



Dr. Bbosa Science

Sponsored by
The Science Foundation College
Uganda East Africa
Senior one to senior six
+256 778 633 682, 753 802709
Based On, best for science

digitalteachers.co.ug



Nurture your dreams

S1 New Curriculum Physics

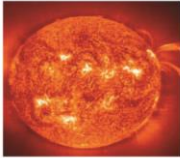
Theme: Light

Chapter 8 – Nature of light, reflection of light at plane surface

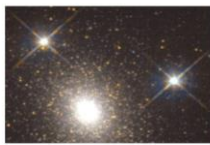
LIGHT is a form of energy that enables us to see. An object is seen only when light from the object enters the eyes.

Sources of light

Natural sources of light



Sun



Stars



Volcanos



Lightning



Fire fly

Artificial sources of light



Candle



Lit Bulb



Fire



Kerosene lamp

Objects like sun, star, lamp etc. that make their own light are called **luminous objects** while objects like moon that do not make their own light but reflect light from other sources to our eyes are called **nonluminous objects**.

Transmission of light

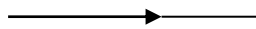
Light travels from its source to another place through vacuum or a medium.

The media of light include:

- (i) **Transparent Medium** is a substance that allows almost all the light to pass through it and objects are clearly seen through it. E.g. colourless water, paraffin, colourless glass.
- (ii) **Translucent medium** is one which allows some light to pass through it but objects are not clearly seen through it. E.g. cloudy liquid, frosted glass and oily paper.
- (iii) **Opaque medium** is one which does not allow light to pass through it at all.

Rays and beams

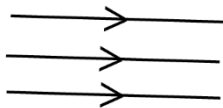
A **ray** is the direction of the path in which light travels. It is represented by a straight line with an arrow on it.



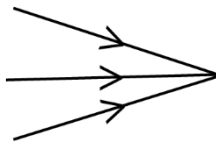
A **beam** is a collection of rays.

There are three kinds of beams:

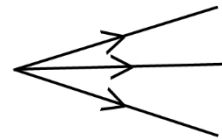
(i) **Parallel beam.** is a collection of rays which do not meet at all.



(a) Parallel beam



(b) Converging beam



(c) Diverging beam

(ii) **Convergent beam.**

Convergent beam is a collection of rays originating from different directions and ending up at the same point.

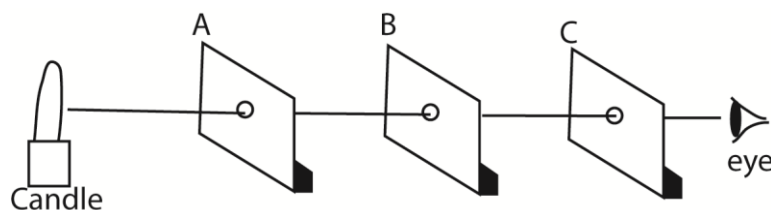
(iii) **Divergent beam** is a collection of rays which originate from one point and are spread out in different directions.

Rectilinear propagation of light

This is the property of light travelling in a straight-line when produced from a source. It is propagated (sent outward) and it travels in straight lines

Experiment to show that light travels in a straight line

Experiment I

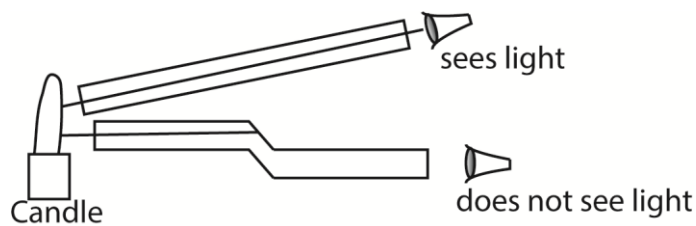


- (i) Equal square cards A,B and D are cut from piece of thick paper board each with a hole in the middle.
- (ii) When the card are arranged as shown above with their holes in a straight line light passes through and seen on the other end.
- (iii) If the middle card is displaced such that its hole is removed from the line, light is cut of from the other end

Conclusion: This shows that light travels in a straight line.

