Alexander Sebastian Kalis

Examen Química

19.06.2021

Pregunta 1:

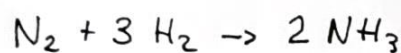Datos:

$V = 7m^3 = 7000 L$

$R = 0.082 \dfrac{atm \cdot L}{K \cdot mol}$

$P = 198\ atm$

$T = 406\ °C = 679\ K$

$n(N_2) = 9 \cdot 10^3\ mol$

$$N_2 + 3H_2 \rightarrow 2NH_3$$

$$9 \cdot 10^3\ mol\ N_2 \quad \frac{2\ mol\ NH_3}{1\ mol\ N_2} = 1.8 \cdot 10^4\ mol\ NH_3$$

Aplicando la fórmula de los gases ideales:

$$P \cdot V = nRT$$

$$P = \frac{nRT}{V} = \frac{1.8 \cdot 10^4 \cdot 0.082 \cdot 679}{7000} = \boxed{143.172\ atm}$$

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Pregunta 2:

Apartado a:

$$\Delta H^\circ_r = \Sigma n \cdot \Delta H_f \text{ productos} - \Sigma n \cdot \Delta n_f \text{ reactivos}$$

$$\Delta H^\circ_r = \Delta H^\circ_f (Na_2 CO_3) + \Delta H^\circ_f (CO_2) + \Delta H^\circ_f (H_2O) - 2\Delta H^\circ_f (Na_2 HCO_3)$$

$$\Delta H^\circ_r = -1131 + (-393.50) + (-241.80) - 2(-947.70) = \underline{129.1 \text{ KJ}}$$

Apartado b:

$$\Delta S^\circ_r = \Sigma n \cdot S \text{ productos} - \Sigma n \cdot S \text{ reactivos}$$

$$\Delta S^\circ_r = S^\circ (Na_2 CO_3) + S^\circ (CO_2) + S^\circ (H_2O) - 2 \cdot S^\circ (Na_2 HCO_3)$$

$$\Delta S^\circ_r = 136 + 213.6 188.70 - 2(102.10) = \underline{\sout{xxxxxx}}$$
$$\underline{334.1 \text{ J}}$$

Apartado c:

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

$$\Delta G^\circ_r = 129.1 - 298 \cdot \underset{334.1}{\sout{xxxxx}} \cdot 10^{-3} = \underset{\underline{29.5 \text{ kJ}}}{\sout{xxxxxx}}$$

Apartado d:

$$\Delta H_r - T \cdot \Delta S_r < 0$$

$$129.1 - 333.5 \cdot 10^{-3} T < 0 \Rightarrow T > \frac{129.1}{\underset{334.1}{\sout{xxxx}} \cdot 10^{-3}} = \sout{xxxxx} = 386.4 K =$$

$$= \underline{\sout{xxxxxx}}$$
$$\underline{113.4 \ ^\circ C}$$

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Pregunta 3:

Datos:

$n = 0.35$ moles $NH_3$         pH ?

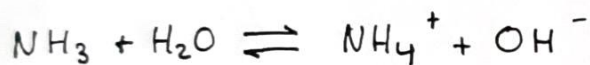$V = 1 L$         $M\ NH_3 = \dfrac{0.35\ moles}{1L} = 0.35 M$

$K_a = 1.81 \cdot 10^{-5}$

Resolución

$$NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$$

| | | | | |
|---|---|---|---|---|
| ini | 0.35 | - | - | - |
| rea | x | - | - | - |
| form | - | - | x | x |
| equi | 0.35-x | - | x | x |

$$K_b = \frac{[NH_4^+][OH^-]}{[NH_3]} = \frac{x^2}{0.35-x} = \frac{x^2}{0.35} \quad \text{(se desprecia } x)$$

$$1.81 \cdot 10^{-5} = \frac{x^2}{0.35} \implies x = 2.517 \cdot 10^{-3} M = [OH^-]$$

$$pOH = -\log([OH^-]) = -\log(2.517 \cdot 10^{-3}) = 2.6$$

$$pH = 14 - 2.6 = \underline{11.4}$$