

Please check the examination details below before entering your candidate information

Candidate surname					Other names				
Centre Number					Candidate Number				

**Pearson Edexcel International Advanced Level**

**Monday 22 January 2024**

Morning (Time: 1 hour 20 minutes)      Paper reference **WPH16/01**

**Physics**

**International Advanced Level**

**UNIT 6: Practical Skills in Physics II**

**You must have:**  
Scientific calculator, ruler

Total Marks

## Instructions

- Use **black** ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B).
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided  
– *there may be more space than you need.*
- **Show all your working out** in calculations and **include units** where appropriate.

## Information

- The total mark for this paper is 50.
- The marks for **each** question are shown in brackets  
– *use this as a guide as to how much time to spend on each question.*
- The list of data, formulae and relationships is printed at the end of this booklet.

## Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ►

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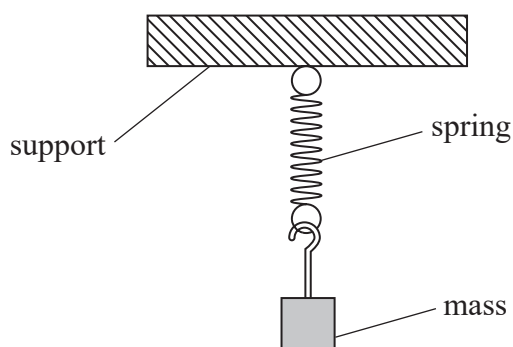
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**Answer ALL questions.**

- 1 A student investigated the oscillations of a stretched spring using the apparatus shown.

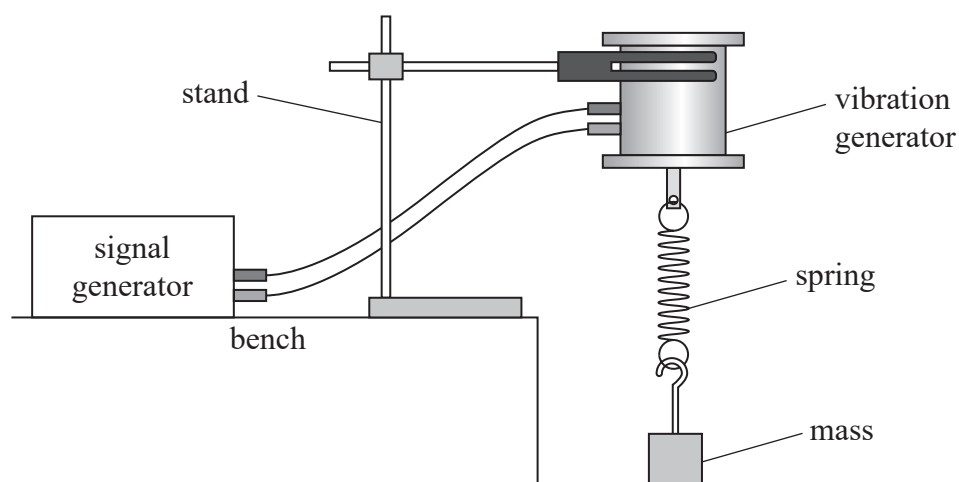


- (a) The student gave the mass a small vertical displacement and released it. She used a stopwatch to determine the time period  $T$  of the oscillations.

Describe how the student should determine an accurate value for  $T$ .

