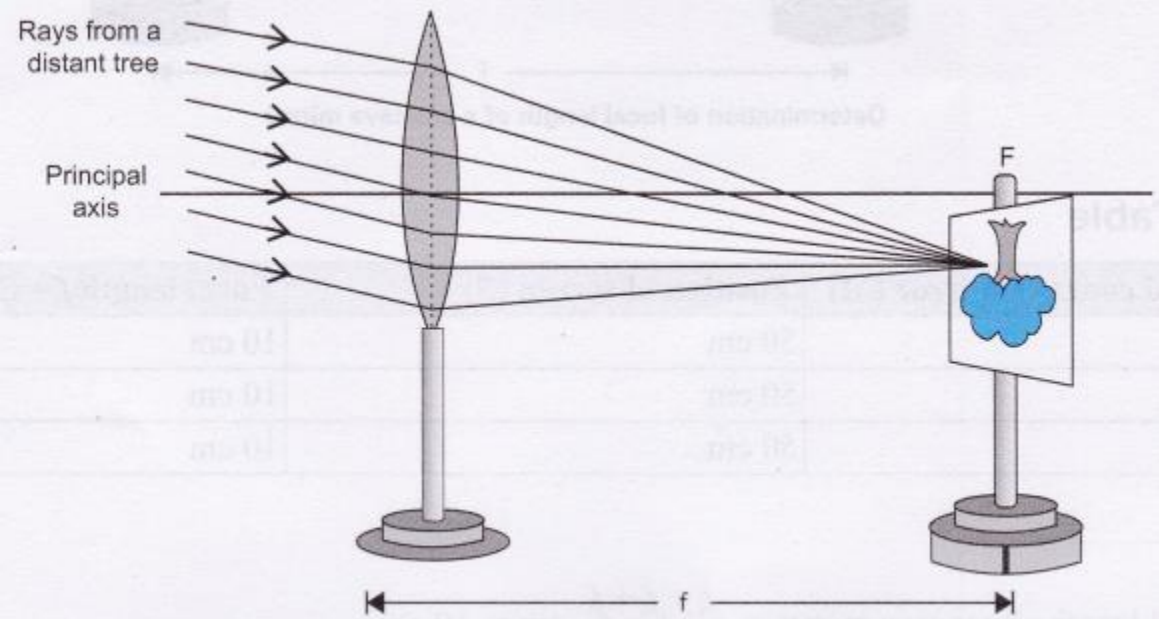
Materials Required

Wooden bench, convex lens, a lens holder, a screen fixed to a stand, a measuring scale; etc.

Procedure

1. Arrange the wooden bench capable of holding the lens and screen horizontally on a table, so that the lens and screen are not disturbed.
2. Keep the lens in a holder facing a distant object say tree branches.
3. Fix the screen on another holder and keep it on the bench.
4. Adjust the position of the screen in such a way that a sharp image of the given distant object falls on it.
5. Note down the position of the lens in the table and the screen, and find the differences and record the same. The difference will give the focal length of the given convex lens.
6. Focus the lens towards various distant objects and repeat the experiment to find the position of sharp image and thereby the focal length.

7. Add all the focal lengths found out and find the mean value of the focal length of the convex lens.



Determination of focal length of a thin convex lens

Observation Table

S.No.	Position of convex lens (L)	Position of screen (S)	Focal length/= (L – S) cm
1.	60 cm	50 cm	f1 = 10 cm
2.	60 cm	50 cm	f2 = 10 cm
3.	60 cm	50 cm	f3 = 10 cm

Calculation

Mean value of focal length of convex lens =

$$\frac{f_1+f_2+f_3}{3}\ \text{cm} = 10\ \text{cm}$$

Result

The focal length of the given convex lens = 10 cm

Precautions

1. Convex lens should be placed vertically.
2. There should be no obstacle or hurdle in the path of rays of light from the distant object incident on the common lens.

3. In order to get a well illuminated and distinct image, it must be ensured that the distanct object is well illuminated.
4. The base of the stands of the convex lens and screen should be parallel to the measuring scale.

Science Lab Manual Viva Voce

Question 1:
Give the mirror image of SMART.
Answer:
TRAMS

Question 2:
Name two types of spherical mirrors.
Answer:
Concave mirror and convex mirror.

Question 3:
Which mirror always produces virtual image?
Answer:
Plane mirror and convex mirror.

Question 4:
Define aperture of a spherical mirror.
Answer:
It is the diameter of the circular rim of a spherical mirror.

Question 5:
Define centre of curvature of a spherical mirror.
Answer:
The centre of the hollow sphere of which spherical mirror is a part is called the centre of curvature.

Question 6:
What is the relation between focal length T and the radius of curvature 'R' of a concave mirror?
Answer:
f = R/2.

