03. REFLECTION OF LIGHT ON DIFFERENT SURFACES

Questions and Answers

1. State the laws of reflection of light.

A. Laws of reflection of light:

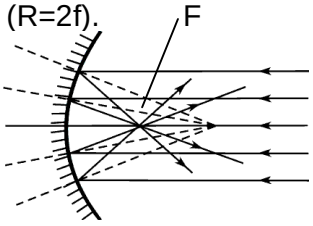
(i) The angle of incidence is equal to the angle of reflection.

(ii) The incident ray, reflected ray and normal to the plane of reflection at point of reflection lie in the same plane.

2. How do you find the focal length of a concave mirror?

A. Hold a concave mirror such that sunlight falls on it. Take a small paper and slowly move it in front of the mirror and find out the point where we get the smallest and brightest spot, which will be the image of the sun. (See to it that our paper is small so that it does not obstruct the incoming sun rays.)

The rays coming from the sun parallel to the principal axis of concave mirror converge to a point. This point is called **Focus or focal point (F)** of the concave mirror. Measure the distance of this spot from the pole of the mirror. This distance is the **focal length (f)** of the mirror. The radius of curvature will be twice this distance (R=2f).



3. Where will the image form when we place an object, on the principal axis of a concave mirror at a point between focus and centre of curvature?

A. When we place an object, on the principal axis of a concave mirror at a point between focus and centre of curvature then the image is formed beyond the centre of curvature. Also the image is inverted, enlarged and real.

4. Find the distance of the image when an object is placed on the principal axis at a distance of 10cm in front of a concave mirror whose radius of curvature is 8cm.

A. Distance of the object (u) = 10cm

Radius of curvature (R) = 8cm

Focal length (f) = $\frac{R}{2} = \frac{8}{2}$ = 4cm

Distance of the image (v) = ?

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

$\frac{1}{v} = \frac{1}{f} - \frac{1}{u} = \frac{1}{4} - \frac{1}{10} = \frac{10-4}{40} = \frac{6}{40} = \frac{3}{20}$

$v = \frac{20}{3}$ = 6.6 cm (on the object side)

5. State the differences between convex and concave mirrors.

	Convex Mirror		Concave Mirror
1	This is a spherical mirror whose reflecting surface is curved outward is called convex mirror.	1	This is a spherical mirror whose reflecting surface is curved inward is called called concave mirror.
2	The focus lies behind the mirror.	2	The focus lies infront of the mirror.
3	It is also known as diverging mirror.	3	It is also known as converging mirror.

6. Distinguish between real and virtual images.

	Real image		Virtual image
1	Real image is formed always in front of the mirror.	1	Virtual image is formed always behind the mirror.
2	Image can be obtained on the screen.	2	Image can not be obtained on the screen.
3	It is formed when light converges to a point after reflection or refraction.	3	It is formed when light appears to be diverges from a point after reflection or refraction.
4	It is always inverted.	4	It is always erect.

NAGA MURTHY- 9441786635
Contact at : nagamurthysir@gmail.com
Visit at : nagamurthy.weebly.com

7. How do you get a virtual image using a concave mirror?

A. When we place an object, on the principal axis of a concave mirror at a point between focus and pole then the erect, enlarged and virtual image is formed behind the concave mirror.

8. What do you know about the terms given below related to spherical mirrors? a) Pole b) Centre of curvature c) Focus d) Radius of curvature e) Focal length f) Principal axis g) Object distance h) Image distance i) Magnification

A. a) Pole: The centre of the reflecting surface of a spherical mirror is called as Pole. It is denoted by 'P'.

b) Centre of curvature: The centre of sphere, of which the reflecting surface of a spherical mirror is a part is called the centre of curvature. It is denoted by 'C'.

c) Focus: The point on the principal axis at which the parallel rays coming from infinity converges after reflection is called focus of the spherical mirror. It is denoted by 'F'.

d) Radius of curvature: The radius of sphere, of which the reflecting surface of a spherical mirror is a part is called the radius of curvature. It is denoted by 'R'.

e) Focal length: The distance between pole and focus is called focal length of the spherical mirror. It is denoted by 'f'.

f) Principal axis: The line passing through the pole and centre of curvature of spherical mirror is called principal axis of the mirror.

g) Object distance: The distance from the pole of spherical mirror to object is called object distance. It is denoted by 'u'.

h) Image distance: The distance from the pole of spherical mirror to image is called image distance. It is denoted by 'v'.

i) Magnification: The relative ratio of size of image formed by spherical mirror to the size of object is known as magnification. It is denoted by 'm'.

$$m = \frac{height\ of\ image}{height\ of\ object} = \frac{image\ distance}{object\ distance}$$

9. Write the rules for sign convention.

A. Sign convention for the parameters related to the mirror equation

(i) All distances should be measured from the pole.

