**Chemistry C1**

**Revision Checklist**

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| **C1.1 The fundamental ideas in chemistry** | | | | | |
| **C1.1.1** Atoms | **a)** All substances are made of atoms. A substance that is made of only one sort of atom is called an element. There are about 100 different elements. Elements are shown in The Periodic Table. The groups contain elements with similar properties. | |  |  |  |
| **b)** Atoms of each element are represented by a chemical symbol, eg O represents an atom of oxygen, and Na represents an atom of sodium. | |  |  |  |
| **c)** Atoms have a small central nucleus, which is made up of protons and neutrons and around which there are electrons.  Protons and neutrons have a mass of 1, electrons have negligible mass. | |  |  |  |
| **d)** The relative electrical charges are as shown:  **Name of particle Charge**  Proton +1  Neutron 0  Electron –1 | |  |  |  |
| **e)** In an atom, the number of electrons is equal to the number of protons in the nucleus because atoms have no overall electrical charge. | |  |  |  |
| **f)** All atoms of a particular element have the same number of protons. Atoms of different elements have different numbers of protons.  Isotopes have the same number of protons and electrons but different numbers of neutrons. | |  |  |  |
| **g)** The number of protons in an atom of an element is its atomic number. The sum of the protons and neutrons in an atom is its mass number.  The proton number of an atom identifies the atom on The Periodic Table. | |  |  |  |
| **h)** Electrons occupy particular energy levels. Each electron in an atom is at a particular energy level (in a particular shell). The electrons in an atom occupy the lowest available energy levels (innermost available shells). The position of electrons around the nucleus can be shown by electron configuration diagrams.  G:\My Pictures\electron configuration of oxygen.png  [2,6] | |  |  |  |
| **C1.1.2** The periodic table | **a)** Elements in the same group in the periodic table have the same number of electrons in their highest energy level (outer electrons) and this gives them similar chemical properties. | |  |  |  |
| **b)** The elements in Group 0 of the periodic table are called the noble gases. They are unreactive because their atoms have stable arrangements of electrons. | |  |  |  |
| **C1.1.3** Chemical reactions | **a)** When elements react, their atoms join with other atoms to form compounds. This involves giving and taking electrons to form ions or sharing electrons to form covalent molecules.  Compounds formed from metals and non-metals consist of ions. Compounds formed from non-metals consist of molecules. In molecules the atoms are held together by covalent bonds. | |  |  |  |
| **b)** Chemical reactions can be represented by word equations or by **balanced** symbol equations. | |  |  |  |
| **c)** No atoms are lost or made during a chemical reaction so the mass of the products equals the mass of the reactants. | |  |  |  |
| **C1.2 Limestone and building materials** | | | | | |
| **C1.2.1** Calcium carbonate | **a)** Limestone, mainly composed of the compound calcium carbonate (CaCO3), is quarried and can be used as a building material. | |  |  |  |
| **b)** Calcium carbonate can be decomposed by heating (thermal decomposition) to make calcium oxide and carbon dioxide.  CaCO3 → CaO + CO2 | |  |  |  |
| **c)** The carbonates of magnesium, copper, zinc, calcium and sodium decompose on heating in a similar way to form the metal oxide and carbon dioxide. | |  |  |  |
| **d)** Calcium oxide reacts with water to produce calcium hydroxide, which is an alkali that can be used in the neutralisation of acids in lakes and acidic soils. | |  |  |  |
| **e)** A solution of calcium hydroxide in water (limewater) reacts with carbon dioxide to produce calcium carbonate. Limewater is used as a test for carbon dioxide. Carbon dioxide turns limewater cloudy. | |  |  |  |
| **f)** Carbonates react with acids to produce carbon dioxide, a salt and water. Limestone is damaged by acid rain.  CaCO3 + H2SO4  → CaSO4 + CO2 + H2O | |  |  |  |
| **g)** Limestone is heated with clay to make cement. Cement is mixed with sand and water to make mortar and with sand, aggregate and water to make concrete. | |  |  |  |
