

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  $\rho$ .  $\gamma$  is a constant.

Given that  $p$  has the base units of  $\text{kg m}^{-1} \text{s}^{-2}$ , show that the constant  $\gamma$  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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- (a) the change in length ( $L_S - L_0$ ), quoting your answer with its uncertainty,

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

(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.

.....  
.....[2]

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

.....  
.....  
.....[2]