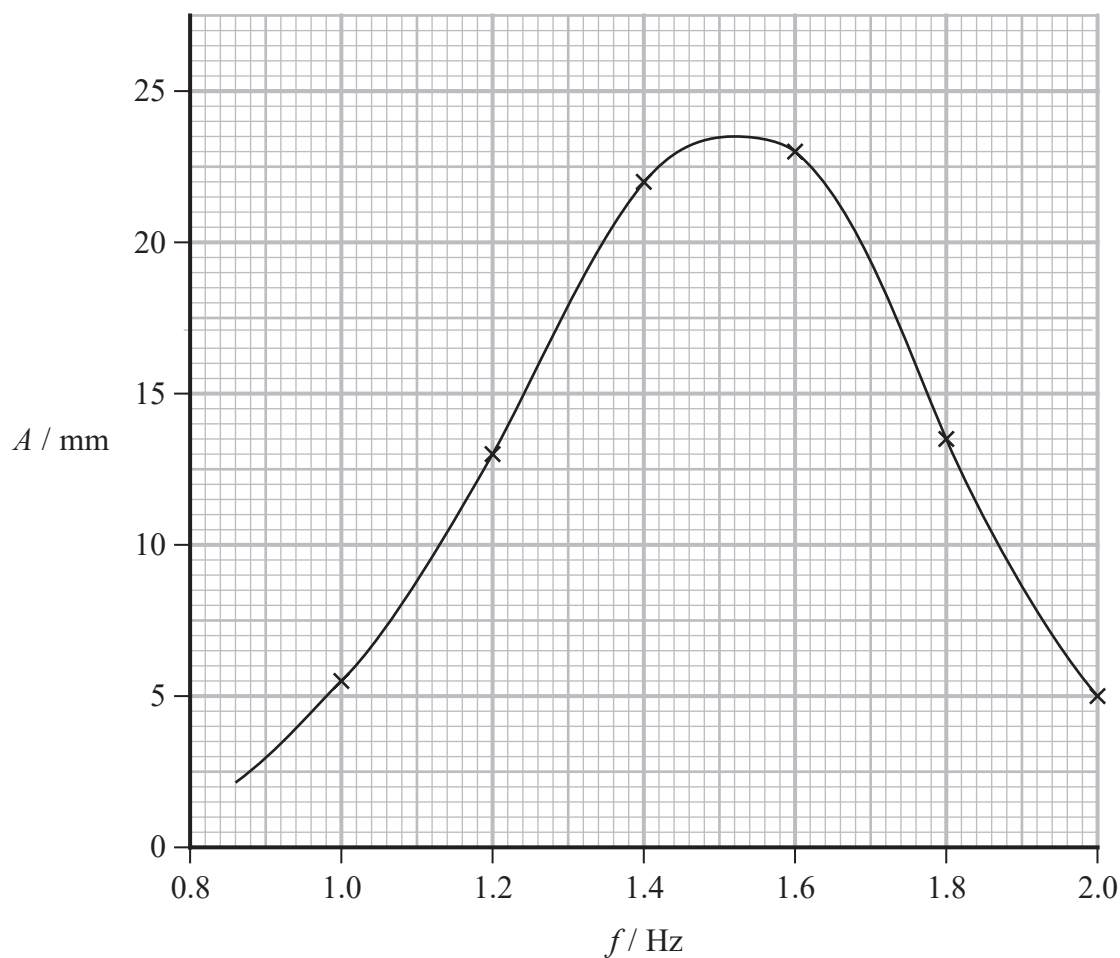
(3)

- (b) The student attached the spring to a vibration generator as shown.



The student used the signal generator to vary the frequency  $f$  of the forced oscillations.

The student measured the amplitude  $A$  of the oscillations at different values of  $f$ , near the resonant frequency  $f_0$ . She plotted a graph of her results as shown.



(i) Determine the value of  $f_0$  from the graph.

(1)

$f_0 = \dots\dots\dots$



(ii) Determine the value of the mass.

$$k = 30 \text{ N m}^{-1}$$

(3)

Mass = .....

(iii) Explain why your value of  $f_0$  may not be accurate.

(2)

