3 **(a)** State the First Law of Thermodynamics.

……

……

……

…… [2]

(b) Starting from kinetic theory expression $p = \frac{1}{3}\frac{Nm}{V}\langle c^2 \rangle$, show that the internal energy of a fixed mass of an ideal gas is equal to $\frac{3}{2}NkT$, where the symbols have their usual meaning.

[2]

(c) A fixed mass of an ideal gas undergoes a cycle of changes ABCDA, as shown in **Fig. 3.1**.

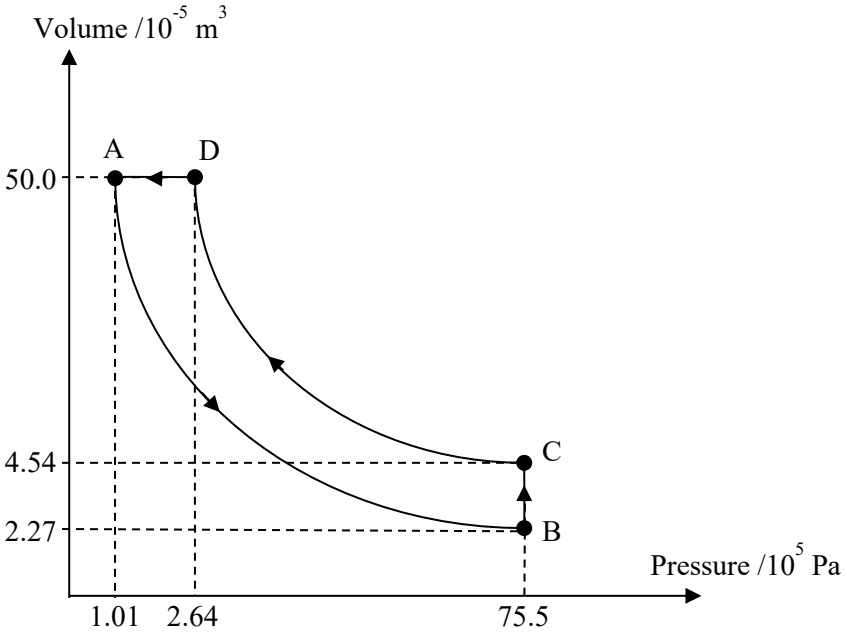

Fig. 3.1 (not to scale)

(i) For this mass of gas,

1. show that the increase in internal energy during the change from B to C is 257 J,

[1]

2. determine the work done on the gas during the change from B to C.

Work done = ……..[2]

(ii) Using your answers in **(c)(i)**, complete **Table 3.1** for the four stages of the cycle.

Stage of cycle	heat supplied to gas / J	work done on gas / J	increase in internal energy of the system / J
A → B	0	182	
B → C			257
C → D	0	- 316	
D → A			

Table 3.1