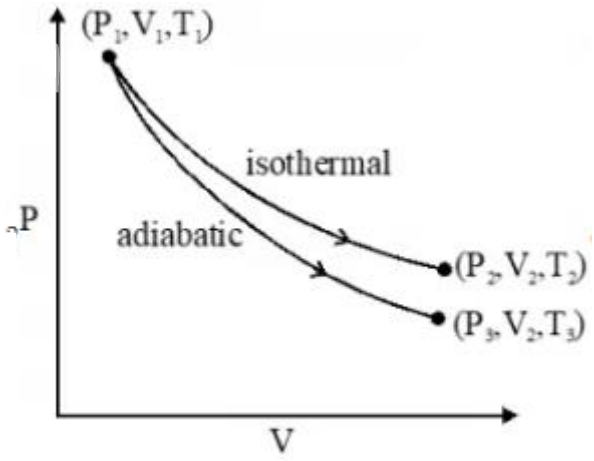

Q. The reversible expansion of an ideal gas under isothermal and adiabatic condition are shown in the figure above. Which of the following statement(s) is(are) correct?

A. T1=T2

B. T3>T1

C. $W_{isothermal} > W_{adiabatic}$

D. $\Delta U_{isothermal} > \Delta U_{adiabatic}$ [JEE,2012]

Solution:

Upper curve: isothermal process. Hence, T1=T2

As, this is an expansion process work done is by the system and W is negative.

For isothermal process, ΔU=0

If we check the area covered by the P-V diagram, then area is more in case of isothermal process. But, $W= -\int PdV$. So, $W_{isothermal} < W_{adiabatic}$

From first law, ΔU = q+W For adiabatic process, q=0. Hence, ΔU=W and W is already negative, so ΔU is also negative for adiabatic process.

So, $\Delta U_{isothermal} > \Delta U_{adiabatic}$

$P_1V_1/T_1= P_2V_2/T_2= P_3V_2/T_3$. Hence, $P_2/T_2=P_3/T_3$. From diagram, as $P_2>P_3$, T_2 has to be greater than T_3 and $T_1=T_2$. So, $T_1>T_3$