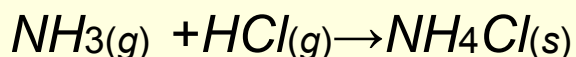


Calculate ΔG for the following reaction at 25°C .
Will the reaction occur spontaneously?



given for the reaction

$$\Delta H = -176.0 \text{ kJ}$$

$$\Delta S = -284.8 \text{ J/K}$$

$$T = 273 \text{ K} + 25^{\circ}\text{C} = 298 \text{ K}$$



$$\Delta G = \Delta H - T\Delta S / 1000$$

$$\Delta G = -176.0 \text{ kJ} - (298 \text{ K})(-284.8 \text{ kJ/K}) / 1000$$

$$\Delta G = -176.0 \text{ kJ} - (-84.9 \text{ kJ})$$

$$\Delta G = -91.1 \text{ kJ}$$

Yes, this reaction is spontaneous at room temperature since ΔG is negative.

$$\Delta G = \Delta H - T\Delta S / 1000$$

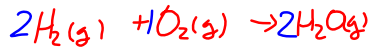
Two ways

$$\Delta G^{\circ} = \sum \Delta G^{\circ}_f \text{ products} - \sum \Delta G^{\circ}_f \text{ reactants}$$

$$\Delta H^{\circ} = \sum \Delta H^{\circ}_f \text{ prod} - \sum \Delta H^{\circ}_f \text{ reactant}$$

$$\Delta S^{\circ} = \sum \Delta S^{\circ}_f \text{ prod} - \sum \Delta S^{\circ}_f \text{ reactants}$$

$$\Delta G = \Delta H - T \Delta S / 1000$$



① 3 mol \rightarrow 2 mol
decrease S
- ΔS

charts

$$2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$$

$$\Delta S \quad 2(131) \quad 205 \quad 2(188)$$

$$\quad \quad \quad 262 \quad 205 \quad 376$$

$$\quad \quad \quad \underline{467}$$

$$\Delta S = 376 - 467 = -91 \text{ J/mol K}$$

$$\Delta H \quad 2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}(\text{g})$$

$$\quad \quad \quad 0 \quad 0 \quad 2(-241)$$

$$\Delta H = -482 \text{ kJ/mol}$$

$$\Delta G = \Delta H - T \frac{\Delta S}{1000}$$

standard condition 298K

$$\Delta G = -482 \text{ kJ/mol} + \left(\frac{298 \cdot (-91)}{1000} \right)$$

$$-482 + 27.1 \text{ kJ/mol}$$

$$-455 \text{ kJ/mol}$$

$$\Delta G = \sum \Delta G_{f, \text{prod}} - \sum \Delta G_{f, \text{react}}$$

$$2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$$

$$0 \quad 0 \quad 2(-228)$$

$$\Delta G = \quad \quad \quad \text{spont} \quad \quad \quad -456 \text{ kJ/mol} - 0$$

⑥ What T does it become spont or non-spont?

$$\Delta G = \Delta H - T\Delta S$$

$$0 = -482 - \left(T \cdot \frac{-89}{1000} \right)$$

$$\frac{482}{89} = T \cdot \frac{89}{1000}$$

$$T = 5416 \text{ K}$$

⑦

$$\Delta G = \Delta H - T\Delta S$$

$$-482 - \left(T \cdot \frac{-89}{1000} \right)$$

becomes less spont. 298K $\Delta G = -456$
5416K $\Delta G = 0$

⑧ above 5416K $\Delta G >$

$$\Delta G = -482 + \left(500 \cdot \frac{-89}{1000} \right)$$

$$\Delta G = -437.5$$