(ii) The distances measured in the direction of incident light, to be taken positive and those measured in the direction opposite to incident light to be taken negative.

(iii) Height of object (Ho) and height of image (Hi) are positive if measured upwards from the axis and negative if measured downwards.

10. The magnification produced by a plane mirror is +1. What does this mean? nagamurthy.weebly.com

A. $m = \frac{height\ of\ image}{height\ of\ object} = \frac{image\ distance}{object\ distance}$

The magnification produced by a plane mirror is +1. This means the size of image is equal to the size of the object. '+' sign represents the image is erect.

11. Imagine that spherical mirrors were not known to human beings. Guess the consequences.

A. If the spherical mirrors are known to human beings then

(i) Many optical instruments were not invented.

(ii) We can not solve the problem of inverted images.

(iii) We can not use spherical mirrors in head lights of vehicles, side mirrors and rear view mirrors.

(iv) Dentists can not perform their treatment easily with out spherical mirrors.

(v) Solar cookers were not yet invented.

12. By observing steel vessels and different images in them; Surya, a third class student, asked his elder sister Vidya some questions. What may be those questions?

A. Surya may asked the following questions:

(i) How can steel vessels form images?

(ii) The image on the plate is different from the image on a bowl. Why?

(iii) When we move some distance, why the size of image in vessel changes?

(iv) Are steel vessels mirrors?

NAGA MURTHY- 9441786635
Contact at : nagamurthysir@gmail.com
Visit at : nagamurthy.weebly.com

13. How do you verify the 1st law of reflection of light with an experiment?

A. <u>Verification of first law of reflection:</u>

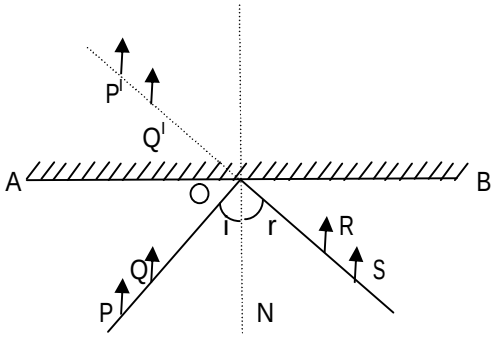
Fix a white paper on a drawing board with the help of clamps. Draw a straight line AB at the centre of the paper and a normal (ON) to AB at 'O'. Draw a straight line PQ making certain angle ($\hat{i}$) with ON. Fix two pins at P and Q on the paper vertically. Observe the images P^I and Q^I of the pins P and Q, in the mirror kept along the line AB. Fix two more pins R and S such that they are in the same line as that of P^I and Q^I. Join R, S and O Measure the angle between RS and ON (angle of reflection).

We find that

angle of incidence = angle of reflection.

Repeat the experiment for different angles of incidence. In all cases the angle of reflection equal to the angle of incidence.

Hence first law of reflection is verified.



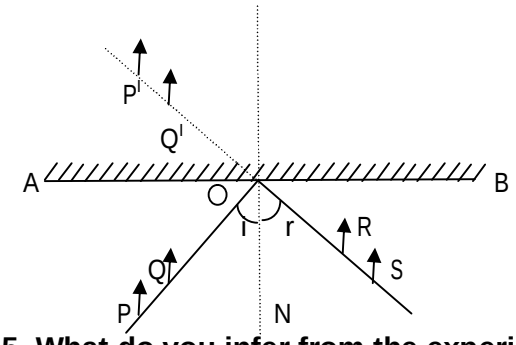
14. How do you verify the 2nd law of reflection of light with an experiment?

A. <u>Verification of second law of reflection:</u>

Fix a white paper on a drawing board with the help of clamps. Draw a straight line AB at the centre of the paper and a normal (ON) to AB at 'O'. Draw a straight line PQ making certain angle ($\hat{i}$) with ON. Fix two pins at P and Q on the paper vertically. Observe the images P^I and Q^I of the pins P and Q, in the mirror kept along the line AB. Fix two more pins R and S such that they are in the same line as that of P^I and Q^I. Join R, S and O

Here the line passing through P and Q is called incident ray and it touches the paper. The line joining R and S is called reflection ray and it touches the same paper. ON is the normal to the mirror at 'O' and it touches the same paper.

