5 (a) An ideal gas is said to consist of molecules that are hard elastic identical spheres.

State two further assumptions of the kinetic theory of gases.

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....

....

.... [2]

(b) The number of molecules per unit volume in an ideal gas is n.

If it is assumed that all the molecules are moving with speed v_x in the x-direction, the pressure p exerted by the gas on the walls of the vessel is given by

$$p = nmv_x^2$$

where m is the mass of one molecule.

Explain the reasoning by which this expression is modified to give the formula

$$p = \frac{1}{3}nm\langle c^2 \rangle$$

where $\langle c^2 \rangle$ is the mean square speed of the molecules.

....

....

....

.... [2]

(c) The density of an ideal gas is 1.2 kg m^{-3} at a pressure of 1.0×10^5 Pa and a temperature of 27 °C.

(i) Calculate the root-mean-square (r.m.s.) speed of the molecules of the gas at 27 °C.

root-mean-square speed = …………………...…… m s^{-1} [3]

(ii) Calculate the mean-square speed of the molecules at 207 °C.

mean-square speed = …………………..………… m² s⁻² [2]

[Total: 9]