General properties of giant molecules

Melting point: Very high since structure is made up of a large number of covalent bonds, all of which need to be broken if atoms are to be separated

Electrical: Don't conduct electricity (have no mobile ions or electrons),

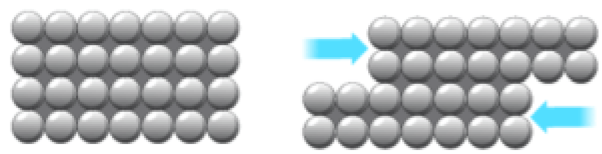
Strength: Hard – exist in a rigid tetrahedral structure e.g. Diamond and silica (SiO_2)

*Graphite is an exception as it conducts electricity and is soft.

3.2 (d) Metallic bonding

-Metallic bonding: a lattice of tightly packed positive ions in a sea of electrons, resulting in crystals, therefore:

1. Metals are malleable and ductile – the layers of ions can slide over each other
2. Metals are good conductors – free electrons take energy



4. Stoichiometry

Relative atomic mass, Ar: the average mass of naturally occurring atoms of an element on a scale where the 12C atom has a mass of exactly 12 units.

Relative molecular mass, Mr: the sum of the relative atomic masses

<u>Determining the name and formula of a compound:</u>

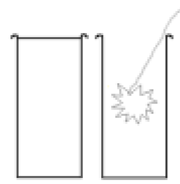
- To determine the formula of an ionic compound the positive charge must equal the negative charge. Naming compounds:
- If only two elements are combined, the name ends in '*–ide*' (*Exception: ammonia)
- With covalent bonds, Greek prefixes are used to denote the number of atoms

1 = mono	carbon monoxide	4 = tetra
2 = di	carbon dioxide	5 = penta
3 = tri	phosphorus trihydride	6 = hexa

- The only time we drop a prefix is if the *mono* is to appear at the beginning of the name If there is an oxide the 'a' or 'o' of the prefix is lost e.g. carbon monoxide
- If a metal ion combines with a polyatomic ion in a compound and one is oxygen, the name ends in *–ate*, (except hydroxides)
- With ionic compounds, the cation (metal) goes first in the name.
- With covalent compounds the element further on the left goes first (hydrogen is thought of being in between nitrogen and oxygen so: phosphorus trihydride / hydrogen peroxide)

combustible. A spark from a machine, or a lit match, can cause an explosion, this also applies to gases from mines (another syllabus specified example).

3. Fill a gas jar with a mixture of hydrogen and oxygen and cover it. Even if you leave it for hours, no reaction will happen. Then dip a platinum wire into the mouth of the jar. The gas mixture explodes immediately with a pop, producing water.



- Light can affect the rate of reaction: photochemical reactions for example in photosynthesis. Light provides energy for the reaction, chlorophyll is a dye that absorbs light.

carbon dioxide + water ⟶ (light + chlorophyll) ⟶ glucose + oxygen $6CO_2 + 6H_2O$ ⟶ (light + chlorophyll) ⟶ $C_6H_{12}O_6 + 6O_2$

Silver salts in photographic film: Silver bromide breaks down, where light strikes the film, so silver is reduced. Silver ions are reduced to silver.

Reversible reactions

Reversible Reactions ⇌ : reactions which can go both ways, depending on the conditions.
Example: $CuSO_4.5H_2O$ (blue) ⇌ $CuSO_4$(white) + H_2O
(to get anhydrous you heat it, & to get the hydrated form, just add water)

Dynamic equilibrium:

- Rate of forward reaction = rate of reverse reaction
- Concentrations of all reactants and products remain
- The system is closed and on the large scale (macroscopic) everything is

If the conditions of an equilibrium are changed, the position of the equilibrium moves to oppose the change

–TEMPERATURE: If the temperature is lowered – the equilibrium moves in the exothermic direction. If the temperature is raised – the equilibrium moves in the endothermic direction.

–PRESSURE: If the pressure is raised the equilibrium moves to reduce pressure, to the side with fewest gas molecules. If the pressure is lowered the equilibrium moves to the side with most gas molecules.

–CONCENTRATION: Decreasing reactant concentration or increasing product concentration moves equilibrium to the reactant side. Increasing reactant concentration or decreasing product concentration moves it to the product side.

NOTE CATALYSTS DO NOT CHANGE THE POSITION OF THE EQUILIBRIUM; REACTION JUST ARRIVES AT EQUILIBRIUM FASTER.

Redox

- Oxidation Is Loss of electrons/the gain of oxygen, Reduction Is Gain of electrons/loss of oxygen. Remember OIL RIG.
- Redox reaction is a reaction where reduction and oxidation happen, where there is electron transfer. Reduction and oxidation must happen together. One substance gives electron(s) to the other.
- In a redox reaction the substances will change oxidation state (their charge will change). Oxidation state is written using roman numerals when there is a transition metal in a word equation.

Universal indicator is an indicator which can be used as paper or in solution:

Strong Acids	Strong Bases (Alkalis)
all molecules dissociate to become ions low pH high conductivity weak bonds	high conductivity high pH weak bonds high dissociation

Weak Acids	Weak Bases
only some molecules dissociate higher pH, low conductivity strong bonds (weaker effervescence when reacting with carbonates or metal than a strong acid)	low conductivity and pH strong bonds therefore low dissociation In alkalis More dissociation i.e. higher concentration of OH- ion = higher pH. In acids higher concentration of H^+ ion (proton) = lower pH

8.2 Types of oxides

- In general, metal oxides are basic, and non-metal oxides are acidic.
- Neutral oxides: are neither acidic nor basic: they are neutral for example carbon monoxide.
- Amphoteric oxides: e.g. Aluminium oxide and zinc oxide: they react with bases and acids.

