Redox Practice
(Titrations)

Short Answer - write your response in the space provided. Express your answer in correct sig figs & units where appropriate.

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1. A technician tests the concentration of methanol, CH_3OH, in diluted windshield washer fluid using a redox titration. A 25.00 mL sample is titrated with 14.50 mL of 0.0200 M $KMnO_4$. Determine the concentration of methanol in the sample given the following redox reaction: K^+ is spectator

$$6H^+ + 2MnO_4^- + 5CH_3OH \rightarrow 5CH_2O + 2Mn^{2+} + 8H_2O$$ **(3 marks)**

① Balanced reaction: ✓

② Convert Known to moles:

$$0.0200\ \frac{mol}{L}\ MnO_4^- \times 0.01450\ L = 0.00029\ mol\ MnO_4^-$$

③ Stoich to unknown:

$$0.00029\ mol\ MnO_4^- \times \frac{5\ mol\ CH_3OH}{2\ mol\ MnO_4^-} = 0.000725\ mol\ CH_3OH$$

④ $[CH_3OH]$ in mol/L

$$\frac{0.000725\ mol\ CH_3OH}{0.02500\ L} = 0.0290\ M$$

(3 S.F.)

2. An impure sample of iron was dissolved in acid. The Fe^{2+} in this solution was titrated with 0.0210 M $KMnO_4$. Use the following data table and redox equation to determine the moles of Fe^{2+} in the sample. **(3 marks)**

$$MnO_4^- + 5Fe^{2+} + 8H^+ \rightarrow Mn^{2+} + 5Fe^{3+} + 4H_2O$$

TRIAL	VOLUME $KMnO_4$
1	~~37.26 mL~~
2	35.18 mL
3	35.22 mL

avg. Δ volume

$= \frac{35.18\ mL + 35.22\ mL}{2}$

$= 35.20\ mL\ KMnO_4^-$

① Balanced Reaction: ✓

② moles Known:

$0.0210 \frac{mol}{L}\ MnO_4^- \times 0.03520 L = 0.0007392\ mol\ MnO_4^-$

③ Stoich:

$0.0007392\ mol\ MnO_4^- \times \frac{5\ mol\ Fe^{2+}}{1\ mol\ MnO_4^-} = 0.003696\ mol\ Fe^{2+}$

④ moles Fe^{2+}: ✓

0.00370 moles Fe^{2+}

(3 S.F.)

3. In the process of extracting tin from a sample of ore, the tin is removed as Sn^{2+} ions. A titration requires 21.43 mL of 0.0170 M $K_2Cr_2O_7$ to reach the equivalence point with the Sn^{2+} in a 0.750 g sample of the ore.

$$3Sn^{2+}_{(aq)} + Cr_2O_7^{2-}{}_{(aq)} + 14H^+_{(aq)} \rightarrow 3Sn^{4+}_{(aq)} + 2Cr^{3+}_{(aq)} + 7H_2O_{(\ell)}$$

Using the reaction, calculate the percent mass of tin in the ore sample. **(4 marks)**

$$\% \text{ mass} = \frac{g\ Sn^{+2}}{g \text{ tin ore sample}} \times 100$$

$$= \frac{?}{0.750\,g} \times 100$$

① Balanced reaction: ✓

② moles Known:

$$0.0170 \frac{mol}{L} Cr_2O_7^{2-} \times 0.02143\ L = 0.00036431\ mol\ Cr_2O_7^{-2}$$

③ Stoich to get moles Sn^{+2}

$$0.00036431\ mol\ Cr_2O_7^{2-} \times \frac{3\ mol\ Sn^{2+}}{1\ mol\ Cr_2O_7^{2-}} = 0.00109...\ mol\ Sn^{2+}$$

④ grams Sn^{2+}?

$$0.00109...\ mol\ Sn^{2+} \times \frac{118.7\ g\ Sn^{2+}}{1\ mol\ Sn^{2+}} = 0.1297...\ g.$$

$$\% \text{ mass} = \frac{0.1297...\ g\ Sn^{2+}}{0.750\ g \text{ ore}} \times 100$$

$$= 17.3\ \%\ (3\ S.F.)$$

4. Consider the following redox reaction in acidic solution:

$$MnO_4^- + H_2O_2 \rightarrow Mn^{2+} + O_2 \qquad \text{(acidic)}$$

a) Write a balanced equation for the above reaction. **(4 marks)**

Tip (get half reactions from data table then just make # e's equal)

$(5e^- + 8H^+ + MnO_4^- \rightarrow Mn^{2+} + 4H_2O)\,2$

$(H_2O_2 \rightarrow O_2 + 2H^+ + 2e^-)\,5$

$10e^- + 16H^+ + 2MnO_4^- \rightarrow 2Mn^{2+} + 8H_2O$

$5H_2O_2 \rightarrow 5O_2 + 10H^+ + 10e^-$

$6H^+ + 5H_2O_2 + 2MnO_4^- \rightarrow 2Mn^{2+} + 5O_2 + 8H_2O$

b) The above reaction was used for a redox titration. At the equivalence point 5.684×10^{-4} mol $KMnO_4$ was required to titrate 5.00 mL of H_2O_2 solution. Calculate the $[H_2O_2]$. **(2 marks)**

① Balanced Reaction ✓ ② moles known ✓

③ Stoich to moles unknown

$$5.684 \times 10^{-4}\ \text{mol}\ MnO_4^- \times \frac{5\ \text{mol}\ H_2O_2}{2\ \text{mol}\ MnO_4^-} = 0.001421\ \text{mol}\ H_2O_2$$

④ $[H_2O_2]$ in mol/L

$$= \frac{0.001421\ \text{mol}\ H_2O_2}{0.00500\ \text{L}}$$

$$= 0.2842\ \text{M}$$

Answer = $[H_2O_2]$ = 0.284 M (3 S.F.)