

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

$$v = \sqrt{\frac{\gamma P}{\rho}}$$

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

- (i) State the S.I. base units of pressure.

base units: [1]

- (ii) Show that γ has no unit.

[2]

- (b) A student conducted an experiment to determine the speed of sound v in air which he found to be 328.85 m s^{-1} .

- (i) He used a pressure gauge with a precision of 5 kPa to measure the pressure P of air which he found to be 105 kPa .

Calculate the fractional error of P .

fractional error = [1]

(ii) The density ρ of air is measured to be $(1.2 \pm 0.1) \text{ kg m}^{-3}$.

1. Calculate the absolute uncertainty in v .

absolute uncertainty in $v = \dots \text{ m s}^{-1}$ [2]

2. State the value of v and its absolute uncertainty to the appropriate number of significant figures.

$v = \dots \pm \dots \text{ m s}^{-1}$ [1]

- (c) The student repeated the experiment in (b) and obtained several values for the speed of sound v

$330 \text{ m s}^{-1}, 326 \text{ m s}^{-1}, 334 \text{ m s}^{-1}, 328 \text{ m s}^{-1}, 332 \text{ m s}^{-1}$

The theoretical value of v is 340 m s^{-1} .

Explain whether there was a systematic error in the experiment.

.....

[1]

[Total: 8]