Question 7:
What is meant by principal axis of a spherical mirror?
Answer:

The imaginary line passing through the pole and the principal focus of the spherical mirror is called its principal axis.

Question 8:
What is the pole of a concave mirror?
Answer:
It is the centre point of the reflecting surface of the concave mirror. It is represented as 'P'.

Question 9:
What is centre of curvature of a concave mirror?
Answer:
Centre of curvature 'C' is the centre of the sphere of which the concave mirror forms a part.

Question 10:
What is radius of curvature of concave mirror?
Answer:
Radius of curvature is the radius of the sphere of which the mirror forms a part.

Question 11:
What is the principal focus (F) of the concave mirror?
Answer:
A point in front of a concave mirror where a beam of light parallel to the principal axis converge.

Question 12:
What is the mirror formula?
Answer:
The mirror formula is =

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

Question 13:
What is the law of reflection for mirror?
Answer:
(i) The incident ray, the reflected ray and the normal, all lie in the same plane.
(ii) $\angle i = \angle r$

Question 14:
How many refracting surfaces does a lens have?
Answer:
Two

Question 15:
Name two types of lenses commonly used.
Answer:
Convex lens and concave lens.

Question 16:
Is focal length of a convex lens taken +ve or – ve?
Answer:
Positive, since it converges light.

Question 17:
Give the len's formula.
Answer:

$$\frac{1}{f} = \frac{1}{v} + \frac{1}{u}, \quad \text{where,} \quad v = \text{Image distance}$$
$$u = \text{Object distance}$$
$$f = \text{focal length}$$

NCERT Science Lab Manual Practical Based Questions

Question 1:
Just by looking at an object, how do you come to know whether it is a smooth surface or rough one?
Answer:
When the object is smooth, reflection is regular and the object shines.
When the object is rough, reflection is irregular, the object appears to be dull.

Question 2:
What type of image is formed by a plane mirror?
Answer:
Plane mirror forms a virtual image, and, lies as far behind the mirror as the object lies in front of it and is laterally inverted.

Question 3:
An incident ray makes an angle of 40° with the plane mirror, what is the angle of reflection?
Answer:
The angle of incidence in this case would be 50°, hence the angle of reflection will be 50°.

Question 4:
Which mirror forms a real focus and why?
Answer:
Concave mirror forms a real focus because it is a converging mirror. All the light rays incident on it converge and actually meet at one point on the principal axis.

Question 5:
Give one condition when concave mirror does not form a real image.
Answer:
When the object is placed between the focus and pole of the concave mirror, the image formed is virtual.

Question 6:
Convex mirror is a diverging mirror so it does not form a real focus. But plane mirror is not a diverging mirror, why does it not form a real focus.
Answer:
In case of plane mirror, the incident rays and the reflected rays form same angle with the mirror and the reflected rays do not converge. So, it forms a virtual image.

Question 7:
State the position of an object if you want to obtain an image of same size in case of concave mirror.
A**nswer:**
The object should be placed at 'C' of the concave mirror.

Question 8:
Name the mirror used for shaving and why?
Answer:
The concave mirror is used for shaving because when an object is placed between the pole and the focus of the mirror, the image formed is virtual and highly magnified.

Question 9:
You are standing facing a mirror and your image appears to be as follows:
Head – appears to be very big Body – appears to be of same size Legs – appear to be very small.
How will you explain for such an image formation?
Answer:
The mirror in this case is combination of three mirrors. The top part is a concave mirror, the middle part is a plane miiTor and the bottom part is a convex mirror.

Question 10:
Name two spherical mirrors.
Answer:
Concave mirror and convex mirrors are spherical mirrors.

Question 11:
What is the relation between the focal length and radius of curvature for concave mirror?
Answer:
The focal length is ‘f’ and radius of curvature is ‘R’ of concave mirror and f = R/2.

Question 12:
Give two uses of concave mirror.
Answer:
Concave mirror is used by dentist and in solar cooker.

Question 13:
What type of image does a concave mirror forms?
Answer:
Concave mirror forms a real image.

Question 14:
If the object is at infinity where will the image be formed in case of concave mirror?
Answer:
The image will be formed at the focus ‘F’.

Question 15:
When does concave mirror form a virtual image?
Answer:
Concave mirror will form a virtual image when the object is placed between pole and the focus.

Question 16:
In case of concave mirror give the sign convention for ‘f’.
Answer:
The ‘f is negative when the image formed is real and T is positive when the image formed is virtual.

Question 17:
When parallel beams fall on a convex lens, what happens?
Answer:
It converges at focus of the convex lens.

Question 18:
When light passes through optical centre of a convex lens, what happens to it?
Answer:
It will go without deviating.

