5 The pressure p of an ideal gas is given by the expression

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

where ρ is the density of the gas.

(a) State what is meant by:

(i) an ideal gas

……

…….. [1]

(ii) the symbol $\langle c^2 \rangle$

……

…….. [1]

(iii) Use the expression above to show that the mean translational kinetic energy of the atoms of an ideal gas is given by:

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

where $\langle E_k \rangle$ is the mean translational kinetic energy, T is the temperature.

Define any symbols that you use.

[4]

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

……

……

…….. [1]

(ii) Explain why, for an ideal gas, the change in internal energy is directly proportional to the change in thermodynamic temperature of the gas.

……

……

……

…….. [2]

(c) A fixed mass of ideal gas in a heat pump undergoes a cycle of changes of pressure, volume, and temperature as illustrated in Fig. 5.1.

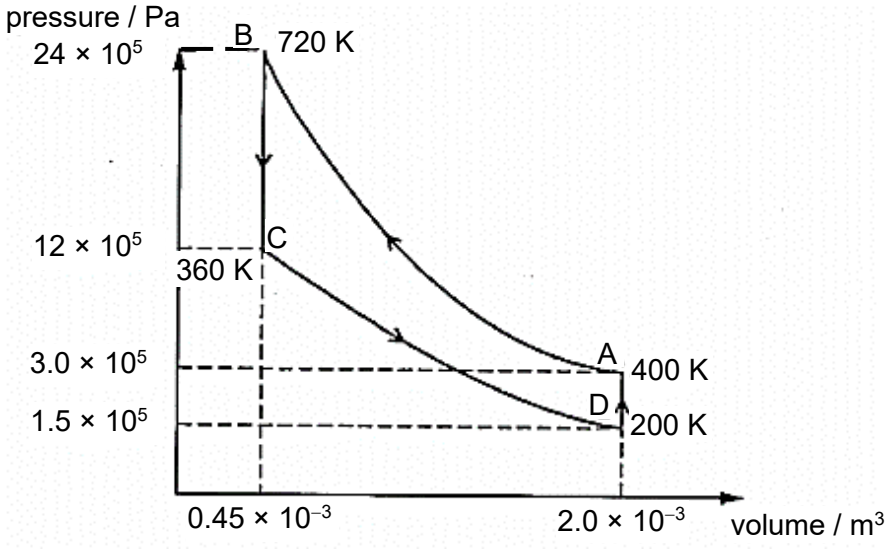

Fig. 5.1

The table below shows the increase in internal energy which takes place during each of the changes A to B, B to C and C to D. It also shows that in both of section A to B and C to D, there is no heat transfer to or from the gas.

Complete the table.

	Increase in internal energy / J	Heat supplied to gas / J	Work done on gas / J
A to B	1200	0	
B to C	−1350		
C to D	−600	0	
D to A			

[3]