

PHYSICS GRADE 10

UNIT 6 SUMMARY

Electromagnetic waves and geometrical optics

6.1 Electromagnetic waves

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Types of waves

There are two types of waves:-

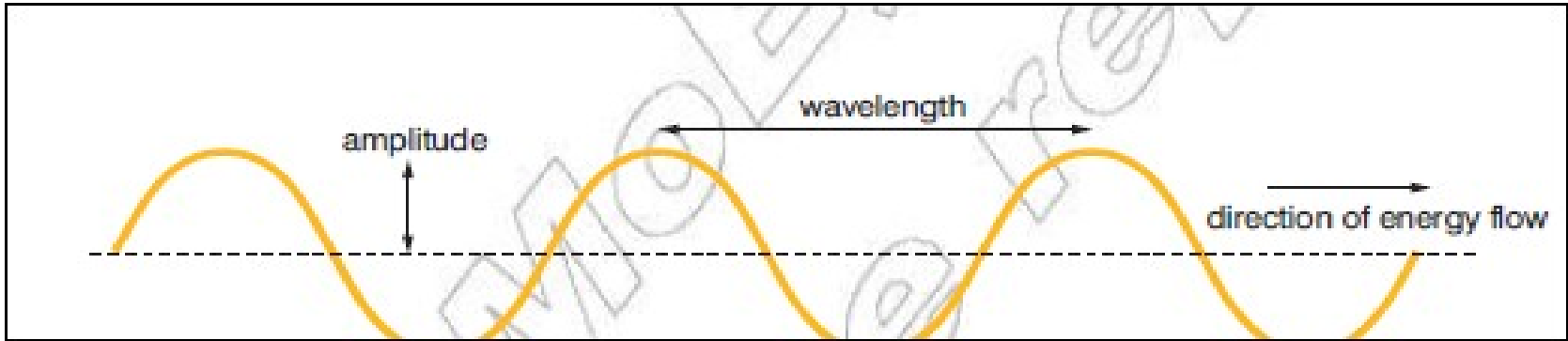
- Transverse wave and
- Longitudinal waves
- ❖ In transverse wave , the vibrations are at right angle to the direction of movement.

- Mechanical waves travel through some medium (material) with time. They have frequency , period ,wavelength and amplitude. Mechanical wave transport energy and not material.

Electromagnetic wave

- It comes electric current and magnetic field
- It produce when magnetic field and electric field are at right angle to each other.
- they carry energy and momentum.
- It is transverse waves
- Do not medium through which it travel. They can travel through vacuum

Representing transverse wave



- Amplitude :- is the distance that the wave moves above or below the base line.
- Frequency of the wave is the number of the complete wave passing a given point in a second.
- Wavelength :- is the distance between successive equivalent point (usually taken as peak or trough).

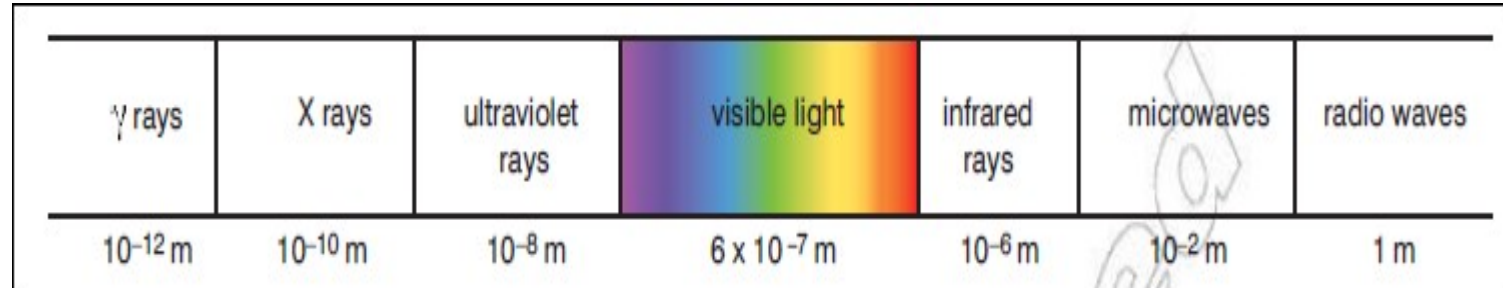
Relation between frequency, wave length and speed

The frequency, wavelength and speed of waves are related as:-

The frequency, wavelength and speed of waves are related as:-
 $v = \lambda f$, f = frequency (Hz) and λ = wave length(m) and v = speed
 v = wave length(m) and V = speed m/s

Electromagnetic waves emitted by the sun.

