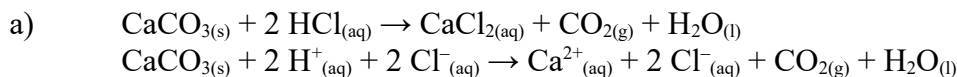


Problema 464: Utilizando as táboas termodinámicas, a) calcula ΔS° da reacción e di se será espontánea desde o punto de vista da desorde. b) calcula ΔG° da reacción (cos datos de ΔH° e ΔS°) e di se será espontánea a temperatura ambiente.



$$\Delta S^\circ_R = \sum n_p \cdot S^\circ_{\text{prod}} - \sum n_r \cdot S^\circ_{\text{react}}$$

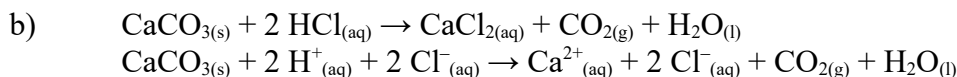
$$\Delta S^\circ_R = 1 \text{ mol} \cdot S^\circ[\text{Ca}^{2+}_{(aq)}] + 2 \text{ mol} \cdot S^\circ[\text{Cl}^-_{(aq)}] + 1 \text{ mol} \cdot S^\circ[\text{CO}_{2(g)}] + 1 \text{ mol} \cdot S^\circ[\text{H}_2\text{O}_{(l)}] -$$

$$- 1 \text{ mol} \cdot S^\circ[\text{CaCO}_{3(s)}] - 2 \text{ mol} \cdot S^\circ[\text{H}^+_{(aq)}] - 2 \text{ mol} \cdot S^\circ[\text{Cl}^-_{(aq)}]$$

$$\Delta S^\circ_R = 1 \text{ mol} \cdot S^\circ[\text{Ca}^{2+}_{(aq)}] + 1 \text{ mol} \cdot S^\circ[\text{CO}_{2(g)}] + 1 \text{ mol} \cdot S^\circ[\text{H}_2\text{O}_{(l)}] - 1 \text{ mol} \cdot S^\circ[\text{CaCO}_{3(s)}]$$

$$\Delta S^\circ_R = 1 \text{ mol} \cdot (-55,1) \frac{\text{J}}{\text{mol K}} + 1 \text{ mol} \cdot 213,8 \frac{\text{J}}{\text{mol K}} + 1 \text{ mol} \cdot 70,0 \frac{\text{J}}{\text{mol K}} - 1 \text{ mol} \cdot 92,9 \frac{\text{J}}{\text{mol K}} = +135,8 \frac{\text{J}}{\text{K}}$$

Hai un aumento da entropía durante esta reacción, por tanto a entropía contribúe favorablemente á espontaneidade.



$$\Delta H^\circ_R = \sum n_p \cdot \Delta H^\circ_{f \text{ prod}} - \sum n_r \cdot \Delta H^\circ_{f \text{ react}}$$

$$\Delta H^\circ_R = 1 \text{ mol} \cdot \Delta H^\circ_f[\text{Ca}^{2+}_{(aq)}] + 2 \text{ mol} \cdot \Delta H^\circ_f[\text{Cl}^-_{(aq)}] + 1 \text{ mol} \cdot \Delta H^\circ_f[\text{CO}_{2(g)}] + 1 \text{ mol} \cdot \Delta H^\circ_f[\text{H}_2\text{O}_{(l)}] -$$

$$- 1 \text{ mol} \cdot \Delta H^\circ_f[\text{CaCO}_{3(s)}] - 2 \text{ mol} \cdot \Delta H^\circ_f[\text{H}^+_{(aq)}] - 2 \text{ mol} \cdot \Delta H^\circ_f[\text{Cl}^-_{(aq)}]$$

$$\Delta H^\circ_R = 1 \text{ mol} \cdot \Delta H^\circ_f[\text{Ca}^{2+}_{(aq)}] + 1 \text{ mol} \cdot \Delta H^\circ_f[\text{CO}_{2(g)}] + 1 \text{ mol} \cdot \Delta H^\circ_f[\text{H}_2\text{O}_{(l)}] - 1 \text{ mol} \cdot \Delta H^\circ_f[\text{CaCO}_{3(s)}]$$

$$\Delta H^\circ_R = 1 \text{ mol} \cdot (-543,0 \frac{\text{kJ}}{\text{mol}}) + 1 \text{ mol} \cdot (-393,7 \frac{\text{kJ}}{\text{mol}}) + 1 \text{ mol} \cdot (-285,0 \frac{\text{kJ}}{\text{mol}}) - 1 \text{ mol} \cdot (-1206,9 \frac{\text{kJ}}{\text{mol}}) = -14,8 \text{ kJ}$$

$$\Delta G^\circ_R = \Delta H^\circ_R - T \cdot \Delta S^\circ_R = -14,8 \text{ kJ} - 298 \text{ K} \cdot 0,1358 \frac{\text{kJ}}{\text{K}} = -55,27 \text{ kJ}$$

Se a variación de enerxía libre é negativa indica que a reacción é espontánea a temperatura ambiente