3 **(a)** Define *specific heat capacity*.

....

....

.... [2]

(b) A sealed container of fixed volume V contains N molecules, each of mass m, of an ideal gas at pressure p.

(i) State an expression, in terms of V, N, p and the Boltzmann constant k, for the thermodynamic temperature T of the gas.

.... [1]

(ii) Show that the mean translational kinetic energy E_K of a molecule of the gas is given by

$$E_K = \frac{3}{2}kT.$$

[2]

(iii) Explain why the internal energy of the gas is equal to the total kinetic energy of the molecules.

....

....

.... [2]

(c) The gas in **(b)** is supplied with thermal energy Q.

(i) Explain, with reference to the first law of thermodynamics, why the increase in internal energy of the gas is Q.

....

....

.... [2]

(ii) Use the expression in **(b)(ii)** and the information in **(c)(i)** to show that the specific heat capacity c of the gas is given by

$$c = \frac{3k}{2m}.$$

[2]

(d) The container in **(b)** is now replaced with one that does not have a fixed volume. Instead, the gas is able to expand, so that the pressure of the gas remains constant as thermal energy is supplied.

Suggest, with a reason, how the specific heat capacity of the gas would now compare with the value in **(c)(ii)**.

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....

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.... [2]

[Total: 12]