➤ The sun emit electromagnetic wave with a wide range of frequency and wave length. This referred to as electromagnetic spectrum. In vacuum electromagnetic waves travel at speed of 3×10^8 m/s. They have different properties and have different wave length.



Some use of electromagnetic waves

used for :-

- Visible light
 - X-ray which used to take picture in side the body to show any bone fracture
- Infrared radiation :- used for inferred cameras

6.2 Reflection of light

Rectilinear propagation of light

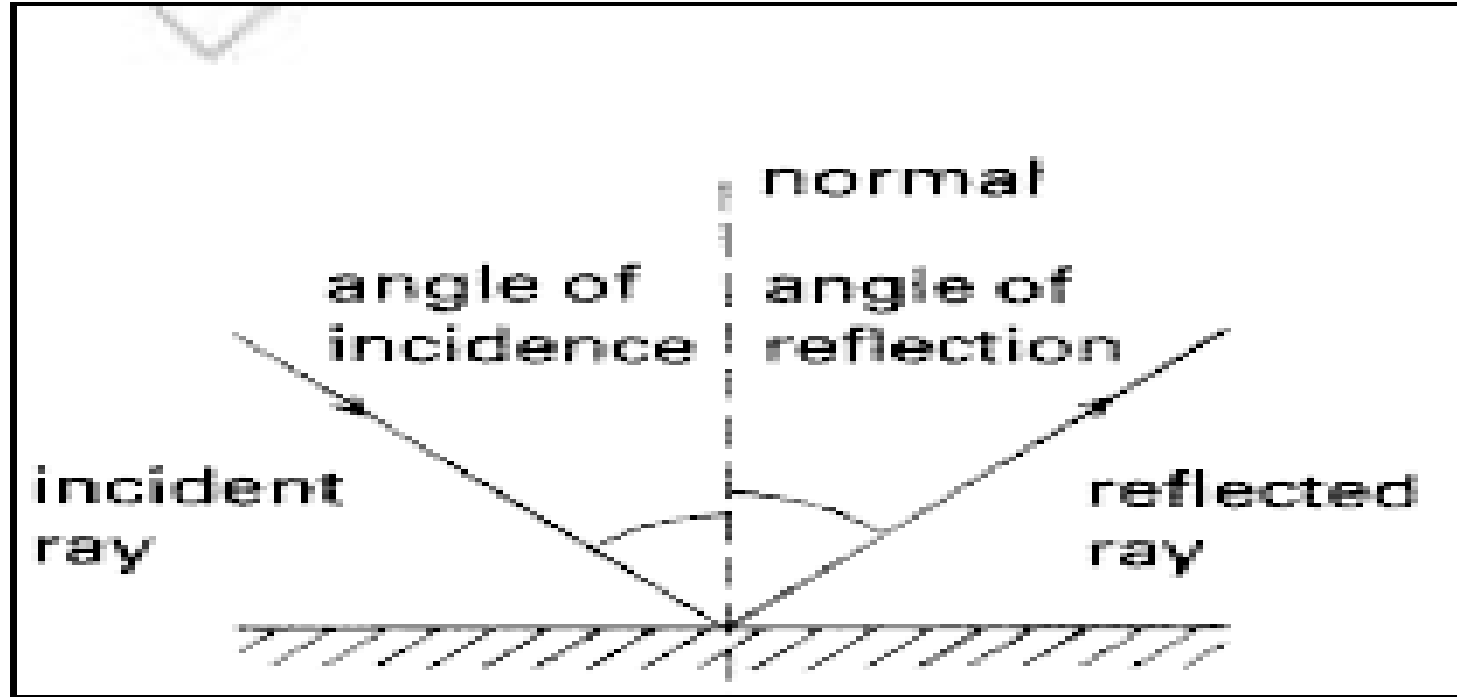
Rectilinear propagation of light simply means that light waves travel on straight line.

Law of reflection

Law of reflection states that :- When measured from the normal:-

- Angle of reflection is equal to angle of incidence ($\angle r = \angle i$)

- The reflected ray lies in the plane which contain the incidence ray and normal ray.



