Oxford Cambridge and RSA

A level Physics B

H557/03 Practical skills in physics

Question Set 4

1 (a) (i) This question is about determining the focal length of a converging lens using the apparatus shown in **Fig. 1.1**.

u is the distance between the lens and the object and *v* is the distance between the lens and the image.

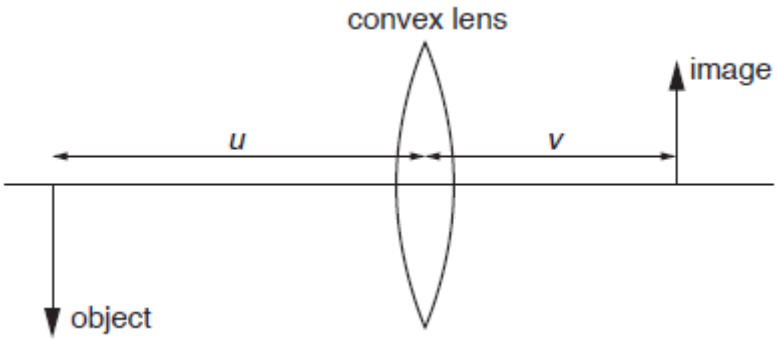

Fig. 1.1

Fig. 1.2 shows some data taken by a student.

u / m ± 1 mm	*v* / m ± 5 mm
−0.500	0.220
−0.475	0.230
−0.450	0.230
−0.425	0.240
−0.400	0.250
−0.375	0.260
−0.350	0.270
−0.325	0.290
−0.300	0.310
−0.275	0.340
−0.250	0.390
−0.225	0.480
−0.200	0.660

Fig.1.2

State which measurement, *u* or *v*, has the greatest absolute uncertainty and suggest why this is the case.

[1]

To assess the reliability of the experiment, the student decided to repeat one measurement (with value of u equal to −0.250) multiple times. These data are shown below in **Fig. 1.3** in a dot-plot, the points at 0.330 and 0.430 are potential outliers.

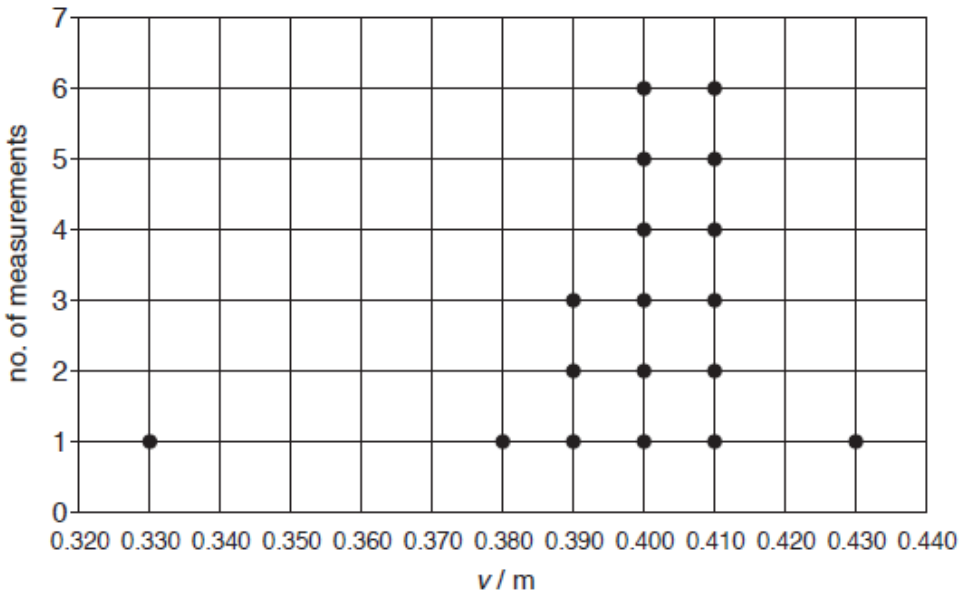

Fig. 1.3

(ii) Ignoring the two potential outliers, calculate the range of the typical values on the dot-plot.

range = ... m

[1]

(iii) Calculate the mean of the values within the range calculated in **(a)(ii)**. Mark this on the dot-plot above.

mean = ... m **[2]**

(iv) The spread of data is given by; *spread* = ± ½ *range*. A measurement can be considered to be an outlier if it is more than twice the spread from the mean. State whether you consider either of the points; 0.330 or 0.430 to be outliers and explain your reasoning.

[2]

(b) **Fig. 1.4** shows a plot of magnification *m* against *v* for the data from **Fig. 1.2**. The last two points are missing from the graph. The uncertainties are too small to be shown on this graph.

