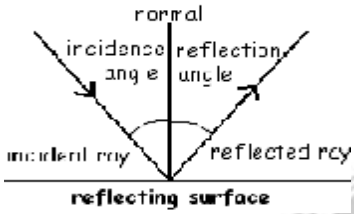
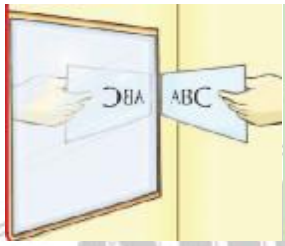
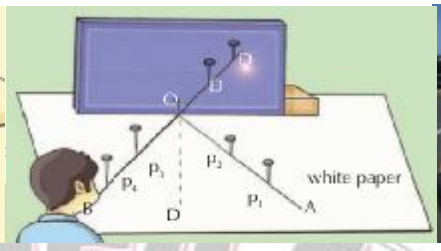
Unit Two: Light Energy

Lesson 1: Mirrors

1. Plane mirror:







Light reflection: It is rebounding (bouncing) light ray in same direction when meeting reflecting surface.

The incident ray: The light ray falls on the reflecting surface.

The reflected ray: The light ray bounces from the reflecting surface.

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

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

-Laws of light reflection:

1st law: the angle of incidence = the angle of reflection.

2nd law: The incident light ray, the reflected ray and the norm to the reflecting surface lie in the same plane.

The properties of an image formed by a plane mirror:

1. Upright.
2. Reversed (lateral inverted).
3. Equal in size to the object.
4. Virtual (can't be received on a screen).
5. The distance between the object & the mirror = the distance between the image & the mirror.

- (G.R): The word «ambulance» is writing laterally inverted. Bec. Mirror forms lateral inverted image So, driver can see word corrected.

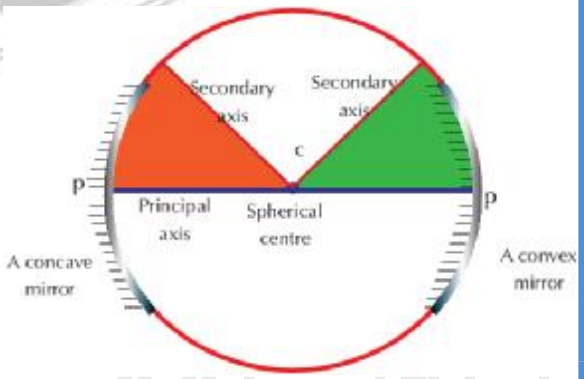
2. Types of spherical mirrors

The concave (converging) mirror:

The reflecting surface is the inner surface of the sphere.

The convex (diverging) mirror:

The reflecting surface is the outer surface of the sphere.



Definitions:

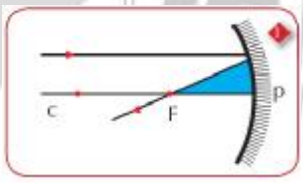
1. **Centre of curvature(C):**
   The center of the sphere that the mirror is a part of it.
2. **Radius of curvature:**
   The radius of the sphere that the mirror is a part of it.
3. **The pole (P):**
   The point in the middle of the reflecting surface of the mirror.
4. **The principle axis (CP):**
   The straight line that passes through the center of curvature (C) and the pole (P).
5. **The secondary axis:**
   The line that passes through the center of curvature (C) and any point on the surface of the mirror except the pole (P).
6. **The focus (F):**
   The point of collection (intersection) of the reflected rays (when these rays fall parallel to the principle axis).
7. **The focal length (FP):**
   The distance between the focus & the pole.
   The focal length = ½ the radius of the curvature

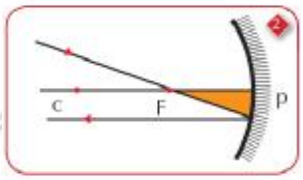
- **To study the cases of the formation of the images by the spherical mirrors, we will use three rules for light rays meeting concave mirror:**

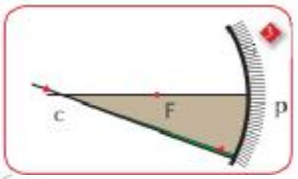
1- The light ray parallel to the principal axis of the mirror. This is reflected through Focus (f).