Experiment II

A candle light can be observed through a straight pipe but when the pipe is bent no light is seen



Experiment III

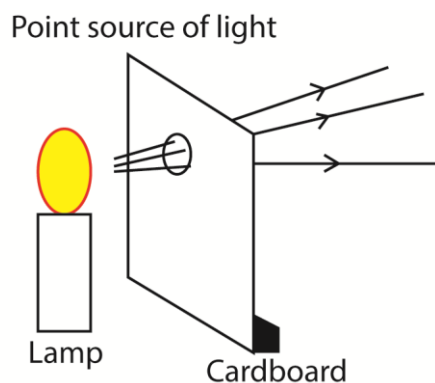
Formation of shadows and eclipses indicates that light travels in straight line.

Shadow

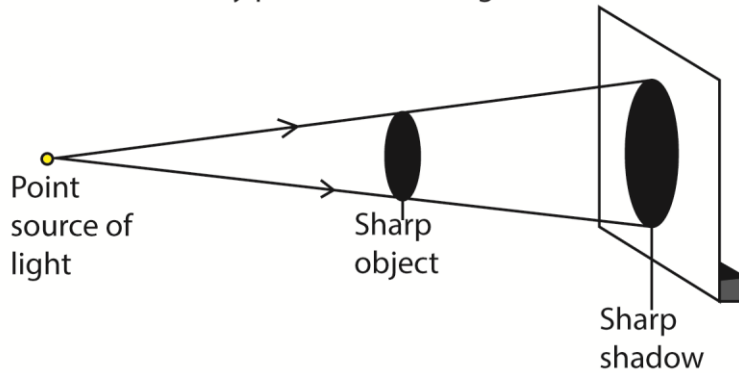
A shadow is formed when an object obstructs light. Shadows are formed because light travels in a straight line.

- (i) A Shadow is formed by a point source is equally sharp as shown below

A point source is a very small source of light. It can be obtained by placing a cardboard with a small hole in front of a lamp as shown.

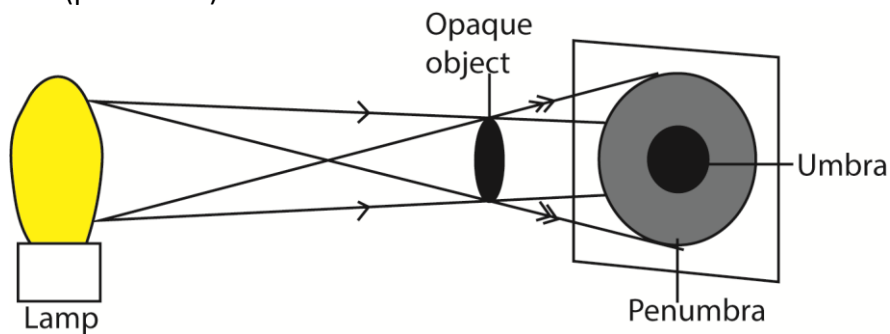


Shadow formed by point source of light



Note: For a point source, when the opaque object is moved near the source, the size of the shadow increases while when the object is moved near the screen, the size of the shadow decreases.

- (ii) A shadow produced by extended source of light has a dark patch (umbra) and a lighter outer patch (penumbra) as shown below



Umbra is a region of the shadow where no light reaches at all.

Penumbra is a region of the shadow where some light reaches.

Note that for an extended source, when the opaque object is moved near the source, then the size of the umbra decreases but the size of the penumbra increases. When the object is moved near the screen, the size of the umbra increases but the size of the penumbra decreases.

Eclipse

An eclipse occurs when the sun, moon and earth are in a straight line. There are three types of eclipses namely: solar, annular and lunar.

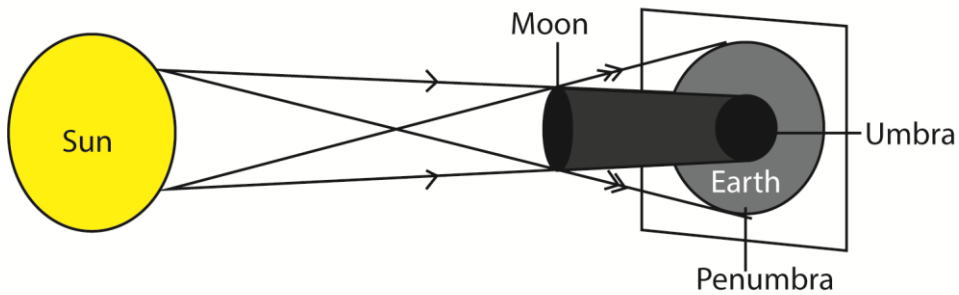
Solar eclipse

Solar eclipse also called eclipse of the sun occurs when the moon is between the sun and earth such that both umbra and penumbra reaches the earth.

The area on earth covered by the umbra has total eclipse and the sun cannot be seen at all.

The area covered by penumbra has partial eclipse and only part of the sun is seen.

Eclipse of the sun

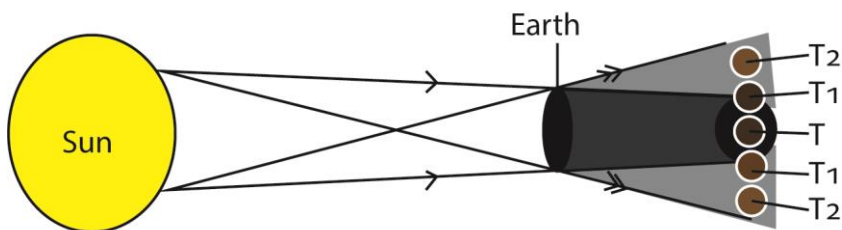


Lunar eclipse

Lunar eclipse is also called eclipse of the moon. Lunar occurs when the earth is between the sun and the moon.

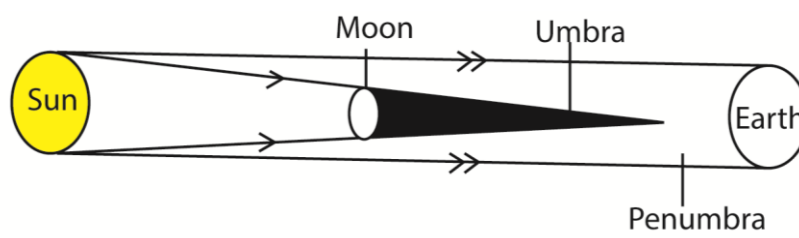
During the eclipse of the moon the earth's shadow is cast on the moon such that when the moon is at position "T," total eclipse occurs, in position "T₁" partial eclipse occurs and when the moon is in position "T₂" no eclipse occurs but the moon is less brighter than usual.

Eclipse of the moon



Annular eclipse

Annular eclipse of the sun occurs when the sun is very far from earth and the moon is between the earth and the sun such that umbra does not reach the earth but only penumbra reaches earth.



Note: Total eclipse of the moon lasts longer than total eclipse of the sun because for total eclipse of moon, the earth which is in the middle is larger than moon in the eclipse of the sun.

FLOURESCENCE AND PHOSPHORESCENCE

Fluorescence is a substance, which absorbs energy and immediately releases the energy in the form of light.

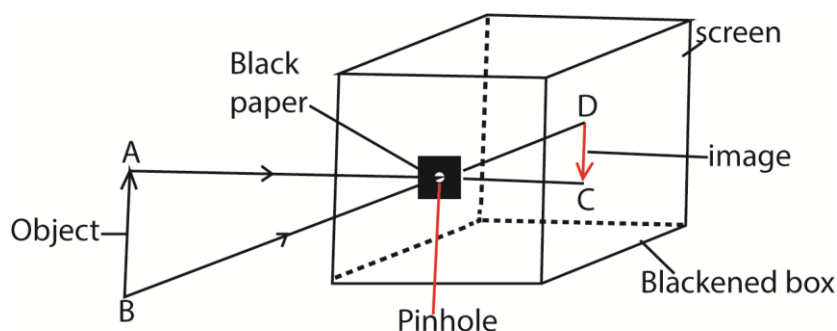
Example of such a substance is Zinc sulphide. The screen of a T.V and C.R.O are made of a fluorescent substance.

