GEOMETRICAL OPTICS 10

IMAGE FORMED BY CONVEX LENS:

(1) ***If the object AB is placed beyond 2F,*** the image will be formed between F & 2F on the other side of the lens.

It will be real, inverted & diminished image, as shown in figure (2) e.g. Camera.

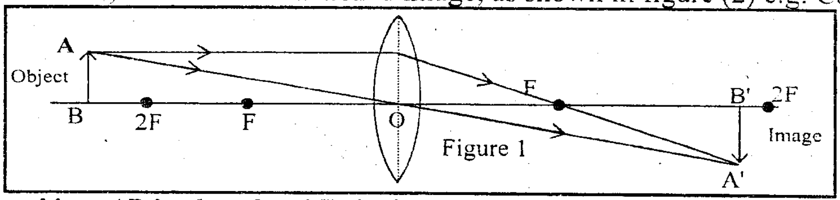


Figure 1

(2) ***If the object AB is placed at 2F,*** the image will be formed at 2F on the other side of lens. It will be real, inverted & equal to the size of the object as show in fig (3).

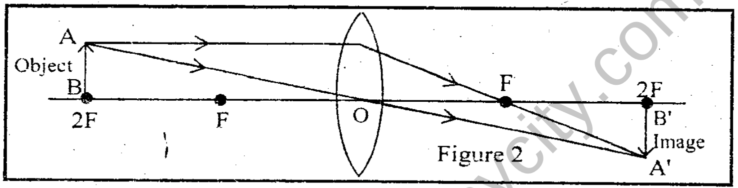


Figure 2

(3) ***If the object AB is placed between F & 2F*** The image will be formed away from 2F on the other side of the lens. It will be inverted, magnified & real image, as shown in figure e.g. enlarger or projector.

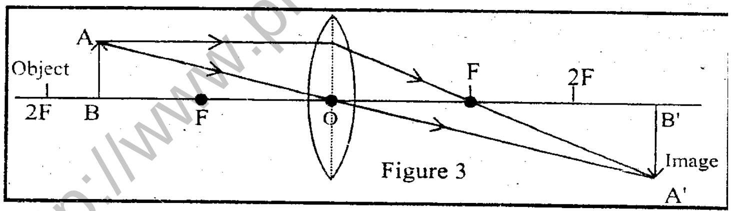


Figure 3

(4) ***If the object AB is at focus F*** the image will be formed at infinity on the other side of the lens. It will be inverted, real & very much magnified image as show in fig (5) e.g. spot light.

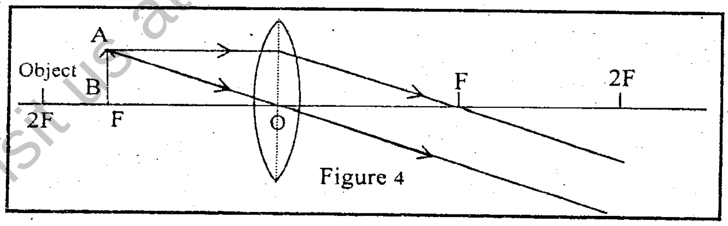


Figure 4

(5) ***If the object AB is between focus & optical centre,*** the image will be formed on the same side of the lens.

It will be erect, magnified & virtual image, as shown in fig (6) e.g. simple microscope.

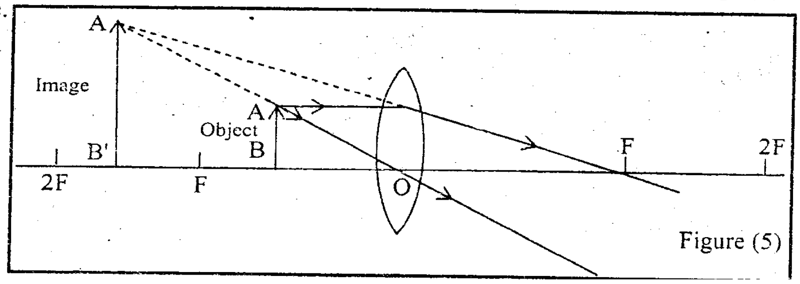


Figure (5)

(6) ***If the object is at infinity,*** its image will be formed at focus. It will be real, inverted & diminished image, as shown in figure (1).

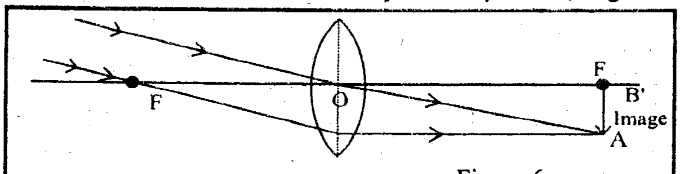


Figure 6

IMAGE FORMED BY CONCAVE LENS:

If the object AB is placed before a concave lens at any point, the image will be formed on the same side of the lens. It will be erect, diminished & virtual image, as shown in figure (7).

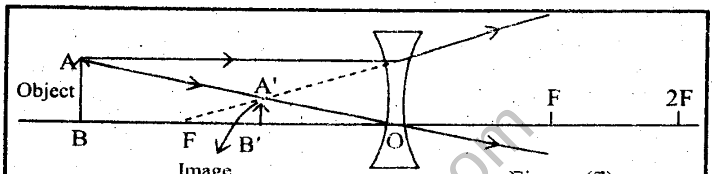


Figure (7)

THIN LENS FORMULA FOR CONVEX LENS:

The relation between object distance "**p**", image distance "**q**" and the focal length "**f**" of a lens is called "lens formula".

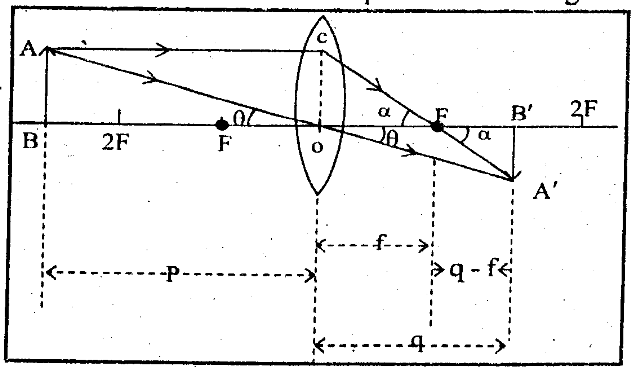
Derivation:

To derive lens formula, consider an object AB placed beyond 2F of a convex lens. By considering any two refracting rays, the image A' B' of the object AB can be obtained, as shown in the figure. In the figure consider the triangles ABO & A' B'O. In these triangles.

$\angle AOB = \angle A'O'B = \theta$ ...... ($\because$ vertical opposite angles)

$\angle ABO = \angle A'B'O = 90^\circ$

As two angles are equal therefore third one will be also equal. Hence triangles ABO & A'B'O are similar. Thus,



$$\frac{AB}{BO} = \frac{A'B'}{B'O}$$

OR $$\frac{B'O}{BO} = \frac{A'B'}{AB}$$

$$B'O = q$$

$$BO = p$$

OR $$\frac{A'B'}{AB} = \frac{q}{p} \quad \text{——— (1)}$$

Now consider triangles COF & A'B'F. In these triangles

$\angle CFO = \angle A'FB' = \alpha$ ---- ($\because$ vertical opposite angles)

$\angle COF = \angle A'B'F = 90^\circ$

As two angles are equal. Hence triangles COF & A'B'O are similar. Thus

$$\frac{A'B'}{FB'} = \frac{CO}{OF}$$

$$CO = AB$$

$$\frac{A'B'}{FB'} = \frac{AB}{OF}$$

OR $$\frac{A'B'}{AB} = \frac{FB'}{OF}$$

$$FB' = q - f$$
$$OF = f$$

OR $$\frac{A'B'}{AB} = \frac{q-f}{f} \longrightarrow (2)$$

Comparing eq. (1) & eq. (2)

$$\frac{q-f}{f} = \frac{q}{P}$$

OR $$\frac{q}{f} - \frac{f}{f} = \frac{q}{P}$$

Dividing each term by "q"

$$\frac{q}{f \times q} - \frac{f}{f \times q} = \frac{q}{P \times q}$$

$$\frac{1}{f} - \frac{1}{q} = \frac{1}{P}$$

$$\boxed{\frac{1}{f} = \frac{1}{P} + \frac{1}{q}}$$

THIN LENS FORMULA FOR CONCAVE LENS:

The relation between object distance "p", image distance "q" and focal length "f" of a lens is called "LENS FORMULA".

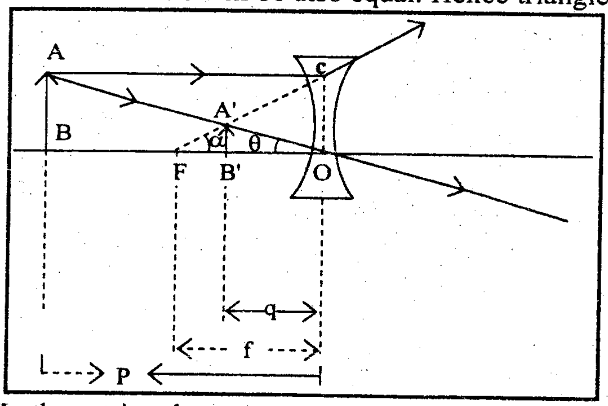
Derivation:

To derive lens formula, consider an object AB placed before a concave lens. By considering any two refracting rays, the image A'B' of the object AB can be obtained, as shown in the figure. In the figure consider triangles ABO & A'B'O. In these triangles,

$\angle AOB = \angle A'OB' = \theta$ ......(∵ common angle)

$\angle ABO = \angle A'B'O = 90°$

As the two angles are equal therefore third one will be also equal. Hence triangles ABO & A'B'O are similar.



$$\frac{A'B'}{B'O} = \frac{AB}{BO}$$

OR $$\frac{A'B'}{AB} = \frac{B'O}{BO}$$

$$B'O = q$$
$$BO = p$$

OR $$\frac{A'B'}{AB} = \frac{q}{P} \longrightarrow (1)$$

Now consider triangle A'B'F & COF. In these triangles,

$\angle A'FB' = \angle CFO = \alpha$ ------ (∵ common angle)

$\angle A'B'F = \angle COF = 90°$

As two angles are equal therefore third one will be also equal. Hence triangles A'B'F & COF are similar.

$$\therefore \frac{A'B'}{B'F} = \frac{CO}{OF}$$

$$CO = AB$$

$$\frac{A'B'}{B'F} = \frac{CO}{OF}$$

OR
$$\frac{A'B'}{AB} = \frac{B'F}{OF}$$

$$B'F = f - q$$

$$OF = f$$

$$\frac{A'B'}{AB} = \frac{f-q}{f} \longrightarrow (2)$$

Comparing eq (1) & (2)

$$\frac{f-q}{f} = \frac{q}{P}$$

$$\frac{f}{f} - \frac{q}{f} = \frac{q}{P}$$

Dividing each term by "q"

$$\frac{f}{f \times q} - \frac{q}{f \times q} = \frac{q}{P \times q}$$

$$\frac{1}{q} - \frac{1}{f} = \frac{1}{P}$$

$$\boxed{\left(\frac{1}{-f}\right) = \frac{1}{P} + \left(\frac{1}{-q}\right)} \longrightarrow (3)$$

Sign Convention:

1. When object is real "p" is taken as positive. When object is virtual "p" is taken as negative.
2. When image is real "q" is taken as positive. When image is virtual "q" is taken as negative.
3. For concave lens "f" is taken as negative. Here image is always virtual $\therefore$ q is taken as negative.

$\therefore$ eq (3) becomes,

$$-\left(\frac{1}{-f}\right) = \frac{1}{P} - \left(\frac{1}{-q}\right)$$

$$\frac{1}{f} = \frac{1}{P} + \frac{1}{q}$$

MAGNIFICATION OR LINEAR MAGNIFICATION:

The ratio between size of image & size of object is called linear magnification. It is denoted by "M" i.e.

$$M = \frac{\text{size of image}}{\text{size of object}} = \frac{q}{p}$$

POWER OF LENS:

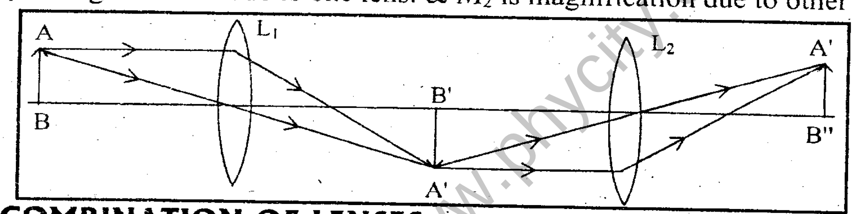
The reciprocal of focal length of a lens is called "power of the lens". Its unit is "DIOPTER".

1diopter is power of a lens whose focal length is "meter".

$$\text{Power in diopters} \therefore = \frac{1}{\text{Focal length in meters}}$$

COMBINATION OF LENSES:

In most of the optical instruments two or more lenses are used. Image obtained due to one lens acts as an object for the second lens. Image due to second lens acts as object for third lens & so on. The total magnification "M" is equal to the product of individual magnifications of the lens. i.e. $M = M_1 \times M_2$,
Where M_1 is magnification due to one lens. & M_2 is magnification due to other lens.



CLOSE COMBINATION OF LENSES:

Consider two lenses L_1 & L_2 of focal length "f_1" & "f_2" respectively placed in contact with each other. Let a point object 'O' is placed at a distance "p" from L_1. If I_1 be the image formed by this lens then the focal length "f_1" of the lens L_1 is given by

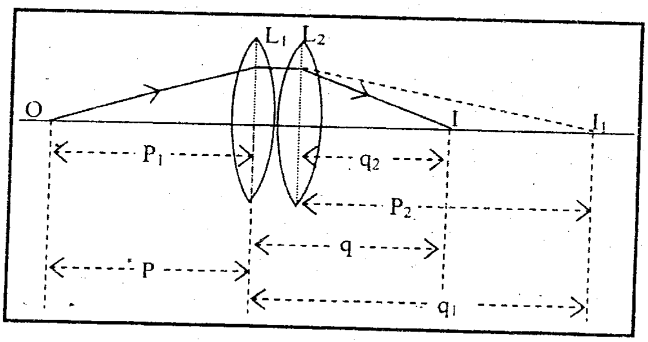
$$\frac{1}{f_1} = \frac{1}{p_1} + \frac{1}{q_1}$$

As $P_1 \cong p$ so $\frac{1}{f_1} = \frac{1}{p} + \frac{1}{q_1} \longrightarrow (1)$

Where q_1 = distance of image I_1 from L_1. This image now serve as a virtual object for the lens L_2. If this lens forms an image "I" of virtual object I_1 at a distance "q" then the focal length of the L_2 is given by

$$\frac{1}{f_2} = -\frac{1}{q_1} + \frac{1}{q} \longrightarrow (2)$$

So Where $p_2 \cong -q_1$
$q_2 \cong q$



Adding eq. (1) & (2)

$$\frac{1}{f_1} + \frac{1}{f_2} = \frac{1}{p} + \frac{1}{q_1} - \frac{1}{q_1} + \frac{1}{q}$$

$$\frac{1}{f_1} + \frac{1}{f_2} = \frac{1}{p} + \frac{1}{q} \longrightarrow (3)$$

If the two lenses are replaced by a single lens of focal length "f" such that it forms an image at a distance "q" of an object placed at a distance "p" from it, such a lens is called ***"EQUIVALENT LENS"*** & its focal length "f" is known as ***"EQUIVALENT FOCAL LENGTH".***

It is given by

$$\frac{1}{f} = \frac{1}{p} + \frac{1}{q} \longrightarrow (4)$$

comparing eq. (3) & (4)

$$\boxed{\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2}}$$

This show that the close combination of the lenses behaves as a single lens.

POWER OF LENSES:

If two lenses with focal length "f_1" & "f_2" are placed in contact with each other. They are equivalent to a single lens with a focal length "f" satisfying

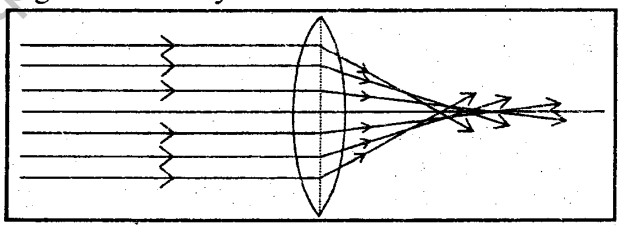
$\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2}$ the power of lenses is $P = P_1 + P_2$

Thus the powers of lenses in contact are simply added to find the resultant power of the combination.

LENS ABERRATION:

There are two main defects in image formation by lenses.

1. Spherical aberration
2. Chromatic aberration



Spherical Aberration:

In the lenses of large aperture, two or more images of an object are formed close to each other. This defect is known as "Spherical aberration".

Reason:

The surfaces of the lens at the edges have less curvature than central portion. So different images are formed at different positions.

How to remove this defect?

(i) This defect can be removed by using only the central portion of a lens. This can be achieved by using a stop on the lens. This makes effective aperture of lens small.

(ii) By making the two surface of lens of different curvatures.

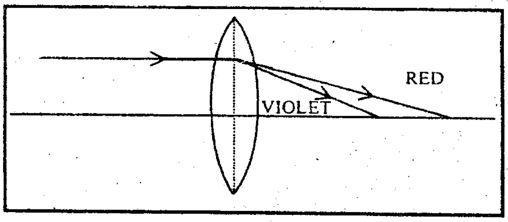
(iii) By combining a strongly convergent lens with a weaker diverging lens.

Chromatic Aberration:

When a lens shows image of different colours at different positions of a white object then lens is defected. This defect is known as "chromatic aberration".

Reason:

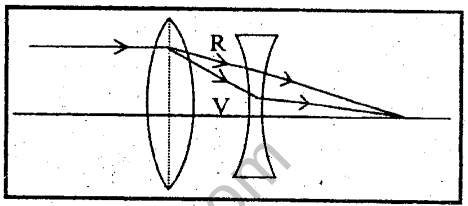
In thick lenses small portion of a lens behaves as a prism. (i.e. it disperses a beam of light). When white light passes through such portions of the lens, it disperse into component colours. As a result, the images of various colours are formed overlapping each other.



HOW TO REMOVE THIS DEFFECT?

To remove this defect a combination of convex lens & a concave lens is used.

The concave lens is made up of glass of suitable refractive index & of suitable focal length. The convex lens reduces deviation. This combination is known as "achromatic combination lenses."



VISUAL ANGLE:

Angle subtended by an object at the eye is called "visual angle".

MAGNIFYING POWER:

It is the ratio between the angle subtended at the eye by an image & the angle subtended at the eye by the object when placed at the same distance (or when viewed directly).

ANGULAR MAGNIFICATION:

It is the ratio of the angle subtended by the image to the angle subtended by the object at the eye.

MAGNIFYING GLASS OR SIMPLE MICROSCOPE:

It is a single convex lens which is used to enlarge the image of an object if the object is placed within its focal length. It is also called a "Simple Microscope".

Construction:

It consists of a converging lens of small focal length fitted in a ring.

Working:

An object AB is placed within focal length of the convex lens. Its virtual, erect & magnified image is formed on same side as the object. The distance between the object & the lens is so adjusted that image, A'B' is formed at the least distance of distinct vision "d" so we can see the image most clear.

Magnifying power:

Magnifying power or Angular Magnification "M" of a magnifying glass is defined as the ratio of visual angle "β" of the image seen through a magnifying glass to the visual angle "α" subtended by the object when placed at the least distance of distinct vision i.e. 25cm.

$$\mathbf{M = \frac{\beta}{\alpha}} \longrightarrow \mathbf{(1)}$$

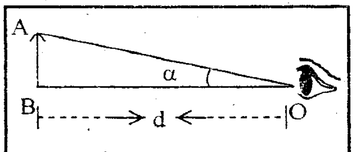


Figure 1

In fig (1) $\tan\alpha = \frac{AB}{BO} = \frac{AB}{d}$

If α is small then $\tan\alpha \cong \alpha$

$$\therefore \alpha = \frac{\mathbf{AB}}{\mathbf{d}} \longrightarrow \mathbf{(2)}$$

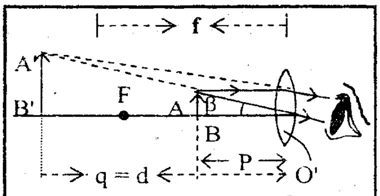


Figure 2

In triangle ABO of fig (2)

$$\operatorname{Tan}\beta = \frac{AB}{BO'} = \frac{AB}{p}$$

If β is small then $\tan\beta \cong \beta$

$$\therefore \beta = \frac{AB}{p} \longrightarrow \mathbf{(3)}$$

Putting the values of α & β from eq. (2) & (3) in (1)

$$M = \frac{\frac{AB}{p}}{\frac{AB}{d}} = \frac{AB}{p} \times \frac{d}{AB}$$

$$\mathbf{M} = \frac{d}{p} \longrightarrow \mathbf{(4)}$$

If "f" be the focal length of the magnifying glass then by lens formula.

$$\frac{1}{f} = \frac{1}{p} + \frac{1}{q}$$

But $q = -d$ ------- ($\because$ image is virtual)

$$\frac{1}{f} = \frac{1}{p} + \frac{1}{q}$$

$$\frac{1}{f} = \frac{1}{p} + \frac{1}{(-d)}$$

$$\frac{1}{f} = \frac{1}{p} - \frac{1}{d}$$

Multiplying each term by "d"

$$\frac{d}{f} = \frac{d}{p} - 1$$

$$1 + \frac{d}{f} = \frac{d}{p}$$

Substituting the value of $\frac{d}{p}$ in eq. (4)

$$\boxed{\mathbf{M = 1 + \frac{d}{f}}}$$

COMPOUND MICROSCOPE:

A compound microscope is an optical instrument used to see very small object such as germs & other microbes.

CONSTRUCTION:

It consists of two convex lenses fitted at the ends of the two tubes which can slide into or out of each other.

Objective:

The convex lens near the object is called objective. It is of short focal length and small aperture.

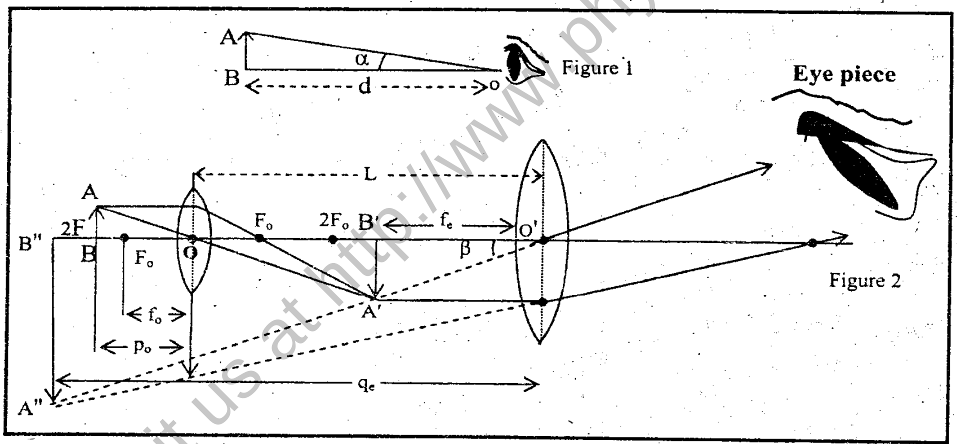
Eye piece:

The second convex lens near the eye, is called eye piece. It is of long focal length and large aperture.

Working:

The object AB is placed between F_0 & $2F_0$ of the objective. It gives real, inverted & magnified image A'B' of the object AB.

Position of the eye piece is such that the image 'AB' acts as object for eye piece this lens gives final image A"B" which is formed at least distance of distinct vision from the eye piece. The final image is virtual, inverted with respect to the object, highly magnified & most clear.



MAGNIFYING POWER:

The ratio of the visual angle "β" subtended by the image at the eye to the angle "α" subtend by the object when both are at same distance from the eye, is called magnifying power "M".

i.e $$M = \frac{\beta}{\alpha} \longrightarrow (1)$$

in fig (1) $$\tan\alpha = \frac{AB}{BO}$$

$$BO = d$$

$$\tan\alpha = \frac{AB}{d}$$

As α is small ∴ $\tan\alpha \cong \alpha$

$$\therefore \alpha = \frac{AB}{d} \longrightarrow (2)$$

In triangle A"B"O of fig (2)

$$\tan\beta = \frac{A''B''}{B''O'}$$

$$B''O' = d$$

$$\tan\beta = \frac{A''B''}{d}$$

As β is small $\therefore \tan\beta \cong \beta$

$$\beta = \frac{A''B''}{d} \longrightarrow (3)$$

Putting the values of α & β from eq. (2) & eq. (3) in eq. (1)

$$M = \frac{\frac{A''B''}{d}}{\frac{AB}{d}} = \frac{A''B''}{d} \times \frac{d}{AB}$$

$$\boxed{M = \frac{A''B''}{AB}}$$

Multiplying & dividing right hand side by A' B'

$$M = \frac{A''B''}{AB} \times \frac{A'B'}{A'B'} = \frac{A'B'}{AB} \times \frac{A''B''}{A'B'} \longrightarrow (4)$$

But $\frac{A'B'}{AB} = \frac{\text{size of image formed by objective}}{\text{size of object}} = \frac{q_0}{P_0} = M_o$

Where M_e = magnification of eye piece $= \frac{A''B'}{A'B'}$

Putting the values of $\frac{A'B'}{AB}$ & $\frac{A''B''}{A'B'}$ in eq. (4)

$$\boxed{M = M_o \times M_e} \longrightarrow (5)$$

Since eye piece acts as magnifying glass

$$\therefore M_e = 1 + \frac{d}{f_e}$$

Where f_e = focal length of eye piece

& $M_o = \frac{q_0}{p_0}$

$\therefore$ eq. (5) becomes, $M = \frac{q_0}{p_0}\left(1 + \frac{d}{f_e}\right) \longrightarrow (6)$

If the object AB is very close to the focus of the objective & the image A'B' is formed very close to the eye piece then.

$P_0 \cong f_o$ = focal length of objective

& $q_0 \cong L$ = distance between the lenses or length of the microscope.

$\therefore$ Eq. (6) becomes

$$\boxed{M \cong \frac{L}{f_o}\left(1 + \frac{d}{f_e}\right)}$$

ASTRONOMICAL TELESCOPE:

An astronomical telescope is an optical instrument which is used to see heavenly bodies such as moon, stars, planets etc.

CONSTRUCTION:

It consists of two convex lenses fixed at the ends of two tubes one of these tubes can slide into or out of the other tube so that the distance between the lenses can be changed.

Objective:

The convex lens near the object is called objective. It is of long focal length and large aperture.

Eye piece:

The second convex lens near the eye, is called eye piece. It is of short focal length and small aperture.

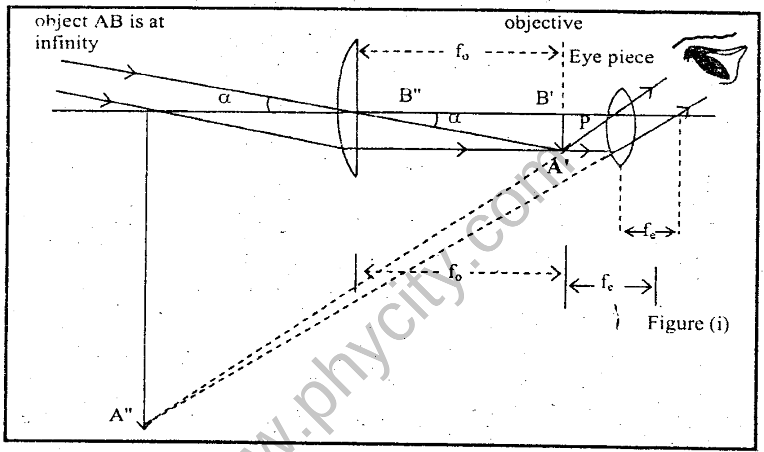


Figure (i)

WORKING:

When parallel rays of light from a distant object falls on the objective, a real, inverted & diminished image A'B' is obtained at principal focus of objective. This image A'B' acts as object for the eye piece. The position of the eye piece is such that a magnified & virtual image A"B" is obtained.

Now the position of eye piece is so adjusted that the final image A"B" is formed at the least distance of distinct vision as shown in figure (i). So we can see the image most clear. The final image is virtual, inverted & magnified as compared to that when seen by nacked-eye.

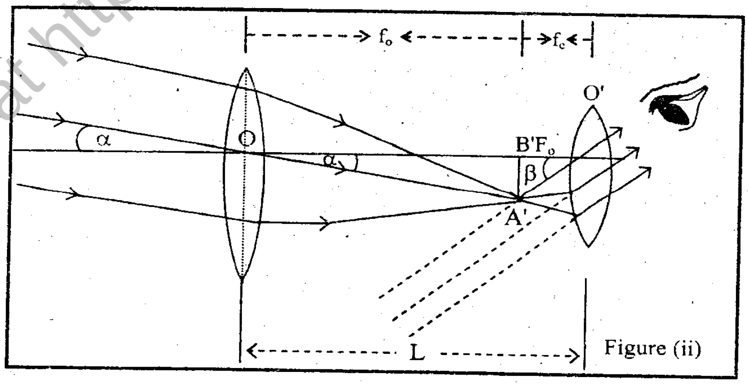


Figure (ii)

MAGNIFYING POWER:

The magnifying power of the telescope is defined as ratio of the angle subtended at the eye by the final image to the angle subtended by the object itself when both the object & image are at infinity.

To obtain this condition the position of the eye piece is so adjusted that the image A'B' is formed at the principal focus of the eye piece & the final image is formed at infinity, as shown in figure (ii). By the definition of magnifying power, $M = \frac{\beta}{\alpha}$

where α = angle subtended by the object
β = angle subtended by the image.
In triangle A'B'O

$$\tan\alpha = \frac{A'B'}{OB'}$$

For small α

$$\tan\alpha \cong \alpha$$

$$\alpha = \frac{A'B'}{f_o} \longrightarrow (1)$$

In triangle A'B'O'

$$\tan\beta = \frac{A'B'}{B'O'}$$

For small β

$$\tan\beta \cong \beta$$

$$\beta = \frac{A'B'}{f_e} \longrightarrow (2)$$

Dividing eq (2) by bq (1)

$$M = \frac{\beta}{\alpha} = \frac{\frac{A'B'}{f_e}}{\frac{A'B'}{f_o}}$$

$$M = \frac{A'B'}{f_e} \times \frac{f_o}{A'B'}$$

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

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

$\therefore$ Magnifying power $= \frac{\text{focal length of objective}}{\text{focal length of eye piece}}$

LENGTH OF TELESCOPE:

When the telescope is focused for infinity, the length of the telescope is equal to the sum of the focal lengths of the objective & eye piece, as shown in the figure (2)

$\therefore$ Length of telescope = $f_o + f_e$

GALILEAN TELESCOPE:

It is an optical instrument which is used to see erect image of distant object.

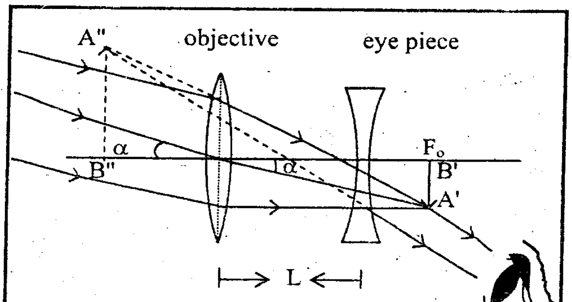


Figure (i)

CONSTRUCTION:

It consists of two lenses fitted at the ends of two tubes which can slide into and out of each other.
The lens towards the object, is called "objective". It is convex lens of large aperture & focal length. The lens towards the eye is called "eye piece". It is a concave lens of small aperture & focal length.

WORKING:

When parallel rays of light from a distant object falls on the objective, its real, inverted & diminished image A'B' is formed at focus "F_o" of the objective. This image acts as virtual object for eye piece. The eye piece forms its erect and virtual image A" B". The position of the eye piece is so adjusted that the final image seen is most clear as shown in Figure (i). The final image A"B" is virtual, erect by unaided eye.

MAGNIFYING POWER:

The ratio of the angle β subtended by the image at the eye to the angle "α" subtended by the object at the eye when both are at the same distance from the eye is called magnifying power "M" i.e.

$$M = \frac{\beta}{\alpha} \longrightarrow (1)$$

To obtain such condition, the eye piece is so adjusted that focus of the two lenses coincides. The image A'B' comes at the principal focus of the eye piece & the final image is formed at infinity as show in fig (ii)

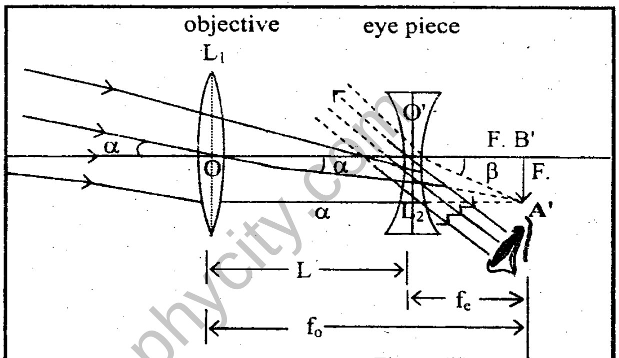


Figure (ii)

In triangle A'B'O,

$$\tan\alpha = \frac{A'B'}{OB'}$$

As α is small

$\therefore \tan\alpha \cong \alpha$

$$\textbf{Thus } \alpha = \frac{A'B'}{f_o} \longrightarrow \textbf{(2)}$$

In triangle A'B'O'

$$\tan\beta = \frac{A'B'}{O'B'}$$

As β is small

$\therefore \tan\beta \cong \beta$

$$\textbf{Thus } \beta = \frac{A'B'}{f_e} \longrightarrow \textbf{(3)}$$

Putting the values of α & β from eq. (2) & (3)
In eq. (1)

$$M = \frac{\frac{A'B'}{f_e}}{\frac{A'B'}{f_o}}$$

$$= \frac{A'B'}{f_e} \times \frac{f_o}{A'B'}$$

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

$$\boxed{M = \frac{\text{focal length of objective}}{\text{focal length of eye piece}}}$$

LENGTH OF TELESCOPE:

When the telescope is focused for infinity the length "L" of telescope is given by

$$L = f_o - f_e$$

TERRESTRIAL TELESCOPE:

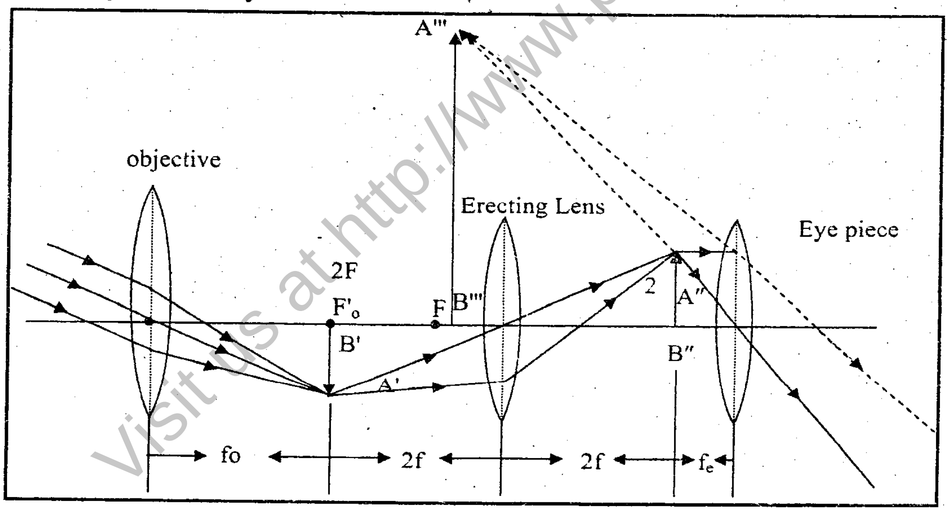
It is an optical instrument which is used to see distant object on the earth. It gives erect images.

CONSTRUCTION:

It consists of three convex lenses. The lens towards the object is called "objective". It is of long focal length and large aperture. The convex lens near the eye is called eye piece. It is of short focal length and small aperture. The third lens is used in between the objective & the eye piece is called "erecting lens or field lens". Its focal length is small.

WORKING:

As the object is at infinity with respect to the objective. The image is real, inverted and diminished. The position of the erecting or field lens is such that the image A'B' is formed at a distance 2F of the erecting lens, so its real, inverted image A"B". the eye piece is so adjusted that the image A" B" is formed within its focal length. The eye piece forms final image A''' B''' at least distance of distinct vision. The final image A''' B''' is virtual & erected with respect to the object. It is magnified with respect to the object seen by unaided eye.



MAGNIFYING POWER:

Since the erecting lens does not magnify therefore the magnifying power of the terrestrial telescope is the same as that of the astronomical telescope. i.e.

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

Approximate length of terrestrial telescope is

$$\boxed{L = f_o + 4f + f_e}$$

f_o = focal length of objective.

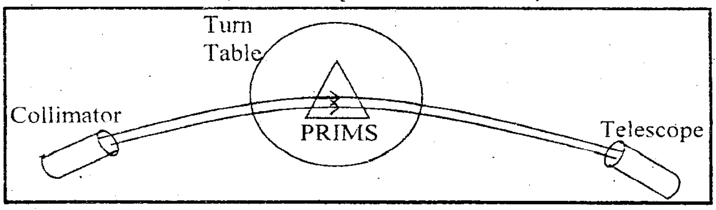
f_e = focal length of eye piece

f = focal length of erecting or field lens. Only disadvantage is that the telescope comes inconveniently long.

SPECTROMETER:

It is an instrument used to study the spectrum of luminous bodies. The essential parts of this instrument are:

a) Collimator b) Telescope c) Turn table



a) COLLIMATOR:

It consists of a metal tube provided with a convex lens on its one end & an adjustable slits on its other end. The length of the tube is altered by a screw to be equal to the focal length of the convex lens so that the collimator produces a parallel beam of light. The instrument while turn table & telescope can rotate about a common axis.

b) TELESCOPE:

It is a simple astronomical telescope which is used for making measurements or for examining the spectrum. The adjustment for focusing the telescope is made with the help of screw. Telescope can rotate about an axis.

c) TURN TABLE:

It is a circular metallic plate which can rotate about an axis. Its height is also adjustable & this can be levelled by means of three screws.

There are arrangements for fine motion of the telescope & turn table. A vernier scale is provided to measure the angle with great accuracy. i.e. in degrees & minutes.

Before using, the collimator is adjusted for parallel rays & the telescope is focused for parallel rays or for infinity for this it is focused on a distant ***object.***

USED:

The spectrometer is an analyzing instrument used primarily to discover & measure the wave lengths of given light.

EMISSION SPECTRUM:

When light from an incandescent solid, liquid or gas is examined by spectroscope, several images are seen separately. This spectrum is called "emission spectrum."

There are three kinds of emission spectrum.

1) CONTINUOUS SPECTRUM:

If all the visible wave length are present in the light which is analyzed, the images overlap into continuous patch. This is called "continuous spectrum".

2) LINE SPECTRUM:

If the source emits only a few definite wavelength, the spectrum viewed consists of bright lines separated from each other. This is called line spectrum.

3) BAND SPECTRUM:

This spectrum consists of bands when high dispersion or resolving powers of grating or prism is used, each band is found composed of many lines arranged in series.

4) ABSORPTION SPECTRUM:

If light containing all the wavelengths is allowed to pass through absorbing medium in gaseous state before entering spectrometer, some of the wavelengths are absorbed & the resulting spectrum will be formed to have dark lines showing the absence of these wavelengths. This type of spectrum is called absorption spectrum.