A Level · OCR · Physics

8 mins 8 questions

Multiple Choice Questions

Measurements & Uncertainties

Sources of Uncertainty / Calculating Uncertainties / Determining Uncertainties from Graphs

Medium (5 questions)	/5
Hard (3 questions)	/3
Total Marks	**/8**

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Medium Questions

1 The Young modulus *E* of a metal can be determined using the expression $E = \frac{4F}{\varepsilon \pi d^2}$,

where *F* is the tension in the wire, *d* is the diameter of the wire and *ε* is the strain of the wire.

Here is some data.

Quantity	Percentage uncertainty
F	5.3
ε	1.2
d	1.0

What is the percentage uncertainty in the calculated value of *E*?

A. 2.1 %

B. 6.4 %

C. 7.5 %

D. 8.5 %

(1 mark)

2 The acoustic impedance *Z* of a material in the shape of a cube can be determined using the equation

$$Z = \frac{Mc}{L^3}$$

where *M* is the mass of the material, *L* is the length of each side of the cube and *c* is the speed of ultrasound in the material.

The percentage uncertainty in L is 1.2 % and the percentage uncertainty in c is 1.8 %. The percentage uncertainty in M is negligible. What is the percentage uncertainty in Z?

A. 2.2 %

B. 3.0 %

C. 4.2 %

D. 5.4 %

(1 mark)

3 A student is conducting an experiment to determine the spring constant k of a spring. The values measured of the force F in the spring and the extension x of the spring are:

$$F = (7.0 \pm 0.1)\ \text{N and } x = (0.094 \pm 0.001)\ \text{m}$$

The student uses the equation $F = kx$ to calculate k.

What is the percentage uncertainty in the student's value of k?

A. 0.37 %

B. 1.3 %

C. 1.5 %

D. 2.5 %

(1 mark)

4 Five measurements of the diameter of a wire at different positions along its length are shown below.

0.32 mm 0.34 mm 0.33 mm 0.32 mm 0.31 mm

What is the percentage uncertainty in the cross-sectional area of the wire?

A. 4.6 %

B. 5.2 %

C. 9.3 %

D. 18 %

(1 mark)

5 A student is calculating the speed v of a wave by measuring its wavelength λ and frequency f. The values measured by the student are:

$$f = (144 \pm 1)\ \text{Hz and } \lambda = (36 \pm 0.1)\ \text{cm}$$

The student calculates the speed using the equation $v = f\lambda$

What is the absolute uncertainty in the speed of the wave?

A. 10 cm s^{-1}

B. 30 cm s^{-1}

C. 50 cm s^{-1}

D. 70 cm s^{-1}

(1 mark)

Hard Questions

1 The diameter of a solid copper sphere is measured using a ruler to be $r = (50 \pm 0.5)$ cm and the density of copper is known to be $?_{Cu} = (8.96 \pm 0.01)$ g cm^{-3} . What is the percentage uncertainty in the mass of the copper sphere?

A. 0.51 %

B. 2.5 %

C. 1.1 %

D. 3.1 %

(1 mark)

2 The current *I* passing through a wire in terms of its area cross-sectional area *A*, electron number density *n*, the charge of an electron *e* and the mean drift velocity of electrons in the wire *v* using the formula:

$$I = Anev$$

Measurements for the current, diameter and mean drift velocity are made for a wire of circular cross-section and the value of *e* is taken to be a universal quantity with negligible uncertainty.

The current is measured to be (0.5 ± 0.01) A, the diameter of the wire is measured to be (1.00 ± 0.01) mm, and the mean drift velocity of the electrons is measured to be (0.35 ± 0.01) mm s^{-1}

What is the uncertainty in the value of the electron number density of the wire's material to one decimal place?

A. 3.0 %

B. 4.0 %

C. 5.9 %

D. 6.9 %

(1 mark)

3 A student conducted an experiment to measure the density of a liquid using a graduated cylinder. The accepted density is 1.00 g/mL. The student made the following measurements:

0.98 g/mL, 0.99 g/mL, 1.02 g/mL, 0.97 g/mL, and 1.01 g/mL

The student then made the following statements:

1. The experiment is accurate because the measured densities are close to the accepted value.

2. The experiment is precise because the measured densities are consistent with each other.

3. To improve precision, the student should increase the number of significant figures in each measurement.

Which statement, or statements, are correct?

A. Only 1

B. Only 2

C. Only 1 and 2

D. Only 2 and 3

(1 mark)