Friday Worksheet **Name: ……..**

Gravimetric worksheet 5

1) A heat-resistant alloy composed of aluminium and iron is analysed to determine the percentage by mass of iron. An 90.50 g sample of alloy is dissolved in concentrated hydrochloric acid where the iron atoms are converted to $Fe^{2+}(aq)$ ions. This solution is accurately transferred to a 250.0 mL volumetric flask and made up to the mark. 20.00 mL aliquots of this solution are then titrated against a standard 0.0395 M potassium permanganate solution.

$5Fe^{2+}(aq) + MnO_4^-(aq) + 8H^+(aq) \rightarrow 5Fe^{3+}(aq) + Mn^{2+}(aq) + 4H_2O(l)$
Four titrations were carried out and the volumes of potassium permanganate solution used were recorded in the table below.

Titration number	1	2	3	4
Volume of $KMnO_4$ (mL)	22.02	21.92	22.15	21.98

a. Write a balanced half-equation, including states, for the conversion of $MnO4^-$ ions, in an acidic solution, to Mn^{2+} ions.

$5e + 8H^+(aq) + MnO_4^-(aq) => Mn^{2+}(aq) + 4H_2O(l)$

b. Calculate the average volume, in mL, of the concordant titres of the potassium permanganate solution.

(22.02 + 21.92 + 21.98) /3 = 21.97

c. Use your answer to part b. to calculate the amount, in mol, of $MnO_4^-(aq)$ ions used in this titration.

$n = C \times V = 0.0395 \times 0.02197 = 8.68 \times 10^{-4}$

d. Calculate the amount, in mol, of $Fe^{2+}(aq)$ ions present in the 250.0 mL volumetric flask.

According to the stoichiometry for every mol of MnO_4^- 5 mol of Fe^{2+} reacts.

Step1 calculate the mol of Fe^{2+} in the 20.0 mL aliquot.

⇨ Mol of Fe^{2+} = 5 X 8.68 X 10^{-4} = 0.00434

Step 2 calculate the mol of Fe^{2+} in the volumetric flask.

⇨ (250/20) X 0.00434 = 0.0543

e. Calculate the percentage, by mass, of iron in the 90.50 g sample of alloy. Express your answer to the correct number of significant figures.

Find the mass of iron in the volumetric flask

⇨ 55.8 X 0.0543 = 3.03g

Find percent by mass of iron in the sample

⇨ (3.03 / 90.50) X 100 = 3.35%