**C3 The Periodic Table – Summary**

**What are atoms like?**

* There are over 100 elements which:
* Contain the same type of atom
* Cannot be broken down chemically
* Combine chemically to make compounds
* Inside atoms, negative electrons orbit a nucleus, made from positive protons and neutral neutrons.
* The elements are arranged in ascending order of atomic number in the periodic table.
* Each element has a different atomic number, which shows the number of protons.
* In a neutral atom, electrons=protons.
* Positive protons and neutral neutrons both have a relative mass of 1.
* Their total gives the atom’s mass number.
* Isotopes have different numbers of neutrons so they have different mass numbers.

**Electrons**

* Electrons have a charge of -1 and almost no mass (0.0005).
* They orbit in shells.
* The first shell holds two and the next two hold eight.
* The periodic table reflects these shells.
* The first shell holds two like the first row.
* The second shell holds eight like the second row.
* Electronic configuration show the electrons in each shell for example: Carbon 2.6

**How atoms combine – ionic bonding**

* Ions are charged atoms or groups of atoms.
* In reactions, metals become positive ions because they lose negative electrons.
* The electrons are given to non-metals.
* In compounds, ionic charges cancel out.
* The + and – ions are strongly attracted, so melting and boiling points are high, but some can dissolve in water.

**Covalent bonding**

* Molecules are groups of non-metal atoms.
* They share electrons to get a full outer shells.
* Electrons in covalent bonds can be shown as dots and crosses – one from each atom.
* Bonds are very strong, but the forces between molecules are weak, so their boiling points are low and they tend to be gases.
* Small molecules like carbon dioxide have no delocalised electrons or ions, so they never conduct electricity.

**Covalent bonding and the periodic table**

* Vertical columns in the periodic table are called groups.
* Elements in the same group have similar properties, because they have the same number of outer electrons.
* The horizontal rows in the periodic table are periods.
* The period shows the number of occupied shells.

**The Group 1 elements**

* To identify group 1 metals, use a flame test.
* Dip moist nichrome wire in the solid and hold it in a blue flame. Observe the colour: Na(yellow), K(Lilac), Li(crimson).
* The alkali metals in group 1 are very reactive.
* They are kept under oil to stop them reacting with oxygen.
* They all react with water exothermically: sodium hydroxide + hydrogen 🡪 sodium hydroxide + hydrogen.
* Electrons are lost so this is oxidation.
* Going down the group, they get more reactive.
* They also get softer, less dense and easier to melt.
* In bigger atoms, the outer electron is further from the pull of the positive nucleus, and is lost more easily.

**The group 7 elements**

* The halogens in group 7 are reactive non-metals.
* They have similar properties because they have seven electrons in their outer shell.
* Going down the group, they get less reactive, their colours darken and boiling points increase.
* They react with metals to make salts, sodium + chlorine 🡪 sodium chloride.
* The reaction is very vigorous.
* NaCl is used for flavouring food, as a preservative and as a raw material for chlorine manufacture.
* Chlorine is used to sterilise water and make pesticides and plastics; iodine to sterilise wounds.
* Halogens react with metals by gaining one electron, to form 1- ions with stable electronic structures.
* This is a reduction because electrons are gained.
* Smaller atoms gain electrons more easily, as their outer shell is closer to the nucleus.
* The order of reactivity is F, Cl, Br, I and At.
* More reactive halogens displace less reactive ones.

**Electrolysis**

* Electrolysis decomposes solutions by turning charged ions into atoms. Any gases formed escape from solution.
* The ions are melted or dissolved so that they are free to move.
* Metal cations (+) and H+ ions are attracted to the cathode (-).
* Non-metal anions (-) move to the anode (+).
* Sulphuric acid releases H2 and O2.
* Hydrogen ‘pops’ with a lit splint.
* Oxygen relights with a glowing splint.
* Aluminium is expensive because it takes a lot of electricity to extract it from the aluminium oxide in bauxite.
* Aluminium oxide 🡪 aluminium + oxygen
* The aluminium oxide is dissolved in molten cryolite to lower its melting point.
* The electrodes are made from graphite (carbon).

**Transition elements**

* Iron and copper are transition metals.
* Their compounds are coloured: copper (blue), Iron (II)(light green), iron (III)(orange).
* Both metals and compounds can be catalysts, for example, iron in the Haber process, nickel in the manufacture of margarine.
* Precipitates form if their ions mix with an alkali. Cu(II) (blue) Fe(II)(grey/green)Fe(III)brown
* Thermal decomposition splits their carbonates up, changes their colour and releases carbon dioxide.
* The carbon dioxide turns limewater cloudy.

**Metal structures and properties**

* Metals are hard, strong, lustrous and dense.
* They form alloys like brass (copper) and steel (iron).
* They have high melting/boiling points.
* They conduct heat and electricity well.
* Each atom contributes delocalised electrons to a regular crystal structure.
* Metallic bonding is the electrostatic attraction between the sea of delocalised electrons and the close-packed positive metal ions.
* Superconductors have little or no resistance.
* They allow loss-free power transmission, super-fast circuits and powerful electromagnets, but they only work at very low temperatures.
* We need to develop superconductors that work at 20◦C