2 **(a)** **(i)** State what is meant by the *internal energy* of a system.

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.....[2]

(ii) Explain why, for an ideal gas, the internal energy is equal to the total kinetic energy of the molecules of the gas.

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.....[2]

(b) The mean kinetic energy $<E_K>$ of a molecule of an ideal gas is given by the expression

$$<E_K> = \frac{3}{2}kT$$

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

A cylinder contains 1.0 mol of an ideal gas. The gas is heated so that its temperature changes from 280 K to 460 K.

(i) Calculate the change in total kinetic energy of the gas molecules.

change in energy = ... J [2]

(ii) During the heating, the gas expands, doing 1.5×10^3 J of work.
State the first law of thermodynamics. Use the law and your answer in **(i)** to determine the total energy supplied to the gas.

For Examiner's Use

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total energy = ... J [3]