Redox Titrations Worksheet

Name Answer Key

1) Which of the following could be titrated using acidified MnO_4^- ions? Circle the correct answer. **(1 mark)**

Na^+ IO_3^- SO_4^{2-} H_2O_2

2) Which of the following acidified solutions could be used to determine the $[Sn^{2+}]$ by redox titration? Circle the correct answer **(1 mark)**

I^- Co^{2+} Cr^{3+} $Cr_2O_7^{2-}$

3) Consider the following redox reaction in acidic solution:

$$MnO_4^- + H_2O_2 \rightarrow Mn^{2+} + O_2$$

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

$2(8H^+ + 5e^- + \overset{+7}{Mn}\overset{-2}{O_4}^- \longrightarrow Mn^{2+} + 4H_2O)$

$5(H_2\overset{-1}{O_2} \rightarrow \overset{0}{O_2} + 2e^- + 2H^+)$

$16H^+ + 2MnO_4^- \longrightarrow 2Mn^{2+} + 8H_2O + 5H_2O_2 \longrightarrow + 5O_2 + 10H^+$

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

b) The above reaction was used for a redox titration. At the equivalence point 6.725×10^{-4} mol $KMnO_4$ was required to titrate 7.50 mL of H_2O_2 solution. Calculate the $[H_2O_2]$. **(2 marks)**

$$6.725\times10^{-4}\ mol\ MnO_4^- \times \frac{5\ mol\ H_2O_2}{2\ mol\ MnO_4^-} \times \frac{\quad}{0.00750\ L} = 0.224\ mol\ dm^{-3}\ H_2O_2$$

4) The data below were obtained in a redox titration of a 30.00 cm^3 sample containing Sn^{2+} ions using 0.150 mol dm^{-3} $KMnO_4$.:

	Volume of $KMnO_4$ used (mL)		
	Trial #1	Trial #2	Trial #3
Initial buret reading	2.00	13.80	24.55
Final buret reading	13.80	24.55	35.32
Titre	11.80	10.75	10.77

Avg titre: 11.11 cm^3

Calculate the $[Sn^{2+}]$ in the original sample. **(4 marks)**

$$0.01111\,dm^3 \times \frac{0.150\,mol\,MnO_4^-}{dm^3} \times \frac{5\,mol\,Sn^{2+}}{2\,mol\,MnO_4^-} \times \frac{}{0.03000\,dm^3}$$

$$= 0.139\,mol\,dm^{-3}\,Sn^{2+}$$

$$2\left(8H^+ + 5e^- + MnO_4^- \longrightarrow Mn^{2+} + 4H_2O\right)$$
$$5\left(Sn^{2+} \longrightarrow Sn^{4+} + 2e^-\right) \Rightarrow$$
$$16H^+(aq) + 2MnO_4^-(aq) + 5Sn^{2+}(aq) \rightarrow 2Mn^{2+}_{(aq)} + 8H_2O(l) + 5Sn^{4+}_{(aq)}$$

5) An impure sample of CaC_2O_4 weighing 0.793 g is titrated with 17.30 cm^3 of 0.125 mol dm^{-3} $KMnO_4$. What is the percent by mass of the CaC_2O_4 in the original sample? **(4 marks)** Hint: carbon dioxide and water are produced in the reaction.

$$2\left(8H^+ + 5e^- + MnO_4^- \longrightarrow Mn^{2+} + 4H_2O\right)$$
$$5\left(\overset{+3\ -2}{C_2O_4^{2-}} \longrightarrow 2\overset{+4\ -2}{CO_2} + 2e^-\right)$$

$$16H^+(aq) + 2MnO_4^-(aq) + 5C_2O_4^{2-}(aq) \longrightarrow 2Mn^{2+}(aq) + 8H_2O(l) + 10CO_2$$

$$0.01730\,dm^3 \times \frac{0.125\,mol\,MnO_4^-}{dm^3} \times \frac{5\,mol\,C_2O_4^{2-}}{2\,mol\,MnO_4^-} \times \frac{80.08\,g\,Ca}{116.1\,g\,CaC_2O_4^{2-}}$$
$$\frac{1\,mol\,C_2O_4^{2-}}{1\,mol\,CaC_2O_4^{2-}}$$

$$= \frac{0.628\,g\,CaC_2O_4}{0.793\,g} = 79.2\%\ CaC_2O_4$$