Phosphorescence is a substance which absorbs the energy falling on it, stores it, and when energy stops falling on it, it releases it in the form of light. An example of such a substance is calcium sulphide.

Pinhole camera

A pinhole camera works on the property of light travelling in a straight line.

A pinhole camera consists of a closed blackened box with a small hole on one face and a screen of tracing paper on the opposite face. The box of pinhole camera is blackened inside to prevent reflections inside the box.



Properties of images formed by pinhole camera

- (i) It is real i.e. it can be produced on the screen. It is formed by real rays of light reaching the screen.
- (ii) It is inverted

Factors affecting the properties of image formed by pinhole camera

- (i) When the distance between the object and the pin hole is reduced the image becomes bigger but less bright because the image is spread over a larger area and vice versa
- (ii) When the distance between the pin hole and screen is increase the image becomes bigger but becomes less bright because an image is spread over a bigger area. And vice versa

- (iii) When the pin hole is enlarged, the image becomes blurred but brighter because of too much light entering

Linear magnification

Linear magnification is the ratio of image size to object size.

Or: **Linear magnification** is the ratio of image distance to object distance.

$$\text{Magnification} = \frac{\text{magnification}}{\text{height of objects}} = \frac{CD}{AB}$$

$$\text{Magnification} = \frac{\text{distance of image from pinhole}}{\text{distance of object from pinhole}}$$

So larger magnification is obtained when the object is nearer the pin-hole and smaller magnification is produced when the object is farther away.

Example 1.

Calculate the height of a building 150m away from a pinhole camera which produces an image 5cm high if the distance between pin hole and screen is 10cm.

Object distance = 150m

Image height = 5cm = 0.05m

Image distance = 10cm = 0.1m

$$\text{Linear magnification} = \frac{\text{image height}}{\text{object height}} = \frac{\text{image distance}}{\text{object distance}}$$

$$= \frac{0.05}{h} = \frac{0.1}{150}$$

$$h=75\text{m}$$

Example 2

The length of a pin-hole camera is 25cm. An object 2m height is placed 10m from the pin-hole. Calculate the height of the image produced and its magnification.

Solution

Image distance = 25cm = 0.25m

Object height = 2m

Object distance = 10m

$$\text{Linear magnification} = \frac{\text{image height}}{\text{object height}} = \frac{\text{image distance}}{\text{object distance}}$$

$$= \frac{\text{image height}}{2} = \frac{0.25}{10}$$

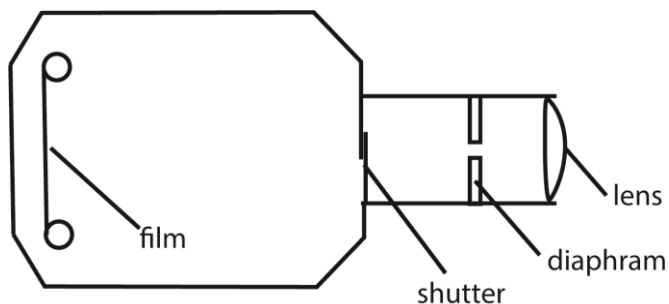
$$\text{Image height} = \frac{0.25}{10} \times 2$$

= 0.05m = 5cm

$$\text{Linear magnification} = \frac{\text{image distance}}{\text{object distance}} = \frac{0.25}{10}$$

= 0.025

Lens camera



- The lens focused light from the object on to film
- The diaphragm controls the amount of light reaching the film
- The shutter controls the exposure time of light reaching the film

Differences between a pinhole camera and a lens camera

- in a pinhole camera the image is always focused while in a lens camera the image is brought to focus by adjusting the position of the lens.
- In pinhole camera the intensity of light entering is fixed while in a lens camera the intensity of light entering is controlled by a shutter or diaphragm.
- In a pinhole camera the image distance is fixed while in a lens camera the image distance is not fixed.