Concave mirror

Concave mirror is a mirror with a reflecting surface that bulges in ward , away from the light source. Using the law of reflection the image formed by the **plane mirror**

- Erected
- Virtual
- Laterally inverted
- The size as object

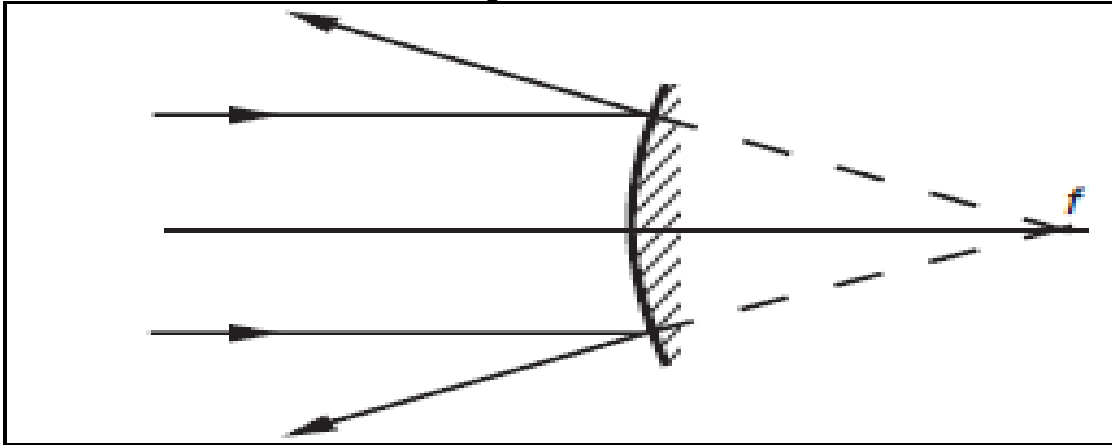
Concave mirror and magnification.

Concave mirror forms:-

- Virtual
- the image is larger than the object
- image formed is magnified

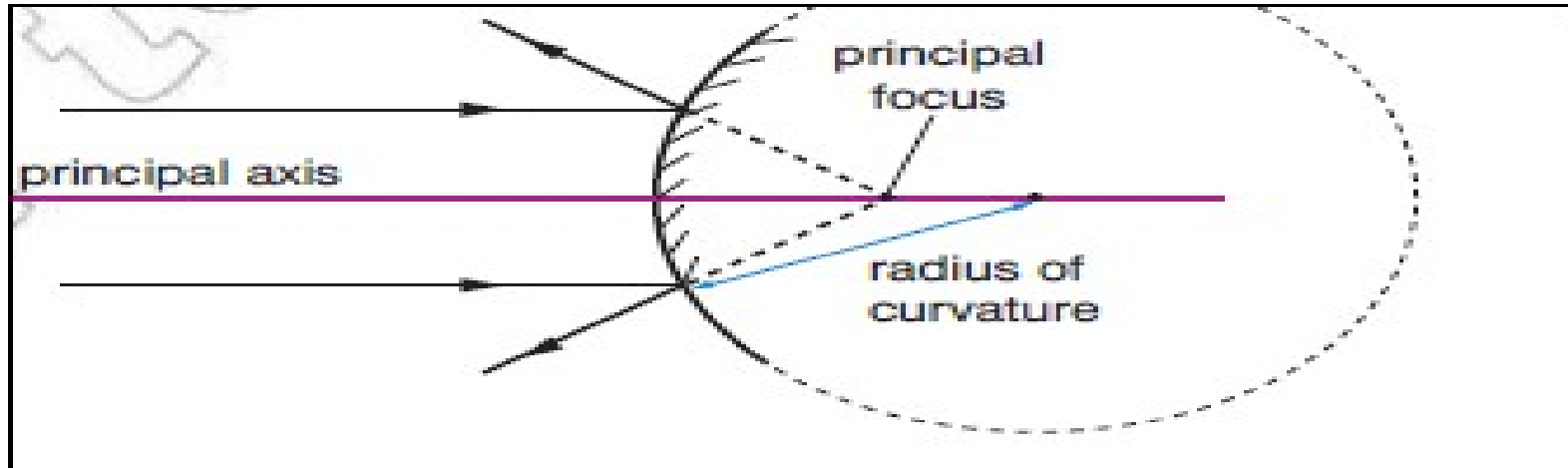
Convex mirror

- Convex mirror reflect the light as it spread out.
- convex mirror can not form a real image ,it form virtual which means short away behind it.