| **C1.3 Metals and their uses** | | | | | |
| **C1.3.1** Extracting metals | | **a)** Ores contain enough metal to make it economical to extract the metal. The economics of extraction may change over time. |  |  |  |
| **b)** Ores are mined and may be concentrated before the metal is extracted and purified. |  |  |  |
| **c)** 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. |  |  |  |
| **d)** Metals that are less reactive than carbon can be extracted from their oxides by reduction with carbon, for example iron oxide is reduced in the blast furnace to make iron.  Haematite, Limestone, coke and air are raw materials for the blast furnace. |  |  |  |
| **e)** Metals that are more reactive than carbon, such as aluminium, are extracted by electrolysis of molten compounds. The use of large amounts of energy in the extraction of these metals makes them expensive. |  |  |  |
| **f)** Copper can be extracted from copper-rich ores by heating the ores in a furnace (smelting). The copper can be purified by electrolysis. The supply of  Copper-rich ores is limited. |  |  |  |
| **g)** New ways of extracting copper from low-grade ores are being researched to limit the environmental impact of traditional mining and allow low grade ores to be mined economically. Copper can be extracted by phytomining, or by bioleaching. |  |  |  |
| **h)** Copper can be obtained from solutions of copper salts by electrolysis or by displacement using scrap iron. |  |  |  |
| **i)** Aluminium and titanium cannot be extracted from their oxides by reduction with carbon. Current methods of extraction are expensive because:  ■ there are many stages in the processes  ■ large amounts of energy are needed. |  |  |  |
| **j)** We should recycle metals because extracting them uses limited resources and is expensive in terms of energy and effects on the environment. |  |  |  |
| **C1.3.2** Alloys | | **a)** Iron from the blast furnace contains about 96% iron. The impurities make it brittle and so it has limited uses. |  |  |  |
| **b)** Most iron is converted into steels. Steels are alloys since they are mixtures of iron with carbon. Some steels contain other metals. Alloys can be designed to have properties for specific uses. Low-carbon steels are easily shaped, high-carbon steels are hard, and stainless steels are resistant to corrosion. |  |  |  |
| **c)** Most metals in everyday use are alloys. Pure copper, gold, iron and aluminium are too soft for many uses and so are mixed with small amounts of similar metals to make them harder for everyday use. |  |  |  |
| **C1.3.3** Properties and uses of metals | | **a)** The elements in the central block of the periodic table are known as transition metals. Like other metals they are good conductors of heat and electricity and can be bent or hammered into shape (malleable). They are useful as structural materials and for making things that must allow heat or  electricity to pass through them easily. |  |  |  |
| **b)** Copper has good electrical conductivity that makes it useful for electrical wiring and has low reactivity so resists corrosion making it useful for plumbing. |  |  |  |
| **c)** Low density and resistance to corrosion make aluminium and titanium useful metals. |  |  |  |
| **C1.4 Crude oil and fuels** | | | | | |
| **C1.4.1** Crude oil | | **a)** Crude oil is a mixture of a very large number of compounds. |  |  |  |
| **b)** A mixture consists of two or more elements or compounds not chemically combined together. The chemical properties of each substance in the mixture are unchanged. It is possible to separate the substances in a mixture by physical methods including distillation. |  |  |  |
| **c)** Most of the compounds in crude oil consist of molecules made up of hydrogen and carbon atoms **only** (hydrocarbons). Most of these are saturated hydrocarbons called alkanes, which have the general formula CnH2n+2. |  |  |  |
| C1.4.2Hydrocarbons | | **a)** Alkane molecules can be represented in the following forms: CnH2n+2  ■ C2H6  H H  I I  ■ H –– C –– C –– H  I I  H H  All the bonds are single.  Methane CH4  Ethane C2H6  Propane C3H8  Butane C4H10 |  |  |  |
