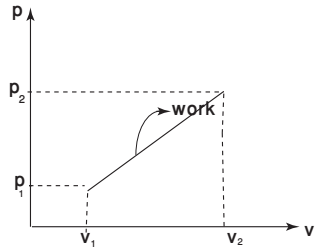
Solutions

1. As it is a phase diagram between pressure and volume, so the work done is just simply the area under the curve.

   For Path AB:

   $W_{AB} = \frac{(V_2 - V_1)(P_1 + P_2)}{2}$

   (i.e Area of trapezium = $\frac{\text{h x (sum of parallel sides)}}{2}$)



   For Path BC:

   As dV=0, so work done is zero. (since $W = \int PdV$)

   For Path CA:

   $W = P_1(V_1 - V_2) = -P_1(V_2 - V_1)$

2. For Path AB:

   Work done is positive because volume is increasing which means dV is positive.

   For Path BC:

   Work is zero.

   For Path CA:

   Work is negative because gas is being compressed. It's volume is decreasing i.e dV is negative.

3.

$$\begin{aligned} W_T &= W_{AB} + W_{BC} + W_{CA} \\ &= \frac{(V_2 - V_1)(P_1 + P_2)}{2} + 0 + (-P_1(V_2 - V_1)) \\ &= (V_2 - V_1)(\frac{(P_1 + P_2)}{2} - P_1) \\ &= \frac{(V_2 - V_1)(P_2 - P_1)}{2} \end{aligned}$$

It's positive since $V_2 > V_1$ and $P_2 > P_1$.

4. It is not different because the system returns to the same point 'A' in the phase diagram with the same state variables.

5. As this system is not isolated from it's environment for such a system work is not a state variable like pressure and volume. Such a system can do work while going in a cycle and returning to the same state.