

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

.....

.....

..... [2]

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

.....

.....

..... [2]

(b) A sample of an ideal gas at thermodynamic temperature  $T$  has internal energy  $U$ .

The gas is compressed so that its temperature increases to  $3T$ .  
During this compression, work  $W$  is done on the gas.

The gas is then cooled at constant volume so that its temperature decreases to  $2T$ .

Complete Table 4.1 to show, in terms of some or all of  $W$ ,  $T$  and  $U$ , the work done on the gas, the thermal energy supplied to the gas and the increase in internal energy of the gas for each of the two processes.

Table 4.1

|             | work done on gas | thermal energy supplied to gas | increase in internal energy of gas |
|-------------|------------------|--------------------------------|------------------------------------|
| compression | $+W$             |                                |                                    |
| cooling     |                  |                                |                                    |

[4]

[Total: 8]

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

.....

.....

..... [2]

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

.....

.....

..... [2]

(b) A sample of an ideal gas at thermodynamic temperature  $T$  has internal energy  $U$ .

The gas is compressed so that its temperature increases to  $3T$ .  
During this compression, work  $W$  is done on the gas.

The gas is then cooled at constant volume so that its temperature decreases to  $2T$ .

Complete Table 4.1 to show, in terms of some or all of  $W$ ,  $T$  and  $U$ , the work done on the gas, the thermal energy supplied to the gas and the increase in internal energy of the gas for each of the two processes.

Table 4.1

|             | work done on gas | thermal energy supplied to gas | increase in internal energy of gas |
|-------------|------------------|--------------------------------|------------------------------------|
| compression | $+W$             |                                |                                    |
| cooling     |                  |                                |                                    |

[4]

[Total: 8]