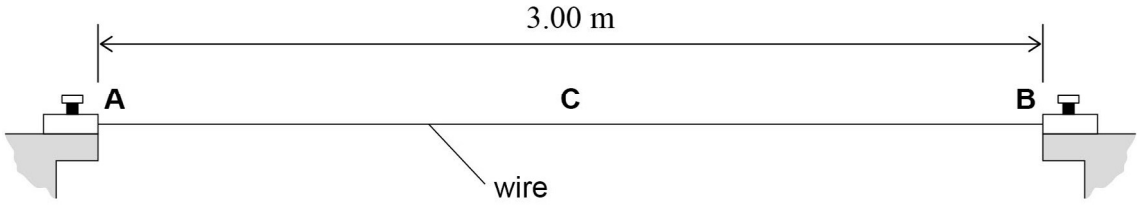
Do not write outside the box

0 2 A student does an experiment to determine the Young modulus of a metal.
Figure 6 shows a wire made from the metal clamped at points **A** and **B** so that the wire is horizontal. The horizontal distance between **A** and **B** = 3.00 m.
C is the mid-point on the wire between **A** and **B**.

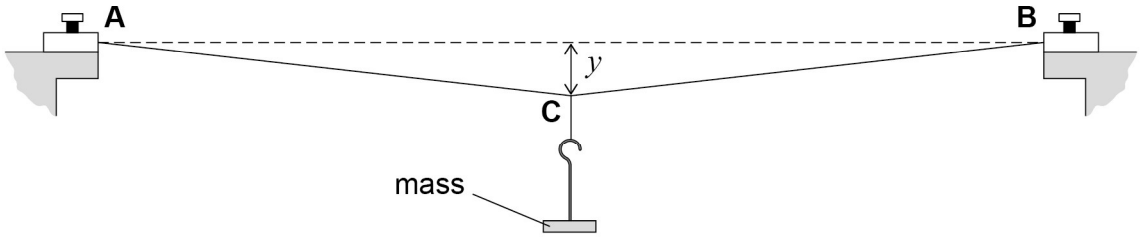
Figure 6



A mass of weight W is suspended at **C** to extend the wire. **Figure 7** shows that **C** moves vertically downwards by a distance y.

Figure 7

not to scale



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0 2 . 1 When W is 1.0 N, y is 6.34 cm.

Show that the wire extends by approximately 3 mm.

[1 mark]

0 2 . 2 Calculate the tension in the wire when W is 1.0 N.

[2 marks]

