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Propagation and Reflection of Light

Q1. Define reflection of light. State the laws of reflection.

Ans: REFLECTION OF LIGHT:

When light is incident from one medium to another medium then whole or some part of light bounces back into the first this phenomenon is known as reflection of light.

The amount of light reflected depends upon the nature of light and the nature of reflecting medium. Light is well reflected from a smooth and glossy surface.

LAWS OF REFLECTION:

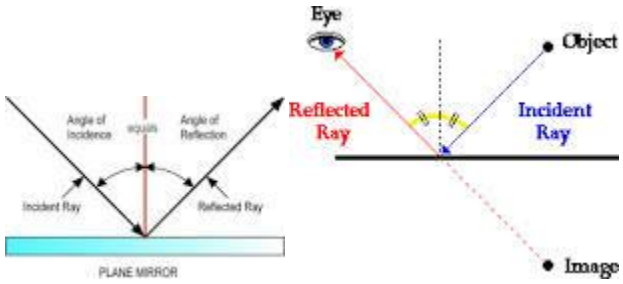
There are two laws of reflection:

1. The angle of incidence is mathematically, we can write.

Angle of incidence = Angle of reflection

$\angle i = \angle r$

2. This incident ray, the reflected ray and the normal all lie in the same plane.

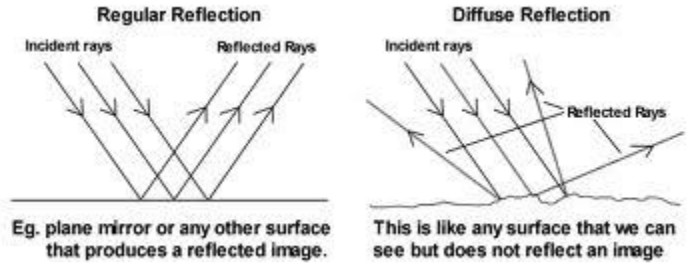


Q2. What is meant by regular and irregular reflection of light? Describe importance of irregular reflection in daily life. Or

Differentiate between regular and irregular reflection.

Ans:

REGULAR REFLECTION	IRREGULAR REFLECTION
1. Reflection of light from smooth, Polished surface is called regular reflection.	Reflection of light from a rough surface is Called irregular reflection.
2. If parallel rays of light fall on regular surface all rays are reflected in the same direction and same angle.	When parallel rays of light fall on irregular surface angle of incidence is not equal to the angle of reflection.



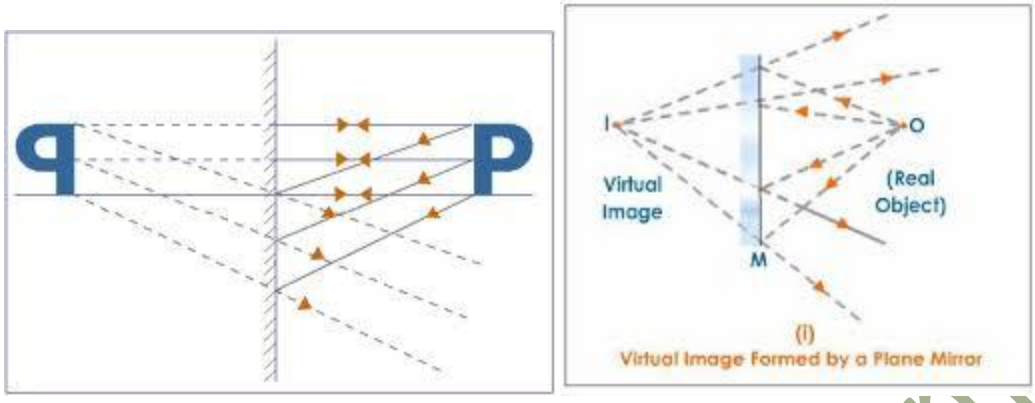
IMPORTANCE OF IRREGULAR REFLECTION:

Irregular reflection plays an important role in nature. It is due to this reflection that we can able to see the non-luminous objects when light strikes on them. Also dust and other panicles hanging in the atmosphere scatter sunlight in all directions and as such we get sufficient light in our rooms and other places where sunlight cannot reach directly. Its due to this fact that sunlight reaches us before sunrise and persists for some time even after the sunset.

