

**1 (a)** The kinetic theory of gases is based on some simplifying assumptions. Molecules of the gas are assumed to behave as hard elastic identical spheres.

State the assumption about ideal gas molecules based on

(i) the nature of their movement,

.....

[1]

(ii) their volume.

.....

[1]

**(b)** The pressure of an ideal gas is given by

$$p = \frac{1}{3} \frac{Nm}{V} <c^2>$$

where  $N$  is the number of gas molecules

$m$  is the mass of a gas molecule

$V$  is the volume of the gas

$<c^2>$  is the mean square speed of the molecules

(i) Explain the significance of the “ $\frac{1}{3}$ ” in the equation.

.....

[1]

(ii) Density of nitrogen gas is found to be  $1.25 \text{ kg m}^{-3}$  at  $0^\circ\text{C}$  and  $101 \text{ kPa}$ .

Assuming nitrogen gas behaves like an ideal gas, determine its root-mean-square speed.

$$\text{root-mean-square speed} = \dots \text{ m s}^{-1} \quad [2]$$

(iii) Use your answer in (b)(ii) to determine the root-mean-square speed of the nitrogen gas at  $127^\circ\text{C}$ .

$$\text{root-mean-square speed} = \dots \text{ m s}^{-1} \quad [2]$$