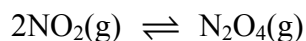


- Consider the following reaction and associated thermochemical data?



Data:	Compound	$\text{NO}_2(\text{g})$	$\text{N}_2\text{O}_4(\text{g})$
	$\Delta_f H^\circ / \text{kJ mol}^{-1}$	33	9
	$S^\circ / \text{J K}^{-1} \text{mol}^{-1}$	240	304

Marks
3

What is the expression for the equilibrium constant, K_c , for this reaction?

$$K_c = \frac{[\text{N}_2\text{O}_4(\text{g})]}{[\text{NO}_2(\text{g})]^2}$$

What are the values of ΔH° and ΔS° for the reaction?

Using $\Delta H^\circ = \sum \Delta_f H^\circ (\text{products}) - \sum \Delta_f H^\circ (\text{reactants})$, the enthalpy change is:

$$\begin{aligned} \Delta H^\circ &= 2\Delta_f H^\circ (\text{products}) - \Delta_f H^\circ (\text{reactants}) \\ &= (9 - 2 \times 33) \text{ kJ mol}^{-1} = -57 \text{ kJ mol}^{-1} \end{aligned}$$

Using $\Delta S^\circ = \sum S^\circ (\text{products}) - \sum S^\circ (\text{reactants})$, the entropy change is:

$$\begin{aligned} \Delta S^\circ &= 2S^\circ (\text{products}) - S^\circ (\text{reactants}) \\ &= (304 - 2 \times 240) \text{ kJ mol}^{-1} = -176 \text{ J K}^{-1} \text{ mol}^{-1} \end{aligned}$$

$$\Delta H^\circ = -57 \text{ kJ mol}^{-1}$$

$$\Delta S^\circ = -176 \text{ J K}^{-1} \text{ mol}^{-1}$$

What is the value of ΔG° for the reaction at 298 K?

Using $\Delta G^\circ = \Delta H^\circ - T\Delta S^\circ$:

$$\begin{aligned} \Delta G^\circ &= (-57 \times 10^3 \text{ J mol}^{-1}) - (298 \text{ K})(-176 \text{ J K}^{-1} \text{ mol}^{-1}) \\ &= -5000 \text{ J mol}^{-1} = -5 \text{ kJ mol}^{-1} \end{aligned}$$

$$\Delta G^\circ = -5 \text{ kJ mol}^{-1}$$

THE REMAINDER OF THIS PAGE IS FOR ROUGH WORKING ONLY.