2- The light ray through focus (F) will reflect parallel to the principal axis.

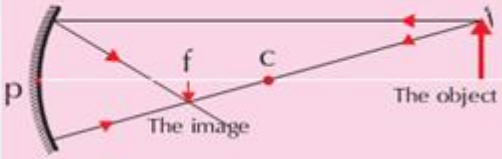
3- The light ray through centre of curvature of the mirror (c). This is reflected back through (c).

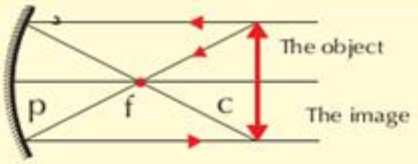
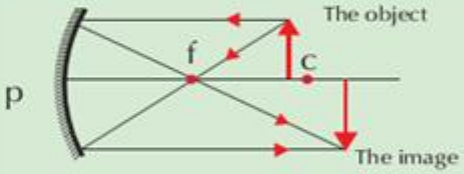
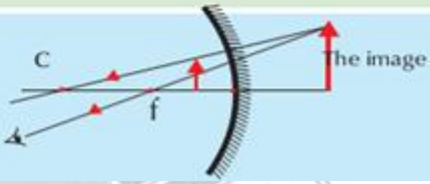






The path of light reflected from a spherical mirror

Position of the object	Position of the images	Characteristics of the images	The cases of image formation
At a distance larger than the radius of curvature.	Between the focus and the centre of curvature	Real – inverted – small in the object	

At the centre of curvature of the mirror.	At the centre of curvature of the mirror.	Real – inverted. Same size as object	
Between c and (f).	At a distance greater than the radius of curvature.	Real - inverted larger than object	
Between (f) and (p).	Behind the mirror	Virtual upright magnified	

Uses of concave mirror:

-Used in solar ovens to collect sun rays & generate heat that cook food without fuel.

Uses of convex mirrors:

-The real view mirror in the car & side view mirrors is convex mirrors (G.R).

-To expand the visibility because it formed virtual, small & erect image.

Determine half the radius of the concave mirror.

The materials:

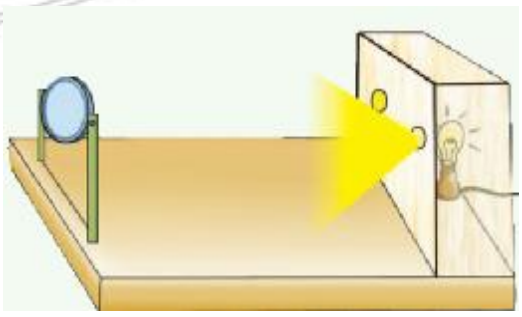
A concave mirror – a holder for the mirror – light box with a hole.

The steps:

1- Place the mirror on a holder in front of the light source (lit hole).

2- Move the mirror nearer and farther until an image of the hole is formed next to it and is equal to it.

3- Measure the distance between the mirror and the hole, it is equal to the radius of curvature of the mirror.



Deduce:

The focal length of the mirror (f) = R/2

Home Work

I) Write the scientific term:

1. The rebounding of light to the same side when it strikes a reflecting surface.
2. The angle between the incident light ray and the perpendicular line on the reflecting surface. [.....]
3. Angle of incidence = Angle of reflection. [.....]
4. The point of collection of parallel light rays to the principal axis of the concave mirror. [.....]
5. Twice the focal length of a spherical mirror. [.....]

