

NAMUNAVIY MASALALAR

1. Reaksiya uchun $\Delta H = -120 \text{ kJ} \cdot \text{mol}^{-1}$ va $\Delta S = -200 \text{ J} \cdot \text{mol}^{-1} \cdot \text{K}^{-1}$; sistemaning harorati $T = 298 \text{ K}$ bo'lganida ΔG ni hisoblang.
2. Reaksiya uchun $\Delta H = +50 \text{ kJ} \cdot \text{mol}^{-1}$ va $\Delta S = +120 \text{ J} \cdot \text{mol}^{-1} \cdot \text{K}^{-1}$; $\Delta G = 0$ bo'ladigan o'tish temperaturasi toping.
3. Standart sharoitda ($T = 298 \text{ K}$) $\Delta G^\circ = -30.0 \text{ kJ} \cdot \text{mol}^{-1}$ berilgan; muvozanat doimiysi K ni hisoblang.
4. Muvozanat doimiysi $K = 0.01$ ($T = 298 \text{ K}$) berilgan; standart erkin energiya o'zgarishi ΔG° ni hisoblang.
5. Reaksiya uchun $\Delta H = +80.0 \text{ kJ} \cdot \text{mol}^{-1}$ va $\Delta S = +100.0 \text{ J} \cdot \text{mol}^{-1} \cdot \text{K}^{-1}$; $T = 500 \text{ K}$ da ΔG ni toping.
6. $\Delta H = -40.0 \text{ kJ} \cdot \text{mol}^{-1}$ va $\Delta S = -50.0 \text{ J} \cdot \text{mol}^{-1} \cdot \text{K}^{-1}$ berilgan; $\Delta G = 0$ bo'ladigan temperaturani aniqlang.
7. Standart sharoitda ($T = 298 \text{ K}$) $\Delta G^\circ = +10.0 \text{ kJ} \cdot \text{mol}^{-1}$; muvozanat doimiysi K ni toping.
8. Muvozanat doimiysi $K = 5.00$ va $T = 350 \text{ K}$ berilgan; ΔG° ni hisoblang.
9. Reaksiya uchun $\Delta H^\circ = -40.0 \text{ kJ} \cdot \text{mol}^{-1}$ va $K(298 \text{ K}) = 10.0$; agar ΔH° T ga deyarli bog'lanmasa, van't Hoff tenglamasidan foydalangan holda $T_2 = 350 \text{ K}$ da K_2 ni toping.
10. Ideal aralashmada 1 mol A va 2 mol B (ya'ni jami 3 mol) 298 K da aralashtiriladi; ideal aralashma uchun tizimning aralashish erkin energiyasi ΔG_{mix} ni toping.

1-masala yechimi

Berilgan:

$$\begin{aligned}\Delta H &= -120 \text{ kJ} \cdot \text{mol}^{-1} \\ \Delta S &= -200 \text{ J} \cdot \text{mol}^{-1} \cdot \text{K}^{-1} \\ T &= 298 \text{ K}\end{aligned}$$

Avvalo ΔH ni kJ dan J ga o'tkazamiz:

$$\Delta H = -120 \text{ kJ} \cdot \text{mol}^{-1} = -120000 \text{ J} \cdot \text{mol}^{-1}$$

Asosiy formula:

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

Hisoblaymiz:

$$T \cdot \Delta S = 298 \cdot (-200) = -59600 \text{ J} \cdot \text{mol}^{-1}$$

$$\Delta G = (-120000) - (-59600)$$
$$\Delta G = -120000 + 59600 = -60400 \text{ J} \cdot \text{mol}^{-1}$$

kJ ko‘rinishida: $-60.40 \text{ kJ} \cdot \text{mol}^{-1}$

Natija: $\Delta G = -60.40 \text{ kJ} \cdot \text{mol}^{-1} \rightarrow$ reaksiya o‘z-o‘zidan boradi.