Terms used in concave and convex

- Principal axis :- is the line passing through the optical vertex and center of curvature of the face of curved mirror.
- Principal focus :- is the point at which all light reflecting from a curved mirror converges.
- Radius of curvature :- is the radius of the sphere that forms the



Distance between real and virtual image

- Real image is the image that can be captured on the screen.
- Virtual image is the image that can not be captured on the screen. Because the light actually pass through the point.
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Because the light actually pass through the point.

- If you know the focal length of converging (concave) mirror it is possible to do calculation.

f = focal length of the mirror.
➤ If you know the focal length of converging (concave) mirror it is possible to do calculation.

u = distance object
 v = distance image
 f = focal length of the mirror.

- If the image is virtual, then we can use a negative sign for distance image.

u_o = distance object

u_i = distance image.

$$\frac{1}{f} = \frac{1}{S_i} + \frac{1}{S_o}$$

Example:- A mirror has a focal length of 200mm (0.20m) . If an object is placed 0.60m from the mirror , where will the image is formed.

Solution :-

$$\frac{1}{f} = \frac{1}{S_i} + \frac{1}{S_o}$$

$$= \frac{1}{f} - \frac{1}{S_o}$$

= -

$$\frac{1}{S_i} = \frac{1}{0.20m} - \frac{1}{0.60m}$$

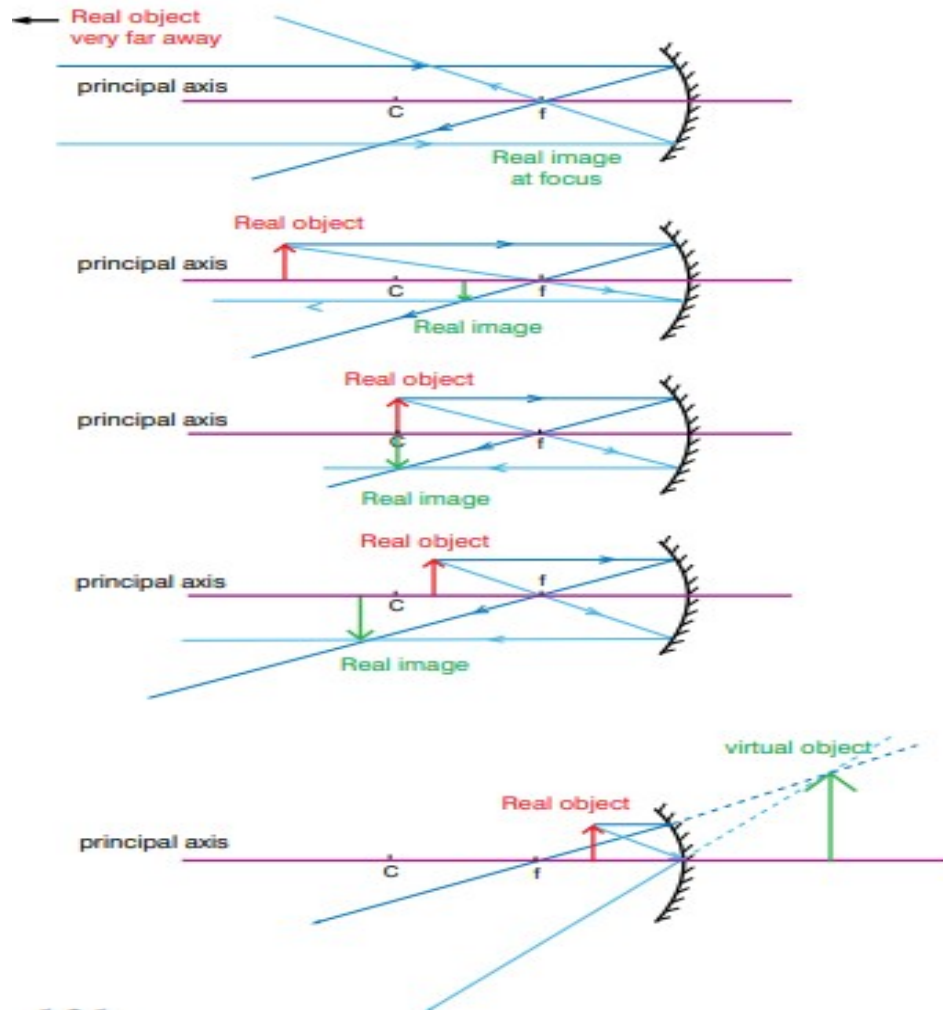
$$= 3.33m \text{ (30cm, 300mm)}.$$

Therefore , a screen would have placed 300mm back from the mirror.
Therefore , a screen would have placed 300mm back from the mirror.

