Edexcel GCSE Chemistry

Topic 3: Chemical changes

Acids

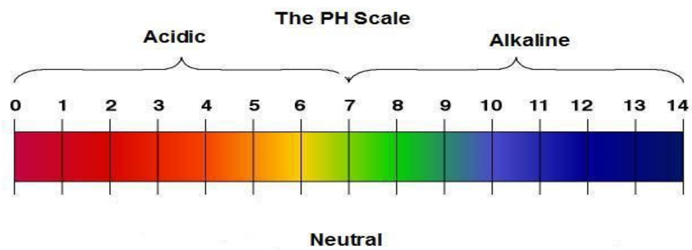
Notes

3.1 Recall that acids in solution are sources of hydrogen ions and alkalis in solution are sources of hydroxide ions

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

3.2 Recall that a neutral solution has a pH of 7 and that acidic solutions have lower pH values and alkaline solutions higher pH values

- 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



3.3 Recall the effect of acids and alkalis on indicators, including litmus, methyl orange and phenolphthalein

- Phenolphthalein
    - Alkaline = pink
    - Acidic = colourless
- Methyl orange
    - Alkaline = yellow
    - Acidic = red
- Litmus
    - Litmus solution
        - Alkaline = blue
        - Acidic = red
    - Litmus paper
        - Blue litmus paper goes red in acidic & stays blue in alkaline
        - Red litmus paper goes blue in alkaline & stays red in acidic

3.4 (HT only) Recall that the higher the concentration of hydrogen ions in an acidic solution, the lower the pH; and the higher the concentration of hydroxide ions in an alkaline solution, the higher the pH

- When an acid is in solution, a higher concentration of H^+ ions means that the solution is more acidic, thus having a lower pH
- When an alkali is in a solution, a higher concentration of OH^- ions means that the solution is more alkaline, thus having a higher pH

3.5 (HT only) Recall that as hydrogen ion concentration in a solution increases by a factor of 10, the pH of the solution decreases by 1

- As the pH decreases by one unit, the H^+ concentration of the solution increases by a factor of 10.

3.6 Core Practical: Investigate the change in pH on adding powdered calcium hydroxide or calcium oxide to a fixed volume of dilute hydrochloric acid

- method:
  - add dilute HCl to the beaker and measure pH
  - add weighed mass of calcium hydroxide and stir then record pH
  - keep adding weighed masses of calcium hydroxide until there is no more change to the pH
- analysis:
  - draw a line graph with mass added on the horizontal axis and with pH on the vertical axis
  - draw a line of best fit (remember to ignore any anomalies)

3.7 (HT only) Explain the terms dilute and concentrated, with respect to amount of substances in solution

- Strong and weak is NOT the same as concentrated and dilute – the latter refers to the amount of substance whereas, the former refers the H^+ ion conc. in aq. solutions
- Concentrated = larger amount of substance in a given volume of a solution
- Dilute = lesser amount of substance in a given volume of a solution

3.8 (HT only) Explain the terms weak and strong acids, with respect to the degree of dissociation into ions

- Strong acid = fully dissociates in aqueous solution (dissociation is where an acid breaks down to release H^+ ions in solution)
  - e.g. hydrochloric, nitric and sulfuric acids
- Weak acid = partially dissociates in aqueous solution
  - e.g. ethanoic, citric and carbonic acids
- Stronger an acid, greater the dissociation, the more H^+ ions released, the lower the pH (for a given conc. of aq. solutions)

3.9 Recall that a base is any substance that reacts with an acid to form a salt and water only

acid + base ⟶ salt + water

3.10 Recall that alkalis are soluble bases

- Examples of alkalis are soluble metal hydroxides

3.11 Explain the general reactions of aqueous solutions of acids with: metals, metal oxides, metal hydroxides, and metal carbonates (all) to produce salts

acid + metal ⟶ salt + hydrogen gas (H_2)

acid + metal oxide ⟶ salt + water

acid + metal hydroxide ⟶ salt + water

acid + metal carbonate ⟶ salt + water + carbon dioxide (CO_2)

