AQA GCSE Chemistry

Topic 4: Chemical changes

Reactions of acids

Notes

(Content in bold is for Higher Tier only)

Reactions of acids with metals

- acids react with some metals to produce a salt and hydrogen:
  - acid + metal -> salt + hydrogen
- **These are redox reactions – this means that one substance is reduced and another substance is oxidised**
- **you should be able to identify which substances are which by looking at electrons gained and lost (following OIL RIG)**
  - **e.g. $2HCl + Mg \rightarrow MgCl_2 + H_2$**
  - **magnesium: $Mg \rightarrow Mg^{2+}$, so ionic equation is $Mg \rightarrow Mg^{2+} + 2e^-$, Mg has lost electrons so <u>Mg has been oxidised</u>**
  - **hydrogen: $2H^+ \rightarrow H_2$, so ionic equation is $2H^+ + 2e^- \rightarrow H_2$, H has gained electrons, so <u>H has been reduced</u>**
  - **because magnesium has been oxidised and hydrogen has been reduced in the same reaction, this is a <u>redox reaction</u>**

Neutralisation of acids and salt production

- Acids are <u>neutralised</u> by alkalis (e.g soluble metal hydroxides) and bases (e.g insoluble metal hydroxides and metal oxides) to produce salts and water
  - acid + alkali -> salt + water
  - acid + base -> salt + water
- acids are <u>neutralised</u> by metal carbonates to produce salts, water and carbon dioxide
  - acid + metal carbonate -> salt + water + carbon dioxide
- The salt produced…
  - In alkali and base reactions depends on the acid used…
    - Hydrochloric acid (HCl) produces chlorides (XCl)
    - Nitric acid (HNO_3) produces nitrates (XNO_3)
    - Sulfuric acid (H_2SO_4) produces sulfates (XSO_4)
  - It also depends on the positive ions in the base, alkali or carbonate i.e. the metal (which is the X in the salts above).
  - <u>remember</u>: the charges on the positive ion from the base/alkali/carbonate and the negative ion from the acid must add up to zero.
    e.g. if you have sodium hydroxide and sulfuric acid, you have Na^+ ions and SO_4^{2-} ions, so you need 2x Na^+ ions, giving you the salt: Na_2SO_4
    the charges on the ions from acids are: Cl^-, NO_3^- and SO_4^{2-}

Soluble salts

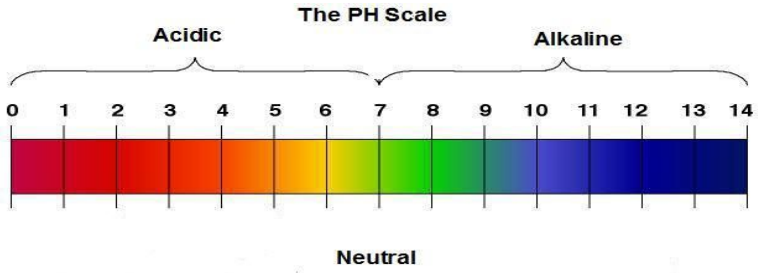
- They can be made from acids by reacting them with solid insoluble substances, such as metals, metal oxides, hydroxides or carbonates:
  1) Add the chosen solid insoluble substance to the acid then the solid will dissolve.
  2) You know the acid has been neutralised when excess solid sinks to the bottom, so keep adding until this happens

3) Filter out excess solid leaving the salt solution, then evaporate some water, then leave the rest to evaporate slowly.

This is called crystallisation.

The pH scale and neutralisation

- Acids produce H^+ ions in aqueous solutions
- Alkalis produce OH^- ions in aqueous solutions
- 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



Titrations (chemistry only)

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:

1. Wash burette using dilute hydrochloric acid and then water
2. Fill burette to 100cm^3 with acid with the meniscus' base on the 100cm^3 line
3. Use 25cm^3 pipette to add 25cm^3 of alkali into a conical flask, drawing alkali into the pipette using a pipette filler
4. Add a few drops of a suitable indicator to the conical flask (eg: phenolphthalein which is pink when alkaline and colourless when acidic)
5. Add acid from burette to alkali until end-point is reached (as shown by indicator)
6. The titre (volume of acid needed to exactly neutralise the acid) is the difference between the first (100cm^3) and second readings on the burette
7. Repeat the experiment to gain more precise results

Titration calculations

- **1dm^3 = 1000cm^3**
- **One mole of a substance in grams the same as its relative atomic mass in grams.**

Working out concentrations:

E.g 25 cm^3 of dilute hydrochloric acid is neutralised by 20 cm^3 of 0.5 mol/dm^3sodium hydroxide. What is the concentration of the hydrochloric acid?

1. **Convert volumes into dm^3.**
   $25/1000=0.025dm^3$ $20/1000=0.02dm^3$
2. **Work out the moles of NaOH**
   moles = volume x concentration
   So, 0.02 x 0.5 = 0.01
3. **Work out mole ratio from equation**
   HCl + NaOH -> H_2O + NaCl
   1:1 ratio, so moles of NaOH = moles of HCl, so moles of HCl=0.01
4. **Work out concentration**
   conc = moles / vol = 0.01 / 0.025 = 0.4 mol dm^{-3}

Strong and weak acids

- **Strong acid = completely ionised in aqueous solution**
  - **e.g. 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)**
- **As the pH decreases by one unit, the H^+ conc. of the solution increases by a factor of 10.**
- **Strong and weak is NOT the same as concentrated and dilute – the latter refers to the amount of substance in a given volume , whereas the former refers to the H^+ ion conc in aq. solutions**