

State Examinations Commission – Physics Higher Level, 2003.

Question 3.

The following is part of a student’s report of an experiment to measure the focal length of converging lens.

“I found the approximate focal length of the lens to be 15 cm. I then placed an object at different positions in front of the lens so that a real image was formed in each case.”

The table shows the measurements recorded by the student for the object distance u and the image distance v .

u/cm	20.0	25.0	35.0	45.0
v/cm	66.4	40.6	27.6	23.2

How did the student find an approximate value for the focal length of the lens?

Describe, with the aid of a labelled diagram, how the student found the position of the image.

Using the data in the table, find an average value for the focal length of the lens.

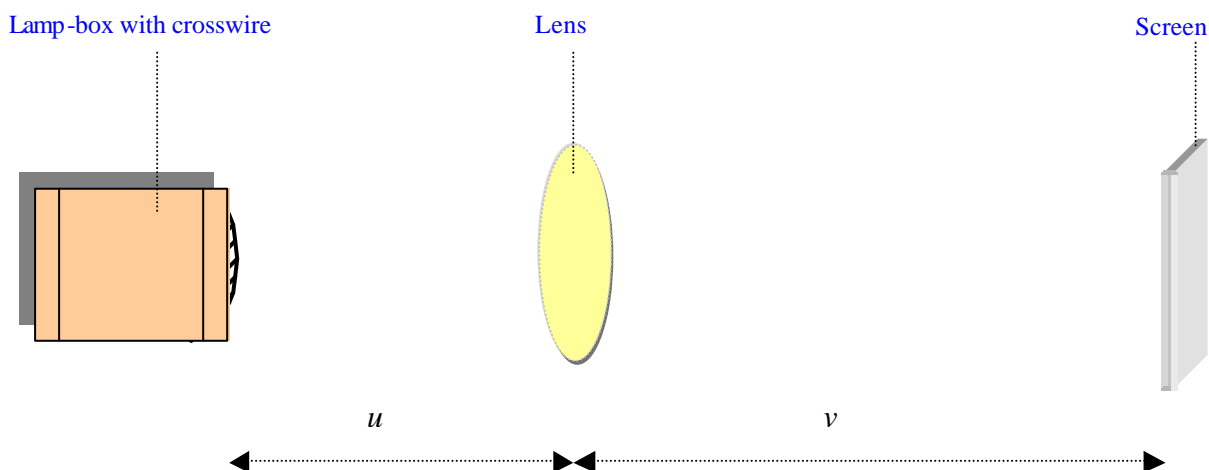
Give two sources of error in measuring the image distance and state how one of these errors can be reduced.

How did the student find an approximate value for the focal length of the lens?

By focussing a distant object (e.g. a rooftop chimney through the laboratory window) onto a screen and then measuring the distance from the lens to this screen.

Describe, with the aid of a labelled diagram, how the student found the position of the image.

The student found the position of the image by moving the screen backwards and forwards until it was sharply focussed upon it.



Using the data in the table, find an average value for the focal length of the lens.

u/cm	20.0	25.0	35.0	45.0
$1/u \text{ cm}^{-1}$	0.05	0.04	0.029	0.022
v/cm	66.4	40.6	27.6	23.2
$1/v \text{ cm}^{-1}$	0.015	0.025	0.036	0.043
$1/u + 1/v \text{ cm}^{-1}$	0.065	0.065	0.065	0.065

Average value for $1/f = 0.065 \text{ cm}^{-1}$. Therefore, Average $f = 15.4 \text{ cm}$.

Give two sources of error in measuring the image distance and state how one of these errors can be reduced.

Sources of error could be 1) reading image distance from front of lens, rather than centre of lens, to the screen and 2) error of parallax in reading of metre stick. To overcome this problem in the reading of the metre stick you should ensure that you are positioned perpendicular to the stick when recording the position of the screen. If the image is not sharply focussed the image distance recorded will obviously be in error.