Question 19:
Does the nature of image formed by a convex lens depend on the position of object?
Answer:
Yes, it forms virtual image only when placed between focus and optical centre and for all other positions it forms real image.

Question 20:
How will you distinguish a concave lens from a convex lens experimentally?
Answer:
If the given lens forms sharp real image of a distant object, it is convex lens. Otherwise, it is a concave lens.

Question 21:
If we cover the one half of the convex lens while focussing a distant object, will it affect the image formed?
Answer:
Image will be formed, as usual but the intensity will be reduced to half the original.

Question 22:
Which out of the two spherical mirrors, has positive focal length? Which of the two will form real and inverted image at its 'F' point, which can be taken on the screen?
Answer:
Convex mirror has positive focal length. Concave mirror forms a highly diminished sized, real and inverted image of the object at 'F' point which can be taken on the screen.

Question 23:
What is the nature of the image formed by a concave lens? Can this be taken on the screen?
Answer:
A concave lens always forms erect and virtual image of the object. The image formed is diminished in size.
The image cannot be taken on the screen.

Question 24:
For finding the focal length of a concave mirror, where do we keep the object? What is the position of image formed? On which structure we get the image? What is the nature of the image formed?
Answer:
A large sized object placed at a far off (Infinity) place, seen from the window of the lab, is taken as object.
The image is formed at F point of the mirror. This image is formed on the screen. The distance between the mirror and the screen is measured; which is equal to focal length of the mirror. The image formed is real and inverted.

NCERT Science Lab Manual LAB MANUAL QUESTIONS

Question 1:
How will you distinguish between a concave and a convex mirror?
Answer:
The differences between concave and convex mirror are:

S.No.	Concave Mirror	Convex Mirror
1.	A spherical mirror, whose reflecting surface is curved inwards.	A spherical mirror, whose reflecting surface is curved outwards.
2.	Image formed may be real and inverted or virtual and erect.	Image formed is always virtual and erect.
3.	Size of the image may be smaller, equal or larger than the size of object.	Size of image is always smaller than the size of object.
4.	Concave mirrors are commonly used in torches, search-lights and vehicles headlights to get powerful parallel beams of light.	Convex mirrors have a wider field of view and hence used as rear-view mirrors.

Question 2:
To detemine the focal length of a concave mirror, a student focuses a classroom window, a distant tree and the sun on the screen with the help of a concave mirror. In which case will the student get more accurate value of focal length?
Answer:
To get the accurate focal length of any mirror the object should be placed at infinity.

Hence, if sun is focused for getting the focal length than it would give better and accurate result.

Question 3:
What will be the nature of image formed by a concave mirror for a distant object?
Answer:
The nature of image formed by the concave mirror is real and inverted for distant object.

Question 4:
In reflector type solar cookers, special concave (parabolic) mirrors are used. In such cookers, what should be the preferable position of food vessel for cooking?
Answer:
In reflector type solar cooker, the position of food vessel should be at the focus of concave mirror.

Question 5:
What type of mirror is used in a torch? Give reasons.
Answer:
In torch behind the bulb a concave spherical mirror is placed so that the parallel beam of light is reflected by it which travels a large distance.

Question 6:
What type of mirror is used as shaving mirror or in vanity boxes?
Answer:
Concave mirror is used as shaving mirror or in vanity boxes because it gives magnified, virtual and erect image.

Question 7:
How will you distinguish between a convex and concave lens?
Answer:

1. Convex lens is bulging out from both the sides whereas concave lens is curved inside from both the sides.
2. Convex lens forms a real focus and the distant object's real, image is formed on the screen but concave lens do not form a real focus and the image formed is virtual.

Question 8:
To determine the focal length of a convex lens, a student focuses a classroom window, a distant tree and the sun on the screen. In which case will the student is closer to accurate value of focal length?
Answer:
The accurate value of the focal length would be obtained by focusing the sun on the screen.

Question 9:
What is the nature of an image formed by a thin convex lens for a distant object? What change do you except if the lens were rather thick?
Answer:
The image formed will be real, diminished and inverted. If the lens were thick then the nature of the image formed will be the same but focal length will be different.

Question 10:
You are provided with two convex lenses of same aperture and different thickness. Which one of them will be of shorter focal length?
Answer:
Thin lens will have shorter focal length.

Question 11:
If we cover one half of the convex lens while focusing a distant object, in what way will it affect the image formed?
Answer:
The image will be formed completely but it will be blurred.

Question 12:
Can this method be used to find the approximate focal length of a concave lens?
Answer:
No, concave lens does not form a real focus.

Question 13:
Which type of lens is used by the watch-makers while repairing fine parts of a wrist watch?
Answer:
Convex lens, as it is used as magnifying lens.

