Do not write outside the box

2 9 A wire is made from a material of Young modulus E.
The wire obeys Hooke's law.
The wire has an unstretched length L and a cross-sectional area A.
When a force is applied to the wire, the extension of the wire is e.

What is the elastic strain energy stored in the wire?

[1 mark]

A $\dfrac{AEe^2}{2L}$ ◯

B $\dfrac{L}{2Ae}$ ◯

C $\dfrac{Ae^2}{2EL}$ ◯

D $\dfrac{AEL}{2e}$ ◯

3 0 As the temperature of a copper wire increases, its resistance

[1 mark]

A remains constant. ◯

B increases. ◯

C decreases. ◯

D remains constant at first and then decreases. ◯

3 1 A $12\ \Omega$ resistor is connected across the terminals of a cell that has an emf of 2.0 V and an internal resistance of $4.0\ \Omega$.
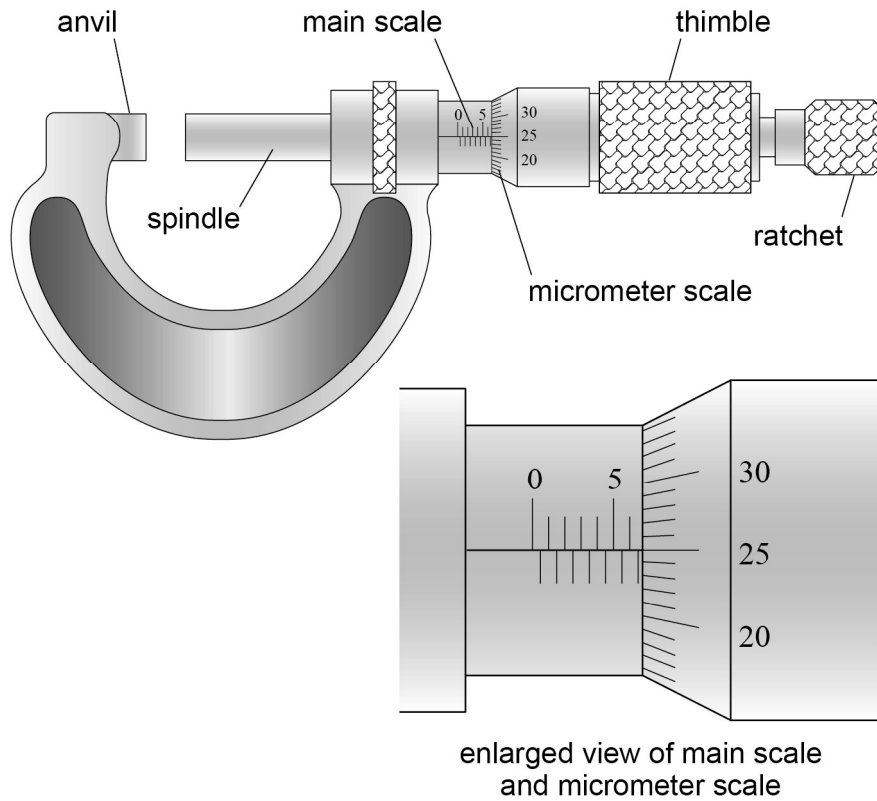
What is the terminal pd?

[1 mark]

A 0.50 V ◯

B 0.75 V ◯

C 1.30 V ◯

D 1.50 V ◯

Turn over ▶

Section A

Answer **all** questions in this section.

0 1 . 1 **Figure 1** shows a micrometer screw gauge.

Figure 1

enlarged view of main scale
and micrometer scale

What is the reading on the micrometer?

Tick (✓) **one** box.

[1 mark]

6.25 ☐

6.75 ☐

7.25 ☐

8.25 ☐

0 1 . 2 A metal wire of diameter d is held in the gap between the anvil and the spindle.
Just before the reading of d is taken, the gap is closed using the ratchet and not the
thimble.

Explain why the gap is closed in this way.

[1 mark]

_____

_____

_____

0 1 . 3 The mass per unit length μ of the metal wire is given by

$$\mu = \frac{\pi \rho d^2}{4}$$

where ρ is the density of the metal.

Values of d and μ are used to calculate ρ.

The percentage uncertainty in d is 1.2%.
The percentage uncertainty in μ is 2.0%.

Calculate the percentage uncertainty in the result for ρ.