tension = _____ N

Question 2 continues on the next page

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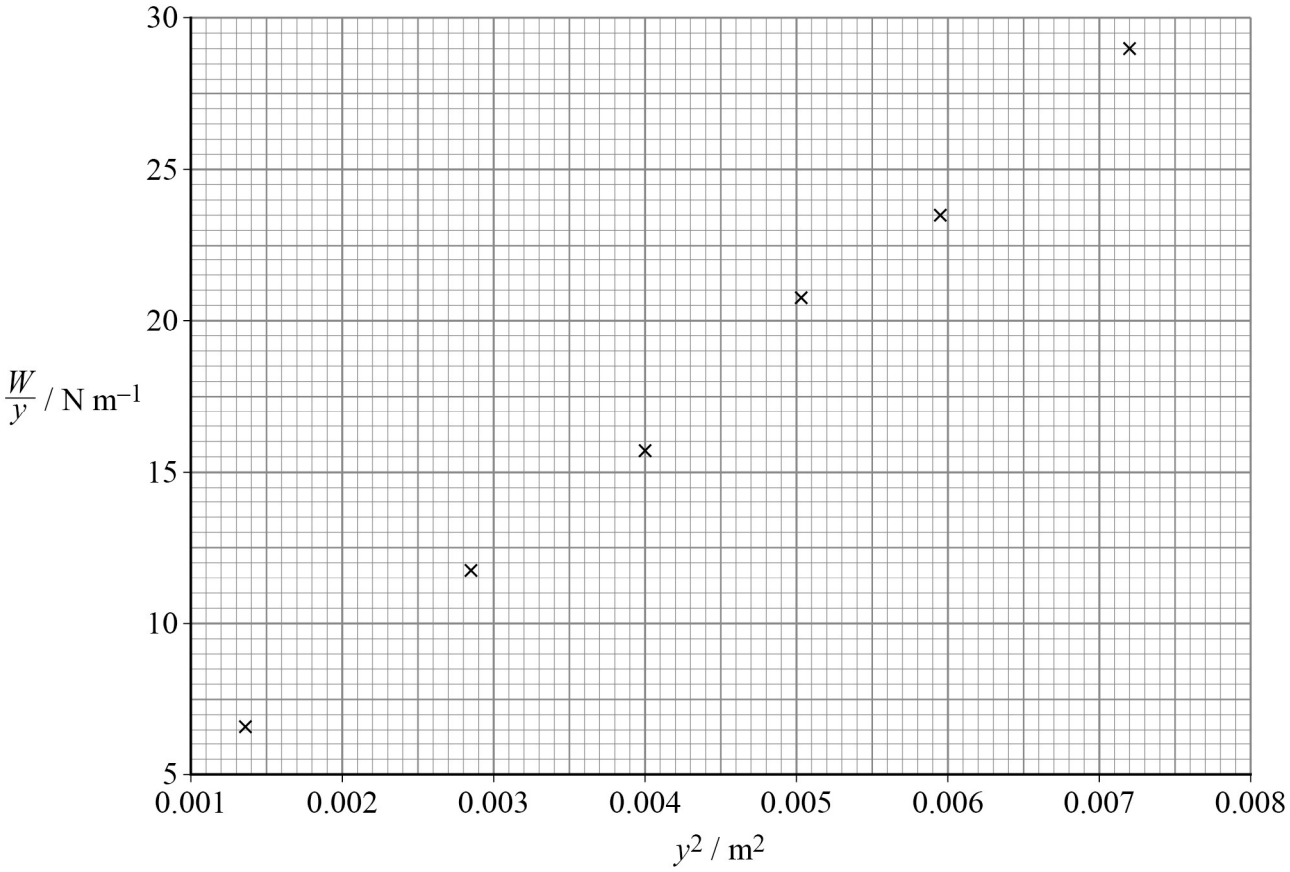
It can be shown that

$$\frac{W}{y} = \frac{EAy^2}{x^3} + k$$

where E = Young modulus of the metal
$A = 1.11 \times 10^{-7}$ m^2
$x = 1.50$ m
k = a constant.

A student measures y for different values of W and plots the graph shown in **Figure 8**.

Figure 8



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0 2 . 3 Determine E using **Figure 8**.

[4 marks]

$E =$ _____ Pa

0 2 . 4 Deduce the fundamental base units for k.

[1 mark]

fundamental base units for $k =$ _____

8

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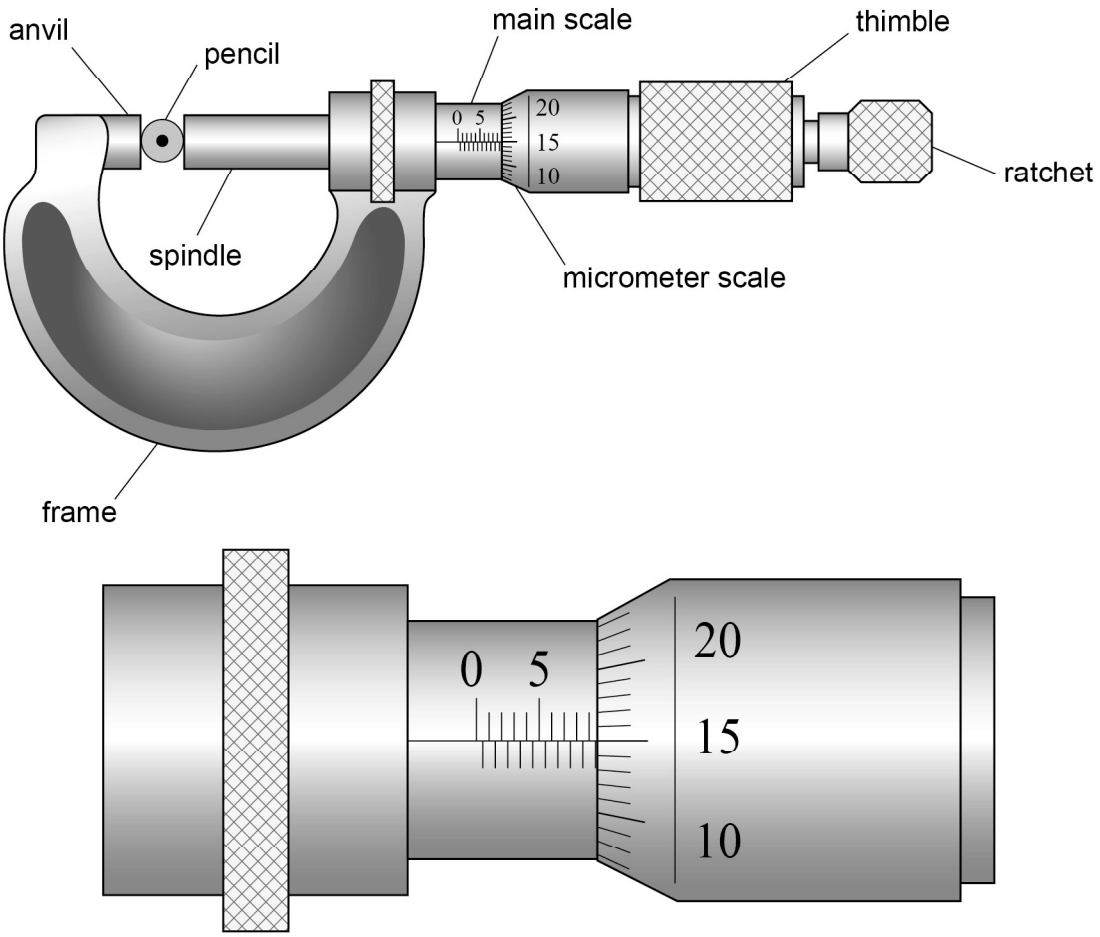
0 3 **Figure 9** shows a micrometer screw gauge used to measure the diameter of a pencil.

