2 **(a)** State

(i) what is meant by *internal energy*,

.....

.....

.....[2]

(ii) the basic assumption of the kinetic theory of gases that leads to the conclusion that there is zero potential energy between the molecules of an ideal gas.

.....

.....[1]

(b) The pressure p and volume V of an ideal gas are related by

$$pV = \frac{1}{3} Nm\langle c^2 \rangle$$

where N is the number of molecules, m is the mass of a molecule and $\langle c^2 \rangle$ is the mean-square speed of the molecules.

Use this equation to show that the mean kinetic energy $\langle E_K \rangle$ of a molecule is given by

$$\langle E_K \rangle = \frac{3}{2} kT$$

where k is the Boltzmann constant and T is the thermodynamic temperature.

[3]

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(c) A cylinder contains 17 g of oxygen gas at a temperature of 12 °C. The mass of 1.0 mol of oxygen gas is 32 g. It may be assumed that the oxygen behaves as an ideal gas.

Calculate, for the oxygen gas in the cylinder,

(i) the mean kinetic energy of a molecule,

mean kinetic energy = ...J [2]

(ii) the number of molecules,

number = ...[2]

(iii) the total internal energy.

internal energy = ...J [1]

[Total: 11]

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