OPTICAL INSTRUMENT

1. Simple microscope: This consists of just a single lens. The object to be magnified is placed between the principal focus and the pole of the lens.

   The image formed is Magnified, Erect and Virtual
2. Slide projector: This also consists of a simple convex lens. The object to be magnified is placed between the principal focus and the center of curvature.

   The image formed will be magnified, inverted and real.
3. Compound Microscope: This comprises 2 convex lenses. The first is called the objective lens (because it is close to the object) and it has a shorter focal length than the second which is called the eyepiece (because it's close to the eye) with a longer focal length.

   $$f_o < f_e$$

   The object to be magnified is placed between f and 2f of the objective lens. The image produced by the objective lens serves as the object of the eyepiece which produces a final Virtual, Inverted and magnified image (VIM image).
4. Telescope: This device is used for viewing distant objects. It comprises two lenses. The first is the objective lens with a longer focal length (f_o) and the eyepiece with a shorter focal length (f_e)

   $$f_o > f_e$$

   Under normal adjustment, the distance between the lenses is the sum of the focal lengths of the two lenses.

$$d = f_o + f_e$$

The angular magnification (M) of the image formed is

$$M = \frac{f_o}{f_e}$$

An object at infinity then forms a final magnified image also at infinity. When adjusted to produce an image (at the near point), the final image is magnified, inverted and virtual.

In a terrestrial telescope, an extra convex lens is inserted between the objective lens and the eyepiece in order to produce a final erect image.

If you look at the galaxy from earth, we see things in the past. If we look at the sun, what we actually see the sun how it was 8mins ago.

5. Camera: The camera also consists of a convex lens which focuses a real inverted image on a film. The aperture is the hole through which light enters the camera and the size of the aperture is controlled by an adjustable diaphragm in order to control the amount of light that comes into the camera and reaches the film.
6. The human eye: Although this is a biological organ, it has a natural convex lens which has a flexible focal length that can be controlled by the ciliary muscles. The lens focuses the image of the object on the retina. The retina is the most sensitive part of the eye. The retina is located at the back of the eye and it is the site of image formation.

Accommodation is the ability of the eye to focus on objects clearly at various distances. Far point is the maximum distance at which the eye can focus objects clearly and the near point is the minimum distance. For a normal eye (i.e. eyes without glasses), the near point is 25cm while the far point is an infinity.

EYE DEFECTS

1. Hypermetropia (Long sightedness): A long sighted person can only distant objects clearly but can’t see near objects clearly (i.e. they are blurred). This is due to a small eyeball and then the image is formed behind the retina. It can be corrected using a convex lens
2. Myopia (Short sightedness): A short sighted person can only see near objects clearly but distant objects remain blurred. This is due to a large eyeball and the image is formed in front of the retina. This can be corrected using a concave lens.
3. Presbyopia: This is known as loss of accommodation (i.e. the inability of the eye to focus objects at various distances. It is usually due to old age and weakening of the ciliary muscles and making the lens weak. It can be corrected lens using a bi-focal lens (i.e. a concave and convex lens)
4. Astigmatism: This is due to the uneven curvature of the cornea. A person suffering from astigmatism will not see equally clearly. It can be corrected by using a cylindrical lens (i.e. a lens that allows light to pass in one direction).

The camera has similar features with the human eye and a comparison between the camera and the human eye.

The eye	Camera
Flexible lens	Rigid lens
Retina	Film
Pupil	Aperture
Iris	Diaphragm
Biological organ	Mechanical Instrument/ Device

GLASS PRISMS

USES OF RECTANGULAR PRISMS

1. Glass prisms are the most commonly used prisms in real life especially in packaging, from cereal boxes to cartons and parcels delivered by mail.
2. In a rectangular glass block (rectangular prism) (also known as a parallel sided glass block), the angle of deviation of the emergent ray is always zero no matter the angle of incidence given in the question.

TRIANGULAR PRISM

A triangular prism is made up of glass or plastic having internal angles of 60, 6h0 and 60 (An equilateral triangular prism) or 90, 45 and 45.

When a ray of light incidents on one phase of the triangular prism it is refracted through the prism and comes out from the other side of the prism the angle of deviation (D) is the angular difference between the incident ray and the emergent ray. Generally, the refractive index of a triangular prism is given as

$$n=\frac{\sin\left(\frac{A+D}{2}\right)}{\sin\left(\frac{A}{2}\right)}$$

DISPERSION OF LIGHT BY A TRIANGULAR PRISM

White light is a mixture of several colors which include

Red, Orange, Yellow, Green, Blue, Indigo and Violet popular in the acronym ROYGBIV

As you move from red down to indigo, the wavelength decreases while the frequency increases.

If a beam of light is incident on a triangular prism, it is refracted through the prism. The emergent rays split into various colors which make up the spectrum of white light. This phenomenon is known as dispersion. The various components of light travel at different speeds in the glass and refract along different directions.

Red light which has the fastest speed is the least deviated while violet with the least speed is the most deviated.

COLOR MIXTURE

When two different colors of the spectrum are superimposed, a third color is produced.

TYPES OF COLORS (IN PHYSICS AND LIGHT NOT PERTAINING TO PAINTING)

1. Primary colors: These are colors (or lights) that can't be gotten from other colors. These colors are Red, Green and Blue

Secondary Colors: These are produced by mixing two other colors

$$Red + Green = Yellow$$

$$Red + Blue = Magenta\,(like\ purple)$$

$$Blue + Green = Cyan\,(Bluish\ green)$$

2. Complementary colors: These are colors that will produce white when mixed together. The combination of all three primary colors gives white.

A color triangle is used for quick remembrance of the color mixture

A corner of the triangle represents primary colors

The side of the triangle represents secondary colors

A mixture of a primary color and the side opposite it produces a white circle. Also, the circle in the center represents white.

A transparent object is seen by the color it transmits while an opaque object is seen by the color it reflects.

Object Color	Reflected Color	Absorbed Color
Red	Red	Blue and Green
Blue	Blue	Red and Green
Green	Green	Red and Blue
Yellow	Red and Green	Blue
Magenta	Red and Blue	Green
Cyan	Blue and Green	Red