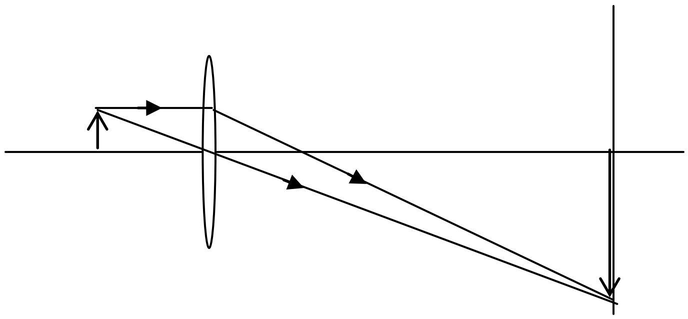
Q- The projection lens in a certain slide projector is a single thin lens. A slide 24.0 mm high is to be projected so that its image fills a screen 1.80 m high. The slide to screen distance is 3.00m.
a) Determine the focal length of the projection lens.
b) How far from the slide should the lens of the projector be placed in order to form the image on the screen?



Let the distance of the slide from the lens be u and that of the screen be v

Then the **magnitude** of magnification

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

Where I is the height of the image and O is the height of the object. Hence

$$\frac{v}{u} = \frac{1.80}{24*10^{-3}} = 75$$

Or v = 75 u

But the slide to screen distance is 3.00 m, hence

u + v = 3.00
or u + 75 u = 3.00

Gives u = 3.00/76 = 0.0395 m

And v = 2.9605 m

a) The focal length of the lens given by the lens formula

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$

Substituting the values of object distance and image distances with appropriate signs we have

$$\frac{1}{f} = \frac{1}{2.9605} - \frac{1}{-0.0395} = \frac{1}{2.9605} + \frac{1}{0.0395}$$

Gives **f = 0.039 m**.

b) The distance between the lens and slide is calculated already

u = 0.0395 m