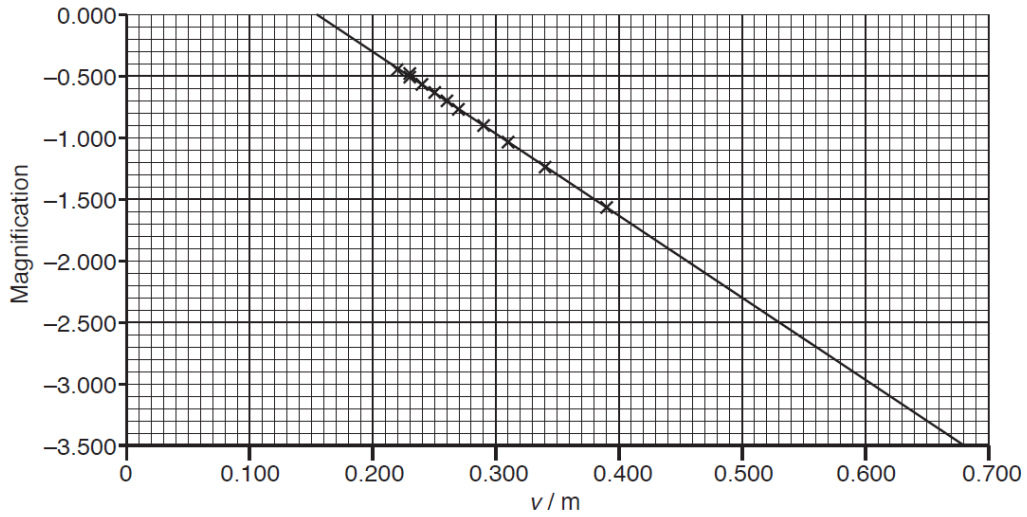

Fig. 1.4

(i) The last two points from **Fig. 1.2** have not been plotted. Complete **Fig. 1.5** below, adding the last two magnification values.

u **/ m**	***v*** **/ m**	***m***
−0.225	0.480	
−0.200	0.660	

Fig. 1.5

[2]

(ii) Add the remaining points to the graph. **[1]**

(iii) Use $\frac{1}{v} = \frac{1}{u} + \frac{1}{f}$ to show that $m = -\frac{v}{f} + 1$.

[2]

(iv) Use data from the graph to calculate the focal length *f* of the lens.

f = ... m **[2]**

(c) A second converging lens of different focal length is used to form an image. Data for the second lens is displayed in **Fig. 1.6**.

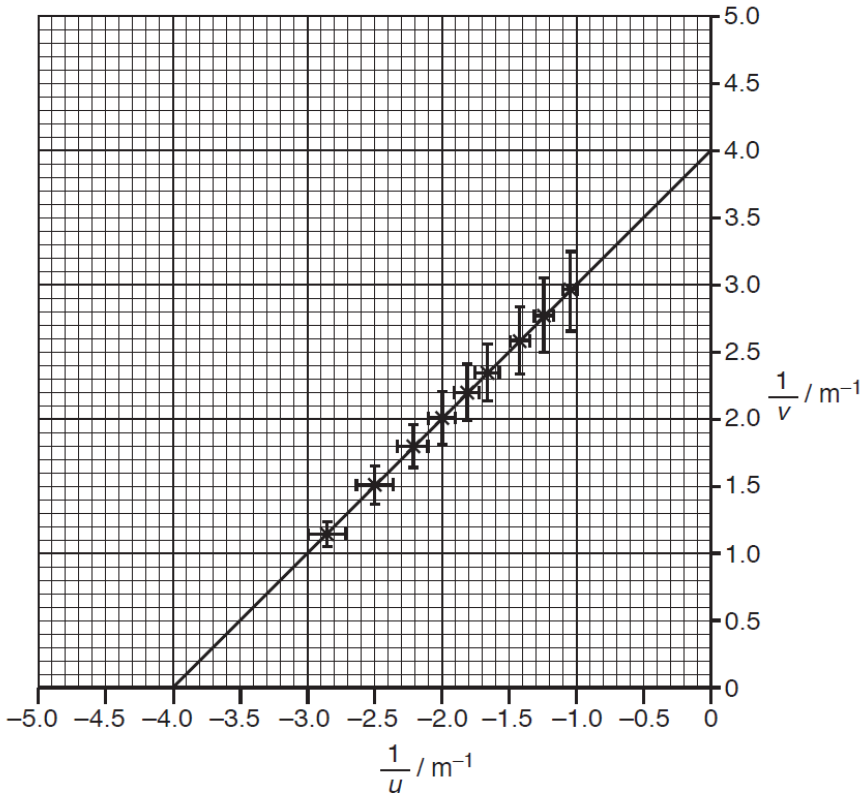

Fig. 1.6

(i) Use **Fig. 1.6** to determine the power of this lens.

Power = ... dioptre

[1]

(ii) Use the uncertainty bars on **Fig. 1.6** to determine the maximum and minimum values forthe power of the lens. Use these values to determine the percentage uncertainty in the power of the lens.

Maximum power value =..... dioptre

Minimum power value = ...dioptre

Percentage uncertainty = ...%

[4]

Total Marks for Question Set 4: 18