

1.

A horizontal pipe has length L and a circular cross-section of radius R . A liquid of density ρ flows through the pipe. The mass m of liquid flowing through the pipe in time t is given by

$$m = \frac{\pi(p_2 - p_1)R^4 \rho t}{8kL}$$

where p_1 and p_2 are the pressures at the ends of the pipe and k is a constant.

An experiment is performed to determine the value of k by measuring the values of the other quantities in the equation in. The values of L and R each have a percentage uncertainty of 2%.

State and explain, quantitatively, which of these two quantities contributes more to the percentage uncertainty in the calculated value of k .

- R contributes $4 \times 2\%$ or 8% and L contributes 2% ; so R contributes more to the percentage uncertainty in k

2.

(b) Fig. 1.1 shows a cuboidal glass block.

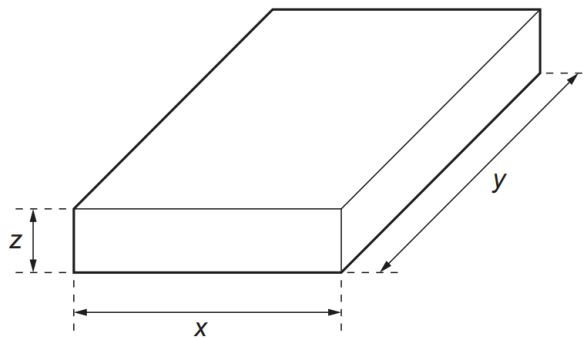


Fig. 1.1 (not to scale)

A student measures the mass m of the block and the side lengths x , y and z . The measurements are shown in Table 1.1.

Table 1.1

quantity	measurement
m	(0.243 ± 0.001) kg
x	(5.41 ± 0.01) cm
y	(11.09 ± 0.01) cm
z	(1.62 ± 0.01) cm

Calculate the percentage uncertainty in the density.

$$(0.001/0.243) \text{ or } (0.01/5.41) \text{ or } (0.01/11.09) \text{ or } (0.01/1.62)$$

$$(\Delta\rho/\rho) = (\Delta m/m) + (\Delta x/x) + (\Delta y/y) + (\Delta z/z)$$

$$= (0.001/0.243) + (0.01/5.41) + (0.01/11.09) + (0.01/1.62)$$

$$= 0.013$$

$$\text{percentage uncertainty in } \rho = 0.013 \times 100$$

$$= 1.3\% \text{ (allow 1 s.f. answer of 1\%)}$$

3. State what is meant by precise

- Measurements have a small range

4. State what is meant by accurate

- Average of the measurements not close to the true value