Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International Advanced Level

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.
- **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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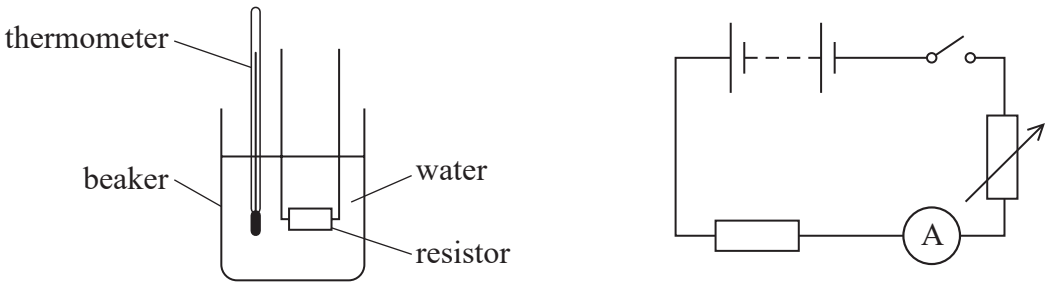
Pearson

Answer ALL questions.

1 A wire-wound resistor can become hot when there is a current in it. This heating effect can be investigated using the apparatus shown.



A student investigated whether the temperature rise of the water $\Delta\theta$ was proportional to the current I in the resistor. For each value of current, the student refilled the beaker with water at the same initial temperature.

(a) (i) Identify two other control variables for this investigation.

(2)

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(ii) The student recorded the following data.

I/A	1.5	2	2.5	3
$\Delta\theta$	3.5	7	9.5	15

Criticise the recording of this data.

(3)

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(b) Explain one improvement the student could make to reduce the uncertainty in the measurement of $\Delta\theta$ for each value of I.

(2)

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(Total for Question 1 = 7 marks)

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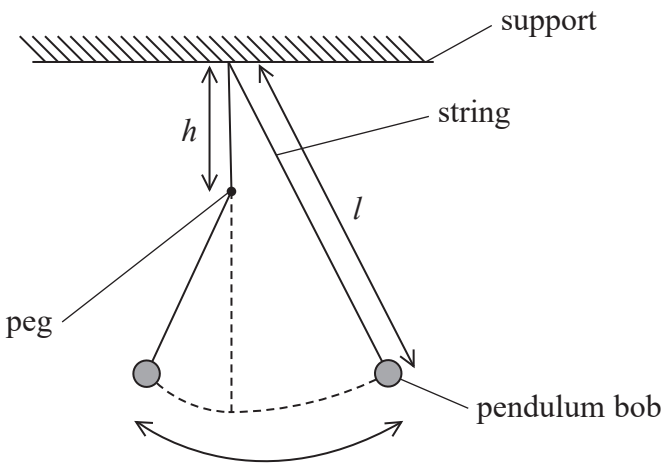
2 A pendulum of length l swings in a vertical plane. The string hits a peg placed at a distance h vertically below the point of suspension as shown. This makes the pendulum shorter for part of its motion.



(a) Determine the time period T for the whole oscillation when $h = 0.25\,\text{m}$.

$l = 1.00\,\text{m}$

(3)

$T =$ .....

(b) A student suggests that an approximate relationship between T and h is given by

$$T^2 = \frac{\pi^2}{g}(2l - h)$$

Devise a plan to test the validity of the relationship using a graphical method. Include the use of a stopwatch and any additional apparatus as required.

(6)

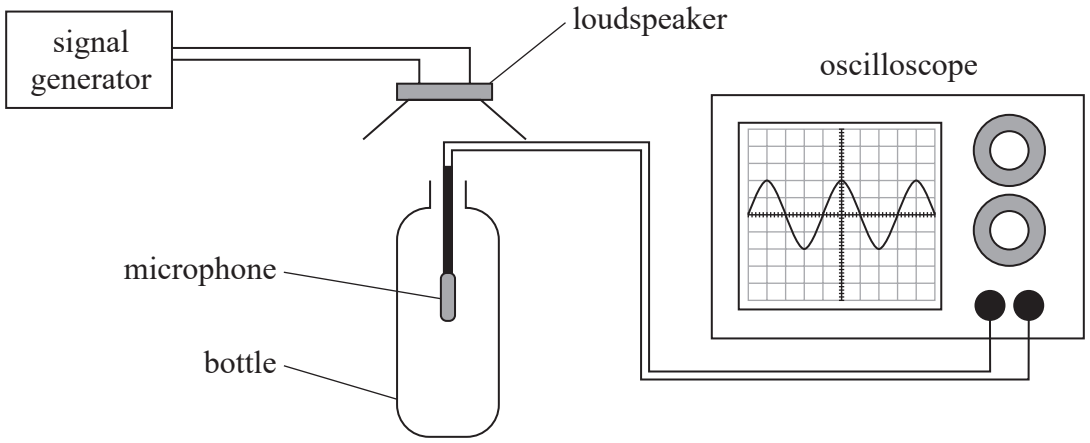
(c) Another student suggests determining T by setting up a light gate attached to a data logger.

