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Subject: Physics

Class: X **Topic: Reflection** **Chapter: 10**

REFLECTION

Reflection of Light: The phenomenon of bouncing back of light into the same medium by the smooth surface is called reflection.

Incident light: Light which falls on the surface is called incident light.

Reflected light: Light which goes back after reflection is called reflected light.

The angle of incidence: The angle between the incident ray and the normal.

An angle of reflection: The angle between the reflected ray and the normal.

Mirror: The surface which can reflect the light is a mirror.

Plane Mirror: If the reflecting surface is a plane then the mirror is plane.

Spherical Mirror: If the reflecting surface is part of the hollow sphere then the mirror is a spherical mirror.

The spherical mirror is of two types:

• **Convex mirror:** In this mirror reflecting surface is convex. It diverges the light so it is also called a diverging mirror.

• **Concave mirror:** In this mirror reflecting surface is concave. It converges the light so it is also called converging mirror.

Parameters of Mirror:

Center of Curvature: The centre of hollow sphere of which mirror is a part.

The radius of curvature: The radius of hollow sphere of which mirror is a part.

Pole: The centre of mirror (middle point) is pole.

Principal axis: The line joining the pole and center of curvature is called principal axis.

Aperture: Size of mirror is called aperture of mirror.

Principal Focus: The point on the principal axis, where all the incident rays parallel to principal axis converge or diverge after reflection through mirror.

Focal Length: The distance between pole and focus point is focal length.

Special Rays for Formation of Image:

• A ray of light which is parallel to the principal axis of a spherical mirror, after reflection converges or diverges from focus.

• A ray of light passing through or appearing from the center of curvature of spherical mirror is reflected back along the same path.

• A ray of light passing through or appearing from the focus of spherical mirror becomes parallel to the principal axis.

• A ray of light which is incident at the pole of a spherical mirror is reflected back making same angle with principal axis.

Use of Concave Mirror:

It is used as a makeup mirror, the reflector in torches, in headlights of cars and searchlights, doctor's head-mirrors, solar furnace, etc.

Sign Conventions of Spherical Mirror

• All the distances are measured from the pole of the mirror as the origin.

• Distances measured in the direction of incident rays are taken as positive.

• Distances measured opposite to the direction of incident rays are taken as negative.

• Distances measured upward and perpendicular to the principal axis are taken as positive.

• Distances measured downward and perpendicular to the principal axis are taken as negative.

Mirror Formula:

1/f=1/v+1/u …

where f, v and u are focal length, image distance, object distance.

Linear Magnification:

This is the ratio of the height of the image to the height of the object.

m=h‘/h …where m = magnification, h = height of image, h’ = height of object

Use of Convex Mirror:

Convex mirror used as rear view mirror in vehicles, as shop security mirrors, etc.

Ray diagrams:

To draw these diagrams, we will have to recall the two rules of reflection for concave mirrors:

• Any incident ray traveling parallel to the principal axis on the way to the mirror will pass through the focal point upon reflection.

• Any incident ray passing through the focal point on the way to the mirror will travel parallel to the principal axis upon reflection.

Step-by-Step Method for Drawing Ray Diagrams

The method for drawing ray diagrams for concave mirror is described below. The method is applied to the task of drawing a ray diagram for an object located beyond the center of curvature (C) of a concave mirror. Yet the same method works for drawing a ray diagram for any object location.

1. Pick a point on the top of the object and draw two incident rays traveling towards the mirror.

Using a straight edge, accurately draw one ray so that it passes exactly through the focal point on the way to the mirror. Draw the second ray such that it travels exactly parallel to the principal axis. Place arrowheads upon the rays to indicate their direction of travel.

2. Once these incident rays strike the mirror, reflect them according to the two rules of reflection for concave mirrors.

The ray that passes through the focal point on the way to the mirror will reflect and travel parallel to the principal axis. Use a straight edge to accurately draw its path. The ray that traveled parallel to the principal axis on the way to the mirror will reflect and travel through the focal point. Place arrowheads upon the rays to indicate their direction of travel. Extend the rays past their point of intersection.

3. Mark the image of the top of the object.

The image point of the top of the object is the point where the two reflected rays intersect. If your were to draw a third pair of incident and reflected rays, then the third reflected ray would also pass through this point. This is merely the point where all light from the top of the object would intersect upon reflecting off the mirror. Of course, the rest of the object has an image as well and it can be found by applying the same three steps to another chosen point. (See note below.)

4. Repeat the process for the bottom of the object.

The goal of a ray diagram is to determine the location, size, orientation, and type of image that is formed by the concave mirror. Typically, this requires determining where the image of the upper and lower extreme of the object is located and then tracing the entire image. After completing the first three steps, only the image location of the top extreme of the object has been found. Thus, the process must be repeated for the point on the bottom of the object. If the bottom of the object lies upon the principal axis (as it does in this example), then the image of this point will also lie upon the principal axis and be the same distance from the mirror as the image of the top of the object. At this point the entire image can be filled in.