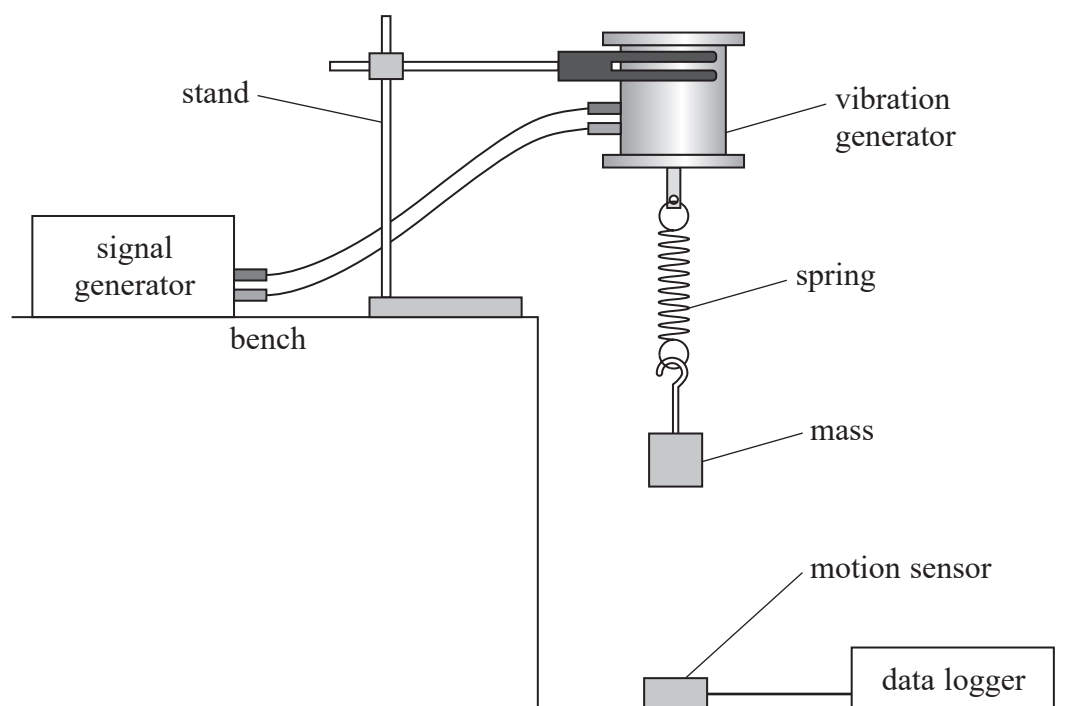
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- (c) The student suggested that a motion sensor and data logger, arranged as shown, would improve the experiment.

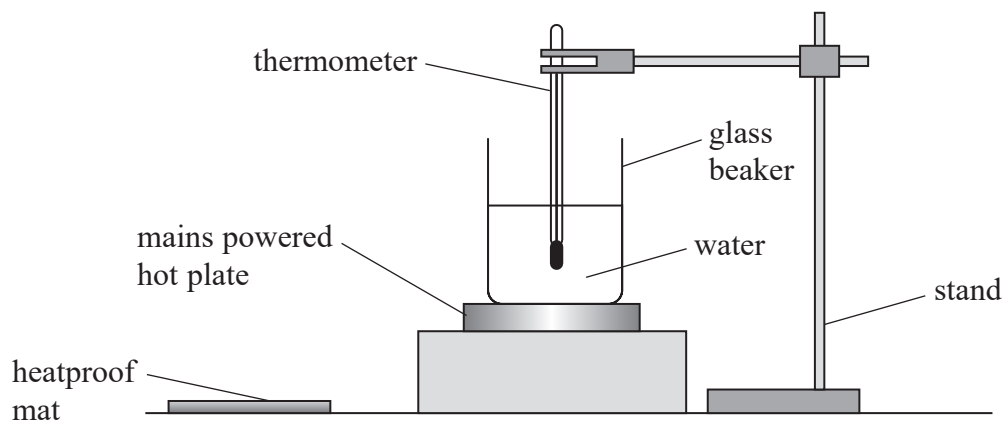


Explain how using a motion sensor and data logger would improve the experiment.

(2)

(Total for Question 1 = 11 marks)

- 2 A student investigated the cooling of hot water using the apparatus shown.



- (a) The student used the hot plate to heat the water until it boiled.  
He moved the glass beaker onto the heatproof mat to allow the water to cool.  
Identify **one** safety issue and how it may be dealt with.

(2)

- (b) The student suggested that the relationship between the temperature  $\theta$  of the water and time  $t$  is

$$\theta = \theta_0 e^{-bt}$$

where  $\theta_0$  is the initial temperature of the water and  $b$  is a constant.

Devise a method to investigate the validity of this relationship.

