

3 (a) The internal energy of an ideal gas is dependent on its state, and is given by the sum of the *random* kinetic energies of all its molecules.

- (i) Explain why it is important to include the word *random* in this definition.

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[1]

- (ii) Explain why the potential energy of the molecules is not included in this definition.

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[1]

- (iii) The pressure p exerted by an ideal gas is given by the equation

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

where ρ is the density of the gas.

Use this equation to derive an expression for the total internal energy U of n moles of an ideal gas at temperature T .

[2]

- (iv) State two physical conditions under which a real gas will behave approximately as an ideal gas.

1.

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.....

2.

[2]

- (b) A heat engine uses 10 moles of an ideal gas as a working substance. Fig. 3.1 shows the changes in pressure and volume of the gas during one cycle ABCA of operation of the engine.

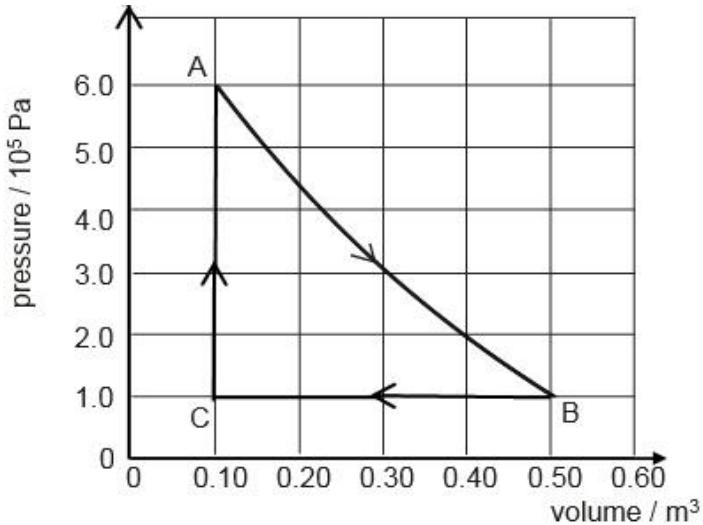


Fig. 3.1

- (i) Using values from Fig. 3.1, calculate the temperature of the gas at point A.

$$\text{temperature} = \dots \text{K} \quad [2]$$

- (ii) Show that the process $A \rightarrow B$ does not take place at a constant temperature.
Show your workings in the spaces provided.

[1]

(iii) Use Fig. 3.1 to estimate the net work done by the gas during one cycle.

$$\text{work done} = \dots \text{J} \quad [2]$$

(iv) Hence, or otherwise, calculate the amount of heat absorbed by the gas during one cycle.

$$\text{heat absorbed} = \dots \text{J} \quad [1]$$

[Total: 12]