Group 1 / 2 = alkali metals (LEFT)

Group 2-3 = transitional metals

Group 4-7 = non-metals

Group 7 = halogens

Group 0 = noble gases (RIGHT)

CC4B - ATOMIC NUMBER AND THE PERIODIC TABLE

- End of 19th century, noble gases discovered
- Hadn't predicted existence due to being inert
- Pair reversals (iodine and tellurium) not explained until 1913, Moseley

Atomic number –

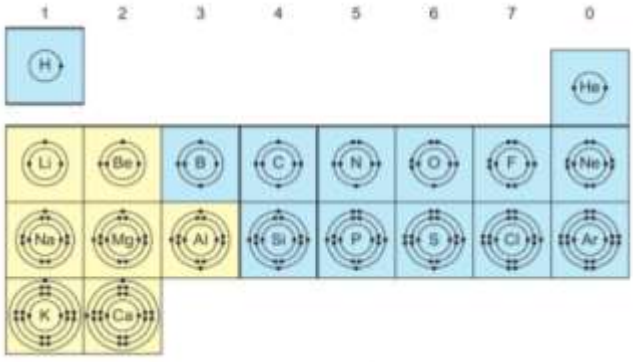
- Moseley showed an elements position was based on its physical properties
- Fired high-energy electrons at elements, making them give off x-rays
- Discovered for every step increase of atomic number, change in energy of x-rays
- Realised atomic number was equal to number of positive charges in nucleus
- Proton then discovered shortly after
- Therefore proved atomic number to be equal to number of protons in nucleus

CC4C - ELECTRON CONFIGURATION

- Electrons occupy electron shells arranged around the nucleus
- Arrangement is known as electric configuration

For first 20 elements

- 1st shell = 2 electrons
- 2cd shell = 8 electrons
- 3rd shell = 8 electrons



- **Vertical column (group)** indicates how many electrons are in outer shell
- **Horizontal column (period)** indicates how many shells there are
- Can be calculated using atomic number of an element – fill shells

ATOM - what makes up an element, consists of protons, neutrons, and electrons on the outer shells

ELEMENT –substance made out of the same atoms (o2)

COMPOUND – substance made out of different atoms that are chemically bonded (co2, H2O)

MIXTURE- substance consisting of different atoms that aren't chemically bonded (Salt water)

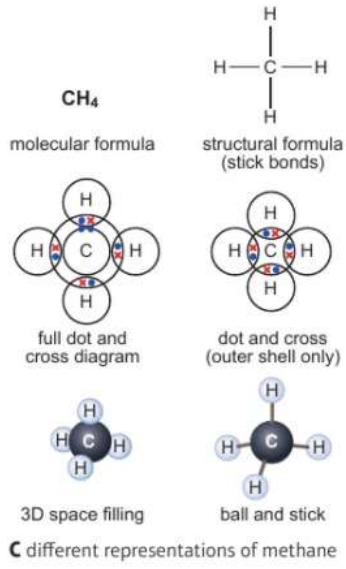
Single covalent bond – only one electron is shared

Double covalent bond – two electrons are shared

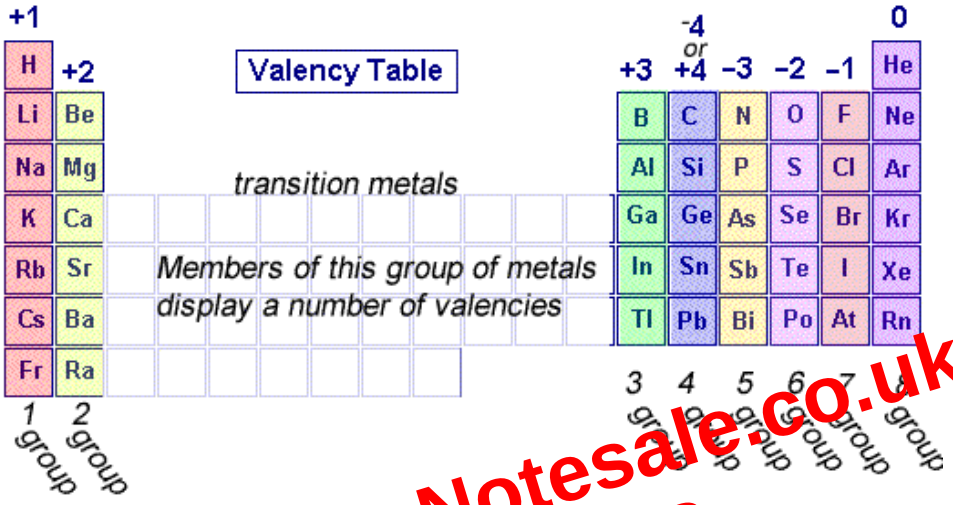
- Used to stabilise atoms by completing their outer shell

MOLECULAR SUBSTANCES – group of atoms held together by covalent bonds

VALENCY – number of covalent bonds formed by atoms / number of electrons needed to complete the outer shell



