AQA Chemistry GCSE Student Progress

Unit 4.4 - Chemical Changes

4.4.1. Reactivity of Metals

4.4.1.1. Metal Oxides

a	I know that metals react with oxygen to produce metal oxides and that the reactions are called oxidation reactions because the metals gain oxygen.			
b	I can explain reduction and oxidation in terms of loss or gain of oxygen.			

4.4.1.2. Reactivity Series

a	I know that when metals react with other substances the metal atoms form positive ions and that the reactivity of a metal is related to its tendency to form positive ions.			
b	I know that metals can be arranged in order of their reactivity in a reactivity series.			
c	I know that the non-metals hydrogen and carbon are often included in the reactivity series.			
d	I can recall and describe the reactions, if any, of potassium, sodium, lithium, calcium, magnesium, zinc, iron and copper with water or dilute acids and where appropriate, place these metals in order of reactivity.			
e	I can explain how the reactivity of metals with water or dilute acids is related to the tendency of the metal to form its positive ion.			
f	I know that a more reactive metal can displace a less reactive metal from a compound.			
g	I can deduce an order of reactivity of metals based on experimental results.			

4.4.1.3. Extraction of Metals and Reduction

a	I know that unreactive metals such as gold are found in the Earth as the metal itself but most metals are found as compounds that require chemical reactions to extract the metal.			
b	I know that metals less reactive than carbon can be extracted from their oxides by reduction with carbon and that reduction involves the loss of oxygen.			
c	I can identify the substances which are oxidised or reduced in terms of gain or loss of oxygen.			
d	I can interpret and evaluate specific metal extraction processes when given appropriate information.			

4.4.1.4. Oxidation and Reduction in Terms of Electrons (HT only)

a	I know that oxidation is the loss of electrons and reduction is the gain of electrons (OILRIG).			
b	I can write ionic equations for displacement reactions.			
c	I can identify in a given reaction, symbol equation or half equation which species are oxidised and which are reduced.			

4.4.2. Reactions of Acids

4.4.2.1. Reactions of Acids with Metals

a	I know that acids react with some metals to produce salts and hydrogen.			
b	I can explain in terms of gain or loss of electrons, that these are redox reactions (HT only).			
c	I can identify which species are oxidised and which are reduced in given chemical equations (HT only).			

4.4.2.2. Neutralisation of Acids and Salt Production

a	I know that acids are neutralised by alkalis (e.g., soluble metal hydroxides) and bases (e.g., insoluble metal hydroxides and metal oxides) to produce salts and water, and by metal carbonates to produce salts, water and carbon dioxide.			
b	I know that the particular salt produced in any reaction between an acid and a base or alkali depends on the acid used (hydrochloric acid produces chlorides, nitric acid produces nitrates, sulfuric acid produces sulfates) and the positive ions in the base, alkali or carbonate.			
c	I can use the formulae of common ions to deduce the formulae of salts.			

4.4.2.3. Soluble Salts

a	I can describe how soluble salts can be made from acids by reacting them with solid insoluble substances, such as metals, metal oxides, hydroxides or carbonates (the solid is added to the acid until no more reacts and the excess solid is filtered off to produce a solution of the salt).			
b	I can describe how salt solutions can be crystallised to produce solid salts.			
c	I can describe how to make pure, dry samples of named soluble salts from information provided.			

4.3.2.4. Limiting Reactants (HT Only)

a	I know that acids produce hydrogen ions (H^+) in aqueous solutions whilst aqueous solutions of alkalis contain hydroxide ions (OH–).			
b	I know that the pH scale, from 0 to 14, is a measure of the acidity or alkalinity of a solution, and can be measured using universal indicator or a pH probe.			
c	I can describe the use of universal indicator or a wide range indicator to measure the approximate pH of a solution and use the pH scale to identify acidic or alkaline solutions.			
d	I know that a solution with pH 7 is neutral, aqueous solutions of acids have pH values of less than 7 and aqueous solutions of alkalis have pH values greater than 7.			
e	I know that, in neutralisation reactions between an acid and an alkali, hydrogen ions react with hydroxide ions to produce water. This reaction can be represented by the equation: $H+(aq) + OH^-(aq) \rightarrow H_2O(I)$			

4.4.2.5. Titrations (Chemistry Only)

a	I know that the volumes of acid and alkali solutions that react with each other can be measured by titration using a suitable indicator.			
b	I can describe how to carry out titrations using strong acids and strong alkalis only (sulfuric, hydrochloric and nitric acids only) to find the reacting volumes accurately.			
c	I can calculate the chemical quantities in titrations involving concentrations in mol/dm^3 and in g/dm^3 (HT Only).			