[2 marks]
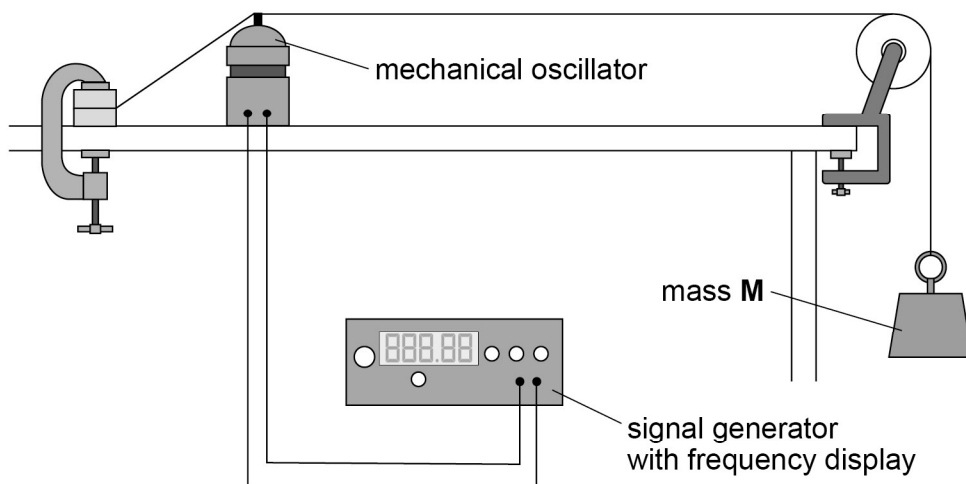
percentage uncertainty = _____ %

Question 1 continues on the next page

Turn over ▶

Figure 2 shows apparatus used to investigate how the frequency of stationary waves on a wire depends on its diameter d.

Figure 2

When the signal generator is switched on, the horizontal part of the wire oscillates.

A student changes the frequency until the first-harmonic stationary wave is produced. The student records the frequency f of the first harmonic and then turns off the signal generator.
She removes the wire and measures d using a micrometer.

She then repeats the experiment for wires of different diameter.

0 1 . 4 The wires used in the experiment are made of the same metal so that ρ is a control variable.
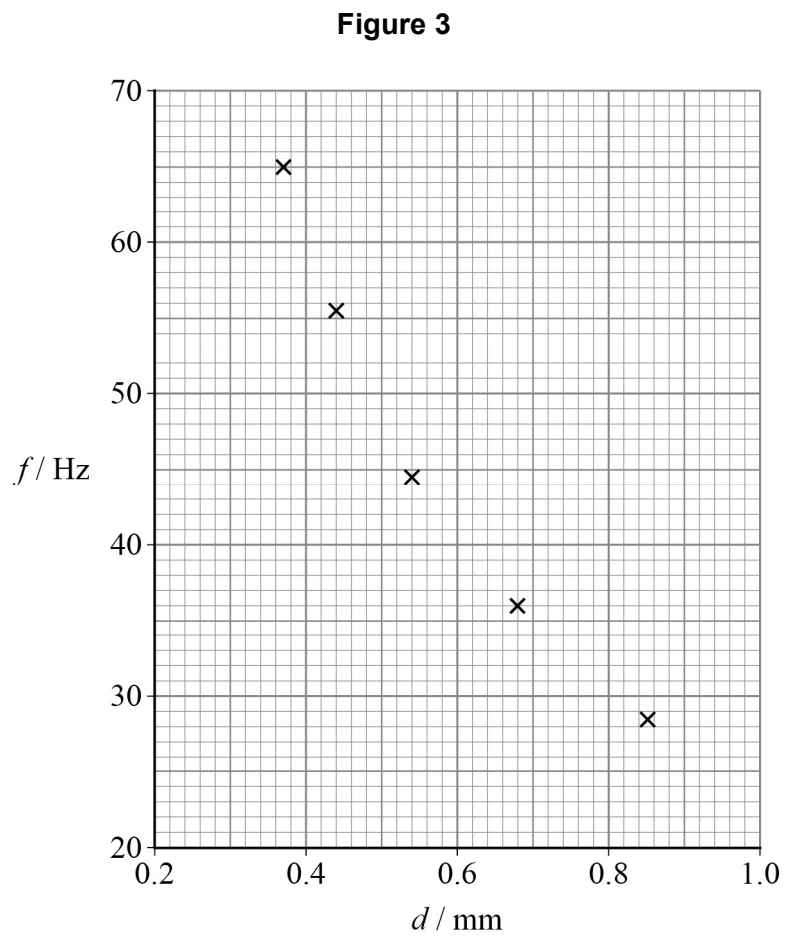
State **two** other control variables in the experiment.

[2 marks]

1 _____

_____

2 _____

_____

Figure 3 is a plot of the experimental data.

Figure 3

f / Hz

d / mm

0 1 . 5   The student suggests that $f \propto \dfrac{1}{d}$.

Deduce, using data points from **Figure 3**, whether this suggestion is correct.

