2 **(a)** The first law of thermodynamics may be expressed in the form

$$\Delta U = q + w.$$

(i) State, for a system, what is meant by:

1. $+q$

.....

.....

2. $+w$.

.....

.....
[2]

(ii) State what is represented by a negative value of ΔU.

.....

.....[1]

(b) An ideal gas, sealed in a container, undergoes the cycle of changes shown in Fig. 2.1.

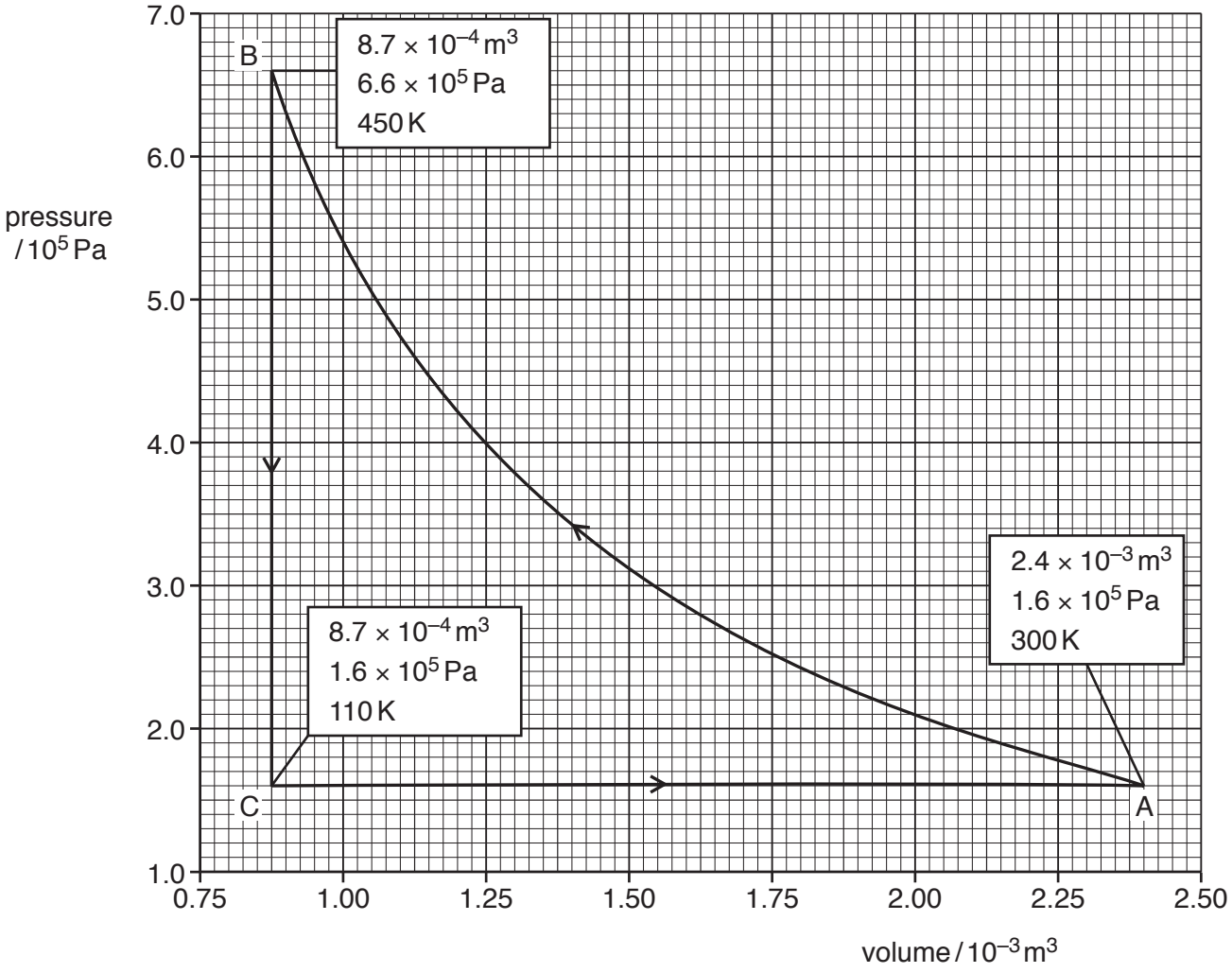

Fig. 2.1

At point A, the gas has volume $2.4 \times 10^{-3}\,m^3$, pressure 1.6×10^5 Pa and temperature 300 K.

The gas is compressed suddenly so that no thermal energy enters or leaves the gas during the compression. The amount of work done is 480 J so that, at point B, the gas has volume $8.7 \times 10^{-4}\,m^3$, pressure 6.6×10^5 Pa and temperature 450 K.

The gas is now cooled at constant volume so that, between points B and C, 1100 J of thermal energy is transferred. At point C, the gas has pressure 1.6×10^5 Pa and temperature 110 K.

Finally, the gas is returned to point A.

(i) State and explain the total change in internal energy of the gas for one complete cycle ABCA.

.....

.....

.....[2]

(ii) Calculate the external work done on the gas during the expansion from point C to point A.

work done = ... J [2]

(iii) Complete Fig. 2.2 for the changes from:

1. point A to point B

2. point B to point C

3. point C to point A.

change	$+q$/J	$+w$/J	ΔU/J
A → B	.....	.....	.....
B → C	.....	.....	.....
C → A	.....	.....	.....

Fig. 2.2

[4]

[Total: 11]