Science Lab Manual - MULTIPLE CHOICE QUESTIONS (MCQs)

Questions based on Procedural and Manipulative Skills
Question 1:
The diameter of a spherical mirror is called
(a) radius of curvature **(b)** aperture
(c) focal plane **(d)** pole
Answer:
(b)
Explanation:
The diameter of a spherical mirror is called its aperture.

Question 2:
The distance between the pole and the principal focus of a concave mirror is called

(a) focus **(b)** focal length
(c) pole **(d)** radius of curvature

Answer:

(b)

Explanation:

It is the point where all the reflected rays meet.

Question 3:

The image formed by a mirror is always virtual. It is

(a) convex mirror
(b) plane mirror
(c) concave mirror
(d) both convex and plane mirrors

Answer:

(d)

Explanation:

Both mirrors don't form real focus, the rays after reflection do not meet.

Question 4:

For a plane mirror, radius of curvature 'R' is

(a) R = infinity
(b) R=f/2
(c) R = 2f
(d) R = 0

Answer:

(a)

Explanation:

For plane mirror, R is at infinity.

Question 5:

The mirror used in solar cooker is

(a) any spherical mirror **(b)** concave mirror
(c) convex mirror **(d)** none of these

Answer:

(b)

Explanation:

All the rays after reflection meet at a point.

Question 6:

The radius of curvature and focal length of a concave mirror are

(a) positive
(b) one is positive and other is negative
(c) negative
(d) none of these.

Answer:
(c)
Explanation:
Both are calculated against the direction of light/ it is Cartesian sign convention.

Question 7:
A beam of parallel rays after falling obliquely in a plane surface
(a) diverges
(b) remains parallel but deviates
(c) converges
(d) remains parallel but does not deviate
Answer:
(b)
Explanation:
Plane surface will reflect the rays, but they will remain parallel.

Question 8:
For a plane mirror, the radius of curvature R is:
(a) R = ∞
(b) R = 0
(c) R = 2f
(d) R = 2/f
Answer:
(a)
Explanation:
R is infinity for plane mirror.

Question 9:
An object is placed at 'C', i.e., centre of curvature of a concave mirror. The distance between the pole of the mirror and the image formed is:
(a) between f and 2f **(b)** equal to f
(c) equal to 2f **(d)** greater than 2f.
Answer:
(c)
Explanation:
If object is at C, then the image if formed at C and C = 2f.

Question 10:
What type of image is formed on our retina?
(a) Plane **(b)** Real
(c) Virtual **(d)** Magnified.
Answer:
(b)
Explanation:
On retina real and inverted image is formed.

Question 11:
A concave mirror forms a real image of the given object. The magnification would be:
(a) positive
(b) negative
(c) both (a) and (b)
(d) none of these
Answer:
(b)
Explanation:
If the image is below the principal axis then magnification is negative.

Question 12:
Image formed by a convex mirror is always:
(a) real and diminished
(b) real and magnified
(c) virtual and diminished
(d) virtual and magnified.
Answer:
(c)
Explanation:
Convex mirror does not form real focus.

Question 13:
For a concave mirror:
(a) 'f' is always positive **(b)** 'f' is always negative
(c) 'f' can be +ve or -ve **(d)** 'f' is both +ve and -ve
Answer:
(b)
Explanation:
The focal length of concave mirror is always negative, as per sign convention.

Question 14:
The mirror formula is:
$(a)\ \frac{1}{f}=\frac{1}{v}+\frac{1}{u}$ $(b)\ \frac{1}{f}=\frac{1}{v}-\frac{1}{u}$
$(c)\ \frac{1}{u}=\frac{1}{f}+\frac{1}{v}$ $(d)\ \frac{1}{f}=\frac{1}{u}-\frac{1}{v}$
Answer:
(a)
Explanation:
As per the formula of mirror.

Question 15:
A ray of light falls on the mirror and after reflection it takes the same path. The incident ray is:
(a) passing through C **(b)** through F
(c) both (a) and (b) **(d)** through P
Answer:
(a)
Explanation:
Any ray that is passing through C will be reflected back in same path.

Question 16:
The lens called as a magnifying glass is
(a) convex lens **(b)** concave lens
(c) concave mirror **(d)** convex mirror
Answer:
(a)
Explanation:
Convex lens gives enlarged image when object is placed between F and pole.

Question 17:
If you are to determine the focal length of a convex lens, you should have [Outside Delhi 2012]
(a) a convex lens and a screen
(b) a convex lens and a lens holder
(c) a lens holder, a screen holder and a scale
(d) a convex lens and a screen, holders for them and a scale.
Answer:
(d)
Explanation:
Screen is used to collect the real image and scale to measure the focal length.