Finding the position and nature of the image formed by concave and convex mirror using the mirror equation and ray tracing methode

- Figure below shows how we can find the position and nature if the image formed by concave mirror by using a ray tracing method.

Images formed by concave mirror



Example :- You stand 15cm away from a converging mirror of focal length of 20cm.

a. Work out the distance of the image.

b. Given :- $f = 20\text{cm}$, $s_o = 15\text{cm}$

Required :- $s_i = ?$

Solution

$$\frac{1}{s_i} = \frac{1}{f} - \frac{1}{s_o}$$

$$= \frac{1}{20\text{cm}} - \frac{1}{15\text{cm}}$$

=

$$= \frac{3-4}{60\text{cm}}$$

= -60cm

$$\frac{1}{s_i} = \frac{-1}{60\text{cm}} \quad (\text{there fore virtual image is formed})$$

$$s_i = -60\text{cm}$$

The magnification relation ship for mirror.

$$\text{Magnification (M)} = \frac{\text{the height of image (h}_i\text{)}}{\text{the height of object (h}_o\text{)}}$$

$$M = \frac{h_i}{h_o}$$

From the above example what is the magnification of an object.

~~Solution:-~~ From the above example what is the magnification of an object.

~~Solution:-~~ $h_i = 60\text{cm}$

$$M = \frac{h_i}{h_o} = \frac{60\text{cm}}{15\text{cm}} = 4$$

Table below summarize about curved mirror

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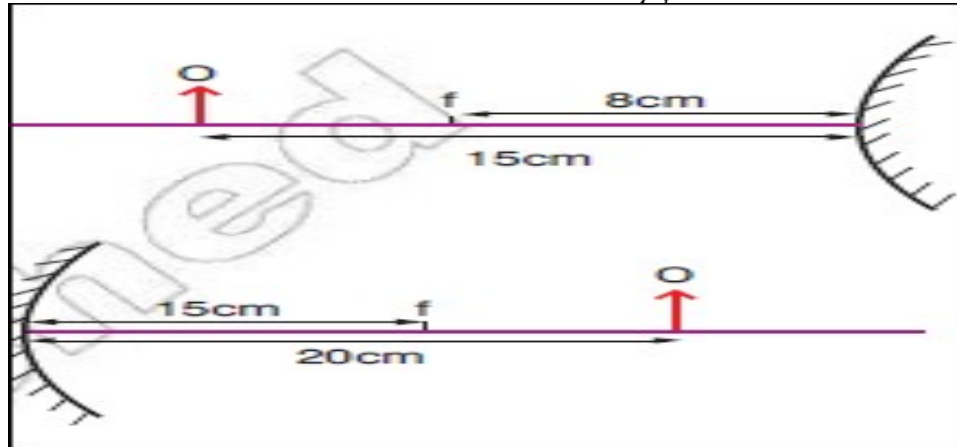
Quantity	Concave mirror	Convex mirror
Focal length f	+ve sign	-ve sign
Object distance s_o	In front of mirror +ve sign	Behind mirror -ve sign (virtual)
Image distance s_i	In front of mirror +ve sign (real)	Behind mirror (virtual)
Magnification m	Image upright +ve sign	Image inverted -ve sign

An object is 10cm from plane mirror. The angle of incidence on a plane mirror is 35° .

Draw the diagram to show the situation and work out

- the angle of reflection
- the position of the virtual image

Example 2:- Find the position and the nature of the image formed by the concave and convex mirror in figure below:



Answer sheet 1

Example 3:- An image formed on screen is three times the size of an object. The object and the screens are 80cm when the image is sharply focused.

a . What is the type and the focal length of the lens used ?

A candle of height 10cm is placed in front of concave mirror whose focal length is 25cm .

a. where the image is formed and what is its type