[2 marks]

Question 1 continues on the next page

Turn over ▶

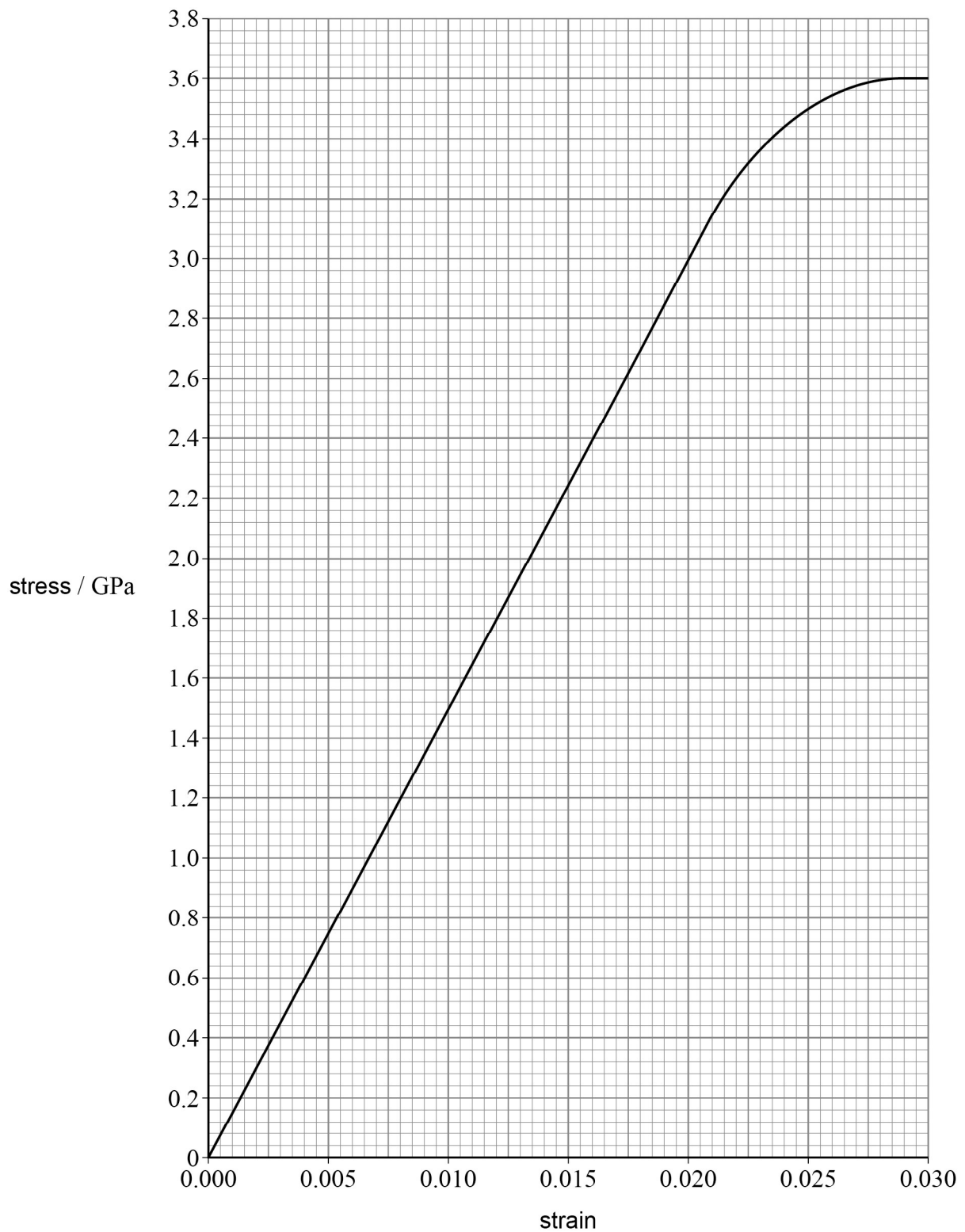**0 1 . 6** Another student repeats the experiment with the mass of **M** doubled.

Explain how this student's plotted data compare with **Figure 3**.

[2 marks]

_____

_____

_____

_____

_____

_____

_____

10

2 7 The graph shows the variation of stress with strain for a material.

What is the Young modulus of the material?

[1 mark]

A 1.2×10^5 Pa ⬭

B 1.5×10^5 Pa ⬭

C 1.2×10^{11} Pa ⬭

D 1.5×10^{11} Pa ⬭

2 8 Which row shows the resistance of an ideal ammeter and of an ideal voltmeter?

[1 mark]

	Resistance of ammeter	Resistance of voltmeter	
A	zero	zero	⬭
B	zero	infinite	⬭
C	infinite	zero	⬭
D	infinite	infinite	⬭

2 9 The current in a resistor is 15 mA.

How many electrons pass through the resistor in 3 minutes?

[1 mark]

A 2.8×10^{17} ⬭

B 1.7×10^{19} ⬭

C 2.8×10^{20} ⬭

D 1.7×10^{22} ⬭

Turn over ▶