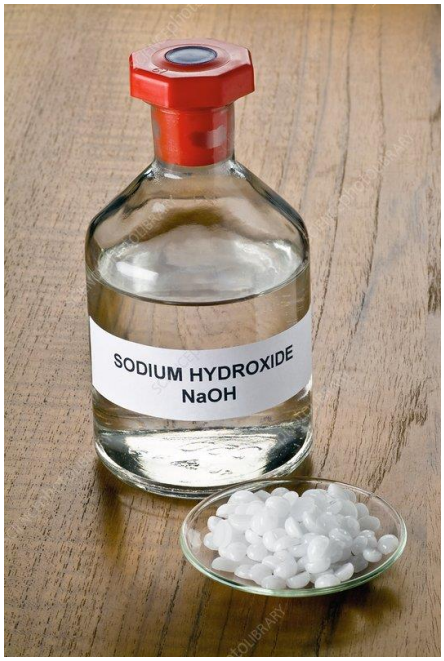
Friday worksheet 7 – volumetric analysis

1. A 20.00 mL aliquot of a solution of sodium hydroxide, from an unlabelled bottle of the solution, was added to a 100 mL conical flask, with two drops of appropriate indicator and titrated with a 0.121M solution of hydrochloric acid.



   Three trials were carried out and the volumes of the standard HCl solution titrated in each trial are shown below.
   12.01 mL, 11.95 mL, 12.04 mL

   a. Is there any result that should be discarded in the calculation of the average titre? Justify your answer..

   b. Calculate the average titre.

   c. Calculate, to the right number of significant figures, the mol of HCl in the average titre.

   d. Calculate, to the right number of significant figures, the mol of NaOH in the conical flask by first writing a balanced chemical equation for the reaction taking place in the flask.

   e. Calculate, to the right number of significant figures, the concentration in mol/L of the sodium hydroxide solution contained in the bottle

   f. Suggest how the following adjustments to the procedure may impact the final calculation of the concentration of NaOH. Circle the right response and justify your answer for each.

      i. Three drops of indicator are added to the conical flask.
      (impact = higher, lower, unchanged)
      .

      ii. 1.0 mL of distilled water was used to rinse the burette.
      (impact = higher, lower, unchanged)

      iii. 1.0 mL of the unknown NaOH solution was used to rinse the glass instrument used to deliver the 20.00 mL aliquot.
      (impact = higher, lower, unchanged)

      iv. 12.00 mL of distilled water is used to rinse the conical flask between trials.
      (impact = higher, lower, unchanged)

2. Hydrogen sulfide, H_2S, can cause an unpleasant smell in water supplies. The concentration of hydrogen sulfide can be measured by titrating with a chlorine standard solution. The equation for the reaction taking place is

$$4Cl_2(aq) + H_2S(aq) + 4H_2O(aq) \rightarrow SO_4^{2-}(aq) + 10H^+(aq) + 8Cl^-(aq)$$

10·00 mL of contaminated water was placed in a 200 mL volumetric flask and made to the mark with distilled water. Several 20.00 mL samples were prepared and titrated using a 0·0100 mol l^{-1} chlorine solution. The following titres were obtained.
20.87 mL, 20.94 mL, 21.01 mL, 21.06mL, 21.03 mL

a. Name an appropriate piece of apparatus which could be used to measure out the water samples.

b. What is meant by the term standard solution?

c. Calculate the average titre of 0·010 mol l^{-1} chlorine solution that was required to reach the end point.

d. What is the difference between ***end point*** and ***equivalence point?***

e. Perform the following calculations that relate to the titration. Show all working out.

i. Calculate the amount, in mol, of chlorine, Cl_2, present in the average titre.

ii. Calculate the amount, in mol, of hydrogen sulfide, present in a 20.00 mL sample of diluted water from the volumetric flask.

iii. Calculate the amount, in mol, of hydrogen sulfide, in the volumetric flask.

Iv Calculate the concentration, in mol/L, of hydrogen sulfide, in the contaminated water sample