Question 18:
A student has to determine the focal length of a convex lens by obtaining the image of a distant object on a screen. Which of the following measures should he take to obtain better results?
(i) Select a lens of small diameter (say 3 cm).
(ii) Select a lens of larger diameter (say 5 cm).
(iii) Select an object very far from the lens.
(iv) Select an object far, but not very far, from the lens.
(v) Keep all the lights of the room on.
(vi) Keep minimum lights of the room on.
(a) (i), (iii) and (v) **(b)** (ii), (iv) and (vi)
(c) (i), (iv) and (vi) **(d)** (ii), (iv) and (v)
Answer:
(b)

Explanation:
To obtain the best focal length, keep the light dim, object far but not very far.

Question 19:
To determine the focal length of given convex lens by obtaining a sharp image of a well lit distant object on a screen, a student generally follows the following steps which are not in proper sequence.
(I) Adjust the position of the lens to obtain a sharp image.
(II) Select a well lit distant object.
(III) Hold the lens between the object and the screen.
(IV) Place a screen opposite to the object on the lab table.
(V) Measure the distance between the lens and the screen.
The correct sequence of these steps are:
(a) II, III, IV, I, V **(b)** II, IV, III, I, V
(c) II, III, I, IV, V **(d)** II, I, III, IV, V
Answer:
(b)
Explanation:
It is the right sequence of the procedure.

Question 20:
A sharp image of a distant object is obtained on a screen using a convex lens. In order to determine the focal length of the lens; we need to measure the distance between the
(a) object and the lens
(b) object and its image (screen)
(c) lens and the image (screen)
(d) lens and the screen and also object and the screen
Answer:
(c)
Explanation:
f= Distance between the image obtained and the reflector / mirror/ lens.

Question 21:
To find the focal length of a concave mirror, Sita should choose which one of the following set-ups?
(a) A mirror holder and a screen holder
(b) A screen holder and a scale
(c) A mirror holder, a screen holder and a scale
(d) A screen, a mirror, holders for them and a scale
Answer:
(d)
Explanation:
Screen is used to collect the real image and scale to measure the focal length.

Question 22:
To determine the focal length of a convex lens by obtaining a sharp image of a distant object we generally follow the following steps which are not in proper sequence. [Delhi 2012]
(I) Hold the lens between the object and the screen.
(II) Measure the distance between the lens and the screen.
(III) Select a well lit distant object.
(IV) Place a screen opposite to the object on the lab table.
(V) Adjust the position of the lens to form a sharp image.
The correct sequence of these steps is:
(a) III, I, IV, V, II **(b)** III, IV, I, V, II
(c) III, IV, V, I, II **(d)** III, I, V, IV, II
Answer:
(b)
Explanation:
It is the right sequence of the procedure.

Question 23:
A student has to determine the focal length of a concave mirror by obtaining the image of a distant object on a screen. For getting the best result he should focus
(a) a distant tree or an electric pole
(b) a well-illuminated distant building
(c) well-lit grills of the nearest window
(d) a burning candle placed at the distant edge of the laboratory table
Answer:
(a)
Explanation:
The object should be not very far and well lit.

Questions based on Observational Skills
Question 24:
A concave mirror gives virtual, erect and enlarged image of the object when placed
(a) at infinity **(b)** between F and C
(c) between F and P **(d)** at F
Answer:
(c)
Explanation:
When object is placed between F and P, then the reflected rays do not really meet.

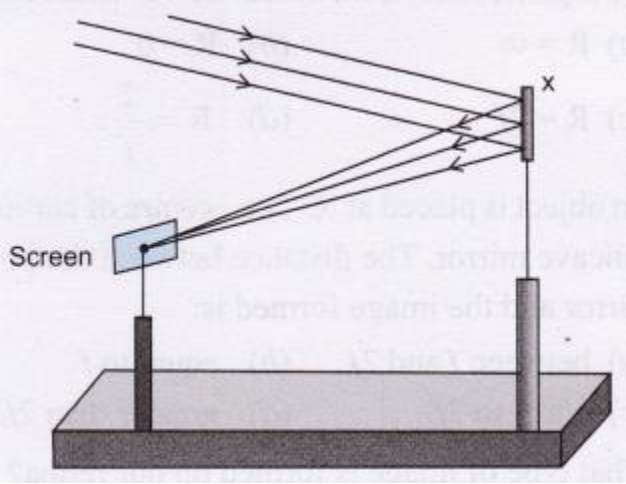
Question 25:
The image formed by a plane mirror is always
(a) real and erect
(b) real and inverted
(c) virtual and erect
(d) virtual and inverted

Answer:
(c)
Explanation:
Plane mirror has virtual focus.

