

MUSTAQIL ISHLASH UCHUN MASALALAR YECHIMLARI

1-masala

Shart: $\Delta H = -80.0 \text{ kJ}\cdot\text{mol}^{-1}$, $\Delta S = +50.0 \text{ J}\cdot\text{mol}^{-1}\cdot\text{K}^{-1}$, $T = 298 \text{ K}$. ΔG ni hisoblang.

Yechim:

1. ΔH ni $\text{J}\cdot\text{mol}^{-1}$ ga o'tkazamiz: $\Delta H = -80.0 \text{ kJ}\cdot\text{mol}^{-1} = -80\,000 \text{ J}\cdot\text{mol}^{-1}$.
2. Formuladan foydalanamiz:
 $\Delta G = \Delta H - T\cdot\Delta S$.
3. $T\cdot\Delta S = 298 \cdot 50 = 14\,900 \text{ J}\cdot\text{mol}^{-1}$.
4. $\Delta G = (-80\,000) - 14\,900 = -94\,900 \text{ J}\cdot\text{mol}^{-1}$.
5. kJ ga o'tkazsak: $\Delta G = -94\,900 \text{ J}\cdot\text{mol}^{-1} = -94.90 \text{ kJ}\cdot\text{mol}^{-1}$.

Natija: $\Delta G = -94.90 \text{ kJ}\cdot\text{mol}^{-1}$. ($\Delta G < 0 \Rightarrow$ reaksiya o'z-o'zidan boradi.)

2-masala

Shart: $\Delta H = +25.0 \text{ kJ}\cdot\text{mol}^{-1}$, $\Delta S = +100.0 \text{ J}\cdot\text{mol}^{-1}\cdot\text{K}^{-1}$. $\Delta G = 0$ bo'ladigan T ni toping.

Yechim:

1. ΔH ni $\text{J}\cdot\text{mol}^{-1}$ ga o'tkazamiz: $\Delta H = 25\,000 \text{ J}\cdot\text{mol}^{-1}$.
2. Shart: $\Delta G = 0 \Rightarrow \Delta H - T\cdot\Delta S = 0 \Rightarrow T = \Delta H / \Delta S$.
3. $T = 25\,000 / 100 = 250.0 \text{ K}$.

Natija: O'tish temperaturasi $T = 250.0 \text{ K}$. ($T > 250 \text{ K}$ bo'lsa $\Delta G < 0 \Rightarrow$ reaksiyaning spontanligi mumkin.)

3-masala

Shart: $\Delta G^\circ = -45.0 \text{ kJ}\cdot\text{mol}^{-1}$ ($T = 298 \text{ K}$). Muvozanat doimiysi K ni toping.

Yechim:

1. $\Delta G^\circ = -45\,000 \text{ J}\cdot\text{mol}^{-1}$.
2. Bog'lanish: $\Delta G^\circ = -R\cdot T\cdot\ln(K) \Rightarrow \ln(K) = -\Delta G^\circ / (R\cdot T) = 45\,000 / (8.314 \cdot 298)$.
3. Hisoblaymiz: $8.314\cdot 298 \approx 2\,477.77$. $\ln(K) \approx 45\,000 / 2\,477.77 \approx 18.163$.
4. $K = e^{(18.163)} \approx 7.73\cdot 10^7$ (ya'ni $\approx 7.7\cdot 10^7$).

Natija: $K \approx 7.7\cdot 10^7$. (Bu qiymat mahsulotlar ustunligini ko'rsatadi.)

4-masala

Shart: $K = 2.00 \cdot 10^3$, $T = 298 \text{ K}$. ΔG° ni $\text{J} \cdot \text{mol}^{-1}$ va $\text{kJ} \cdot \text{mol}^{-1}$ da hisoblang.

Yechim:

1. $\Delta G^\circ = -R \cdot T \cdot \ln(K)$.
2. $\ln(2.00 \cdot 10^3) = \ln(2000) \approx 7.600902$.
3. $R \cdot T = 8.314 \cdot 298 \approx 2\,477.77$.
4. $\Delta G^\circ = -2\,477.77 \cdot 7.600902 \approx -18\,831.8 \text{ J} \cdot \text{mol}^{-1}$.
5. kJ ga o'tkazsak: $\approx -18.83 \text{ kJ} \cdot \text{mol}^{-1}$.

Natija: $\Delta G^\circ \approx -18\,831.8 \text{ J} \cdot \text{mol}^{-1} \approx -18.83 \text{ kJ} \cdot \text{mol}^{-1}$.

5-masala

Shart: $\Delta H^\circ = +60.0 \text{ kJ} \cdot \text{mol}^{-1}$ (taxminan T ga bog'lanmaydi). $K_1 = 10.0$ da $T_1 = 300 \text{ K}$; $T_2 = 350 \text{ K}$. Van't Hoff tenglamasidan foydalanib K_2 ni toping.

Yechim:

1. $\Delta H^\circ = +60\,000 \text{ J} \cdot \text{mol}^{-1}$.
2. Van't Hoff tenglamasi: $\ln(K_2 / K_1) = -\Delta H^\circ / R \cdot (1/T_2 - 1/T_1)$.
3. Hisoblaymiz: $1/T_2 - 1/T_1 = (1/350) - (1/300) = -0.0004761904762 \text{ K}^{-1}$.
4. $-\Delta H^\circ / R = -60\,000 / 8.314 \approx -7\,218.45$.
5. $\ln(K_2 / K_1) = (-7\,218.45) \cdot (-0.0004761904762) \approx +3.43654$.
6. $\ln(K_2) = \ln(K_1) + 3.43654 = 2.302585093 + 3.43654 \approx 5.73913$.
7. $K_2 = e^{(5.73913)} \approx 310.9$.