Q3. Explain the formation of a image by a plane mirror.

Ans: IMAGE FORMED BY A PLANE MIRROR:

Consider an object 'O', placed in front of a plane mirror. The rays of object 'O' are reflected by the plane mirror M and enters our eye. The line which joins the image I and the object O makes an angle of 90^{o} with the surface of the mirror M. From the geometrical construction, the distance OM and IM are equal. Therefore, we feel that the light rays from I, but in fact they come from 'O' and reflected by the mirror. At the mirror surface we find that the angle of incidence is equal to the angle of reflection.



Observing the images formed by a plane mirror we note four main characteristics of the images which are following:

1. Images are found to be laterally inverted, that is the right side of the object appears as the left side of the image.
2. Images are found to be of the same size as that of the object.
3. The image formed is found to be virtual, that is, it cannot be obtained on a screen.
4. The image is as far behind the mirror as the object, is in front of the mirror.

Q4. What are spherical mirrors? Also define the following terms:

(a) Center of Curvature **(b) Radius of Curvature** **(c) Pole of Mirror**

(d) Principal Axis **(e) Principal Focus** **(f) Focal Length**

Ans: SPHERICAL MIRRORS:

A spherical mirror is a portion of the surface of a polished hollow, sphere.

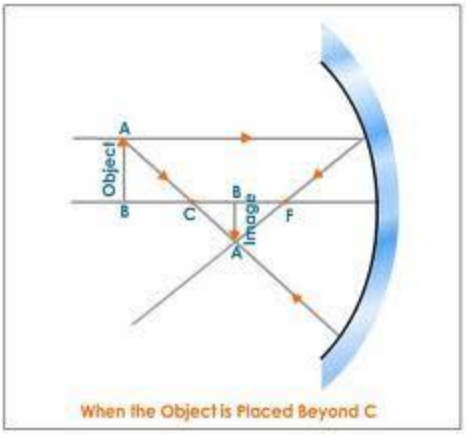
The spherical mirrors are of two types.

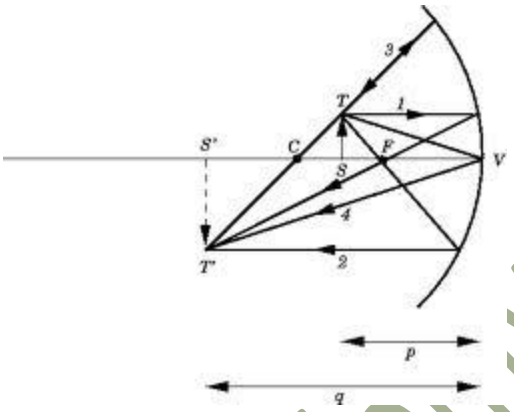
CONVEX MIRROR OR DIVERGING MIRROR:

The spherical mirror whose outer surface (convex shape) is made reflecting is known as convex mirror.

CONCAVE MIRROR OR CONVERGING MIRROR:

The spherical mirror whose inner surface (concave shape) is made reflecting is known as Concave mirror.





(a) CENTER OF CURVATURE:

The centre of that hollow glass sphere, whose part is the spherical mirror is known as center of curvature of mirror denoted by "C".

(b) RADIUS OF CURVATURE:

The radius of that hollow glass sphere whose part is the spherical mirror is known as radius of curvature of the mirror on diagram CM is the radius of sphere.

(c) POLE OF MIRROR:

The central point of the spherical mirror is known as pole of mirror.

