Raffles Institution
Year 5 H2 Chemistry 2024
Tutorial 1 – Redox Reactions

Answers to Self-Check Questions

1 Let the oxidation number of the underlined atoms in the following species be x.

(a) Note: Ba^{2+} & SO_4^{2-}

$+2 + x + 4(-2) = 0$

$x = +6$

(b) Note: Na^{+} & VO_4^{3-}

$3(+1) + x + 4(-2) = 0$

$x = +5$

(c) $x + (-2) = +2$

$x = +4$

(d) $2x + 4(-2) = -2$

$x = +3$

(e) $2(+1) + 2x = 0$

$x = -1$

(f) $2x + 4(-2) = 0$

$x = +4$

(g) Note: F is more electronegative than Br.

$x + (-1) = 0$

$x = +1$

(h) Note: F is more electronegative than I.

$x + 7(-1) = 0$

$x = +7$

2 **(a)**

$\overset{-3}{N}H_3(aq) + H\overset{-1}{C}l(aq) \rightarrow \overset{-3}{N}H_4\overset{-1}{C}l(aq)$

This is not a redox reaction since there is no change in initial and final oxidation states for all elements.

(b)

$\overset{0}{3Mg}(s) + 2\overset{+1}{N}H_3(g) \rightarrow \overset{+2}{Mg_3}\overset{0}{N_2}(s) + 3\overset{0}{H_2}(g)$

This is a redox reaction where the oxidation number of H decreases from +1 in NH_3 to 0 in H_2, and the oxidation number of Mg increases from 0 in Mg to +2 in Mg_3N_2.

3 **(a)** $2Na_2S_2O_3 + I_2 \rightarrow Na_2S_4O_6 + 2NaI$

Amount of $Na_2S_2O_3$ required $= 15.0 \times 10^{-3} \times 0.100 = 1.50 \times 10^{-3}$ mol

Amount of I_2 produced = $1.50 \times 10^{-3} \div 2 = 7.50 \times 10^{-4}$ mol

(b) $O_3 + 2KI + H_2O \rightarrow I_2 + O_2 + 2KOH$

Amount of O_3 in the mixture $= 7.50 \times 10^{-4}$ mol

Volume of O_3 in the mixture $= 7.50 \times 10^{-4} \times 22.7 = 0.01703\ dm^3 = 17.03\ cm^3$

$\%$ of O_3 in the mixture $= \dfrac{17.03}{500} \times 100\% = 3.41\%$

4 **(a)** $NaOH(aq) + HCl(aq) \rightarrow NaCl(aq) + H_2O(l)$

Amount of HCl reacted $= 22.50 \times 10^{-3} \times 0.100 = 2.250 \times 10^{-3}$ mol

Amount of NaOH in $25.0cm^3$ of solution **H** $= 2.250 \times 10^{-3}$ mol

Amount of NaOH in $100cm^3$ of solution **H** $= \dfrac{2.250 \times 10^{-3}}{25.0} \times 100 = 9.00 \times 10^{-3}$ mol

(b) $2MnO_4^-(aq) + 5H_2O_2(aq) + 6H^+(aq) \rightarrow 2Mn^{2+}(aq) + 5O_2(g) + 8H_2O(l)$

Amount of MnO_4^- reacted $= 10.0 \times 10^{-3} \times 0.0200 = 2.00 \times 10^{-4}$ mol

Amount of H_2O_2 in $25.0cm^3$ of solution **H** $= \frac{2.00 \times 10^{-4}}{2} \times 5 = 5.00 \times 10^{-4}$ mol

Amount of H_2O_2 in $100cm^3$ of solution **H** $= \frac{5.00 \times 10^{-4}}{25.0} \times 100 = 2.00 \times 10^{-3}$ mol

(c) $Na_2O_2 + 2H_2O \rightarrow 2NaOH + H_2O_2$

Amount of Na_2O_2 = Amount of H_2O_2 produced $= 2.00 \times 10^{-3}$ mol

Amount of NaOH from $Na_2O_2 = 2 \times 2.00 \times 10^{-3} = 4.00 \times 10^{-3}$ mol

Amount of NaOH from $Na_2O = 9.00 \times 10^{-3} - 4.00 \times 10^{-3} = 5.00 \times 10^{-3}$ mol

$Na_2O + H_2O \rightarrow 2NaOH$

Amount of $Na_2O = 5.00 \times 10^{-3} \div 2 = 2.50 \times 10^{-3}$ mol