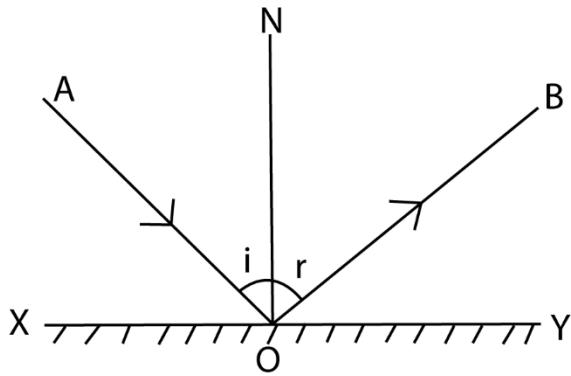
Differences between the lens of a camera and eye

- The distance between the lens and retina is fixed while that between the lens and film in camera is variable
- The focal length of the eye's lens is variable while that of a camera is fixed
- Eye lens is living while the camera lens is artificial

Reflection of light

Reflection is the process by which light energy falling on a body or surface bounces off. The surface from which reflection occurs is called the reflecting surface.

Types of rays



Incident ray (AO) is a ray of light from source of light falling on to the reflecting surface.

Reflected ray (OB) is a ray of light which has been bounced off from the reflecting surface.

Normal (ON) is one which at 90° with the reflecting surface. So this is incident and reflected along the same path

Angle of reflection (r) is the angle made by the reflected ray with the normal at the point of incidence on the reflecting surface.

Angle of Incidence (i) is the angle made by the incident ray with the normal at of incidence on the reflecting surface.

The laws of reflection

First of law of reflection states that the incident ray, the reflected ray and the normal at the point of incidence all lie in the same plane.

Second law of reflection states that the angle of incidence is equal to angle of reflection.

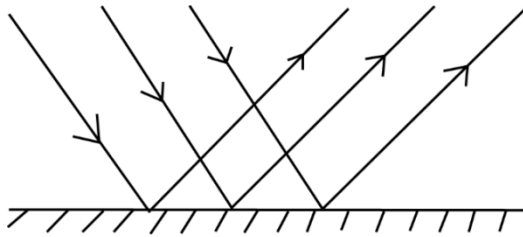
Types of reflection

There are two types of reflection namely:

- Regular reflection.
- Irregular reflection.

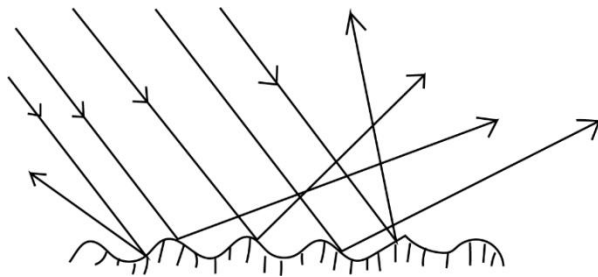
Regular reflection

Regular reflection occurs when a parallel incident beam strikes a smooth reflecting surface and a parallel reflected beam is obtained. Example of smooth plane surface is a plane mirror.