II) Put (√) or (×) and correct the false ones:

1. The distance between the object and a plane mirror is more than the distance between the plane mirror and the image. ( )
2. When the angle between the incident ray and the plane mirror surface is 60º, so the angle of reflection is 50º. ( )
3. The formed image for a body put in front of a convex mirror is virtual, inverted and small. ( )
4. A spherical mirror of diameter equals 14 cm, its focal length is 6 cm. ( )
5. The focus is the point that is in the middle of the reflective surface of the mirror. ( )

III) Give reasons for:

1. Concave mirror is used in cooking by using solar energy.

2. A convex mirror is put at the left side of the driver of a car.

3. The incident light ray falling perpendicular on a reflecting surface reflects on itself.

4. The word AMBULANCE is written in a converted way on the ambulance car.

IV) Show by drawing the path, the direction of rays and properties of image in the following cases:

• An object in front of a concave mirror at a distance less than its focal length.

• The image that is formed by the convex mirror.

• An object in front of a concave mirror at a distance equal to its focal length.

• An object in front of a concave mirror at a distance of 7 cm. Knowing that its focal length is 5 cm.

V) An object is put at a distance 20 cm from a mirror the image is formed on a screen and has a length equal to the object.

(1) What is the type of the mirror?

.....

(2) Calculate the focal length of the mirror.

.....

(3) Draw the path rays that show the formation of this image.

.....

.....

Lesson 2: Lenses

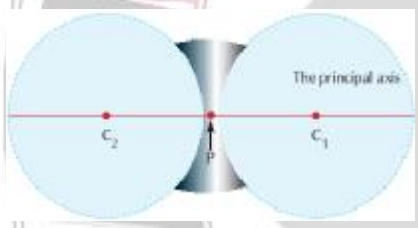
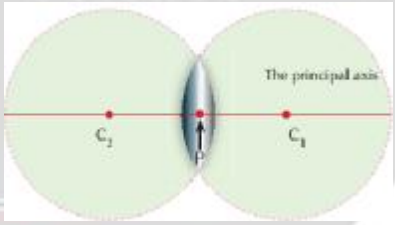
v *Lens:*

It is a transparent medium (glass or plastic) which has two spherical surfaces (faces) or (consists of two mirrors) and refract light.

v *The uses of lenses:*

a. medical eyeglasses.
b. magnifying lenses are used to fix watches.
c. In telescope that study planets.
d. In microscopes.

v *Types of lenses:*

Concave lens	Convex lens
1. It is thin at its centre and more thickness at the tips. 2. Diverges (scatters) light rays. 3. It has a virtual focus.	1. It is thick at the centre and less thickness at the tips. 2. Converges (collects) light rays. 3. It has a real focus.
 	 

- *Definitions:*

1. The centre of curvature of the lens face (c): Is the centre of the sphere where this face is a part of it.

2. The optical centre of the lens (p): Is a point inside the lens placed on the principal axis in the mid distance between its faces.

3. The radius of curvature of the face of the lens (r): Is the radius of the sphere where the face is a part of it.

4. The principal axis: Is the line between the centers of curvature of the lens passing by the optical center.

5. Real Focus (f): Is the intersection of refracted light rays. f = r/2

6. Virtual Focus (f): Is the intersection of extension of refracted light rays.

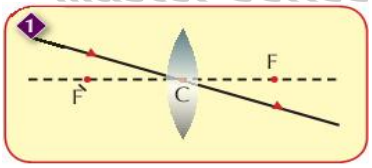
7. Focal length (FP): Is the distance between focus and optical center.

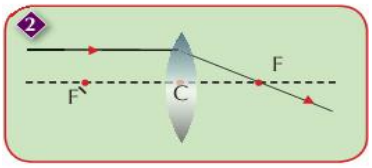
The cases of the formation of the images by the convex lens (collective):

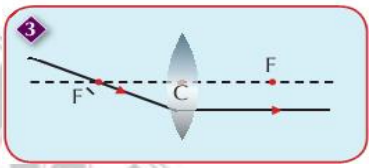
1. If ray falls by optical center thus complete in its direction without any refraction.

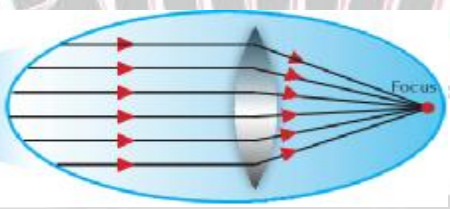
2. If ray falls parallel to the principal axis thus refracts passing through the focus.