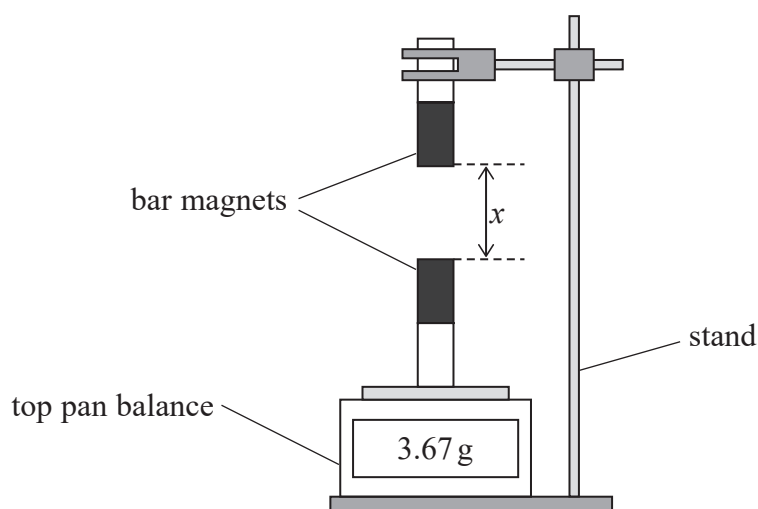
Your method should use a suitable graph.

(6)

(Total for Question 2 = 8 marks)



- 3 A student investigated the force  $F$  between two bar magnets, using the apparatus shown. The magnets are separated by a distance  $x$ .



- (a) Describe an accurate method to measure a single value of  $x$  using a 30 cm ruler.

You should include any additional apparatus.

(3)

- (b) The student predicted that the relationship between  $F$  and  $x$  was of the form

$$F = kx^p$$

where  $k$  and  $p$  are constants.

Explain how a graph of  $\log F$  against  $\log x$  can be used to determine the value of  $p$ .

(2)



- (c) The student varied the distance  $x$  and determined the corresponding force  $F$ . He recorded the following data.

$x / \text{mm}$	$F / \text{mN}$		
102	11.22		
117	7.56		
128	5.25		
145	3.43		
166	2.09		
197	1.18		

- (i) Plot a graph of  $\log F$  against  $\log x$  on the grid opposite.

Use the additional columns for your processed data.

(6)

- (ii) Determine the gradient of the graph.

(3)

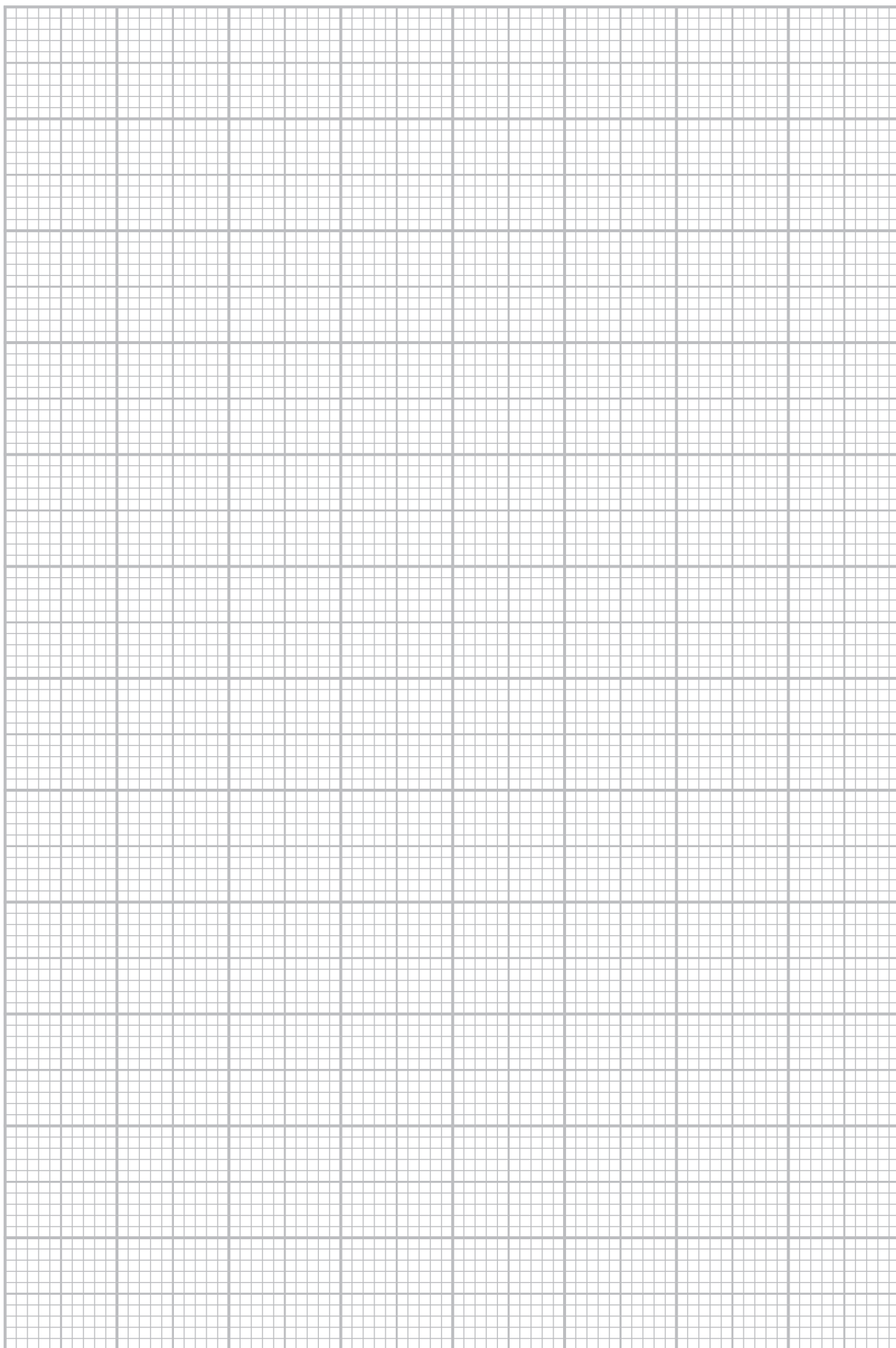
Gradient = .....



