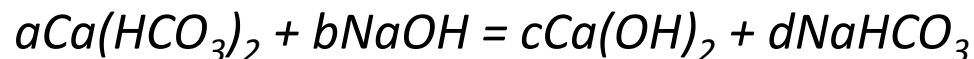


Balancing chemical reactions

Slide#6 solution)

Basic rule: conservation of matter (atoms)



$$\text{Ca: } a = c \quad (1)$$

$$\text{Na: } b = d \quad (2)$$

$$\text{H: } 2a + b = 2c + d \quad (3)$$

$$\text{C: } 2a = d \quad (4)$$

$$\text{O: } 6a + b = 2c + 3d \quad (5)$$

Four unknowns → three equations needed (obtain the ratio of each)

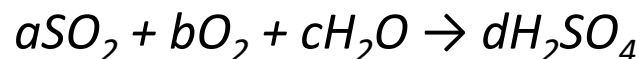
e.g., use (1), (2) & (4): $2a = 2c = b = d$ (satisfies (3) & (5) as well)



Balancing redox reactions

Slide#13 solution)

Basic rule: conservation of matter (atoms + electrons)



$$\text{S: } a = d \quad (1)$$

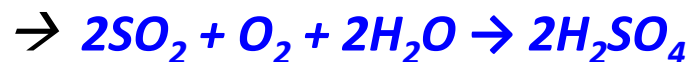
$$\text{O: } 2a + 2b + c = 4d \quad (2)$$

$$\text{H: } 2c = 2d \quad (3)$$

$$e^-: (\text{O}_2 [0] + 4e^- \rightarrow 2\text{O}^{2-}) \times b; \quad (\text{S}^{4+} \rightarrow \text{S}^{6+} + 2e^-) \times a$$

$$4b = 2a \quad (4)$$

e.g., use (1), (2) & (4): $a = 2b = c = d$ (satisfies (2) as well)



Chemical equilibrium: solubility

Slide#19 solution)

i) Assume ionic strength is negligible (activity = molarity)

$$[Ca^{2+}] = [CO_3^{2-}]$$

$$K_s = 10^{-8.48} = [Ca^{2+}][CO_3^{2-}] = [Ca^{2+}]^2$$

$$[Ca^{2+}] = 5.75 \times 10^{-5} M$$

ii) Without the assumption

Let's assume NaCl is a sole contributor of ionic strength

$$I = \frac{1}{2} [(0.01 M) \cdot (1^2) + (0.01 M) \cdot (1^2)] = 0.01 M$$

$$\log \gamma_{Ca} = \log \gamma_{CO_3} = -0.5 \cdot 2^2 \left(\frac{\sqrt{0.01 M}}{1 + \sqrt{0.01 M}} - 0.2 \cdot 0.01 M \right) = -0.175$$

$$\gamma_{Ca} = \gamma_{CO_3} = 10^{-0.175} = 0.664$$

$$\gamma_{Ca} [Ca^{2+}] = 5.75 \times 10^{-5} M$$

$$[Ca^{2+}] = 8.66 \times 10^{-5} M \text{ (valid if within 5% error is accepted)}$$