2-masala yechimi

Berilgan:

$$\Delta H = +50 \text{ kJ} \cdot \text{mol}^{-1}$$
$$\Delta S = +120 \text{ J} \cdot \text{mol}^{-1} \cdot \text{K}^{-1}$$

$\Delta G = 0$ bo‘ladigan temperaturani topish kerak.

ΔH ni J ga o‘tkazamiz:

$$\Delta H = 50000 \text{ J} \cdot \text{mol}^{-1}$$

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

$$\Delta G = 0 \text{ deb olsak:}$$

$$0 = \Delta H - T \cdot \Delta S$$

$$T = \Delta H / \Delta S = 50000 / 120 = 416.7 \text{ K}$$

Natija: $T \approx 416.7 \text{ K} \rightarrow$ shu temperaturadan yuqorida reaksiya o‘z-o‘zidan boradi.

3-masala yechimi

Berilgan:

$$\Delta G^\circ = -30 \text{ kJ} \cdot \text{mol}^{-1} = -30000 \text{ J} \cdot \text{mol}^{-1}$$
$$T = 298 \text{ K}$$

Muvozanat doimiysi K ni topamiz.

Formuladan foydalanamiz:

$$\Delta G^\circ = -R \cdot T \cdot \ln(K)$$

$$\ln(K) = -\Delta G^\circ / (R \cdot T)$$

$$\ln(K) = 30000 / (8.314 \cdot 298)$$

$$8.314 \cdot 298 \approx 2477.77$$

$$\ln(K) \approx 12.11$$

$$K = e^{12.11} \approx 1.81 \cdot 10^5$$

Natija: $K \approx 1.8 \cdot 10^5 \rightarrow$ mahsulotlar ancha ustun.

4-masala yechimi

Berilgan:

$$\begin{aligned} K &= 0.01 \\ T &= 298 \text{ K} \end{aligned}$$

$$\Delta G^\circ = -R \cdot T \cdot \ln(K)$$

$$\text{Avvalo } \ln(0.01) = -4.60517$$

$$\Delta G^\circ = -8.314 \cdot 298 \cdot (-4.60517)$$

$$8.314 \cdot 298 \approx 2477.77$$

$$\Delta G^\circ = 2477.77 \cdot 4.60517 \approx 11410 \text{ J} \cdot \text{mol}^{-1}$$

kJ ko‘rinishida: $11.41 \text{ kJ} \cdot \text{mol}^{-1}$

Natija: $\Delta G^\circ \approx +11.41 \text{ kJ} \cdot \text{mol}^{-1}$ (reaksiya o‘z-o‘zidan bormaydi).

5-masala yechimi

Berilgan:

$$\Delta H = +80 \text{ kJ} \cdot \text{mol}^{-1} = 80000 \text{ J} \cdot \text{mol}^{-1}$$

$$\Delta S = +100 \text{ J} \cdot \text{mol}^{-1} \cdot \text{K}^{-1}$$

$$T = 500 \text{ K}$$

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

$$\Delta G = 80000 - 500 \cdot 100$$

$$\Delta G = 80000 - 50000 = 30000 \text{ J} \cdot \text{mol}^{-1}$$

yoki $30 \text{ kJ} \cdot \text{mol}^{-1}$.

Natija: $\Delta G = +30 \text{ kJ} \cdot \text{mol}^{-1} \rightarrow$ reaksiya bu haroratda o‘z-o‘zidan bormaydi.

6-masala yechimi

Berilgan:

$$\Delta H = -40 \text{ kJ} \cdot \text{mol}^{-1} = -40000 \text{ J} \cdot \text{mol}^{-1}$$

$$\Delta S = -50 \text{ J} \cdot \text{mol}^{-1} \cdot \text{K}^{-1}$$

$\Delta G = 0$ deb olamiz:

$$0 = \Delta H - T \cdot \Delta S$$

$$T = \Delta H / \Delta S = (-40000)/(-50) = 800 \text{ K}$$

Natija: $T = 800 \text{ K} \rightarrow$ shu temperaturada $\Delta G = 0$ bo'ladi.