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- (iii) The student suggested that the relationship between  $F$  and  $x$  is an inverse square relationship.

Explain whether the graph supports this suggestion.

(3)

(Total for Question 3 = 17 marks)

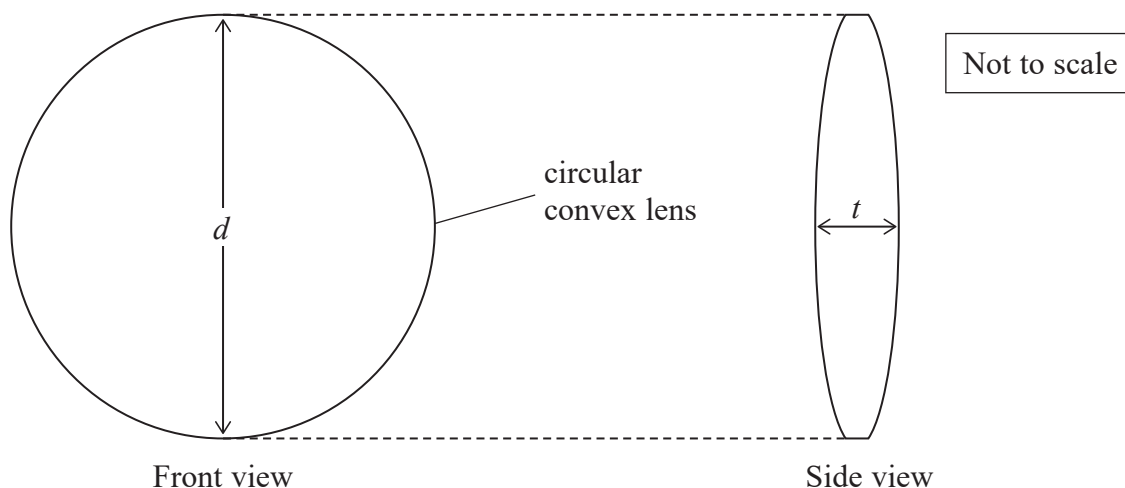
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- 4 A student made measurements of a circular convex lens, as shown.



- (a) (i) The student used vernier calipers to measure the diameter  $d$ .

Explain **one** technique she should use to measure  $d$ .

