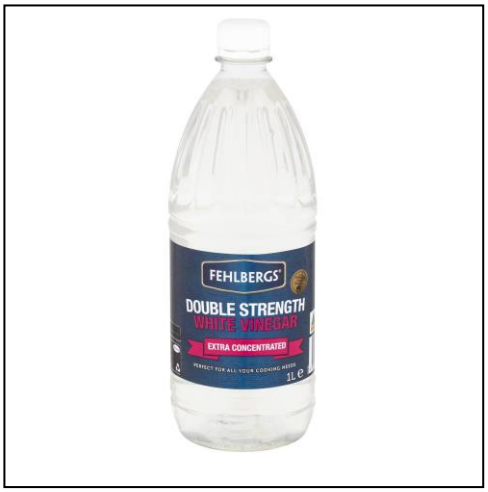
Lesson 3a – dilution before titration-solutions

The acetic acid (ethanoic acid) concentration of a brand of vinegar is to be determined using volumetric analysis. A 20.00 mL aliquot is taken from the original bottle of vinegar and placed in a 200 mL volumetric flask and made to the mark using distilled water.
A volume of 25.00 mL was transferred from the volumetric flask to a 100mL conical flask and titrated to the end point using a standard solution of 0.201 M Na_2CO_3. An average titre of 20.16 mL was obtained. Find the concentration of acetic acid in the original sample in %m/v.



a) Write the balanced overall equation for the reaction taking place in the conical flask between the ethanoic acidl and the $NaHCO_3$.
$2CH_3COOH(aq) + Na_2CO_3 \rightarrow 2NaOOCCH_3\ (aq) + CO_2(g) + H_2O(l)$

b) Find the mol of Na_2CO_3 in the average titre

Mol of Na_2CO_3 = C X V = 0.201mol/L X 0.02016 L= 4.05×10^{-3}mol

c) Find the mol of acetic acid in the conical flask.

Mol of acetic acid = 2 X mol of Na_2CO_3 = 8.10×10^{-3}mol

d) Find the concentration, in mol/L, of acetic acid in the volumetric flask
Since the 8.10×10^{-3}mol of acetic acid came from a 25.00 mL sample of the solution in the volumetric flask, we can calculate the concetration of acetic acid in the 25.00 mL sample.
=>8.10×10^{-3}mol / 0.0250 = 0.324M
concetration of acetic acid in the volumetric flask = concetration of acetic acid in the 25mL sample
hence concentration of acetic acid in the volumetric flask = 0.324M

e) Find the concentration in mol/L in the original undiluted sample

Since the original sample was diluted we can use the formula
$C_1V_1 = C_2V_2$
$C_1 = C_2V_2 / V_1$
=> C_1 = 0.324 X 0.200 / 0.0200 = 3.24 M

f) Find the concentration of acetic acid, in %m/v, in the original sample .

Convert mol/L to %m/v
=> 3.24 mol/L = (3.24 X 60.0 g) / 1000) X 100 = 19.44%m/v

Unpack the information by drawing a flow diagram.

Convert mol/L to %m/v
19.44%m/v

20.00mL original sample

200mL volumetric flask

25.00mL aliquot is taken

An average titre 20.16 mL of a 0.201 M Na_2CO_3.

Concetration of CH_3COOH in the volumetric flask is 0.324M
This was diluted from the original sample in a ration 1:10.
$C_1V_1 = C_2V_2$
$C_1 = C_2V_2/V_1$ = 0.324 0.200 / 0.0200
C_1 = 3.24M

8.10 X 10^{-3}mol of CH_3COOH in the conical flask that came from 25.00 mL of solution from the volumetric flask
Concentration of CH_3COOH
= 8.10 X 10^{-3}mol / 0.025 = 0.324M

4.05 X 10^{-3}mol of Na_2CO_3