Topic 3 – Acids

- **pH SCALE:**
- Note - difference between a base and an alkali:
  - Some bases are soluble
  - When dissolved in water, bases are called alkalis **(**→all alkalis are soluble)
- Acids and alkalis can be described using the pH scale:
  - Scale runs from pH1 (strong acid) to pH14 (strong alkali)
  - A neutral liquid has a pH of 7 (e.g water)
  - pH5 - weak acid…pH9 - weak alkali
- Universal indicator can be used to find out if a liquid is an acid or an alkali by dipping it into the liquid and observing its colour:
  - Yellow/orange/red – acid…green – neutral…blue/purple – alkali
  - The closer to red the stronger the acid (i.e red – strong acid, yellow – weak acid)
  - The closer to purple the stronger the alkali (i.e purple – strong alkali, blue – weak alkali)
- Litmus paper (must be damp to work) is also an indicator:
  - Blue litmus paper turns red under acidic conditions (no change under alkaline or neutral conditions)
  - Red litmus paper turns blue under alkaline conditions (no change under acidic or neutral conditions)
- **INDIGESTION**
- **Indigestion remedies/neutralisation reactions:**
- The stomach produces hydrochloric acid (HCl):
  - It kills bacteria that may be in the food
  - It provides acidic conditions for digestive enzymes to work best
- Sometimes the stomach can produce too much acid→indigestion
- Medicines called antacids (which contain bases/alkalis) can neutralise the excess stomach acid→are used in treating indigestion
- This - whereby an acid reacts with an alkali - is called a neutralisation reaction
- Antacids can either be metal oxides, metal hydroxides or metal carbonates
- General equations for these neutralisation reactions:
  - Metal oxide + acid→salt + water
  - Metal hydroxide + acid→salt + water
  - Metal carbonate + acid→salt + water + carbon dioxide
- The salt formed depends on the acid:
  - In the case of indigestion remedies the acid being neutralised is HCl (as it is the one present in the stomach)→chloride salts are produced
    - E.g if indigestion tablet contains calcium carbonate…
    - Hydrochloric acid + calcium carbonate →calcium chloride + water + carbon dioxide
    - Balanced equation: $2HCl_{(aq)} + CaCO_{3\,(s)} \rightarrow CaCl_{2\,(aq)} + H_2O_{(l)} + CO_{2\,(g)}$
  - Sulphuric acid and nitric acid can also be neutralised…(*these acids aren't present in the stomach so the reactions below are just general examples of neutralisation reactions, showing the salt that forms in each case*)
  - If sulfuric acid is neutralised→sulphate salts are produced:
    - E.g Sulfuric acid + copper oxide→copper sulfate + water

        - Chemical equation: $H_2SO_{4\,(aq)} + CuO_{\,(s)} \rightarrow CuSO_{4\,(aq)} + H_2O_{\,(l)}$
    - If nitric acid is neutralised→nitrate salts are produced:
        - E.g Nitric acid + sodium hydroxide→sodium nitrate + water
        - Chemical equation: $HNO_{3\,(aq)} + NaOH_{\,(s)} \rightarrow NaNO_{3\,(aq)} + H_2O_{\,(l)}$
- **ELECTROLYSIS OF HYDROCHLORIC ACID**
- Electrolysis is a process in which electrical energy, from a d.c. (direct current) supply, decomposes compounds
- E.g hydrochloric acid can be broken down into its component parts – hydrogen and chlorine – by electrolysis
    - Word equation: hydrochloric acid → hydrogen + chlorine
    - Balanced chemical equation: $2HCl \rightarrow H_2 + Cl_2$
- Compounds that can be decomposed by electrolysis are electrolytes
- During electrolysis it's useful to be able to test the gases that could be given off (see below for chemical tests of chlorine, oxygen and of hydrogen)
- **ELECTROLYSIS OF SEA WATER**
- The most common dissolved substance in sea water is sodium chloride (common salt)
- Chlorine gas can be obtained from sea water by electrolysis
- Indeed, if a direct current is passed through sea water, chlorine gas is produced at one of the electrodes (hydrogen produced at the other)
- Chemical test for chlorine:
    - Hold a piece of damp blue litmus paper in the mouth of the test tube
    - If the gas is chlorine the paper will first turn red and then turn white as it's bleached
- **Uses of chlorine:**
- Chlorine is a yellow-green gas with a pungent smell
- Uses of chlorine:
    - 1. Kills microorganisms→used to treat water supply (e.g used in swimming pools)
    - 2. In manufacturing bleach and other cleaning products
    - 3. In the manufacture of plastics such as PVC
- Chlorine has many uses mainly because of its high reactivity (→ability to readily form compounds with other substances)
- However, chlorine gas is also toxic→if a gas leak occurred near a town, or a tanker transporting the gas had an accident, it could have devastating consequences
- **ELECTROLYSIS OF WATER**
- Electrolysis of water results in hydrogen and oxygen gas being given off at the electrodes
    - Word equation: water → hydrogen + oxygen
    - Chemical equation: $2H_2O \rightarrow 2H_2 + O_2$
- Chemical test for hydrogen:
    - Hold a lighted splint in the mouth of the test tube
    - If the test tube contains some hydrogen it will explode with a squeaky 'pop'
- Chemical test for oxygen:
    - Light a splint and then blow the flame out so that the end of the splint is just glowing
    - Put the glowing splint in the mouth of the test tube

    - If the gas is oxygen, the glowing splint will relight bursting into flame again
- **Uses of hydrogen and oxygen:**
- Hydrogen is used as a rocket fuel (→highly flammable)
- Hydrogen is also the lightest gas, but due to its high flammability, hydrogen is rarely used to fill airships (helium is used instead because it's safer)
- Oxygen is given as supplemental air in hospitals