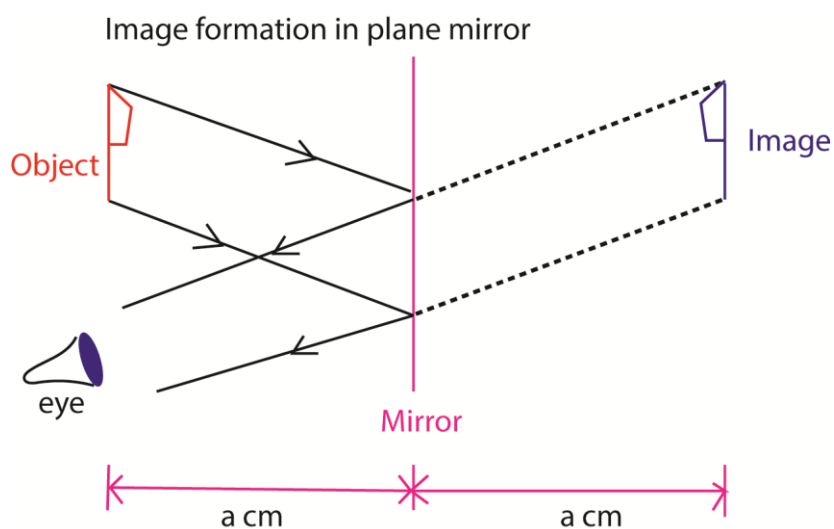
Irregular or diffused reflection

Diffuse reflection occurs when a parallel incident beam strikes a rough surface and a scattered reflected beam is obtained.



The images formed by a plane mirror

An image in a plane mirror is formed by reflection of light as shown below



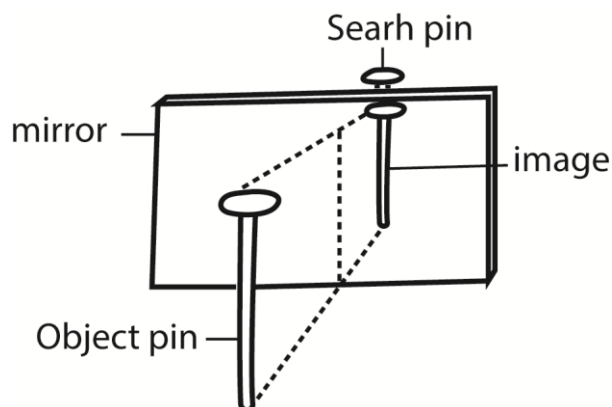
Properties of image formed by a plane mirror

- (i) It is **virtual**, i.e. it cannot be produced on the screen and is formed by imaginary rays.
- (ii) It is **Lateral inverted**, i.e., the right of the object is the left of the image and the left of the object is the right of the image
- (iii) Same size as the object
- (iv) Same distance from the mirror as the object
- (v) It is erect

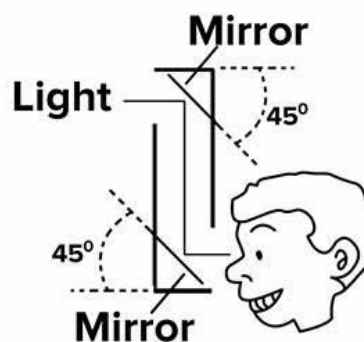
Note: The linear magnification produced by a plane mirror is **1** since Image distance from the mirror is equal to object distance from the mirror. And the image size is equal to the object size.

Formation of image by no parallax in plane mirror

1. Obtain a sheet of paper and draw a mirror line.
2. Place the mirror on the line as shown.
3. Place the pin at least 5 cm from the mirror and obtain another pin (search pin)
4. Move the search pin behind the mirror to locate the position of the image where there is **no parallax** and place your second pin.



The periscope



A **periscope** is an optical instrument used to observe objects from a concealed position, typically over or around obstacles. It operates on the principle of **light reflection**, using mirrors or prisms placed at **45-degree angles** to redirect light to the observer.

Uses of a Periscope

- **Submarines:** Allows sailors to see above water while remaining submerged.
- **Military applications:** Used in trenches and armored vehicles for surveillance.
- **Science and industry:** Helps monitor hazardous environments like nuclear reactors.
- **Tanks and armored vehicles:** Enables soldiers to view surroundings without exposure.
- **Observation towers:** Used in security and wildlife monitoring.

Revision questions

1. (a) with the aid of a diagram, explain the laws of reflection of light.

(b) State three application of reflection of light.
2. With aid of a diagram explain how solar eclipse forms
3. Mention the properties of images formed by the pinhole camera.
4. Distinguish between natural and artificial sources of light giving two examples of each.
5. Using a diagram explain the properties of a shadow formed from extended source of light

Please obtain free notes, exams and marking guides of Physics, chemistry, biology, history, from digitalteachers.co.ug website.

Thanks

Dr. Bbosa Science