Discuss whether this modification would improve the investigation.

(3)

(Total for Question 2 = 12 marks)

3 A student investigated standing waves using the apparatus shown.



The signal generator was adjusted until a loud sound was heard at a particular frequency, known as the resonant frequency.

(a) Describe how the student should use the oscilloscope to identify the resonant frequency and determine its value.

(4)

(b) The student reduced the volume V of air inside the bottle by adding known volumes of water. He recorded the following values of the resonant frequency f for each value of V.

V / cm^3	f / Hz		
576	221		
476	244		
376	275		
276	323		
176	408		
126	485		

(i) Plot a graph of $\log f$ against $\log V$ on the grid opposite. Use the additional columns in the table to record your processed data.

(6)

(ii) It is suggested that the relationship between f and V is given by

$$f = kV^{-\frac{1}{2}}$$

where k is a constant.

Discuss whether the graph supports this suggestion.

(5)

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(Total for Question 3 = 15 marks)

4 An L-shaped steel rod was held horizontally in a stand clamped by its shorter end as shown.

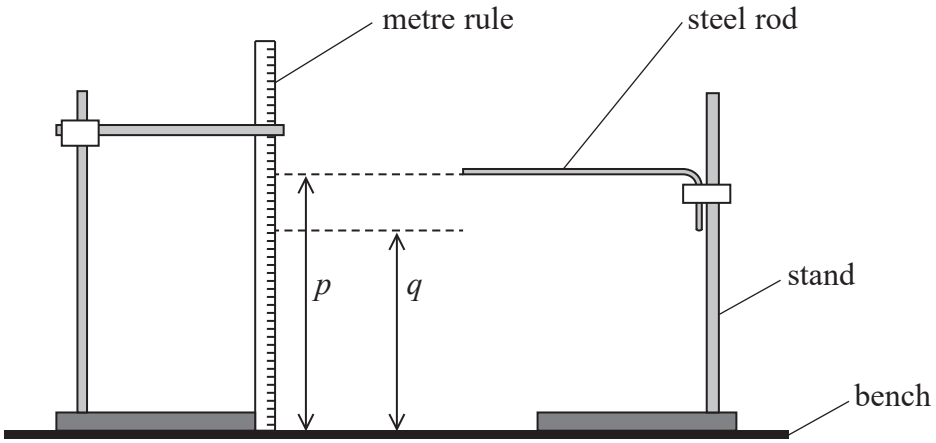

Diagram not to scale

The end of the steel rod was at a height p above the bench.

A student attached a mass m to the end of the steel rod causing it to bend towards the bench. The end of the steel rod was then at a height q above the bench.

(a) (i) Describe two techniques she should use when measuring p and q.

(2)

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(ii) The difference between p and q was recorded as 26 mm ± 1 mm.

Explain why the uncertainty in this value is given as 1 mm.

(2)

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(b) The steel rod had a circular cross-section with a diameter d of approximately 2 mm.

(i) Explain the most appropriate instrument the student should use to measure d.

(2)

(ii) Explain one technique that she should use to measure d.

(2)

(iii) She recorded the following measurements.

d / mm				
2.35	2.37	2.34	2.35	2.33

Calculate the mean value of d in mm and its uncertainty.

(2)

Mean value of d = ... mm ± ..... mm

(c) The shear modulus G is a measure of a material's resistance to bending, and is given by

$$G = \frac{32mglx^2}{\pi yd^4}$$

where m is the mass attached to the end of the rod and y is the vertical deflection.

l and x are the lengths as shown below.

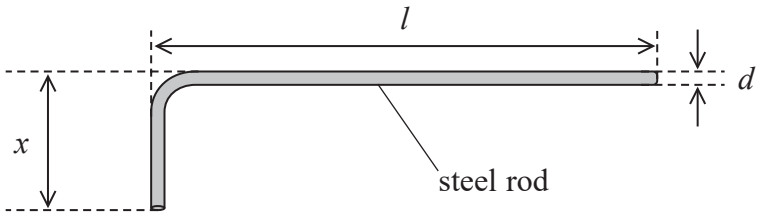

Diagram not to scale

Determine a value of G for steel in $\mathrm{N\,m^{-2}}$.

m = 100 g with negligible uncertainty
l = 58.9 cm ± 0.1 cm
x = 10.3 cm ± 0.1 cm
y = 26 mm ± 1 mm

(2)

G = ... $\mathrm{N\,m^{-2}}$

(d) The table shows values of G for different types of steel.

Type of steel	Structural steel	Carbon steel
$G / 10^9\ \mathrm{N\ m^{-2}}$	79.3	77.0

Deduce whether the data provided in part (c) would allow the student to determine the type of steel the rod was made from.

(4)

(Total for Question 4 = 16 marks)

TOTAL FOR PAPER = 50 MARKS