Question 26:
The mirror that always gives a virtual image and the image is smaller w.r.t. object, then the mirror is
(a) concave **(b)** convex
(c) plane **(d)** none of these.
Answer:
(b)
Explanation:
Convex mirrors always form diminished images.

Question 27:
The object when placed at the focus of the concave mirror, the image is formed at
(a) infinity **(b)** centre of curvature
(c) focus **(d)** between F and O
Answer:
(a)
Explanation:
The rays after reflection do not meet in this case.

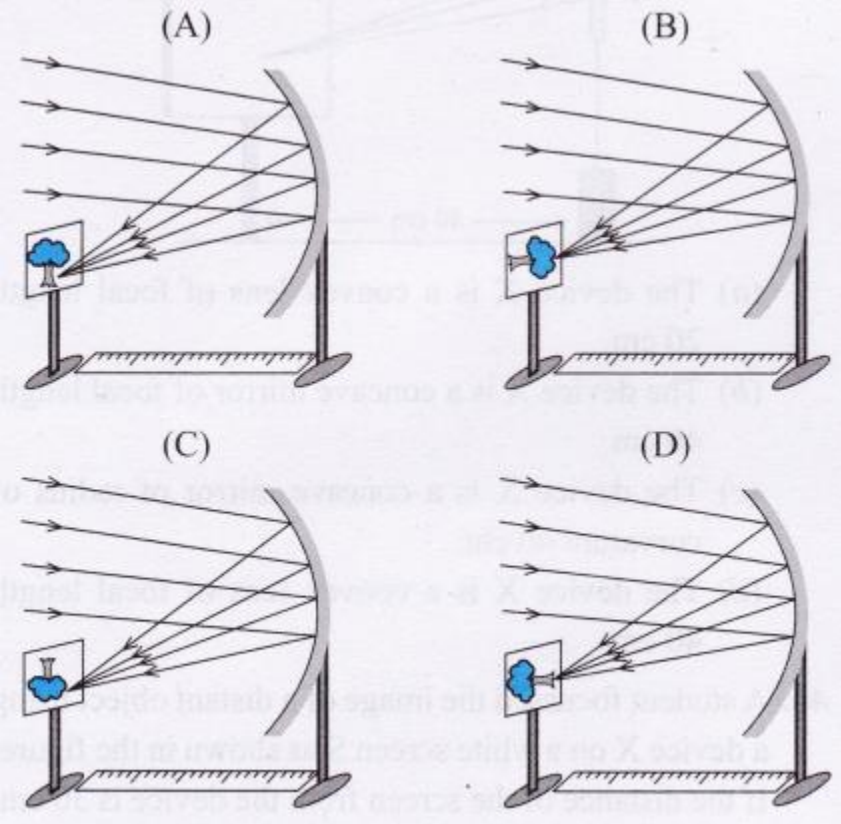
Question 28:
A student determines the focal length of a device X by it , focussing the image of a far off object on the screen positioned as shown in the figure below. The device X is a:



(a) convex lens **(b)** concave lens
(c) concave mirror **(d)** convex mirror.
Answer:
(c)

Explanation:
As the reflected rays are converging at focus.

Question 29:
Parallel rays from a distant tree, incident on a concave mirror form an image on the screen.



The correct formation of image on the screen is shown in:
(a) A **(b)** B **(c)** C **(d)** D.
Answer:
(c)
Explanation:
The image formed is real and inverted.

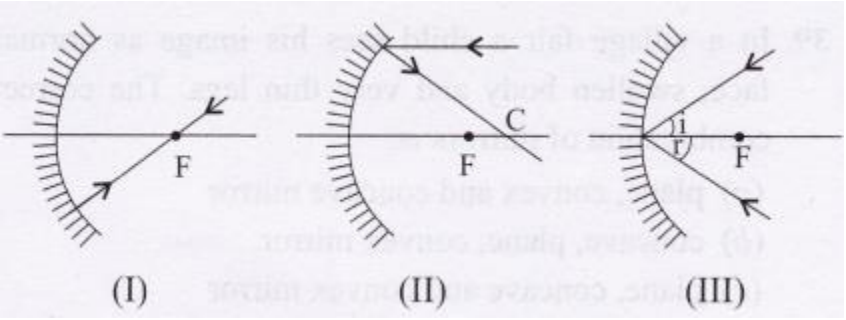
Question 30:
The mirror used in car head light is:
(a) concave **(b)** convex
(c) plane **(d)** concavo-convex.
Answer:
(a)
Explanation:
Concave mirror acts as reflectors to focus light.

Question 31:
An object is placed at the centre of curvature of a concave mirror. The image will be formed:
(a) at C **(b)** beyond C
(c) between F and C **(d)** at F.
Answer:
(a)
Explanation:
If object is at C, then the image is also formed at C.

