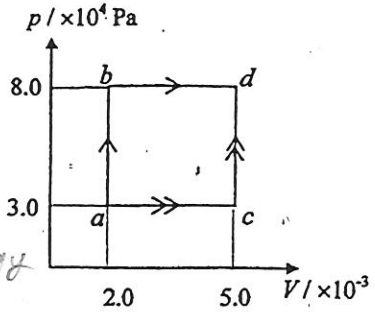
Example 3

A series of thermodynamic processes is shown in the p-V diagram below. In process *ab*, 150 J of heat are added to the system, and in process *bd*, 600 J of heat are added. Find

(a) the internal energy change in the process *ab*,
(b) the internal change in the process *abd*,
(c) the total heat added in process *acd*.

[150J, 510J, 600J]



ab

$\Delta V = 0$, $W = 0$

$q = 150J$

$\Delta u = q + w$

$= 150 + 0$

$= 150J$

increase of internal energy of 150J ab

bd $W = -p\Delta V$

$= -8(10^4)[3.0 \times 10^{-3}]$

$= -240J$

$\Delta u = 600 + (-240)$

$= 360J$

abd $(\Delta u)_{abd} = q_{abd} + W_{abd}$

$510 = (\Delta u)_{acd}$

$= q_{acd} + W_{acd}$

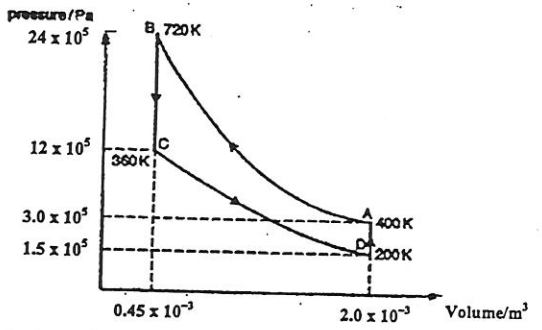
$= q + -3 \times 10^4 (3 \times 10^{-3})$

$= q - 90$

$q_{acd} = 600J$

Example 4

A fixed mass of gas in a heat pump undergoes a cycle of changes of pressure, volume and temperature as illustrated in the diagram below. The gas is assumed to be ideal.



The table below shows the increase in internal energy which take place during each of the changes A to B, B to C and C to D. It also shows that in both of section A to B and C to D, no heat is supplied to the gas. Using the first law of thermodynamics and necessary data from complete the table.

	Increase in internal energy / J	Heat supplied to gas / J	Work done on gas / J
A to B	1200	0	1200
B to C	−1350	−1350	0
C to D	−600	0	−600
D to A	a = 750	750	0

$1200 = 0 + W$

$W = 1200J$

$-1350 = q + 0$

$q = -1350$

$-600 = 0 + W$

$W = -600J$

$\Delta T = 0$

$\therefore \Delta u = 0$

$1200 + (-1350) + (-600) + a = 0$

$a = 750J$

$\Delta u = q + w$

$750 = q + 0$

$q = 750$