

JEE previous year questions:

Chemical Thermodynamics-V

1. An ideal gas undergoes isothermal compression from 5m^3 to 1m^3 against a constant external pressure of 4Nm^{-2} . Heat released in this process is used to increase the temperature of 1 mole of Al. If molar heat capacity of Al is $24\text{J mol}^{-1}\text{K}^{-1}$, the temperature of Al increases by
(Mains, 2019)

- A) $2/3\text{K}$
- B) $3/2\text{K}$
- C) 1K
- D) 2K

Ans: A) $2/3\text{K}$

Explanation:

Work done on isothermal irreversible for ideal gas

$$\begin{aligned} &= -P_{\text{ext}} (V_2 - V_1) \\ &= -4\text{N/m}^2 (1\text{m}^3 - 5\text{m}^3) \\ &= 16\text{Nm} \end{aligned}$$

Isothermal process for ideal gas

$$\Delta U = 0 \text{ so, } Q = -W = -16\text{Nm} = -16\text{J}$$

Heat used to increase temperature of Al,

$$Q = nC_m\Delta T$$

$$16 = 1 \times 24 \times \Delta T$$

$$\text{So, } \Delta T = 2/3\text{K}$$