

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]

3 (a) (i) State what is meant by an ideal gas.

.....

.....

..... [2]

(ii) Use one of the basic assumptions of the kinetic theory to explain what can be deduced about the potential energy associated with the random motion of molecules in an ideal gas.

.....

.....

..... [2]

(b) A sample of 0.26 m³ of an ideal gas is at pressure 2.0 × 10⁵ Pa and temperature 290 K.

Determine:

(i) the number *N* of molecules of the gas

$N =$

[2]

(ii) the average translational kinetic energy *E_k* of one molecule of the gas

$E_k =$ J

[2]

(iii) the internal energy of the gas. Explain your reasoning.

internal energy =

J [2]

(c) The volume V of the gas in **(b)** is now varied, keeping its pressure constant.

On Fig. 3.1, sketch the variation with V of the internal energy U of the gas.



Fig. 3.1

[2]

[Total: 12]