CH1201 Quiz 7

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Q. a) Step 1 :

$dV = 0$

$dU = \Delta U$

First Law :

$$\Rightarrow dU = dq + dw$$

$$\Rightarrow dU = dq = nC_v dT$$

$$\Rightarrow \boxed{\Delta U = nC_v \Delta T} \quad -(1)$$

Step 2 :

$dq = 0 \quad ; \quad dU = -\Delta U$

$P_{ext} = P$

First Law,

$$\Rightarrow dU = dq + dw$$

$$\Rightarrow dU = dw = -P_{ext}\, dV$$

$$\Rightarrow -\Delta U = -P\Delta V$$

$$\Rightarrow \boxed{\Delta U = P\Delta V} \quad -(11).$$

Substituting (ii) in (i),

$\Rightarrow P\Delta V = nC_v \Delta T$

$\Rightarrow \boxed{\Delta T = \left(\frac{P}{nC_v}\right)\Delta V}$ ans.

b) The state of gas is defined by different state variables. eg. P, V, T, initial energy, etc.

If atleast one of these state variables change, the state of the gas is changed as well.

In the given two steps, we can see that the volume of the gas changes in step 2. ∴, even though $dV = 0$ in the process combined, the state of the gas changes.

c) After completion of both steps, $\Delta U = 0$ as for any "ideal" gas, internal energy depends solely on the temperature. Thus, as $\Delta U = 0 \Leftrightarrow \Delta T = 0$, hence, temperature remains constant and there is no net change.