

1 (a) Make reasonable estimates of the following quantities.

(i) The mass of an adult.

mass = kg

(ii) The weight of a hand phone at Earth's surface.

weight = N

(iii) The energy required for an adult to climb up to the top row in the school auditorium.

energy = J

(iv) The pressure on your feet at a depth of 1.0 m in an adult swimming pool.

pressure = Pa

[2]

(b) (i) The theory of gas flow through small diameter tubes at low pressures is an important consideration of high vacuum technique.

One equation which occurs in the theory is

$$Q = \frac{kr^3(p_1 - p_2)}{L} \sqrt{\frac{M}{RT}}$$

where k is a number without units, r is the radius of the tube, p_1 and p_2 are the pressures at each end of the tube of length L , M is the molar mass of the gas, R is the molar gas constant and T is the thermodynamic temperature.

Use the equation to find the base SI units of Q .

base SI units of Q = [2]

(ii) The value of r for the equation in (b)(i) is $(1.37 \pm 0.05) \times 10^{-4}$ m.

What percentage uncertainty does this introduce into the value of Q ?

percentage uncertainty = % [1]