(d) PRINCIPAL AXIS:

The straight line passing through the center of curvature and pole of the mirror is known as principal axis of spherical mirror.

(e) PRINCIPAL FOCUS:

When a beam of light parallel to the principal axis and reflect to the concave mirror it converges to a point on the principal axis. In the case of convex mirror when a beam of rays parallel to the principal axis and reflect to the convex mirror it appears to diverge from a point on the principal axis. This point is called the principal focus "F".

(f) FOCAL LENGTH:

The distance between principal focus F to P is called focal length. It is denoted by f.

Q5. Differentiate between real and virtual images?

Ans:

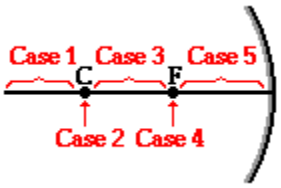
REAL IMAGE	VIRTUAL IMAGE
1.An image is said to be real if the rays of light actually pass through a point or converge a point.	A virtual image is only visible to eye and the reflected rays of light to come from one point or diverge one point.
2.The real image can be seen on screen	Virtual image cannot be seen on a screen.

3. The distance of real images and objects are taken as positive	Distances of virtual objects and images are take as negatives.

Q6. An object is moved from infinite distance towards pole concave mirror then illustrate the nature of image formed at different positions.

OR

Write the image location in a concave mirror with the diagram when the object is at:



i. **Object is at Infinity**
ii. **Beyond 'C'**
iii. **At 'C'**
iv. **Between 'F' and 'C'**
v. **At 'F'**
vi. **Between 'F' and 'P' or with in focal length.**

Ans:

1) OBJECT IS AT INFINITY

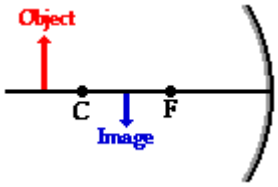
POSITION:

When an object is at infinity to the mirror then image is formed at principal focus 'F'

NATURE:

It is real and inverted,

Size: Image is extremely diminished



2) OBJECT BEYOND 'C'

POSITION:

When an object is placed beyond 'C' then image is formed between 'F' and 'C'.

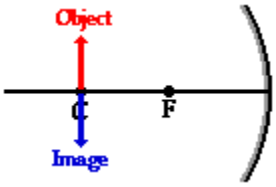
NATURE:

It is real and inverted.

SIZE:

Image is diminished.

3) OBJECT IS AT 'C'



POSITION:

When an object is at 'C' then image is formed at center of curvature.

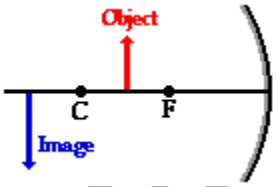
NATURE:

It is real and inverted.

SIZE:

Image is equal in size.

4) OBJECT LIES BETWEEN 'F' AND 'C'



POSITION:

When an object lies between 'F' and 'C'
then image is formed beyond 'C'.

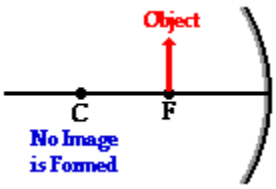
NATURE:

It is real and inverted

SIZE:

Image is magnified.

5) OBJECT IS AT 'F'



POSITION:

When an object is placed at principal focus
then its image is formed at infinity.

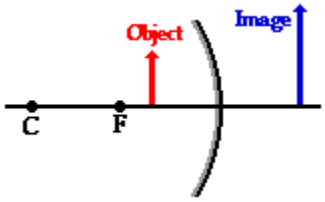
NATURE:

It is real and inverted.

SIZE:

Image is extremely magnified.

