Lesson 3 For Book 2

Exercise 1 *The skills of filtration*

a) Explain why filtration can be used to remove **mud particles** from muddy water, but cannot be used to remove **sodium chloride** from sea water. (3 marks)

→ To filter solid from a solution, the solid particles must be _____ in water.

b) So, how can we obtain NaCl(s) from sea water?

Exercise 2 *Preparation of ionic salt*

The following two methods can be used to convert copper metal into copper(II) nitrate solution:

$$\textit{Method 1}: \quad Cu(s) \rightarrow CuO(s) \xrightarrow{\text{dilute } HNO_{3(aq)}} Cu(NO_3)_2(aq)$$

$$\textit{Method 2}: \quad Cu(s) \xrightarrow{\text{dilute } HNO_{3(aq)}} Cu(NO_3)_2(aq)$$

(a) Refer to Method 1.

(i) Suggest how copper metal can be converted into copper(II) oxide. State the expected observation in the reaction that you have suggested.

(ii) Name the type of reaction that occurs between copper(II) oxide and dilute nitric acid.

(b) In Method 2, the reaction of copper metal with dilute nitric acid gives *copper(II) nitrate, nitrogen monoxide and water*. Write the chemical equation for this reaction.

(c) Which of these methods would you recommend for the conversion of copper metal into copper(II) nitrate solution ? Justify your answer with TWO reasons.

1)

2)

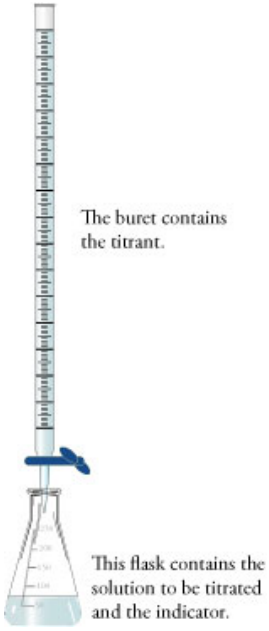
Volumetric Analysis

- *Chemical Analysis* has two main parts, they are qualitative and quantitative analysis. This section involves the determination of the amount of a substance in a sample, so it is the q_____ part → Analytical Chemistry (分析化學)
- Titration is usually learnt and tested in HKCEE level. What is it?

→ It is the method used to find out the **concentraion** of a sample s_____.

→ Types = Acid Base , Thermometric, electrical conductivity titration, …

What is Acid Base titration?



- Titration = involving the titrant (上/下), the titrate (上/下)

→ **Titrant** (or called s_____ solution) is the reagent with k_____ concentration while **titrate** is the sample with unknown concentration.

- Titration involves the use of p_____ , b_____, volumetric flask , conical flask and indicator.

→ **Pipette** is used to transfer the sample into the _____ flask.

(10___cm^3 / 25___cm^3 more accurately)

→ **Burette** is used to contain the standard solution.

→ **Conical flask** for containing the t_____ and i_____.

- Two important but confusing terms

→ equivalence point is **not** the point of which the pH of the solution is **7**, it is the theoretical point that all acid and base were *reacted completely* (sample and titrant) to form the salts.

→ end point is the point of which we observe the colour change of the i_____.

Preparation of a standard solution

How can we prepare 250cm^3 of a standard 1M NaOH for titration?

→ we can first calculate the mass of NaOH needed =

→ use an electric balance to weigh out the mass of NaOH required.

→ dissolve all the powder with not more than ____ mL water.

→ Pour the solution into a ___ volumetric flask and then make up the solution to 250cm^3 using _____ water until the g_____ mark is reached.

→ Mix the solution well by shaking

Or By **dilution** with a standard with *known but higher* concentration. Why higher?

Selection of substances to make a standard solution

Iodine is a volatile substance. Why we cannot use I_2 solution as standard like NaOH?

→ As iodine is volatile, the iodine solution will not have a s_____ concentration.

→ Some criteria to be a standard

1) Non-v_____ 2) High rel. molecular mass (reduce abs. error in weighing)

3) Non water-a_____ (**hygroscopic**) ***4) Chemically s_____

5) High purity of the raw material

How can we observe the end point (✗ equivalence point)?

- Before performing the acid base titration, we need to add a few drops of indicator. The c_____ change of indicator allows us to observe the end point.

→ It is better for us to have the end point near the equivalent point.

→ A suitable indicator is selected if its working pH range (the pH range which it will change its colour) fits in the pH range of the titration near the end point.

