Lesson 5 – volumetric analysis

1. Jonathon analysed a sample of vinegar for its acetic acid content. Using a 25mL pipette he took a 25.00 mL sample of vinegar stock solution and placed it in a 250 mL volumetric flask. Distilled water was then added to the mark. A 20.00 mL sample was taken from the volumetric flask and placed in a 100mL conical flask. The sample in the conical was titrated against a 0.100 M NaOH solution. A titre of 17.85 mL was needed to reach the end point.

a) Stephen also conducted the same investigation. However he rinsed his conical flask with distilled water. Would his result be higher, lower or the same as Jonathon's? Explain
No change. Water in the conical flask does not change the amount of acetic acid present in the 20.00mL sample taken from the volumetric flask.

b) Stephen conducted the investigation for a second time. This time he rinsed his burette with distilled water. Would his result be higher, lower or the same as Jonathon's? Explain
Higher. Since the NaOH in the burette is diluted a greater volume needs to be dispensed to give the same mol of NaOH to react with the acetic acid in 20.00mL of diluted vinegar.

c) Acetic acid is a monoprotic acid (CH_3COOH). Write a balanced chemical equation for the reaction between acetic acid and NaOH.

$NaOH(aq) + CH_3COOH(aq) \Rightarrow NaCH_3COO(aq) + H_2O(l)$

d) Calculate the mol of acetic acid present in the 20.00mL sample placed in the conical flask.
n_{NaOH} = C X V
⇨ *n = 0.100 X 0.01785 = 0.00179 mol.*
Since NaOH reacts with acetic acid in a 1:1 ratio
⇨ $n_{acetic\ acid} = 0.00179$

e) Calculate the concentration of acetic acid in the volumetric flask in mol/L.

Since the 20.00mL sample placed in the conical flask came from the volumetric flask its concentration is the same as the solution in the volumetric flask.
C = n/V
=>C = 0.00179/0.0200 =0.0895M

f) Calculate the concentration of acetic acid, in mol/L, found in the stock solution to the right number of significant figures.

Calculate the mol of acetic acid in the volumetric flask.
$n_{acetic\ acid} = C\ X\ V = 0.0895\ X\ 0.250 = 0.0224$

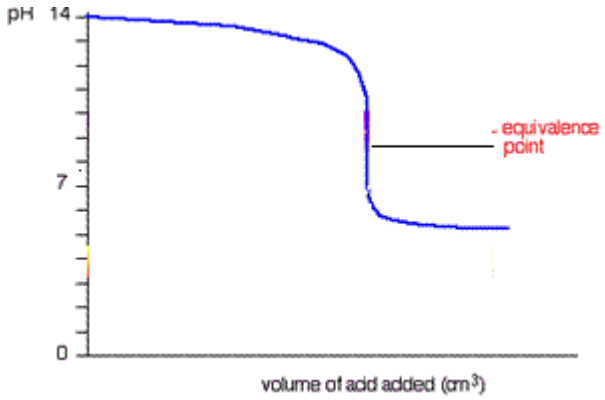
Since this amount came from the 25.00mL sample of stock solution the concentration of the acetic acid in the stock solution is given by the expression

⇨ *C = n/V = 0.0224/0.02500 = 0.896M*

g) Explain the difference between equivalence point and end point.

End point is when the indicator changes colour while the equivalence point is when the reactants are added in the exact stoichiometric ratio as indicated by the equation. The end point follows the equivalence point by about one drop.

h) A titration was conducted and the pH curve shown on the right. Select from the words below to complete the sentence.
strong acid, weak acid, strong base, weak base



A *strong base* is titrated against a *weak acid*

i) Two indicators are provided for students to use. Phenolphthalein and methyl orange. Which indicator should be used and why?
Phenolphthalein because according to the data booklet provided it will change colour at a pH range 8.3 – 10, close to the equivalence point where as methyl orange will not change colour near the equivalence point as it will change at a pH range of 3.1 -4.4

j) Explain why the equivalence point, shown on the pH curve above is not at pH of 7?
When all the reactants have completely reacted CH_3COONa and H_2O remain. The CH_3COO^- ion is a weak base and will react with water, to a certain extent, to produce OH^- ions.

$CH_3COO^-(aq) + H_2O(l) \Rightarrow CH_3COOH(aq) + OH^-(aq)$
This will give a pH greater than 7.