Transition elements

A collection of metals with high densities, high boiling points, the ability to form colored compounds, and the ability to act as catalysts. They are also:

--Good conductors of heat and electricity (silver is the best)

--Much less reactive than group one metals, except for iron which rusts easily

--Have no trend in reactivity, can form complex ions

--Can form several differently charged ions: have variable valency, therefore…..

--They can form more than one compound with another element: FeO, Fe2O3

** Transition metals have variable oxidation states: e.g. Fe(ii), Fe (iii)

Noble gases

Noble gases are unreactive, (also non metals, colourless gases and monatomic).

Uses:

- Helium- filling balloons and aircrafts because it is lighter than air and will not catch fire.
- Argon – filling (tungsten) light bulbs to stop the

11. Air and Water

Water

Chemical test for water.

- . Anhydrous means there is no water in the compound. When you add water to anhydrous copper(II)sulfate, it will turn blue .

  $CuSO_4(s) + 5H_2O(l) \longrightarrow CuSO_4.5H_2O(s)$

  Anhydrous copper(II) sulfate (white) + water ⟶ hydrated copper(II) sulfate (blue)
- Cobalt chloride which changes from blue to pink when water is added.

  $CoCl_2(s) + 6H_2O(l) \longrightarrow CoCl_2.6H_2O(s)$

  Anhydrous cobalt(II) chloride (blue) + water ⟶ hydrated cobalt(II) chloride (pink)

The purification of the water supply by filtration and chlorination.

- Water from lakes and rivers are not pure. It may contain bacteria, dead animals and plants, dirt etc.
- Filtration is used to separate insoluble substances from the water.
- Afterwards, the water is chlorinated (treated with chlorine) to get rid of bacteria and microbes that couldn't be removed through filtration.

Uses of water in industry and in the home.

- Water is used in factories as a solvent for many chemicals and as a coolant to stop industrial processes from getting too hot.
- Water is also used to generate electrical power (through hydroelectric power stations or by using steam to drive turbines).
- In agriculture, water is used on farms for watering crops and feeding animals.
- At home, water is used for drinking, cooking, washing and cleaning purposes.

*Water is essential for life; it covers 2/3 of our planet. Humans need drinking water with low levels of (dissolved) salts and microbes. Water is also needed for crop irrigation, and therefore is essential for life.

Properties of sulphuric acid:

-Forms salts called sulphates

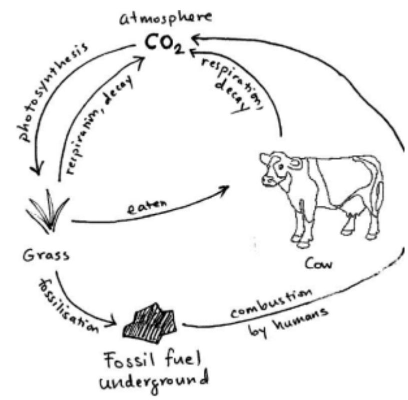
-When concentrated, it is a dehydrating agent, and a thick oily liquid

-It turns blue litmus red

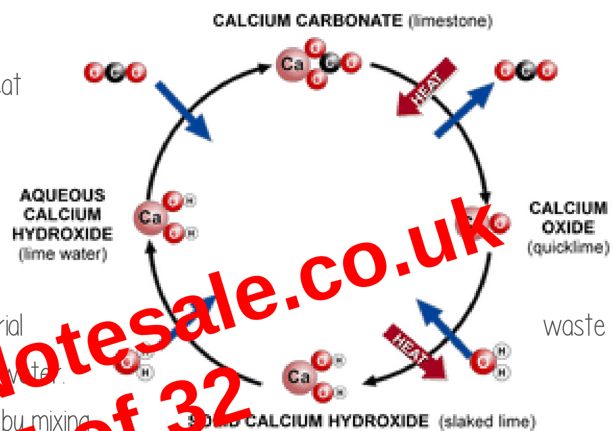
-It is a strong acid

-normal strong acid properties (reacts with bases, low pH, high conductivity etc.)

Carbon Cycle



13. Carbonates



Manufacture of lime (CaO) from limestone ($CaCO_3$) $CaCO_3$ + heat ⟶ CaO + CO_2

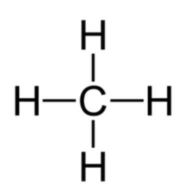
Uses of quicklime (CaO): making steel from iron, to neutralise acidity in soil, a drying agent in industry

Uses of slaked lime (calcium hydroxide): neutralise acidity in soil, and in lakes affected by acid rain, neutralising acidic industrial waste products, e.g. flue gas desulphurisation, made by adding CaO to water.

Uses of calcium carbonate (limestone): making cement – made by mixing limestone with clay, heating the mixture strongly in a kiln like the one below, adding gypsum (calcium sulphate), and grinding up the final solid to give a powder (diagram page 13)

Making iron from iron ore – the limestone reacts with (neutralises) sand (an impurity) forming slag (calcium silicate), which is then used for road building.

14 Organic Chemistry

methane	CH_4	
ethane	C_2H_6