WJEC England GCSE Chemistry

Topic 7: Chemistry of acids

Notes

(Content in bold is for Higher Tier only)

Reactions of acids with metals

acid + metal → salt + hydrogen

Neutralisation of acids and salt production

acid + alkali → salt + water
acid + base → salt + water
acid + metal carbonate → salt + water + carbon dioxide

- Examples of alkalis are soluble metal hydroxides
- Examples of bases are insoluble metal hydroxides
- All three of these above reactions are neutralisation reactions
- The salt produced…
    - depends on the acid used…
        - Hydrochloric acid produces chlorides
        - Nitric acid produces nitrates
        - Sulfuric acid produces sulfates
    - It also depends on the positive ions in the base, alkali or carbonate i.e. the metal, which makes up the first part of the name e.g. sodium chloride

Soluble salts

They can be made from acids by reacting them with solid insoluble substances, such as metals, metal oxides, hydroxides or carbonates:

1. Add the chosen solid insoluble substance to the acid then the solid will dissolve.
2. You know the acid has been neutralised when excess solid sinks to the bottom.
3. Filter out excess solid leaving the salt solution, then evaporate some water, then leave the rest to evaporate slowly. Crystals of the salt will form and remain

soluble salts can also be made from soluble bases:

1. carry out a titration to determine the exact volume of acid that reacts with the base
2. react these exact volumes, leaving a solution of just the salt and water
3. warm the solution to evaporate the water and leave just crystals of the salt

The pH scale and neutralisation

- Acids produce H^+ ions in aqueous solutions
- Alkalis produce OH^- ions in aqueous solutions
- Larger H+ concentration, lower pH, stronger acid / weaker base
- The pH scale (0 to 14) measures the acidity or alkalinity of a solution, and can be measured using universal indicator of a pH probe
    - pH 7 is neutral
    - < pH 7 is acidic

    - > pH 7 is alkaline
- $H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$ is the ionic equation of any neutralisation reaction between an acid and a base
- Neutralisation reactions include an acid reacting with base to form a salt plus water, or with carbonate to form a salt plus water and carbon dioxide

Titrations

The volumes of acid and alkali solutions that react with each other can be measured by titration using a suitable indicator.

How to carry out a titration:

- add acid to burette using a funnel, record the volume in the burette to start
- add known volume of alkali to a conical flask and add some indicator
- place conical flask on white tile (so you can see colour change clearly)
- add acid to alkali until you reach the end point
- calculate how much acid has been added (titre)
- repeat until you get concordant titres

Titration calculations

- once you have carried out a titration, you know the exact volume of an acid that reacts with the exact volume of an alkali
- if you only knew the concentration of the acid and wanted to calculate the concentration of the alkali:
    - calculate moles of acid using moles = concentration x volume
    - calculate the mole ratio of acid to alkali using the equation for the reaction
    - work out how many moles of alkali you have using the mole ratio and moles of acid (e.g. if you have 5 moles of acid and the ratio of acid to alkali is 1:2, you will have 10 moles of alkali)
    - calculate the concentration of the alkali using concentration = mol ÷ volume
- follow the same method for if you have both concentrations but only one volume

Strong and weak acids

- **Strong acid = completely ionised (ionised=releasing H^+ ions) in aqueous solution**
    - **Hydrochloric, nitric and sulfuric acids**
- **Weak acid = partially ionised in aqueous solution**
    - **Ethanoic, citric and carbonic acids**
- **Stronger an acid, lower the pH (for a given conc. of aq. solutions)**
- **Strong and weak is NOT the same as concentrated and dilute:**

- **concentrated/dilute refers to the amount of substance in a given volume:**
  concentration (g dm^{-3}) = mass ÷ volume
  concentration (mol dm^{-3}) = moles ÷ volume
- **strong/weak refers to the above – the H^+ ion conc. in aq. solutions**

- **as hydrogen ion concentration increases by a factor of ten the pH value of a solution decreases by one**
- Reactions are more vigorous with stronger acids – e.g. effervescence is greater with a stronger acid and a carbonate than that of a weaker acid…

Test for carbon dioxide gas

- Bubble the gas through the limewater (calcium hydroxide) and it will turn milky (cloudy)

Test for carbonates

- Carbonates react with dilute acids to create carbon dioxide.
- This gas can be bubbled through limewater, if the limewater goes cloudy, the gas is CO_2.

Test for sulfate ions

- First add dilute hydrochloric acid, followed by barium chloride solution
- A white precipitate will form when sulfate ions are in this solution

Practical assessments

- SP7A Preparation of crystals of a soluble salt from an insoluble base or carbonate
- SP7B Titration of a strong acid against a strong base using an indicator