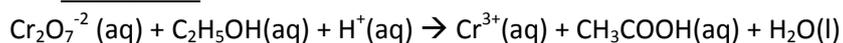


Lesson 2 Volumetric analysis - titrations involving redox reactions, %m/m and errors.

- 1) A wine bottle was labelled 3.0 %m/m of ethanol. Volumetric analysis was used to determine and verify the alcohol content of the wine. A 110.0 gram sample of the wine was placed into a 250 mL volumetric flask and made up to the mark with deionised water. A 20.00 mL aliquot was placed into a 100 mL conical flask and two drops of the appropriate indicator added before titrating with a 0.450 M  $\text{K}_2\text{Cr}_2\text{O}_7$  solution. Four titres were obtained 10.10 mL, 9.88 mL, 10.00 mL and 10.05 mL.

The unbalanced overall reaction is shown below.



a) Write a balanced equation for the:

i. oxidation half reaction

ii. reduction half reaction

iii. overall reaction

b) Calculate the average titre

c) Calculate the amount in mol of  $\text{Cr}_2\text{O}_7^{-2}$  in the average titre.

d) Calculate the amount of ethanol in the conical flask.

e) ) Calculate the concentration of ethanol in %m/m.

2) An outline of a titration method, to determining the concentration of acetic acid in a particular brand of vinegar, is given below.

1. A burette is filled with a standard solution of sodium carbonate.
2. The vinegar is diluted by a factor of 10 in a volumetric flask.
3. A pipette is used to transfer 20.00 mL of diluted vinegar to a conical flask and a few drops of phenolphthalein indicator is added.
4. The diluted vinegar is titrated with the base. Titrations are repeated until three concordant results are obtained.

The equation for the reaction is



- a) The glassware was rinsed before the titration. Indicate which solution should be used to finally rinse each of these pieces of glassware
  - i. volumetric flask
  - ii. pipette
  - iii. burette
  - iv. conical flask
- b) Explain why the vinegar must be diluted

c) One student's results are given below. The data shown in the student's laboratory book was

- concentration of  $\text{Na}_2\text{CO}_3(\text{aq}) = 0.108 \text{ M}$
- volume of undiluted vinegar = 12.00 mL
- total volume of diluted vinegar = 200.00 mL
- volume of diluted vinegar used in each titration = 20.00 mL
- average titre of  $\text{Na}_2\text{CO}_3 = 16.36 \text{ mL}$

Based on these results, calculate the concentration, in  $\text{mol L}^{-1}$ , of acetic acid in the undiluted vinegar solution. Give the answer to the correct number of significant figures.