Natija: $K_2 \approx 3.11 \cdot 10^2$ (ya'ni ≈ 310.9).

6-masala

Shart: Ideal aralashmada 2 mol A va 1 mol B (jami 3 mol) 298 K da aralashtiriladi. Ideal aralashma uchun $\Delta G_{\text{aralashma}}$ ni $\text{J} \cdot \text{mol}^{-1}$ hisobida toping.

Yechim:

1. $x_A = 2/3 \approx 0.6666667$; $x_B = 1/3 \approx 0.3333333$.
2. Formula: $\Delta G_{\text{aralashma}} = n_{\text{jami}} \cdot R \cdot T \cdot (x_A \cdot \ln x_A + x_B \cdot \ln x_B)$.
3. $x_A \cdot \ln x_A \approx 0.6666667 \cdot (-0.405465108) = -0.270310072$.
 $x_B \cdot \ln x_B \approx 0.3333333 \cdot (-1.098612289) = -0.366204096$.
yig'indi ≈ -0.636514168 .
4. $n_{\text{jami}} \cdot R \cdot T = 3 \cdot 8.314 \cdot 298 \approx 7\,433.316$.
5. $\Delta G_{\text{aralashma}} \approx 7\,433.316 \cdot (-0.636514168) \approx -4\,731.03 \text{ J}$.

Natija: $\Delta G_{\text{aralashma}} \approx -4\,731.0 \text{ J}$ (ya'ni $\approx -4.731 \text{ kJ}$, tizim bo'yicha erkin energiya kamayadi).

7-masala

Shart: $\Delta H = -20.0 \text{ kJ} \cdot \text{mol}^{-1}$, $\Delta S = -10.0 \text{ J} \cdot \text{mol}^{-1} \cdot \text{K}^{-1}$, $T = 298 \text{ K}$. ΔG ni hisoblang va spontanligini aniqlang.

Yechim:

1. $\Delta H = -20\,000 \text{ J} \cdot \text{mol}^{-1}$; $\Delta S = -10 \text{ J} \cdot \text{mol}^{-1} \cdot \text{K}^{-1}$.
2. $\Delta G = \Delta H - T \cdot \Delta S = (-20\,000) - 298 \cdot (-10) = -20\,000 + 2\,980 = -17\,020 \text{ J} \cdot \text{mol}^{-1}$.
3. $\Delta G = -17.02 \text{ kJ} \cdot \text{mol}^{-1}$.

Natija: $\Delta G < 0 \Rightarrow$ reaksiya o'z-o'zidan boradi (spontan) bu haroratda.

8-masala

Shart: Reaksiya $A \rightleftharpoons B$. Boshlang'ich: $[A]_0 = 1.000 \text{ M}$, $[B]_0 = 0.000 \text{ M}$. Muvozanat doimiysi $K = 4.00$. Muvozanatdagi $[A]$ va $[B]$ ni toping.

Yechim:

1. Muvozanatda $[A] = 1.000 - x$, $[B] = x$.
2. $K = [B] / [A] = x / (1.000 - x) = 4.00$.
3. $x = 4.00 \cdot (1.000 - x) = 4.000 - 4x \Rightarrow x + 4x = 4.000 \Rightarrow 5x = 4.000$.
4. $x = 0.8000 \text{ M}$.
5. $[A] = 1.000 - 0.800 = 0.2000 \text{ M}$; $[B] = 0.8000 \text{ M}$.

Natija: $[A] = 0.2000 \text{ M}$, $[B] = 0.8000 \text{ M}$.

9-masala

Shart: $K = 0.0500$ berilgan ($T = 400 \text{ K}$). Standart erkin energiya o'zgarishi ΔG° ni $\text{J} \cdot \text{mol}^{-1}$ da hisoblang.

Yechim:

1. $\Delta G^\circ = -R \cdot T \cdot \ln(K)$.
2. $\ln(0.0500) \approx -2.995732274$.
3. $R \cdot T = 8.314 \cdot 400 = 3\,325.6$.
4. $\Delta G^\circ = -3\,325.6 \cdot (-2.995732274) = 3\,325.6 \cdot 2.995732274 \approx 9\,965.9 \text{ J} \cdot \text{mol}^{-1}$.
5. $\text{kJ ga o'tkazilsa} \approx 9.966 \text{ kJ} \cdot \text{mol}^{-1}$.

Natija: $\Delta G^\circ \approx +9\,965.9 \text{ J} \cdot \text{mol}^{-1}$ (ya'ni $\approx +9.97 \text{ kJ} \cdot \text{mol}^{-1}$).

10-masala

Shart: $\Delta H = -100.0 \text{ kJ} \cdot \text{mol}^{-1}$ va $\Delta S = -150.0 \text{ J} \cdot \text{mol}^{-1} \cdot \text{K}^{-1}$. Qaysi T dan pastda $\Delta G < 0$ bo'ladi? (maksimal T ni aniqlang)

Yechim:

1. $\Delta H = -100\,000 \text{ J} \cdot \text{mol}^{-1}$; $\Delta S = -150 \text{ J} \cdot \text{mol}^{-1} \cdot \text{K}^{-1}$.
2. $\Delta G < 0 \Rightarrow \Delta H - T \cdot \Delta S < 0$. Ikkala qiymat manfiy bo'lgani uchun $T < \Delta H / \Delta S$.
3. $T = (-100\,000) / (-150) = 666.666... \text{ K} \approx 666.7 \text{ K}$.

Natija: Agar $T < 666.7 \text{ K}$ bo'lsa, $\Delta G < 0 \Rightarrow$ reaksiya o'z-o'zidan boradi; $T > 666.7 \text{ K}$ da $\Delta G > 0$.