Revision video worksheet – volumetric analysis

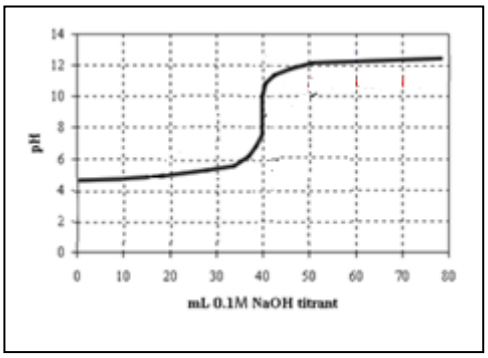
1. A 20.0 mL aliquot of commercial brick cleaner was placed in a 250 mL volumetric flask and made to the mark with distilled water. A 20.0 mL aliquot was taken from the flask and placed into a 100mL conical flask with 2 drops of methyl orange indicator and titrated against a 0.100 M Na_2CO_3 solution. An average titre of 20.12 mL was achieved. Calculate, to the correct number of significant figures, the concentration, in mol/litre, of HCl in the original sample.

2. 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 250 mL volumetric flask and made to the mark using distilled water. A volume of 20.00 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 $NaHCO_3$. An average titre of 20.16 mL was obtained.

   a. Find the concentration in mol/L in the original undiluted sample.

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

3. 3. A solution of an organic, monoprotic acid, whose concentration is unknown, is titrated with a 0.100 M NaOH solution. The pH curve for this titration is shown on the right. A 20.00 mL aliquot is taken from the original bottle of this monoprotic acid and placed in a 200 mL volumetric flask and made to the mark using distilled water. 25.00 mL was transferred from the volumetric flask to a 100mL conical flask and titrated to the end point. An average titre of 40.00 mL was obtained.



   a) Write the balanced overall equation for the reaction taking place in the conical flask between the weak monoprotic(HA) acid and the NaOH.

   b) Find the mol of NaOH in the average titre.

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

   d) Find the mol of the monoprotic acid in the volumetric flask.

   e) Find the concentration in mol/L in the original undiluted sample of the monoprotic acid.

   f) What indicator is suitable for this titration? Justify your choice.

   g) How accurate would the determination of the acid concentration be if methyl orange was used as an indicator?

4. The concentration of vitamin C in a filtered sample of lemon juice was determined by titrating the juice with 8.810×10^{-4} M iodine, I_2, solution using starch solution as an indicator. The molar mass of vitamin C is 176.0 g mol^{-1}. The reaction can be represented by the following equation.

$$C_6H_8O_6(aq) + I_2(aq) \rightarrow C_6H_6O_6(aq) + 2H^+(aq) + 2I^-(aq)$$

The following method was used:

1. Weigh a clean 200 mL conical flask and record the result in an appropriate table, fig 1.

2. Use a 10 mL measuring cylinder to measure 5 mL of grapefruit juice into the conical flask and reweigh it. Record the result in an appropriate table, fig 1.

Item weighed	Mas of item (g)
200 mL conical flask	251.00
Conical flask and lemon juice	255.90

Fig 1

3. Add 20 mL of deionised water to the conical flask.

4. Add a drop of starch solution to the conical flask.

5. Titrate the diluted grapefruit juice against the I_2 solution

a. If the titre was found to be 23.52 mL calculate the concentration, in % (m/m), of vitamin C in the lemon juice.

b. Explain the impact on the determination of the concentration of vitamin C in the lemon juice if:

- only 15 mL of deionised water was added to the conical flask.
- the burette was rinsed with deionized water just prior to the titration.
- the volume of the I_2 solution, in the burette, was always read 1.50 mL less than the real value due to parallax error
- the balance was not properly calibrated and consistently gave a reading 0.589 grams less than the true value.