Question 32:
To find the focal length of a concave mirror Rahul focuses a distant object with this mirror. The chosen object should be:
(a) a tree **(b)** a building
(c) a window **(d)** the Sun
Answer:
(a)
Explanation:
The object should be far but not very far.

Question 33:
For finding the focal length of a convex lens by obtaining the image of a distant object, one should use as the object
(a) a well lit distant tree
(b) window grill in the class room
(c) any distant tree
(d) a lighted candle kept at the other end of the table
Answer:
(a)
Explanation:
The light and distance of the object is important consideration for correct focal length.

Question 34:
Different paths of ray are shown in the following figures. Which of the following is correct?

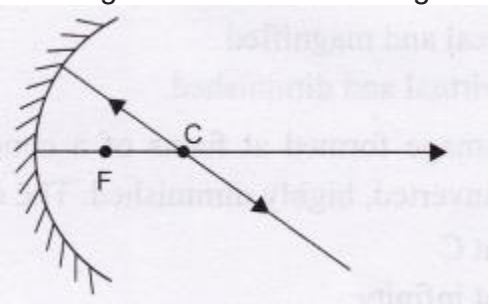


(a) Figure II only **(b)** Figure I only
(c) Figure III only **(d)** Both I and II

Answer:
(c)
Explanation:
It follows the rule of reflection of light by spherical mirror.

Questions based on Reporting and Interpretation Skills

Question 35:
The angle of reflection in the given figure is

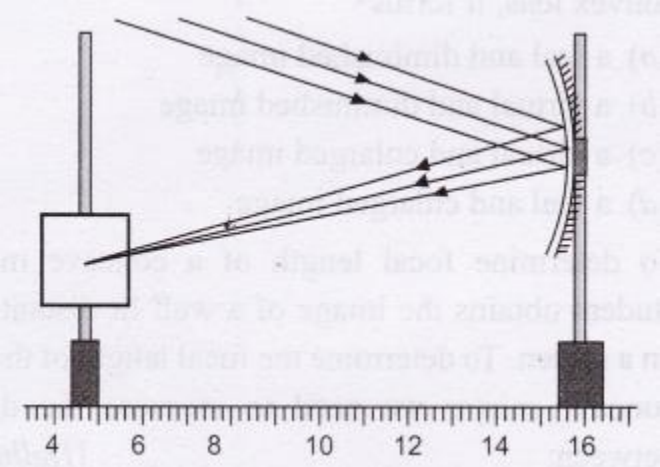


(a) 90° **(b)** 0° **(c)** 360° **(d)** 180°

Answer:
(b)
Explanation:
The angle of reflection is formed between normal and reflected ray.

Question 36:
An incident ray makes an angle of 30° with the surface of the plane mirror. The angle of reflection is
(a) 30° **(b)** 90°
(c) 60° **(d)** 0°
Answer:
(c)
Explanation:
The angle of reflection is 60 degrees. Note that the angle of incidence is not 30 degrees; it is 60 degrees since the angle of incidence is measured between the incident ray and normal.

Question 37:
The focal length of the concave mirror in the experimental set-up shown below, equals:



(a) 10.3 cm **(b)** 11.0 cm
(c) 11.7 cm **(d)** 12.2 cm.

Answer:

(b)

Explanation:

It is the distance between the focus and the mirror.

Question 38:

A convex mirror has focal length of 15 cm. An object is placed at 20 cm from the pole of this lens. The nature of the image formed will be.

(a) virtual, erect and diminished
(b) virtual, erect and enlarged
(c) real, inverted and diminished
(d) real, inverted and enlarged.

Answer:

(a)

Explanation:

Convex mirror forms virtual image when object is placed beyond focus.

Question 39:

In a village fair a child sees his image as normal face, swollen body and very thin legs. The correct combination of mirrors is:

(a) plane, convex and concave mirror
(b) concave, plane, convex mirror
(c) plane, concave and convex mirror
(d) convex, concave and plane mirror.

Answer:

(c)

Explanation:

Plane mirror gives image of same size, concave mirror enlarges the image and convex mirror gives diminished image.

Question 40:
Two plane mirrors are placed opposite to each other and a candle is placed in between, the image formed will be:
(a) real and infinite
(b) virtual and infinite
(c) real and magnified
(d) virtual and diminished.
Answer:
(b)
Explanation:
Two plane mirrors at opposite position will reflect the images at infinity, virtual image is formed by the plane mirror.