6) OBJECT IS PLACED BETWEEN 'F' AND 'C'



POSITION:

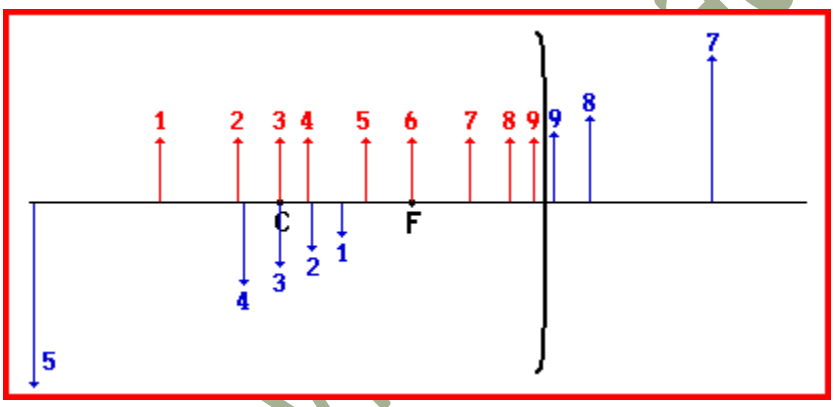
When an object is placed between 'F' and 'P'
then image is formed behind the mirror.

NATURE:

It is virtual and erected.

SIZE:

Image is magnified.



Q7. Derive mirror equation using concave mirror.

Ans: MIRROR FORMULA (EQUATION FOR SPHERICAL MIRROR)

Suppose an object "AB" is placed between 'F' and 'C' of the concave mirror. Two rays AP and AD are incident on the mirror. Ray AP is reflected with the same angle along the direction PA' obeying the law of reflection.

As ΔA'PB' and ΔAPB are similar.

$$\text{Therefore,} \frac{A'B'}{PB'} = \frac{AB}{PB}$$

$$, \frac{AB}{A'B'} = \frac{PB}{PP}$$

$$\text{Or} \quad \frac{h_o}{h_i} = \frac{p}{q}$$

Ray AD which passes through 'F' becomes parallel to the principal axis PB.

As ΔABF = ΔFPD

$$\frac{AB}{BF'} = \frac{DP}{F'P}$$

$$\frac{AB}{DP} = \frac{BF'}{F'P}$$

As AB = h_o, DP = A'B' and A'B' = h_i , F'P = f and BF' = p – f

But as ho / hi = p' - q / f …….(2)

From equation (1)

$$\frac{ho}{hi} = \frac{p}{q}$$

$$\frac{p}{q} = \frac{p - f}{f}$$

dividing both sides by 'p'

$$\frac{p}{pq} = \frac{p - f}{fp}$$

$$\frac{p}{pq} = \frac{p}{fp} - \frac{f}{fp}$$

$$\frac{1}{q} = \frac{1}{f} - \frac{1}{p}$$

$$\frac{1}{f} - \frac{1}{p} = \frac{1}{q}$$

This equation is known as mirror equation

Q8. How a concave mirror is used on head lights and search lights to throw light at a Long distance.

Ans: In head lights and in search lights the electric lamp is placed at the focal point of concave mirror. So that light rays become parallel after reflection from concave mirror. so that these do not scatter and reach at large distance.

Q9. Give some uses of spherical mirrors?

Ans: There are some important uses of spherical mirrors.

i. A concave mirror is used in micro scope to illuminates the object.

ii. They are used in objectives of telescopes.

iii. These mirrors are used by the doctors to examine eyes, throat, and noses of patients.

iv. The spherical mirrors are uses in head lights of automobiles.

v. These are also used in shaving mirrors.

Q10. Describe structure and working formula.

Ans: STRUCTURE:

It consists of a rectangular box, a very small hole on one side and frosted glass plate, tracing paper or photographic film on the opposite side.

WORKING:

A narrow pencil of rays staring from point A passes through the pinhole 'O" and illuminates a small area at 'A'. Similarly a narrow pencil of rays starting from 'C' illuminates a small area at 'C'. In this way points lying between A and C illuminate corresponding points between 'A' and 'C' and a real and inverted image A'C' of the object AC is formed on the back of the camera.