Figure 9



main scale and micrometer scale
shown enlarged

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0 3 . 1 State the reading on the micrometer.

[1 mark]

reading = _____ unit = _____

0 3 . 2 The micrometer has a zero error.

Describe how to determine an accurate measurement for the diameter of the pencil using this micrometer.

[2 marks]

_____

_____

_____

_____

_____

_____

_____

3

END OF SECTION A

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2 6 A mass m is added to a vertical spring that is initially unextended, as shown in **Diagram 1**.

The mass is then lowered until it hangs stationary on the spring, as shown in **Diagram 2**.

The extension of the spring is now ΔL.

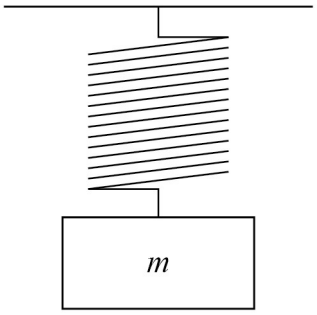

Diagram 1

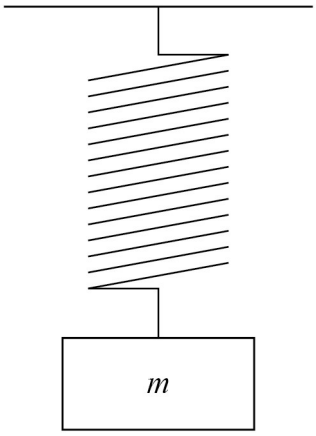

Diagram 2

How much energy is transferred from the mass–spring system?

[1 mark]

A $\frac{mg\Delta L}{2}$ ⬭

B $mg\Delta L$ ⬭

C $\frac{3mg\Delta L}{2}$ ⬭

D $2mg\Delta L$ ⬭

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3 2 A wire is made from a material of density ρ.
The wire has a mass m and an initial length L.
When the tensile force in the wire is F the extension of the wire is ΔL.

What is the Young modulus of the material?

[1 mark]

A $\frac{F\rho L^2}{m\Delta L}$ ⬭

B $\frac{FL^2}{m\rho\Delta L}$ ⬭

C $\frac{F\rho}{m\Delta L}$ ⬭

D $\frac{FmL^2}{\rho\Delta L}$ ⬭

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1 4 A mass **M** hangs in equilibrium from a vertical spring that obeys Hooke's law.
M is pulled down by $10\ \text{cm}$ and then released to oscillate about the equilibrium position.
M returns to the equilibrium position for the first time $0.50\ \text{s}$ after release.

Which row gives the amplitude and the period of the oscillations?

[1 mark]

	Amplitude / cm	**Period / s**	
A	10	1.0	⬭
B	10	2.0	⬭
C	20	2.0	⬭
D	20	1.0	⬭