GEOMETRIC OPTICS

This is the branch of physics that studies light as a wave phenomenon.

Light can be defined as the visible form of energy radiated outward from a source.

Light is an example of an electromagnetic wave because it does not require a material medium for its propagation (i.e. it can travel in a vacuum). It is also a typical example of a transverse wave.

SOURCES OF LIGHT

The energy associated with light is called **luminous energy**. Objects that can produce light are called **luminous objects**. Luminous objects can be divided into two. They are

1. **Natural sources**: these include as the sun, stars, fireflies and glowing worms etc. These produce light without electrical or mechanical means.
2. **Artificial sources**: these include torches, bulb, candle, fluorescent lamp and photographer flash tube etc. They can only produce light by electrical or mechanical means.

Non-luminous objects do not produce light. They can only be seen when the rays of light from luminous objects fall on them and reflect into the eyes. Common examples of non-luminous objects include moons, concrete walls, books, humans etc.

TRANSMISSION OF LIGHT

Substances such as clean water and glass allow light to pass through and can be seen through easily. These types of objects are called **transparent objects**.

Substances such as moon, books and concrete walls don't allow light to pass through them. These types of objects are called opaque objects.

From experiments, we know that light travels in a straight line. This can be expressed by the ray model of light.

RAY MODEL OF LIGHT

This model is also called the **Rectilinear Propagation of Light**. This model simply explains how light travels in a straight line path called a light ray. This is the phenomenon that also defines light in a

straight line. This model is used to explain concepts like reflection, refraction, mirrors and lenses. The two major effects of the rectilinear propagation are **Shadow** and **Eclipse**

RAY OF LIGHT

A ray of light can be defined as the direction or path along which light travels. A light ray is an imaginary straight line with arrows drawn in the direction in which the light is traveling. It is usually represented with a straight line having an arrow pointing in the direction of the light. The combination of two or more rays of light is known as a **beam of light**.

A train of light (or group of light rays) can be represented by a **wavefront**.

A wavefront is defined as the locus of points all of which are in the same phase. More often than not, we use ray diagrams instead of wave fronts to represent a train of light

TYPES OF BEAM OF LIGHT

1. **Parallel beam of light**: This is a collection of rays of light that travel parallel to each other. That is to say they meet at infinity.
2. **Convergent beam**: This is a collection of rays of light that meet at a point
3. **Divergent beam**: This is a collection of rays of light all starting from a particular point and leaving from that point.

HUYGEN'S PRINCIPLE

When light rays propagate from a point to another, they have shapes and it is important to determine the shape of the propagation. Huygen's principle is a geometrical method for finding what the shape of a wave front will be at particular instant in the wave's path.
Huygen's principle states that: Every point of a wave front may be considered as the source of small secondary wavelets, which spread out in all directions from the centers with a velocity equal to the velocity of propagation of the wave.

When wave fronts are spherical, the rays radiate from the center of the sphere. However, when wave fronts are plannar, the rays are perpendicular to the wave fronts and parallel to each other.

SHADOW

This can be defined as the region where rays of light do not reach due to the obstruction by an opaque object. In a shadow, two regions are usually defined. They are umbra and penumbra.

1. **Umbra**: This is the region of a shadow where rays of light do not reach at all. It is the dark part of a shadow
2. **Penumbra**: This is the region where rays of light slightly reach. That is the slightly brighter than the darkness.

ECLIPSE

This is another effect of rectilinear propagation of light. Eclipse occurs when the celestial bodies (The sun, moon and the earth) are collinear i.e. they are on a straight line

1. ECLIPSE OF THE SUN (SOLAR ECLIPSE): This occurs when the moon is between the sun and the earth. This occurs during the day.
2. ECLIPSE OF THE MOON (LUNAR ECLIPSE): This occurs when the earth is between the sun and the moon. This occurs at night.

PINHOLE CAMERA

This was the first type of camera produced in 1666. It works on the principle of rectilinear propagation of light. In consists of a box with a pin hole at one end and a wax paper which acts as a screen at the opposite. When a luminous object such as a lighted candle is placed in front of the pin hole, the image of the candle can be seen on the screen but inverted.

The smaller the hole, the smaller the image but is not bright. The bigger the hole, the bigger the image but it is brighter. From these statements, it can be seen that a brighter image is gotten from a bigger hole because more light is admitted into the camera.

Pinhole camera was used by the early artists to give correct perspective about drawing and painting. It is also used by the land surveyors for accurate land measurements.

The major disadvantage about this is that it cannot be used to take snapshots

MAGNIFICATION

This can be defined as the ratio of the size of the image to the size of real object.

Magnification has no unit i.e. it has no dimension

$$magnification = image\ object$$

$$magnification = \frac{image\ height}{object}$$

$$m = \frac{H_i}{H_o}$$

$$magnification = \frac{Image\ distance}{Object\ distance}$$

$$m = \frac{v}{u}$$

If m > 1: Image size > Object size: That means that the object has been magnified

If m < 1: Image size < Object size: That means that the image has been diminished

If m = 1: Image size = Objet size: