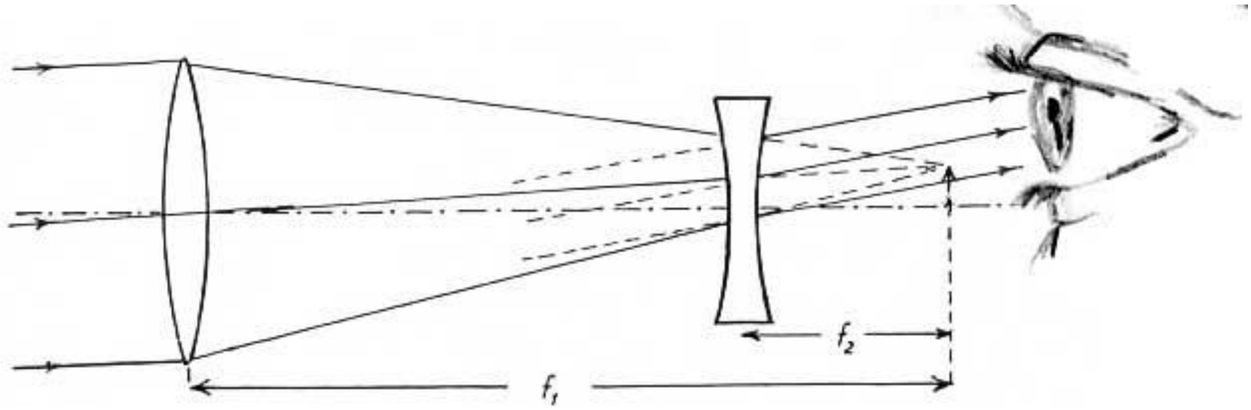
Answer on Question#39833 - Physics – Optics

Solve. THE MAGNIFYING POWER OF GALILEAN TELESCOPE IN THE NORMAL ADJUSTMENT IS 20.THE DIFFERENCE BETWEEN THE MAGNIFYING POWER AND LENGTH OF THE TELESCOPE IS 19.05.THE FOCAL LENGTH OF OBJECTIVE AND EYE PIECE ARE: (inmeters)

1. 1 and -0.05
2. 0.05 and 2
3. 1 and 0.05
4. 2 and 0.05

Solution.

GALILEAN TELESCOPE



Objective is a convex lens of large focal length f_1;

Eye piece is a divergent (concave) lens of short focal length f_2. Eye piece forms an erect and virtual image at the focus of objective on when adjustment is correct.

Magnifying power is the ratio of visual angle subtended by the image to the visual angle subtended by the object.

$$M = \frac{angle\ subtended\ by\ the\ final\ image\ of\ eye}{angle\ subtended\ by\ the\ object\ at\ the\ objective}$$

$$M = \frac{\beta}{\alpha}$$

Since $\alpha$and β are small angle, therefore we can assume $\alpha = \tan\alpha$, $\beta = \tan\beta$

$$M = \frac{\tan\alpha}{\tan\beta}$$

$$M = \frac{f_o}{f_e} = \frac{f_1}{f_2}$$

Length of telescope.

Distance b/w objective lens and eye piece is called length of telescope.
From figure:
Length of telescope is

$$L = f_o - f_e = f_1 - f_2$$

In our case.

$$M = 20.$$

$$M - L = 19.05$$

$$L = 20 - 19.05 = 0.95\ m$$

$$\begin{cases} M = \dfrac{f_1}{f_2} \\ L = f_1 - f_2 \end{cases}$$

$$\begin{cases} 20 = \dfrac{f_1}{f_2} \\ 0.95 = f_1 - f_2 \end{cases}$$

$$\begin{cases} 20 = \dfrac{f_1}{f_2} \\ f_1 = 0.95 + f_2 \end{cases}$$

$$\begin{cases} 20 = \dfrac{0.95 + f_2}{f_2} \\ f_1 = 0.95 + f_2 \end{cases}$$

$$\begin{cases} 20f_2 = 0.95 + f_2 \\ f_1 = 0.95 + f_2 \end{cases}$$

$$\begin{cases} 19f_2 = 0.95 \\ f_1 = 0.95 + f_2 \end{cases}$$

$$\begin{cases} f_2 = \dfrac{0.95}{19} = 0.05m \\ f_1 = 0.95 + 0.05 = 1m \end{cases}$$

Answer:

$$focal\ length\ of\ objective\ is\ 1\ m.$$
$$focal\ length\ of\ eyepiece\ is\ 0.05m.$$

Answer #3. 1 and 0.05