

State Examination Commission – Physics Higher Level, 2007

Question 3

In an experiment to measure the focal length of a concave mirror, an approximate value for the focal length was found. The image distance v was then found for a range of values of the object distance u . The following data was recorded

u/cm	15.0	20.0	25.0	30.0	35.0	40.0
v/cm	60.5	30.0	23.0	20.5	18.0	16.5

How was an approximate value for the focal length found?

What was the advantage of finding the approximate value for the focal length?

(10)

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

(12)

Calculate the focal length of the concave mirror by drawing a suitable graph based on the recorded data.

(18)

How was an approximate value for the focal length found?

By focusing a distant object onto a screen and measuring the distance from the mirror to the screen

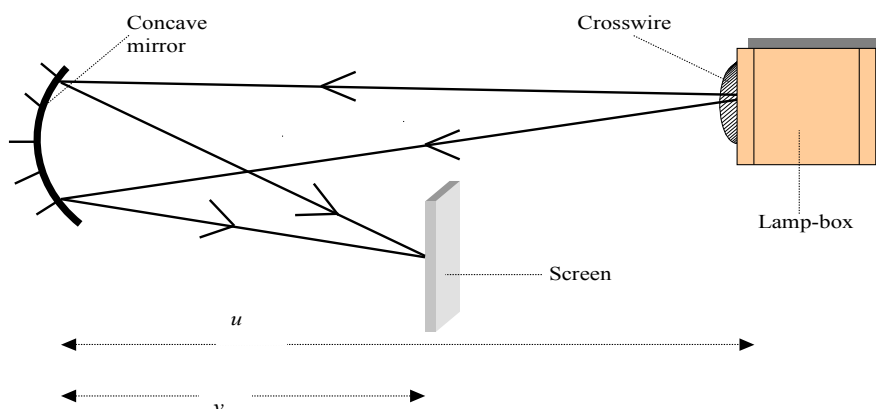
What was the advantage of finding the approximate value for the focal length?

(10)

To help confirm the final answer and also to learn what distance the object should be placed, at the very least, from the mirror. (Placing object inside focus yields a virtual image which cannot be placed on screen)

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

(12)



The apparatus was set up as illustrated in the diagram.

The screen was moved back and forth until a sharp image of the cross-hairs from the lamp box appeared on it.

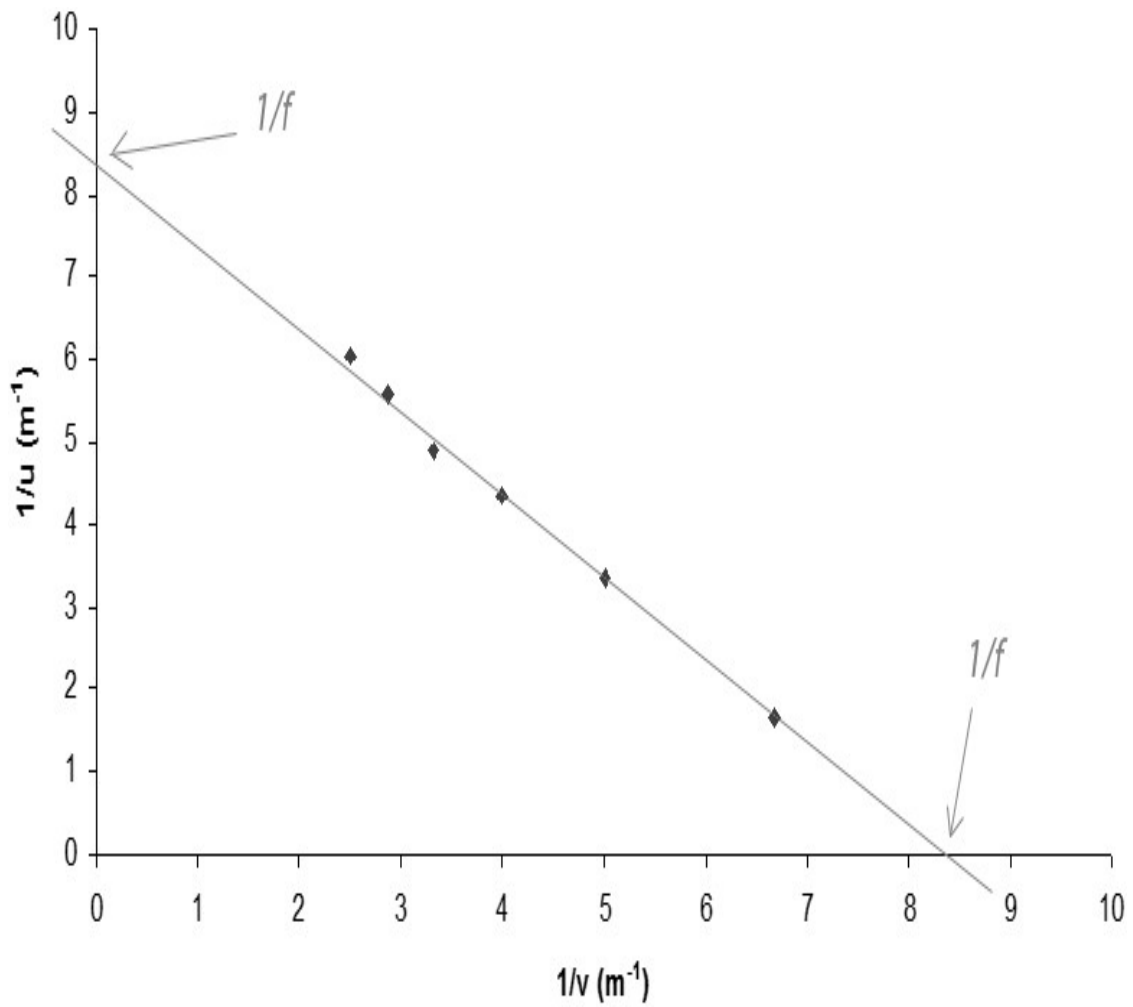
The distance from the screen to mirror was then measured. This is v .

Calculate the focal length of the concave mirror by drawing a suitable graph based on the recorded data.

(18)

u/m	0.150	0.200	0.250	0.300	0.350	0.400
v/m	0.605	0.300	0.230	0.205	0.180	0.165
$1/u \text{ m}^{-1}$	6.67	5.00	4.00	3.33	2.86	2.50
$1/v \text{ m}^{-1}$	1.65	3.33	4.35	4.88	5.56	6.06

A graph of $1/u$ was plotted against $1/v$ as shown below.



The graph should make equal intercepts with both axes, the value of this intercept being $1/f$. Our intercepts are 8.4 and 8.3, giving an average of 8.35 m⁻¹

$$\begin{aligned} \text{i.e., } 1/f &= 8.35 \text{ m}^{-1} \\ \Rightarrow f &= 0.12 \text{ m}^{-1} = 12 \text{ cm} \end{aligned}$$