4.4.2.6. Strong and Weak Acids (HT Only)

a	I know that a strong acid is completely ionised in aqueous solution. Examples of strong acids are: hydrochloric, nitric and sulfuric acids.			
b	I know that a weak acid is only partially ionised in aqueous solution. Examples of weak acids are: ethanoic, citric and carbonic acids.			
c	I know that, for a given concentration of aqueous solutions, the stronger an acid, the lower the pH.			
d	I can use and explain the terms dilute and concentrated (in terms of amount of substance), and weak and strong (in terms of the degree of ionisation) in relation to acids.			
e	I know that as the pH decreases by one unit, the hydrogen ion concentration of the solution increases by a factor of 10.			
f	I can describe neutrality and relative acidity in terms of the effect on hydrogen ion concentration and the numerical value of pH (whole numbers only).			

4.4.3. Electrolysis

4.4.3.1. The Process of Electrolysis

a	I know that when an ionic compound is melted or dissolved in water, the ions are free to move about within the liquid or solution. These liquids and solutions are able to conduct electricity and are called electrolytes.			
b	I know that passing an electric current through electrolytes causes the ions to move to the electrodes. Positively charged ions move to the negative electrode (the cathode), and negatively charged ions move to the positive electrode (the anode). Ions are discharged at the electrodes producing elements. This process is called electrolysis.			
c	I can write and balance half equations for the reactions occurring at the electrodes during electrolysis (HT only).			

4.4.3.2. The Electrolysis of Molten Ionic Compounds

a	I know that when a simple ionic compound (eg lead bromide) is electrolysed in the molten state using inert electrodes, the metal (lead) is produced at the cathode and the non-metal (bromine) is produced at the anode.			
b	I can predict the products of the electrolysis of binary ionic compounds in the molten state.			

4.4.3.3. Using Electrolysis to Extract Metals

a	I know that metals can be extracted from molten compounds using electrolysis.			
b	I know that electrolysis is used if the metal is too reactive to be extracted by reduction with carbon or if the metal reacts with carbon and that large amounts of energy are used in the extraction process to melt the compounds and to produce the electrical current.			
c	I can describe how aluminium is manufactured by the electrolysis of a molten mixture of aluminium oxide and cryolite using carbon as the positive electrode (anode).			
d	I can explain why a mixture is used as the electrolyte and why the positive electrode must be continually replaced.			

4.4.3.4. Using Electrolysis of Aqueous Solutions

a	I know that the ions discharged when an aqueous solution is electrolysed using inert electrodes depend on the relative reactivity of the elements involved: • at the negative electrode (cathode), hydrogen is produced if the metal is more reactive than hydrogen; • at the positive electrode (anode), oxygen is produced unless the solution contains halide ions when the halogen is produced. This happens because in the aqueous solution water molecules break down producing hydrogen ions and hydroxide ions that are discharged.			
b	I can predict the products of the electrolysis of aqueous solutions containing a single ionic compound.			

4.4.3.5. Representation of Reactions at Electrodes as Half Equations (HT Only)

a	I know that, during electrolysis, at the cathode (negative electrode), positively charged ions gain electrons and so the reactions are reductions.			
b	I know that, at the anode (positive electrode), negatively charged ions lose electrons and so the reactions are oxidations.			
c	I know that reactions at electrodes can be represented by half equations, for example: $2H^+ + 2e^- \rightarrow H_2$ and $4OH^- \rightarrow O_2 + 2H_2O + 4e^-$ or $4OH^- - 4e^- \rightarrow O_2 + 2H_2O$			