| **b)** The many hydrocarbons in crude oil may be separated into fractions, each of which contains molecules with a similar number of carbon atoms, by evaporating the oil and allowing it to condense at a number of different temperatures. This process is fractional distillation. The fractional distillation column is hotter at the bottom and colder at the top. |  |  |  |
| **c)** Some properties of hydrocarbons depend on the size of their molecules.  The longer the carbon chain the higher the melting point, the more viscous the hydrocarbon and the less flammable and less volatile it becomes.  These properties influence how hydrocarbons are used as fuels. |  |  |  |
| **C1.4.3** Hydrocarbon fuels | | **a)** Most fuels, including coal, contain carbon and/or hydrogen and may also contain some sulfur. The gases released into the atmosphere when a fuel burns may include carbon dioxide, water (vapour), carbon monoxide, sulfur dioxide and oxides of nitrogen. Solid particles of carbon (particulates) may also be released. |  |  |  |
| **b)** The combustion of hydrocarbon fuels releases energy. During complete combustion in unlimited air the carbon and hydrogen in the fuels are oxidised to form carbon dioxide and water.  In incomplete combustion with limited air the carbon is oxidised to carbon monoxide and water is still produced. |  |  |  |
| **c)** Sulfur dioxide and oxides of nitrogen cause acid rain, carbon dioxide causes global warming, and solid particles cause global dimming. |  |  |  |
| **d)** Sulfur can be removed from fuels before they are burned, for example in vehicles. Sulfur dioxide can be removed from the waste gases after combustion, for example in power stations. |  |  |  |
| **e)** Biofuels, including biodiesel and ethanol, are produced from plant material. There are economic, ethical and environmental issues surrounding their use. |  |  |  |
| C1.5 Other useful substances from crude oil | | | | | |
| **C1.5.1** Obtaining useful substances from crude oil | | **a)** Hydrocarbons can be cracked to produce smaller, more useful molecules. This process involves heating the hydrocarbons to vaporise them. The vapours are either passed over a hot catalyst or mixed with steam  and heated to a very high temperature so that thermal decomposition reactions then occur. |  |  |  |
| **b)** The products of cracking include alkanes and unsaturated hydrocarbons called alkenes. Alkenes have the general formula CnH2n. |  |  |  |
| **c)** Unsaturated hydrocarbon molecules can be represented in the following forms: CnH2n  Ethene C2H4  Propene C3H6  Butene C4H8  ■ C3H6  H H H  I I I  ■ H –– C –– C = C  I I  H H  They contain at least one C=C double bond. |  |  |  |
| **d)** Alkenes react with bromine water, turning it from orange to colourless. |  |  |  |
| **e)** Some of the products of cracking are useful as fuels. |  |  |  |
| **C1.5.2** Polymers | | **a)** Alkenes can be used to make polymers such as poly(ethene) and poly(propene). In these reactions, many small molecules (monomers) join together to form very large molecules (polymers).  For example:  H H H H  I I I I  n C = C -C ––– C-  I I I I  H H H H n  ethene poly(ethene) |  |  |  |
| **b)** Polymers have many useful applications and new uses are being developed, for example: new packaging materials, waterproof coatings for fabrics, dental polymers, wound dressings, hydrogels, smart materials (including shape memory polymers). |  |  |  |
| **c)** Many polymers are not biodegradable, so they are not broken down by microbes and this can lead to problems with waste disposal. |  |  |  |
| **d)** Plastic bags are being made from polymers and cornstarch so that they break down more easily. Biodegradable plastics made from cornstarch have  been developed. |  |  |  |
| **C1.5.3** Ethanol | | **a)** Ethanol can be produced by hydration of ethene with steam in the presence of a catalyst. |  |  |  |
| **b)** Ethanol can also be produced by fermentation with yeast, using renewable resources. This can be represented by:  sugar 🡪 carbon dioxide + ethanol  There are advantages and disadvantages to producing ethanol by fermentation and |  |  |  |
| **C1.6 Plant oils and their uses** | | | | | |