Hence Incident ray, reflected ray and normal lies on the same paper. Hence second law of reflection is verified.



15. What do you infer from the experiment which you did with concave mirrors and measured the distance of object and distance of image?

A. (i) If the object moves towards the concave mirror, the image moves away from the mirror.

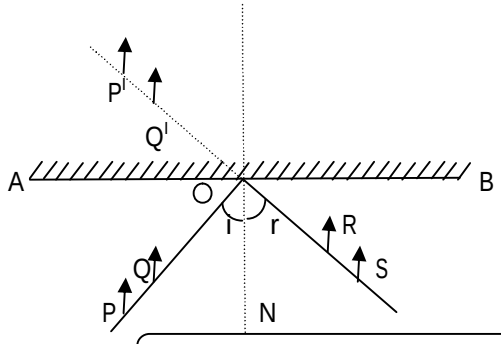
(ii) If the object moves towards the concave mirror, the size of the image also increased. (Except when it is placed before F).

16. Find the plane of the reflection experimentally for the incident ray which passes through the heads of the pins pierced in front of the mirror.

A. <u>Finding the plane of reflection:</u>

Fix a white paper on a drawing board with the help of clamps. Draw a straight line AB at the centre of the paper and a normal (ON) to AB at 'O'. Draw a straight line PQ making certain angle ($\hat{i}$) with ON. Fix two pins at P and Q on the paper vertically. Observe the images P^I and Q^I of the pins P and Q, in the mirror kept along the line AB. Fix two more pins R and S such that they are in the same line as that of P^I and Q^I. Join R, S and O.

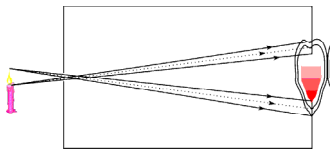
Adjust the pins so that they were pierced to same height on the board. Put a paper on the heads of pins. The plane where the paper touches the mirror is called as plane of reflection for the incident ray which passes through the heads of the pins.



NAGA MURTHY- 9441786635
Contact at : nagamurthysir@gmail.com
Visit at : nagamurthy.weebly.com

20. Draw and explain the process of formation of image with a pinhole camera?

A.



Take two barrels or boxes so that one can be immersed through another.

Place a dark, thick black paper at one end of the big barrel, and tie it with rubber band. Make a hole with pin at the centre of the paper. Tie a oiled paper which is semi transparent to the second small barrel. Immerse small barrel into big barrel and observe the flame of the candle. **nagamurthy.weebly.com**

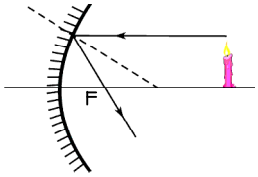
The light which comes from the top of the flame goes straight towards the bottom of the screen. Similarly the rays from the bottom of the flame goes straight towards the top of the screen. This leads to the formation of an inverted image.

If we increase the size of the pin hole camera, we get blurred image with big size. If the size of the hole is equal to the size of the flame , we get no image on the screen.

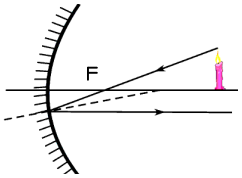
21. Draw suitable rays by which we can guess the position of the image formed by a concave mirror.

A. The following are the suitable rays by which we can guess the position of the image formed by a concave mirror.

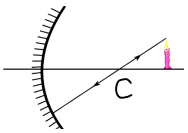
(i) All rays that are parallel to the axis get reflected such that they pass through the focal point of the mirror.



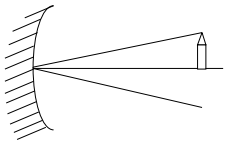
(ii) A ray that passes through the focal point of the mirror will travel parallel to the axis after reflection.



(iii) a ray coming from the tip of the object going through the centre of curvature to meet the mirror, it will get reflected along the same line.

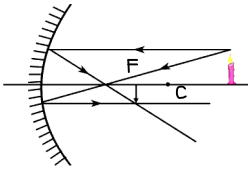


(iv) Along with these three Rays 'the ray which comes from the object and reaches the pole of the mirror' is also useful in drawing ray diagrams. For this ray, the principal axis is the normal.



22. Show the formation of image with a ray diagram when an object is placed on the principal axis of a concave mirror away from the centre of curvature.

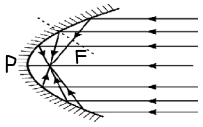
A. When an object placed on the principal axis of a concave mirror and away from the centre of curvature, the image is formed between focus and centre of curvature. It is real, inverted and diminished in size.