→ We should be familiar with the indicators methyl orange and p_____

(Actually, they are a weak organic a____. So, …any potential problem?)

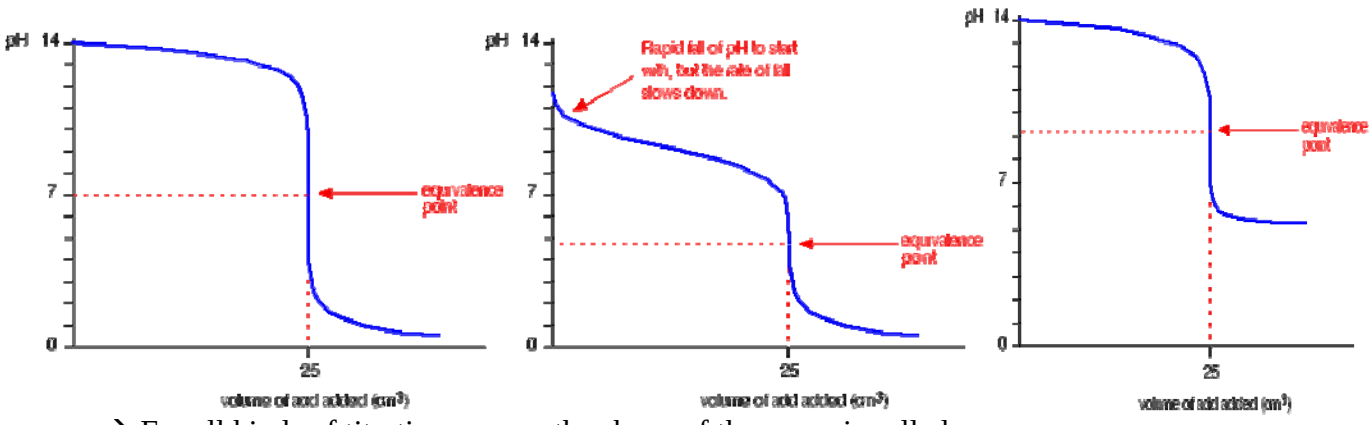
Indicator	*colour at low pH*	*Working pH range*	*colour at high pH*
methyl orange		3.2 – 4.4	
phenolphthalein		8.2 – 10.0	

→ Correct Choice of indicators for different types of A-B titrations

Titration Type	*Example*	*Suitable indicator(s)*
Strong A and Strong B	HCl and NaOH	Methyl orange , Phenolpthalein
Strong A and weak B	HNO_3 and NH_3	Methyl orange
Weak A and Strong B	Organic A and KOH	Phenolpthalein
Weak A and Weak B	Organic A and NH_3	Not a feasible titration!

p.s. The above choice is selected according to the below three kinds of titration curves

1) strong acid v strong base 2) strong acid v weak base 3) weak acid vs strong base



→ For all kinds of titration curves, the shape of the curve is called sigmoidal shape = S-Shaped

→No need to learn the curve for weak A and weak B

Calcuations on titration

- No matter what types of the questions you encountered, we have the

  Calculation Skill 1) Write down the FULL chemical equations first

  2) Molarity = no of mole / volume , unit = _____/M

  3) Mean titre is usually not including the first trial

- There are Five types of questions in the DSE syllebus

  1) Standardization = to find out the molarity of a unknown sample (??? M)
  2) Basicity of an acid = to find out the ***no. of proton*** that will be given out in water per each acid molecule
  3) Molar mass of a substance (metal / acid/ base) = mass of the sample must be given to you
  4) Relative atomic mass of an element (e.g metal but not acid/base)
  5) Number of water molecules of crystallization (e.g $CuSO_4*5H_2O$)
  6) Purity of a substance = $\frac{\text{actual mass of the substance}}{\text{actual mass of the substance + impurities}}$ * 100%

Exercise 3 *Review for the concept of Molarity and Concentration*

From a **saturated** aqueous solution of $Ca(OH)_2$, several 20.0 cm^3 aliquots (=amount) of the solution were withdrawn by a apparatus. Each aliquot was titrated with 0.100 M HCl using an appropriate indicator. The mean titre was 9.10 cm^3.

a) What is the type of the A-B titration? State a suitable indicator.

b) State the meaning of saturated solution.

→ A **saturated** solution means that the s_____ has no dissolving power to dissolve any s_____ anymore.

c) Calculate the molarity of the hydroxide ions in the saturated solution.

(Hint = Remember to write down the *equation* involved first)

(0.02275M)