| **C1.6.1** Vegetable oils | | **a)** Some fruits, seeds and nuts are rich in oils that can be extracted. The plant material is crushed and the oil removed by pressing or by using a solvent and filtering off the plant material and in some cases by distillation.  Water and other impurities are removed. |  |  |  |
| **b)** Vegetable oils are important foods and fuels as they provide a lot of energy. They also provide us with nutrients. |  |  |  |
| **c)** Vegetable oils have higher boiling points than water and so can be used to cook foods at higher temperatures than by boiling. This produces quicker cooking and different flavours but increases the energy that the food releases when it is eaten. |  |  |  |
| **C1.6.2** Emulsions | | **a)** Oils do not dissolve in water. They can be used to produce emulsions. Emulsions are thicker than oil or water and have many uses that depend on their special properties. They provide better texture, coating ability and appearance, for example in salad dressings, ice creams, cosmetics and paints. |  |  |  |
| **b) Emulsifier molecules have a hydrophilic head and hydrophobic tail.** |  |  |  |
| **C1.6.3** Saturated and unsaturated oils | | **a)** Vegetable oils that are unsaturated contain double carbon-carbon bonds C-C. These can be detected by reacting with bromine water. |  |  |  |
| **b) Vegetable oils that are unsaturated can be hardened by reacting them with hydrogen in the presence of a nickel catalyst at about 60 °C.**  **Hydrogen adds to the carbon–carbon double bonds. The hydrogenated oils have higher melting points so they are solids at room**  **temperature, making them useful as spreads and in cakes and pastries.** |  |  |  |
| C1.7 Changes in the Earth and its atmosphere | | | | | |
| **C1.7.1** The Earth’s crust | | **a)** The Earth consists of a core, mantle and crust, and is surrounded by the atmosphere. |  |  |  |
| **b)** The Earth’s crust and the upper part of the mantle are cracked into a number of large pieces (tectonic plates). |  |  |  |
| **c)** Convection currents within the Earth’s mantle driven by heat released by natural radioactive processes cause the plates to move at relative speeds of a few centimetres per year. |  |  |  |
| **d)** The movements can be sudden and disastrous. Earthquakes and / or volcanic eruptions occur at the boundaries between tectonic plates. |  |  |  |
| **C1.7.2** The Earth’s atmosphere | | **a)** For 200 million years, the proportions of different gases in the atmosphere have been much the same as they are today:  ■ about four-fifths (78 %) nitrogen  ■ about one-fifth (21%) oxygen  ■ (0.9%) Argon  Air also contains small proportions of various other gases, including carbon dioxide, water vapour and noble gases. |  |  |  |
| **b)** During the first billion years of the Earth’s existence there was intense volcanic activity. This activity released the gases that formed the early atmosphere and water vapour that condensed to form the oceans. |  |  |  |
| **c)** There are several theories about how the atmosphere was formed. One theory suggests that during this period the Earth’s atmosphere was mainly carbon dioxide and there would have been little or no oxygen gas (like the atmospheres of Mars and Venus today). There may also have been water vapour and small proportions of methane and ammonia. |  |  |  |
| **d)** There are many theories as to how life was formed billions of years ago. |  |  |  |
| **e) One theory as to how life was formed involves the interaction between hydrocarbons, ammonia and lightning. (Miller Urey)** |  |  |  |
| **f)** Plants and algae produced the oxygen that is now in the atmosphere. |  |  |  |
| **g)** Most of the carbon from the carbon dioxide in the air gradually became locked up in sedimentary rocks as carbonates and fossil fuels. |  |  |  |
| **h)** The oceans also act as a reservoir for dissolved carbon dioxide but increased amounts of carbon dioxide absorbed by the oceans has an impact on the marine environment. |  |  |  |
| **i)** Nowadays the release of carbon dioxide by burning fossil fuels increases the level of carbon dioxide in the atmosphere.  This causes the greenhouse effect and global warming. |  |  |  |
| **j) Air is a mixture of gases with different boiling points and can be fractionally distilled to provide a source of raw materials used in a variety of industrial processes.** |  |  |  |

Main topics to revise –