

4 (a) State **two** of the basic assumptions of the kinetic theory of gases.

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2 .....

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[2]

(b) An ideal gas has amount of substance  $n$ .

The gas is initially in state X, with pressure  $2p$  and volume  $V$ .

The gas is cooled at constant volume to state Y, with pressure  $p$ .

The gas is then heated at constant pressure to state Z, with volume  $2V$ .

Finally, the gas returns at constant temperature to state X.

- (i) Determine an expression for the temperature  $T$  of the gas in state X, in terms of  $n$ ,  $p$  and  $V$ .  
Identify any other symbols that you use.

[2]

- (ii) On Fig. 4.1, sketch the variation with volume of pressure for the gas as the gas undergoes the three changes. The state X is labelled. Label states Y and Z.

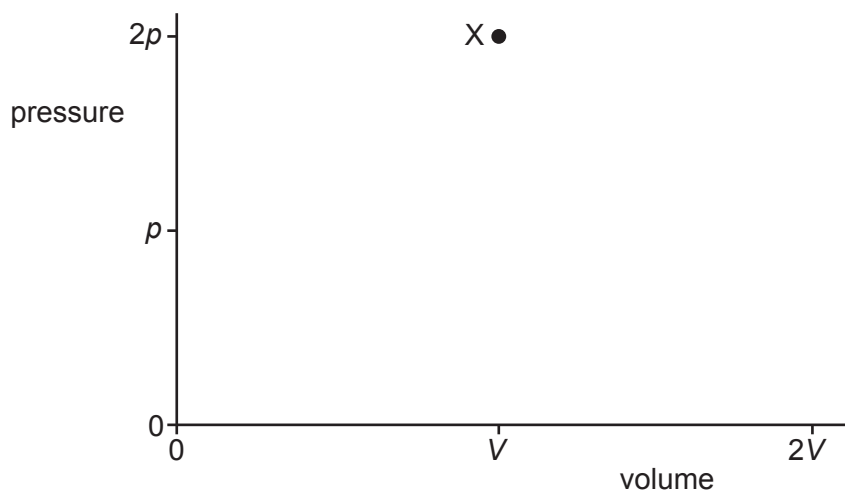


Fig. 4.1

[3]

- (iii) During the change of state from Y to Z, the increase in internal energy of the gas is  $U$ .  
During the change of state from Z to X, the work done on the gas is  $W$ .

Complete Table 4.1 to indicate, for each of the three changes of state, the increase in internal energy of the gas, the thermal energy transferred to the gas and the work done on the gas, in terms of  $p$ ,  $V$ ,  $U$  and  $W$ .

**Table 4.1**

change	increase in internal energy of gas	thermal energy transferred to gas	work done on gas
X to Y			
Y to Z	$+U$		
Z to X			$+W$