Friday Worksheet **Name: …….**
Volumetric 6

A wine bottle is marked as having an alcohol content of 13.0% v/v. In other words, for every 100 mL of wine 13.0 mL of ethanol is present. To test this claim a student conducted a titration to determine the amount of alcohol in 20.0 mL of wine.
Three 20.0 mL aliquots of the wine were titrated with a 1.652 M $K_2Cr_2O_7$ solution and an average titre of 20.00 mL was obtained.
Wine is thought to be a good source of antioxidants.

1) Write the balanced reduction reaction where $Cr_2O_7^{-2}$ is reduced to Cr^{3+}
   $Cr_2O_7^{-2}(aq) + 14H^+(aq) + 6e \rightarrow 2Cr^{3+}(aq) + 7H_2O(l)$
2) Write the balanced half equation for the oxidation of CH_3CH_2OH to CH_3COOH
   $CH_3CH_2OH(aq) + H_2O(l) \rightarrow CH_3COOH(aq) + 4H^+(aq) + 4e$
3) Write the overall balanced equation for the reaction.
   $2Cr_2O_7^{-2}(aq) + 16H^+(aq) + 3CH_3CH_2OH(aq) \rightarrow 4Cr^{3+}(aq) + 11H_2O(l) + 3CH_3COOH(aq)$

4) Determine the mol of $Cr_2O_7^{-2}$ in the average titre.
   $n = C \times V = 1.652M \times 0.0200\ L = 0.0330$
5) Determine the mol of ethanol present in the 20.0 mL aliquot.
   => mol of ethanol = (3/2) X mol of $Cr_2O_7^{-2}$ = (3/2) X 0.0330 = 0.0496
6) Determine the mass, in grams, of ethanol present in the 20.0 mL aliquot.
   => mass of ethanol = 0.0496 X 46 = 2.28 grams
7) If ethanol has a density of 0.789 g/mL at room temperature what volume of ethanol is present in the 20.0 mL aliquot?
   => d = m/V = 0.789 g/mL X 2.28g / V
   => V = 2.28 / 0.789 g/mL = 2.89 mL
8) Calculate the concentration of the ethanol in %v/v to the right number of significant figures.
   => 2.89 / 20.0 = 14.5% v/v
9) The table below represents the results from the three titrations conducted by the student.

Titre	*Start (mL)*	*Finish(mL)*	*Total (mL)*
1	*0.00*	*21.20*	*21.20*
2	*21.20*	*40.06*	*19.94*
3	*1.20*	*20.20*	*19.00*

a) How accurate are the results of the investigation. Explain how the investigation can be changed to make the result more accurate.
   More titrations need to be done in order to obtain concordant results. Only concordant results can be averaged.
b) How would the student explain the higher percentage of alcohol in the wine?
   The wine contains antioxidants which will react with the $Cr_2O_7^{-2}$.