Calculate ΔG for the following reaction at 25^0C.
Will the reaction occur spontaneously?

$$NH_{3(g)} + HCl_{(g)} \rightarrow NH_4Cl_{(s)}$$

given for the reaction

$\Delta H = -176.0kJ$

$\Delta S = -284.8J/K$

$T = 273K + 25^0C = 298K$

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

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

$\Delta G = -176.0kJ - (-84.9kJ)$

$\Delta G = -91.1kJ$

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

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

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Two ways

$\Delta G^0 = \sum \Delta G^0_f \text{ products} - \sum \Delta G^0_f \text{ reactants}$

$\Delta H^\circ = \sum \Delta H^\circ_{f\,prod} - \sum \Delta H^\circ_{f\,reactant}$

$\Delta S^\circ = \sum \Delta S^\circ_{f\,prod} - \sum \Delta S^\circ_{f\,reactants}$

$\Delta G = \Delta H - T\Delta S_{1000}$

$2H_2(g) + O_2(g) \rightarrow 2H_2O(g)$

① 3 mol → 2 mol

decrease S

$-\Delta S$

charts $2H_2 + O_2 \rightarrow 2H_2O$

ΔS $2(131)$ 205 $2(188)$

262 205 376

467

$\Delta S = 376 - 467 = -91\ J/mol\,K$

ΔH $2H_2 + O_2 \rightarrow 2H_2O_{(g)}$

0 0 $2(-241)$

$\Delta H = -482\ KJ/mol$

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

$\frac{KJ}{mol} = \frac{KJ}{mol} - K\left(\frac{J}{mol\,K}\right)\left(\frac{KJ}{1000\,J}\right)$

standard condition 298K

$\Delta G^\circ = -482\ KJ/mol + \left(298\left(\frac{-91}{1000}\right)\right)$

ΔH -482 $+$ ΔS $27.1\ KJ/mol$

$-455\ KJ/mol$

$\Delta G = \Sigma \Delta G_{f\,prod} - \Sigma \Delta G_{f\,react.}$

$2H_2 + O_2 \rightarrow 2H_2O$

0 0 $2(-228)$

$\Delta G = -456 - 0$ ①

spont KJ/mol

(6.) What T does it become spont? or non spont.?

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

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

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

$T = 5416\ K$

(7.) $\Delta G = \Delta H - T\Delta S$

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

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

5416K $\Delta G = 0$

(8.) above 5416K $\Delta G +$

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

T

$\Delta G = -437.5$

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