23. Make a solar heater/cooker and explain the process of making.

A. Make a wooden/ iron frame in the shape of TV dish. Cut acrylic mirror sheets in to 8 or 12 pieces in the shape of isosceles triangles with a height equal to the radius of your dish antenna. The bases of 8 or 12 triangles together make the circumference of the dish. Stick the triangle mirrors to the dish. Solar heater/cooker is ready.

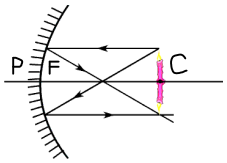
Arrange it so that concave part faces sun. Find its focal point and place a vessel at that point. It will get heated. We can even cook rice in that vessel



NAGA MURTHY- 9441786635
Contact at : nagamurthysir@gmail.com
Visit at : nagamurthy.weebly.com

24. To form the image on the object itself, how should we place the object in front of a concave mirror? Explain with a ray diagram.

A. To form the image on the object itself, we place the object at the centre of curvature of a concave mirror.



25. How do you appreciate the role of spherical mirrors in daily life?

A. Spherical mirrors plays an important role in our day to day life.

(i) We can get different sizes of images and at desired distances by spherical mirrors.

(ii) Spherical mirrors, which converges light at a point used in solar appliances.

(iii) Concave mirrors are used by ENT doctors to see the effected parts more visible.

(iv) Spherical mirrors are used in wars in olden days to destroy the ships.

(v) Concave mirrors are used to see celestial bodies.

(vi) Convex mirrors are used as rear view mirrors.

So, I appreciate the role of spherical mirrors in daily life.

26. How do you appreciate the use of reflection of light by a concave mirror in making of TV antenna dishes?

A. TV antennas have signal receiving box on their concave part. The signals of desired channel get reflected by the concave surface and converges to the focal point. The signal receiving box is fixed at the focus of antenna. It receives signals and sends to the processing unit. So I appreciate this phenomenon, reflection of light by a concave mirror.

27. Have you ever observed the image of the sky in rain water pools on earth? Explain the reflection of light in this context. nagamurthy.weebly.com

A. The image of the sky reflected in the rain water pools on earth. The rays coming from the top of the object will reach the lower part in the pool. The image of the sky is inverted and the surface of water in the pool acts as mirror.

28. Discuss the merits and demerits of using mirrors in building elevation.

A. Merits of using mirrors**:**

(i) They can be cut into different sizes.

(ii) They do not rust.

(iii) They do not let water to pass through them.

Demerits of using mirrors**:**

(i) They can break easily.

(ii) Using mirrors is more expencive.

29. Why do we prefer a convex mirror as a rear-view mirror in the vehicles?

A. Convex mirrors always forms virtual, erect and diminished image of the object irrespective of the distance of the object. So It is used as rear view or side view mirror in vehicles, so that It enables the driver to see most of the traffic behind him/her.

30. A convex mirror with a radius of curvature of 3m is used as rear view in an automobile. If a bus is located at 5m from this mirror, find the position, nature and size of the image.

A. (for convex mirror u taken with negative sign)

Distance of the object (u) = -5m

Radius of curvature (R) = 3m

Focal length (f) = $\frac{R}{2} = \frac{3}{2}$ = 1.5m

Distance of the image (v) = ?

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

$$\frac{1}{v} = \frac{1}{f} - \frac{1}{u} = \frac{1}{1.5} - \frac{1}{-5} = \frac{2}{3} + \frac{1}{5} = \frac{10+3}{15} = \frac{13}{15}$$

$$v = \frac{15}{13} = 1.15 \text{ m}$$

Image formed behind the mirror and it is virtual, erect, diminished.

31. An object is placed at a distance of 10cm from a convex mirror of focal length 15cm. Find the position and nature of the image.

A. (for convex mirror u taken with negative sign)

Distance of the object (u) = -10cm

Focal length (f) = 15cm

Radius of curvature (R) = 2f = 30cm

Distance of the image (v) = ?

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

$$\frac{1}{v} = \frac{1}{f} - \frac{1}{u} = \frac{1}{15} - \frac{1}{-10} = \frac{10+15}{150} = \frac{25}{150}$$

$$v = \frac{150}{25} = 6\text{cm}$$

Image formed behind the mirror and it is virtual, erect, diminished.

NAGA MURTHY- 9441786635
Contact at : nagamurthysir@gmail.com
Visit at : nagamurthy.weebly.com