

## Physics Practical work: (Using a simulation to determine focal length of a lens

Instead of the normal glass lens, students are required to use the **Geometric Optics** at the **Physics Educational Technology website**.  
<http://www.colorado.edu/physics/phet/web-pages/index.html>

Note, the simulations at this website could be downloaded in advance so that the students can work offline.

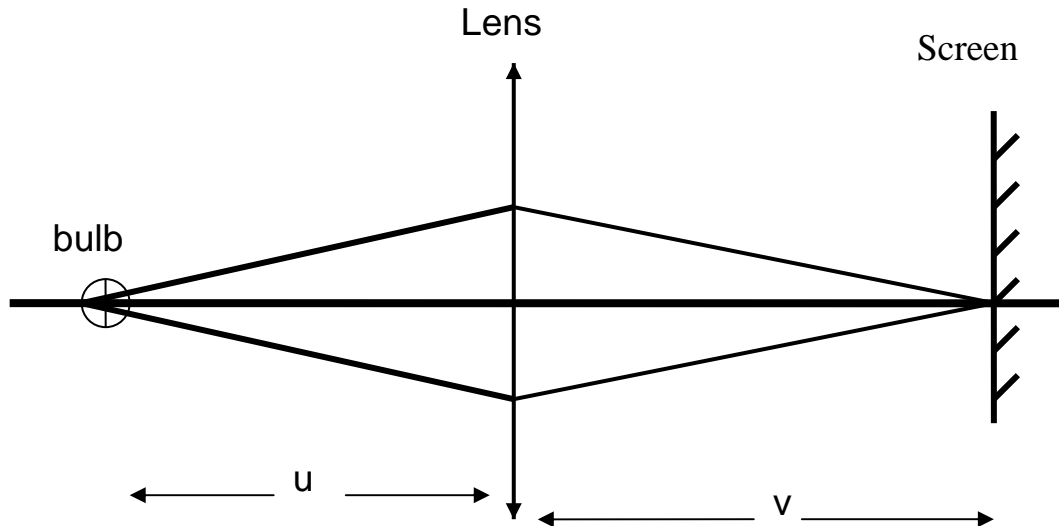
Students must be provided with a pencil, ruler and a graph paper. It must be emphasized that use of this simulation does not replace all what is involved in the traditional experiment. It is only the physical equipment which has been replaced by the electronic equipment. The students have still to draw the table of results, take measurements, plot them on the graph, draw the best possible line through the points, and determine the slope of the graph like in the traditional experiments. In this case ICT would just be addressing the problem of shortage of experiment.

### Expt 1: DETERMINATION OF THE FOCAL LENGTH, $f$ , OF A CONVERGING LENS USING THE GEOMETRICAL OPTICAL SIMULATIONS

- (a) Select a converging lens of refractive index  $n = 1.53$  and radii of curvature  $r = 0.63$  m and diameter = 0.8 m. Do this by adjusting the radius of curvature to 0.63m and the refractive index to 1.53. Also and choose marginal rays, screen and ruler.
- (b) Calculate the focal length  $f_1$  of the lens using

$$\frac{1}{f_1} = (n-1) \left( \frac{1}{r} + \frac{1}{r} \right)$$

- (c) Arrange the screen the lens and the illuminated object as shown in the fig. below.



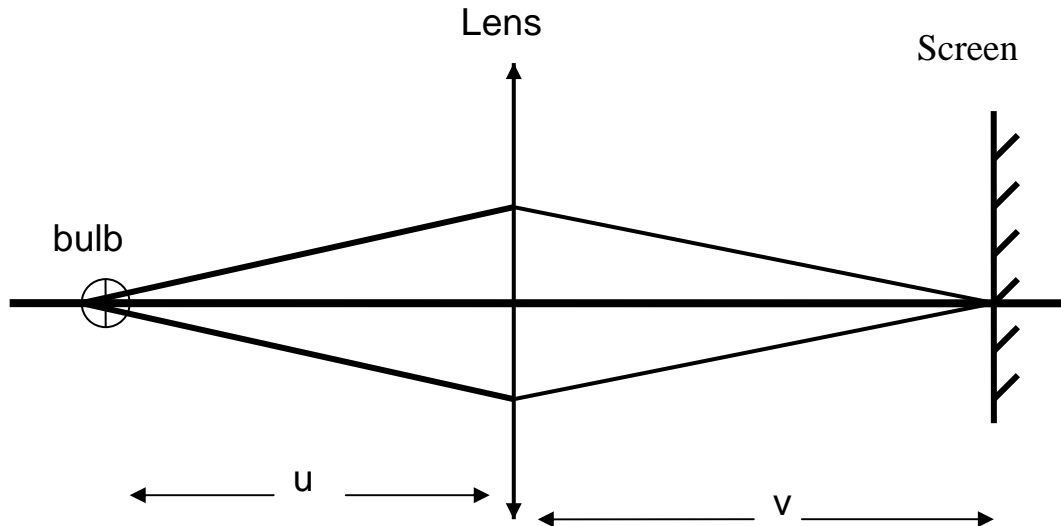
- (d) Place the object (bulb) at a distance  $u = 100$  cm from the lens and adjust the position of the screen until a clearly focussed image is obtained. Measure and record the image distance  $v$ . Calculate the linear magnification  $m = \frac{v}{u}$  and the value of  $(v+u)$ .
- (e) Repeat (d) above for object distances  $u = 120$  cm,  $140$  cm and  $180$  cm.
- (f) Tabulate your results including columns for  $u$ ,  $v$ ,  $m$  and  $(v+u)$ .
- (g) Plot a graph of  $m$  against  $v$  and determine the slope  $s$  of the graph.
- (h) Calculate the focal length  $f_2$  of the lens using  $f_2 = 1/s$ .
- (i) Calculate the average focal length  $f$  of  $f_1$  and  $f_2$ .

### Experiment 2: Determination of focal length $f$ of a converging lens

- (a) Choose a lens of a lens of refractive index  $n = 1.5$ , radius of curvature =  $0.3$  m and diameter =  $0.8$  m.
- (b) Calculate the focal length  $f$  of the lens using

$$\frac{1}{f} = (n-1) \left( \frac{1}{r} + \frac{1}{r} \right)$$

- (c) Arrange the screen the lens and the illuminated object as shown in the fig. below.



- (d) Place the object (bulb) at a distance  $u = 1.5 f$  from the lens and adjust the position of the screen until a clearly focussed image is obtained. Measure and record the image distance  $v$ . Calculate and record the value of  $(v+u)$
- (e) Repeat (d) above for object distances  $u = 2.0 f, 2.5 f, 3.0 f, 3.5 f$  and  $4.0 f$ .
- (f) Tabulate your results including columns for  $u, v$  and  $(v+u)$ .
- (g) Plot a graph of  $(u + v)$  against  $u$ . Read from the graph the minimum value of  $(u + v)$ . Call this value  $y$ . Read the value of  $u$  when  $(u + v)$  is minimum. Call this value  $x$ .
- (h) Calculate the focal length  $f_1$  of the lens using  $y = 4f_1$
- (i) Calculate the focal length  $f_2$  of the lens using  $x = 2f_2$
- (j) Calculate the average focal length  $f$  of  $f_1$  and  $f_2$ .