

Answer **all** the questions in the spaces provided.

- 1 (a) (i) Define *density*.

.....

.....

- (ii) State the base units in which density is measured.

..... [2]

- (b) The speed v of sound in a gas is given by the expression

$$v = \sqrt{\left(\frac{\gamma p}{\rho}\right)},$$

where p is the pressure of the gas of density ρ . γ is a constant.

Given that p has the base units of $\text{kg m}^{-1} \text{s}^{-2}$, show that the constant γ has no unit. [3]

- 2 A student uses a metre rule to measure the length of an elastic band before and after stretching it.

The lengths are recorded as

length of band before stretching, $L_0 = 50.0 \pm 0.1 \text{ cm}$

length of band after stretching, $L_S = 51.6 \pm 0.1 \text{ cm}$.

Determine

- (a) the change in length ($L_S - L_0$), quoting your answer with its uncertainty,

$$(L_S - L_0) = \dots\dots\dots \text{ cm [1]}$$

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$$(L_S - L_0) = \dots\dots\dots \text{ cm [1]}$$

(b) the fractional change in length, $\frac{(L_S - L_0)}{L_0}$,

fractional change = [1]

(c) the uncertainty in your answer in (b).

uncertainty = [3]

Answer **all** the questions in the spaces provided.

1 Make reasonable estimates of the following quantities.

(a) mass of an apple

mass = kg [1]

(b) number of joules of energy in 1 kilowatt-hour

number = [1]

(c) wavelength of red light in a vacuum

wavelength = m [1]

(d) pressure due to a depth of 10 m of water

pressure = Pa [1]

2 A student uses a micrometer screw gauge to measure the diameter of a wire. He fails to notice that, with the gauge fully closed, the reading is not zero.

(a) State and explain whether the omission introduces a random error or a systematic error into the readings of the diameter.

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(b) Explain why the readings are precise but not accurate.

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