

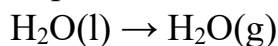
JEE previous year questions:

Chemical Thermodynamics-IV

1. For water $\Delta_{\text{vap}} H = 41 \text{ kJ mol}^{-1}$ at 373 K and 1 bar pressure. Assuming that water vapour is an ideal gas that occupies a much larger volume than liquid water, the internal energy change during evaporation of water is _____ kJ mol^{-1} [Use: $R = 8.3 \text{ J mol}^{-1} \text{ K}^{-1}$] (JEE Mains, 2021)

Ans: 38

Explanation:



$$\Delta H = 41 \text{ kJ/mol (given)}$$

$$\text{We know, } \Delta H = \Delta U + \Delta n_g RT = 41 \text{ kJ/mol} = \Delta U + 1 \times (8.3/1000) \times 373$$

$$(\text{As, } R = (8.3/1000) \text{ kJ mol}^{-1} \text{ K}^{-1})$$

$$\Delta U = 41 - 3.0959 = 38 \text{ kJ/mol}$$

2. For water at 100°C and 1 bar, $\Delta_{\text{vap}} H - \Delta_{\text{vap}} U =$ _____ $\times 10^2 \text{ J mol}^{-1}$. (Round off to the Nearest Integer)

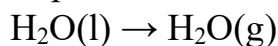
$$[\text{Use: } R = 8.31 \text{ J mol}^{-1} \text{ K}^{-1}]$$

[Assume volume of $\text{H}_2\text{O(l)}$ is much smaller than volume of $\text{H}_2\text{O(g)}$.

Assume $\text{H}_2\text{O(g)}$ treated as an ideal gas] (JEE Mains, 2021)

Ans:31

Explanation:



$$\Delta_{\text{vap}} H - \Delta_{\text{vap}} U = \Delta n_g RT = 1 \times 8.31 \times 373 \approx 31 \times 10^2 \text{ J}$$

3. The difference between ΔH and ΔU ($\Delta H - \Delta U$), when the combustion of one mole of heptane(l) is carried out at a temperature T, is equal to:

(JEE Mains, 2019)

A) $-4RT$

B) $3RT$

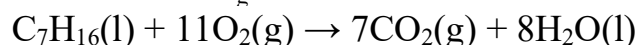
C) $-3RT$

D) $4RT$

Ans: A) $-4RT$

Explanation:

$$\Delta H - \Delta U = \Delta n_g RT$$



$$\text{Here, } \Delta n_g = 7 - 11 = -4$$

$$\therefore \Delta H - \Delta U = -4RT$$

4. For silver, $C_p(\text{J K}^{-1} \text{mol}^{-1}) = 23 + 0.01 T$. If the temperature (T) of 3 moles of silver is raised from 300 K to 1000 K at 1 atm pressure, the value of ΔH will be close to :

A) 62 kJ

B) 16 kJ

C) 13 kJ

D) 21 kJ

(JEE Mains, 2019)

Ans: A) 62 kJ

$$n = 3$$

$$T_1 = 300$$

$$T_2 = 1000$$

$$C_p = 23 + 0.01T$$

We know,

$$\Delta H = \int_{T_1}^{T_2} nC_p dT$$

$$= \int_{300}^{1000} 3(23 + 0.01T) dT$$

$$= 3[23T + 0.005T^2]$$

$$= 3[23(1000 - 300) + (1/200) \{(1000)^2 - (300)^2\}]$$

$$= 61950 \text{ J}$$

$$= 61.95 \text{ kJ}$$

$$\approx 62 \text{ kJ}$$