3. If ray falls by the focus thus refracts parallel to the principal axis.



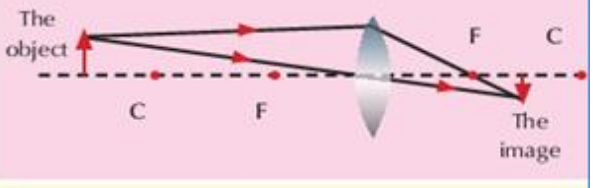
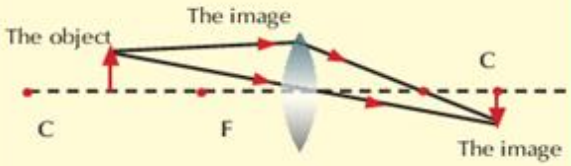
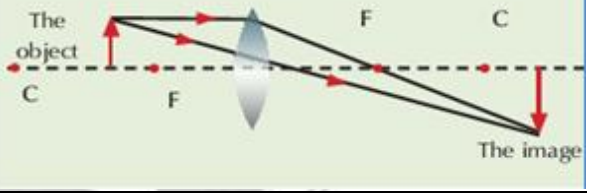
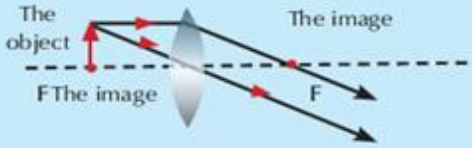
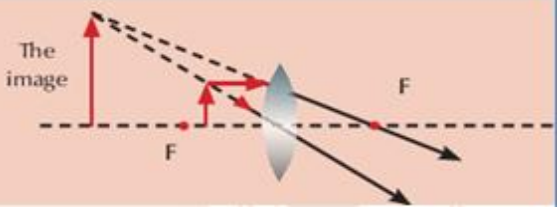




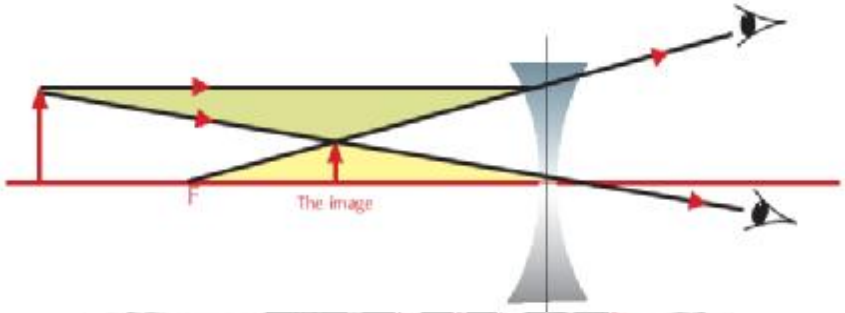


$r = 2f$

The images formed by the convex lens:

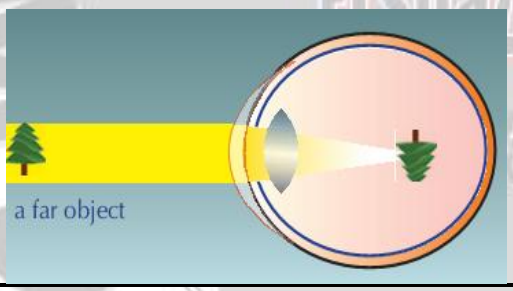
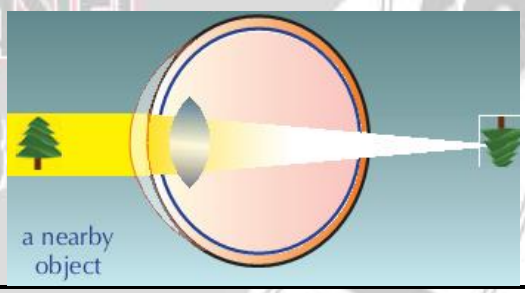
Position of the body	Position of the image	Characteristics of the image	Case of image formation
More than twice the focal length	Between the focus and twice the focal length	Real, inverted, and smaller the object	
At twice the focal length	At twice the focal length	Real, inverted and equal to the object	
Between the focus and twice the focal length	At a distance larger than twice the focal length	Real, inverted and enlarged	
At the focus	No image is formed	No image is formed	
At a distance smaller than the focal length	Forms in front of the lens at the object side	Virtual, upright and enlarged	