- Metal oxides are normally bases (because insoluble)
- Metal hydroxides are bases/alkalis if insoluble/soluble
- To name salts:
  - first part is simply the name of the metal in the oxide/hydroxide/ carbonate
  - second part comes from the acid:
    - hydrochloric acid (HCl)- chloride
    - nitric acid (HNO_3)- nitrate
    - sulfuric acid (H_2SO_4)- sulfate

3.12 Describe the chemical test for: hydrogen and carbon dioxide (using limewater)

- Test for hydrogen:
  - Use a burning splint held at the open end of a test tube of the gas
    - Creates a 'squeaky pop' sound

- Test for carbon dioxide:
  - Bubble the gas through the limewater (calcium hydroxide solution) and it will turn milky (cloudy)

3.13 Describe a neutralisation reaction as a reaction between an acid and a base

3.14 Explain an acid-alkali neutralisation as a reaction in which hydrogen ions (H^+) from the acid react with hydroxide ions (OH^-) from the alkali to form water

- for any neutralisation reaction with an acid and an alkali the ionic equation is:

$$H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$$

3.15 Explain why, if soluble salts are prepared from an acid and an insoluble reactant: excess of the reactant is added, the excess reactant is removed, and the solution remaining is only salt and water

- Excess of the reactant is added
  - this is to ensure your volume of acid reacts completely
- excess reactant is removed
  - this is done by filtration of the insoluble reactant and is done so that you are left with just a salt and water
- the remaining solution is only salt and water
  - this is because all of your acid has fully reacted and you have filtered off your other reactant, and that the only products of your reaction are a salt and water
  - if you have used a carbonate you would still only have a salt and water remaining as carbon dioxide gas would have been given off into the atmosphere

3.16 Explain why, if soluble salts are prepared from an acid and a soluble reactant: titration must be used, the acid and the soluble reactant are then mixed in the correct proportions, and the solution remaining, after reaction, is only salt and water

- Titration must be used:
  - both reactants are liquids/soluble, so if you have an excess of one you would not be able to easily remove it from your mixture of products, this means you need to measure the exact amount of volumes that react, which is easily done using a titration.
  - You can then mix the exact proportions of the two reactants
- The exact amount of acid has thus been added to the soluble reactant, meaning that the leftover solution is only salt and water, no acid or alkali, because they have been completely neutralised

3.17 Core practical: Investigate the preparation of pure, dry hydrated copper sulfate crystals starting from copper oxide including the use of a water bath

- method:
  - add an excess of copper oxide (insoluble) to your acid (sulfuric acid- H_2SO_4- as you are making copper SULFATE)
  - use a filter and filter paper to filter off any copper oxide that hasn't reacted (your solution should be blue as copper sulfate solution has been formed)
  - evaporate off the water by placing your final solution in a water bath

3.18 Describe how to carry out an acid-alkali titration, using burette, pipette and a suitable indicator, to prepare a pure, dry salt

How to carry out a titration:

1. Wash burette using the 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 alkali 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
8. To prepare a pure, dry salt – you warm the salt solution to evaporate the water
9. Crystals form

3.19 Recall the general rules which describe the solubility of common types of substances in water: all common sodium, potassium and ammonium salts are soluble, all nitrates are soluble, common chlorides are soluble except those of silver and lead, common sulfates are soluble except those of lead, barium and calcium, and common carbonates and hydroxides are insoluble except those of sodium, potassium and ammonium

type of salt	soluble	insoluble
sodium	all	
potassium	all	
ammonium	all	
nitrates	all	
chlorides	all except...	silver, lead
sulfates	all except...	lead, barium, calcium
carbonates	sodium, potassium, ammonium	...all except
hydroxides	sodium, potassium, ammonium	...all except

3.20 Predict, using solubility rules, whether or not a precipitate will be formed when named solutions are mixed together, naming the precipitate if any

- first, work out what the products of your reaction will be
- then, use the table in 3.19 to determine if any salts formed are soluble/insoluble
- any INSOLUBLE salts will form as a precipitate (as any soluble salts will remain in solution)

3.21 Describe the method used to prepare a pure, dry sample of an insoluble salt

1. mix the two solutions needed to form the salt
2. filter the mixture using filter paper, which the insoluble salt will be left on
3. wash the salt using distilled water
4. leave the salt to dry on filter paper (water will evaporate, speed this process up by drying it in an oven)