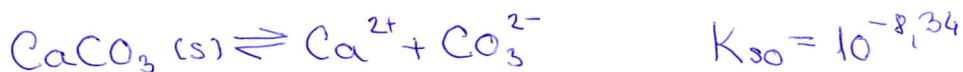
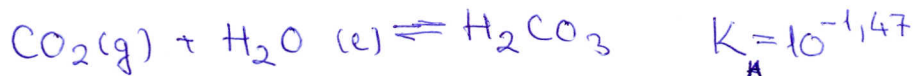


PRIOLOG 5.



$$[\text{Ca}^{2+}] = ?$$

Kada je kalcit u ravnoteži s vod. otopinom i  $\text{CO}_2$  iz zraka u sustavu su prisutne sljedeće vrste:  $\text{Ca}^{2+}$ ,  $\text{CO}_3^{2-}$ ,  $\text{HCO}_3^-$ ,  $\text{H}_2\text{CO}_3$ ,  $\text{CO}_2$ ,  $\text{H}^+$ ,  $\text{OH}^-$ . Parc. pritisak  $\text{CO}_2$  je zadan ( $0,003 \text{ atm}$ ) te je preostalo 6 nepoznanica. Trebamo 6 jednažbi:

$$1. \quad K_{\text{H}} = \frac{[\text{H}_2\text{CO}_3]}{p_{\text{CO}_2}} = 10^{-1,47}$$

$$2. \quad K_1 = \frac{[\text{H}^+][\text{HCO}_3^-]}{[\text{H}_2\text{CO}_3]}$$

$$3. \quad K_2 = \frac{[\text{H}^+][\text{CO}_3^{2-}]}{[\text{HCO}_3^-]}$$

$$4. \quad K_{\text{so}} = [\text{Ca}^{2+}][\text{CO}_3^{2-}]$$

$$5. \quad K_{\text{w}} = [\text{H}^+][\text{OH}^-]$$

$$6. \quad 2[\text{Ca}^{2+}] + [\text{H}^+] = 2[\text{CO}_3^{2-}] + [\text{HCO}_3^-] + [\text{OH}^-]$$

$$[\text{H}_2\text{CO}_3] = 10^{-1,47} \cdot 0,003 \text{ atm} = 1,02 \times 10^{-4} \text{ M}$$

$$[\text{HCO}_3^-] = K_1 \cdot \frac{[\text{H}_2\text{CO}_3]}{[\text{H}^+]} \cdot \frac{[\text{OH}^-]}{[\text{OH}^-]} = 10^{-6,35} \cdot \frac{1,02 \times 10^{-4} [\text{OH}^-]}{10^{-14}} = 4,56 \times 10^3 [\text{OH}^-]$$

$$[\text{CO}_3^{2-}] = K_2 \cdot \frac{[\text{HCO}_3^-]}{[\text{H}^+]} \cdot \frac{[\text{OH}^-]}{[\text{OH}^-]} = 10^{-10,33} \cdot \frac{4,56 \times 10^3 [\text{OH}^-]^2}{10^{-14}} = 2,13 \times 10^7 [\text{OH}^-]^2$$

$$[\text{Ca}^{2+}] = \frac{K_{\text{so}}}{[\text{CO}_3^{2-}]} = \frac{10^{-8,34}}{2,13 \times 10^7 [\text{OH}^-]^2} = 2,14 \times 10^{-16} [\text{OH}^-]^{-2}$$

$$[\text{H}^+] = \frac{10^{-14}}{[\text{OH}^-]}$$

PRILOG 5 (nastavak)

$$2. \frac{2,14 \times 10^{-16}}{[\text{OH}^-]^2} + \frac{10^{-14}}{[\text{OH}^-]} = 2 \cdot 2,13 \times 10^7 [\text{OH}^-]^2 + 4,56 \times 10^3 [\text{OH}^-] + [\text{OH}^-] / [\text{OH}^-]$$

$$4,28 \times 10^{-16} + 10^{-14} [\text{OH}^-] = 4,26 \times 10^7 [\text{OH}^-]^4 + 4,56 \times 10^3 [\text{OH}^-]^3$$

$$4,26 \times 10^7 [\text{OH}^-]^4 + 4,56 \times 10^3 [\text{OH}^-]^3 - 10^{-14} [\text{OH}^-] = 4,28 \times 10^{-16}$$

→ metoda "pokušaj - pogreška" → vidi Excel dokument

$$[\text{OH}^-] = 4,54 \times 10^{-7} \text{ M} \Rightarrow \text{pH} = 7,66$$

Sad se vraćamo u jednačbe na prethodnoj strani i dobijemo:

$$[\text{CO}_3^{2-}] = 2,13 \times 10^7 \times (4,54 \times 10^{-7})^2 = 4,39 \times 10^{-6} \text{ M}$$

$$[\text{Ca}^{2+}] = \frac{2,14 \times 10^{-16}}{[\text{OH}^-]^2} = 1,04 \times 10^{-3} \text{ mol/dm}^3$$

Ili, ako želimo izraziti topljivost u mg/L:

$$n = \frac{m}{M} \Rightarrow m = n \cdot M$$

$$m = 1,04 \times 10^{-3} \text{ mol} \times 40,08 \text{ g/mol} = 41,6 \times 10^{-3} \text{ g}$$

$$\rho = \frac{m}{V} \Rightarrow \rho(\text{Ca}^{2+}) = 41,6 \text{ mg/L}$$