7-masala yechimi

Berilgan:

$$\Delta G^\circ = +10 \text{ kJ} \cdot \text{mol}^{-1} = +10000 \text{ J} \cdot \text{mol}^{-1}$$

$$T = 298 \text{ K}$$

$$\ln(K) = -\Delta G^\circ / (R \cdot T)$$

$$\ln(K) = -10000 / (8.314 \cdot 298)$$

$$8.314 \cdot 298 = 2477.77$$

$$\ln(K) \approx -4.036$$

$$K = e^{-4.036} \approx 0.0177$$

Natija: $K \approx 0.0177 \rightarrow$ tenglik reaktantlar tomon.

★ 8-masala yechimi

Berilgan:

$$K = 5.00$$

$$T = 350 \text{ K}$$

$$\Delta G^\circ = -R \cdot T \cdot \ln(K)$$

$$\ln(5) \approx 1.609$$

$$R \cdot T = 8.314 \cdot 350 \approx 2910$$

$$\Delta G^\circ = -2910 \cdot 1.609 \approx -4684 \text{ J} \cdot \text{mol}^{-1}$$

$$\text{Yoki } -4.684 \text{ kJ} \cdot \text{mol}^{-1}$$

Natija: $\Delta G^\circ \approx -4.68 \text{ kJ} \cdot \text{mol}^{-1} \rightarrow$ reaksiya spontan.

9-masala yechimi

Berilgan:

$$\Delta H^\circ = -40 \text{ kJ} \cdot \text{mol}^{-1} = -40000 \text{ J} \cdot \text{mol}^{-1}$$

$$T_1 = 298 \text{ K}, K_1 = 10$$

$$T_2 = 350 \text{ K}$$

Tenglama:

$$\ln(K_2 / K_1) = -\Delta H^\circ / R \cdot (1/T_2 - 1/T_1)$$

$$\begin{aligned} 1/T_2 - 1/T_1 &= (1/350) - (1/298) = -0.00049856 - \Delta H^\circ / R \\ &= -(-40000)/8.314 = +4811.5 \end{aligned}$$

Demak:

$$\ln(K_2/K_1) = 4811.5 \cdot (-0.00049856) \approx -2.399$$

$$\ln(K_2) = \ln(10) + (-2.399)$$

$$\ln(10) = 2.303$$

$$\ln(K_2) \approx 2.303 - 2.399 = -0.096$$

$$K_2 = e^{-0.096} \approx 0.908$$

Natija: $K_2 \approx 0.91$

10–masala yechimi (ideal aralashmaning erkin energiyasi)

Berilgan:

$$n(A) = 1 \text{ mol}$$

$$n(B) = 2 \text{ mol}$$

$$n(\text{umumiy}) = 3 \text{ mol}$$

$$T = 298 \text{ K}$$

Ulushlar:

$$x(A) = 1/3$$

$$x(B) = 2/3$$

Ideal aralashma formulasi:

$$\Delta G_{\text{aralashish}} = n(\text{umumiy}) \cdot R \cdot T \cdot (x(A) \cdot \ln(x(A)) + x(B) \cdot \ln(x(B)))$$

Hisoblaymiz:

$$x(A) \cdot \ln(x(A)) = (1/3) \cdot \ln(1/3) = \text{manfiy son}$$

$$x(B) \cdot \ln(x(B)) = (2/3) \cdot \ln(2/3) = \text{manfiy son}$$

Ikki manfiy sonning yig'indisi: ≈ -0.6365

$$n \cdot R \cdot T = 3 \cdot 8.314 \cdot 298 \approx 7433$$

$$\begin{aligned} \Delta G_{\text{aralashish}} &= 7433 \cdot (-0.6365) \approx -4731 \text{ J} \\ &= -4.731 \text{ kJ} \end{aligned}$$

Natija: $\Delta G_{\text{aralashish}} \approx -4.73 \text{ kJ}$ (ideal aralashma hosil bo'lganda erkin energiya kamayadi).