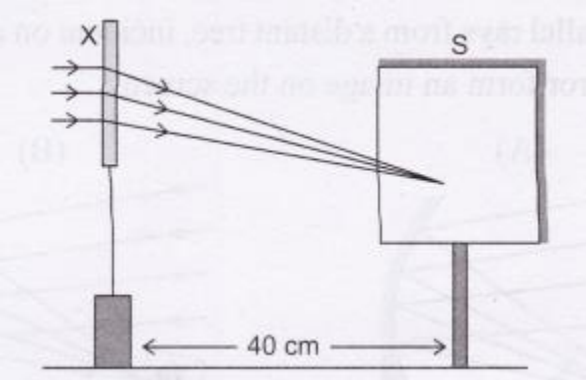
Question 41:
The image formed at focus of a concave mirror is real, inverted, highly diminished. The object is:
(a) at C
(b) at infinity
(c) between F and C
(d) beyond C.
Answer:
(b)
Explanation:
If the object is placed at infinity, the image is formed at focus.

Question 42:
When an object is placed at a distance 2f from the optical centre of the convex lens, its image will be formed at a distance.
(a) f **(b)** 2f **(c)** f/2 **(d)** 3f/2
Answer:
(b)
Explanation:
If the object is placed at 2f then the image will be formed at 2f.

Question 43:
If an object is placed between the focus and pole of a convex lens, it forms
(a) a real and diminished image
(b) a virtual and diminished image
(c) a virtual and enlarged image
(d) a real and enlarged image
Answer:
(c)
Explanation:
If object is between F and pole of convex lens then the image formed is enlarged and virtual.

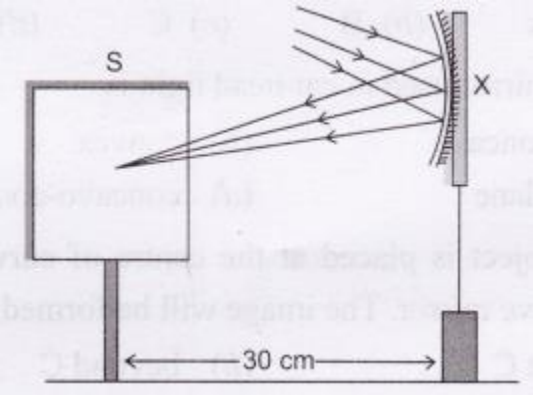
Question 44:
To determine focal length of a concave mirror a student obtains the image of a well lit distant object on a screen. To determine the focal length of the given concave mirror we need to measure the distance between:
(a) mirror and the object
(b) mirror and the screen
(c) screen and the object
(d) screen and the object and also mirror and the screen
Answer:
(b)
Explanation:
l= distance between lens and the image.

Question 45:
A student focussed the image of a distant object using a device 'X' on a white screen 'S' as shown in figure. If the distance of the screen from the device is 40 cm, select the correct statement about the device.



(a) The device X is a convex lens of focal length 20 cm.
(b) The device X is a concave mirror of focal length 40 cm.
(c) The device X is a concave mirror of radius of curvature 40 cm.
(d) The device X is a convex lens of focal length 40 cm.
Answer:
(d)
Explanation:
Convex lens converges all the rays and the distance between lens and focus is 40 cm.

Question 46:
A student focussed the image of a distant object using a device X on a white screen S as shown in the figure. If the distance of the screen from the device is 30 cm, select the correct statement about the device X.



(a) The device X is a concave mirror of focal length 15 cm.
(b) The device X' is a concave mirror of focal length 30 cm.
(c) The device X is a concave mirror of radius of curvature 30 cm.
(d) The device X is a convex mirror of focal length 30 cm.

Answer:

(b)

Explanation:

Concave mirror is a converging mirror and the distance between mirror and screen is focal length.

Question 47:

A student has obtained the image of a distant object with a concave mirror to determine its focal length. If he has selected a well illuminated red building as object, which of the following correctly describes the features of the image formed?

(a) Virtual, inverted, diminished image in red shade
(b) Real, erect, diminished image in pink shade
(c) Real, inverted, diminished image in red shade
(d) Virtual, erect, enlarged image in red shade

Answer:

(c)

Explanation:

Concave mirror always forms real and diminished image of distant object.

Question 48:

A student has obtained an image of a well-illuminated distant object on a screen to determine the focal length, f_1 of the given spherical mirror. The teacher then gave him another mirror of focal length, f_2 and asked him to obtain a focussed image of the same object on the same screen. The student found that in order to focus the same object using the second mirror, he has to move the mirror away from the screen. From this observation it may be concluded that both the spherical mirrors given to the student were (select the correct option)

(a) Concave and $f_2 > f_1$
(b) Concave and $f_1 > f_2$
(c) Convex and $f_2 < f_1$
(d) Convex and $f_1 > f_2$

Answer:

(a)

Explanation:

Concave mirror will give the real focus and on moving the mirror away from the screen "f_2" is greater than f_1.