(2)

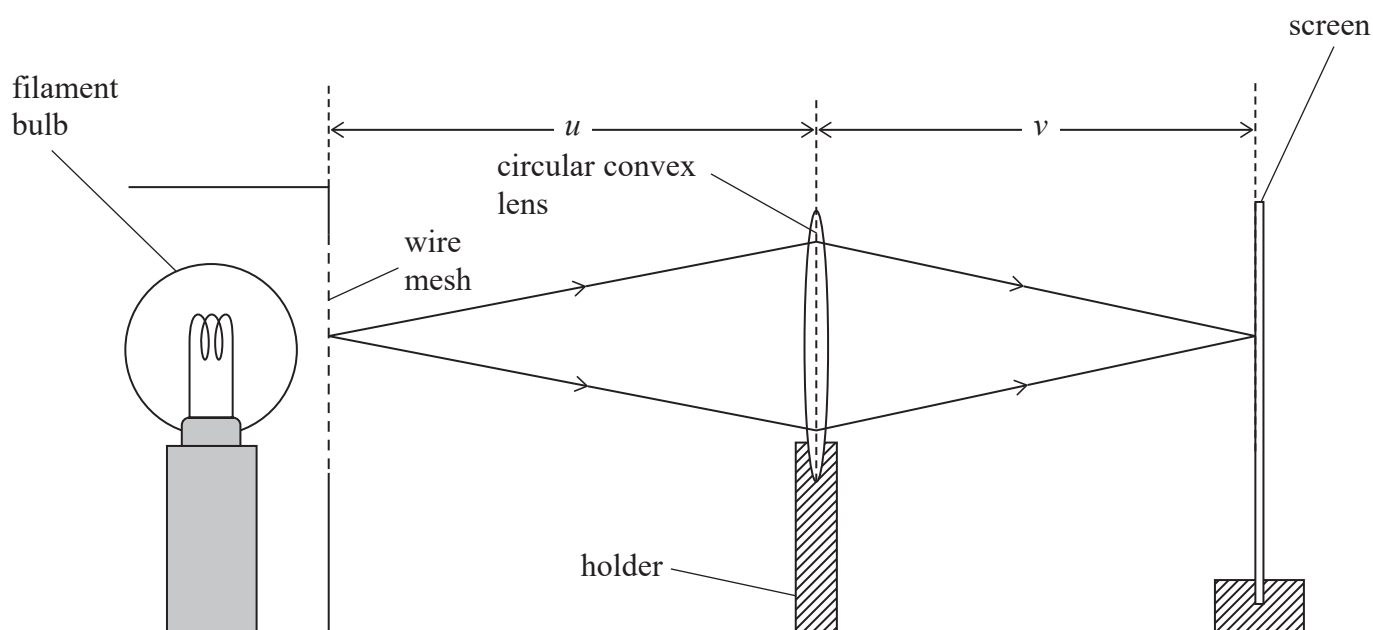
- (ii) The student estimated that the thickness  $t$  of the centre of the lens was approximately 5 mm.

Explain the most appropriate instrument the student should use for a single measurement of  $t$ .

Your answer should include a calculation.

(2)

- (b) The student placed the circular convex lens in a holder. She set up the apparatus, as shown.



The student moved the position of the holder until the lens formed a sharp image of the wire mesh on the screen. She measured the distances  $u$  and  $v$  with a metre rule.

The student determined the focal length  $f$  of the lens using the formula

$$f = \frac{uv}{u + v}$$

Show that the uncertainty in  $f$  is about 0.2 cm.

$$u = 29.6 \text{ cm} \pm 0.1 \text{ cm}$$

$$v = 19.2 \text{ cm} \pm 0.1 \text{ cm}$$

$$f = 11.6 \text{ cm}$$

(4)



- (c) The refractive index of the material used to make the lens is determined using the formula

$$n = 1 + \frac{d^2}{8tf}$$

$$d = 5.02 \text{ cm} \pm 0.02 \text{ cm}$$

$$t = 4.28 \text{ mm} \pm 0.01 \text{ mm}$$

$$f = 11.6 \text{ cm} \pm 0.2 \text{ cm}$$

- (i) Determine the value of  $n$ .

(2)

$$n = \dots\dots\dots$$

- (ii) Determine the percentage uncertainty in  $n$ .

(2)

$$\text{Percentage uncertainty in } n = \dots\dots\dots$$

- (iii) The refractive index of crown glass is 1.52

Deduce whether the lens could be made of crown glass.

(2)

(Total for Question 4 = 14 marks)

TOTAL FOR PAPER = 50 MARKS