The image formed by a concave lens is always: virtual, small & erect.



v *Vision Defects:*

The person with normal vision sees the far object clearly (the far object according the normal eye is present at 6m). This clear vision remains if the object comes closer not less than 25 cm.

Short sightedness	*Long sightedness*
1. The Person can see near objects clearly and far objects seem distorted.	*The person can see far objects clearly and can't see near objects.*
2. The image of far objects is formed in front of the retina. 	*The image of near objects is formed behind the retina.* 
3. What causes it? *a. The diameter of the eyeball is too long.* *b. The eye lens more convex.* *c. Decreasing the focal length.*	*What causes it?* *a. The diameter of the eyeball is too short.* *d. The eye lens less convex.* *b. Increasing the focal length.*
4. It is treated (corrected) by using Concave lens (diverging lens).	*It is treated (corrected) by using convex lens.*

Contact lens: It is very thin lenses made of plastic, and can stick to the eye cornea by the eye fluid instead of medical glasses.

Technology of Unit (2)

1- Land measurement:

Land surveyors and topographical scientists use a mirror to determine heights and distances and to make very accurate measurements.

2- **According to the old Greek legend that** Archimedes knew a lot about mirrors and the use of sunlight as a weapon against the Roman fleet in 212 B.C. he used a huge concave mirror to collect the sun rays and directed towards the sails of ships so as to generate extreme heat that led to the burning of these sails.

3- Cataract:

Is one of the most dangerous diseases that injure the eye lens and becomes dark as a result of old age, illness, and side effects of drugs in addition to genetic readiness.
Treatment is done through surgery to exchange the eye lens with a plastic lens.

Home Work

I) Complete the following statements:

1. A point inside the lens placed on the principal axis in the mid distance between its faces is .....
2. The radius of the convex lens = ... Its focal length.
3. The long sighted person needs a medical eye glasses with .....Lenses .
4. The optical piece that forms an equal, inverted image of the body is the.....

II) Write the scientific term:

1. The line joining between the two centers of curvature of the lens and passing through the optical center.
2. A vision defect results due to the formation of the image in front of retina.
3. The lenses that are used instead of glasses and can stick to the eye cornea.
4. A disease infects the eye lens, so it becomes dark.

III) Give reasons for:

1. The convex lens has two foci, but the concave mirror has one focus.

.....

2. The short – sightedness is treated by using a concave lens.

.....

3. It's impossible to obtain a real image by using a concave lens.

.....

4. The convex lens is called converging lens while the concave lens is called diverging lens.

.....

IV) What happens when?

1. A light ray is incident parallel to the principal axis of the convex lens.

.....

2. The eye lens is too convex.

.....

3. A light ray passes through the optical center of the lens.

.....

V) Define each of the following:

1. The lens.
2. The center of curvature of the lens face.
3. Short sight defect.

VI) Problems:

1. A concave lens has a focal length equals 3 cm. An object is placed at a distance of 4 cm. From the lens, determine the position of the formed image and its properties by drawing the light rays.

2. A convex lens. Its focal length equals 5 cm. An object is placed at a distance 7 cm from the lens, Determine the position of the formed image and its properties by drawing only two light rays.

3. Mention the position and properties of the image formed of an object is put at a distance less than the focal length.

4. A convex lens with focal length of 20 cm an object was placed at a distance of 40 cm from the lens. Assign the distance of object's image from the lens and mention its properties.