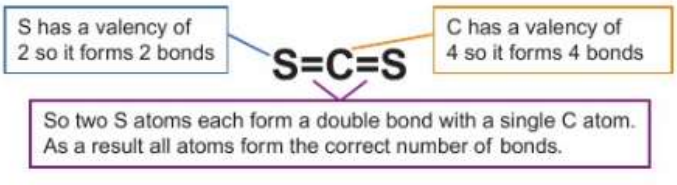
C different representations of methane



Group number	Example	Outer electrons	Bonds formed	Valency
	C and	4	4	4
5	N and P	5	3	3
6	O and S	6	2	2
7	F and Cl	7	1	1

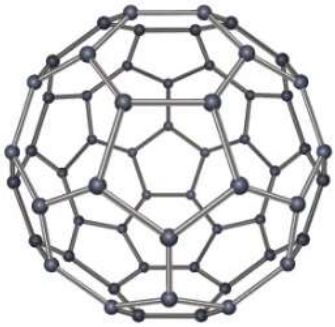
D valencies of some elements

Diagram E shows how molecular formulae can be worked out by matching up the valencies, so that all atoms have the correct number of bonds (and so a complete outer electron shell).

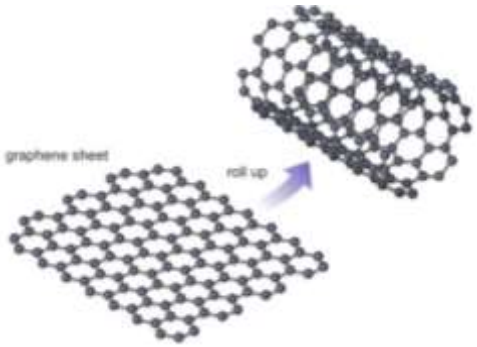


(You can also swap the valencies between elements)

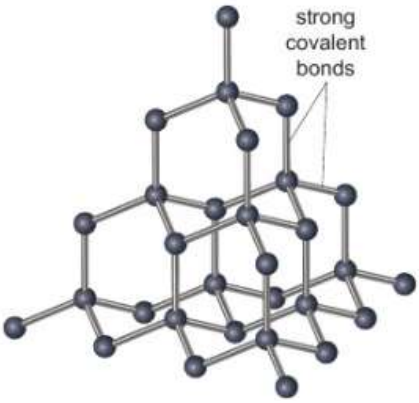
Buckminster fullerene (Bucky ball) –



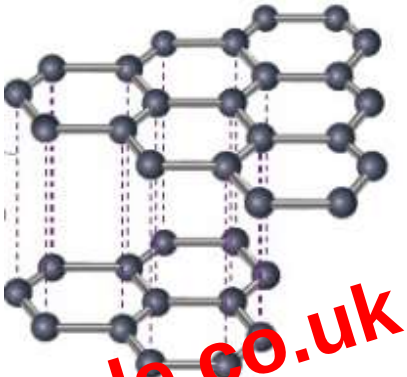
Graphene –



Diamond -



Graphite -



CC7C – PROPERTIES OF METALS

Properties -

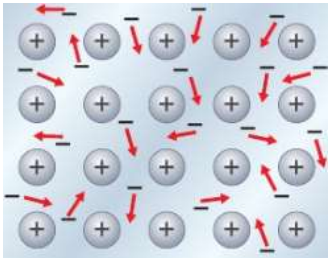
- Malleable – used for infrastructure/building
- Good conductors of electricity – used as wires in circuits (copper)
- Shiny – making jewellery
- Very high melting and boiling points
- High density

Metallic bonding -

- Metals tend to have 1-3 electrons on their outer shell, which become delocalised meaning they are free to move around
- This establishes positive ions (due to loss of electrons) in a sea of negative, delocalised electrons
- Electrostatic attraction between cations and anions

Metallic structure –

- Atoms packed together in lattice structure
- Stacked layers of positive ions
- Sea of delocalised negative electrons that move around feely



EMPIRICAL FORMULA – simplest whole number ratio of atoms/ions of each element in it

1. MASS OF EACH COMPOUND/RELATIVE ATOMIC MASS
2. DIVIDE BOTH BY SMALLEST NUMBER
3. MULTIPLY NUMBERS IF NOT WHOLE NUMBERS

	CA	CL
MASS	10g	17.8g
RELATIVE ATOMIC MASS	40	35.5
MASS/RAM	0.25	0.5
DIVISION BY SMALLEST NUMBER	0.25/0.25 = 1	0.5/0.25 = 2
	CA = 1	CL = 2

= $CaCl_2$

MOLECULAR FORMULA - how many atoms of each element are actually in a molecule

RELATIVE FORMULA MASS/ EMPIRIAL FORMULA MASS

MULTIPLY EMPIRACLE FORMULA BY THE RESULT

1. GLUCOSE = CH20
2. RFM = 180
3. EFM = CH20 = (12X1)+(1X2)+(16X1) = 30
4. 180/30 = 6
5. NOW TIMES EVERYTHING IN THE EMPIRICAL FORMULA BY 6 – C6H1206

CC9B – CONSERVATION OF MASS

THE LAW OF CONSERVATION OF MASS – mass can`t be created nor destroyed, only rearranged (total mass of reactants = total mass of products)

- When a solute is dissolved into a solvent, the mass of the resulting solution is the mass of both the solute + solvent – no atoms are lost long the way

CONCENTRATION – the amount of solute dissolved in a given volume of solution , measured in – GMD-3

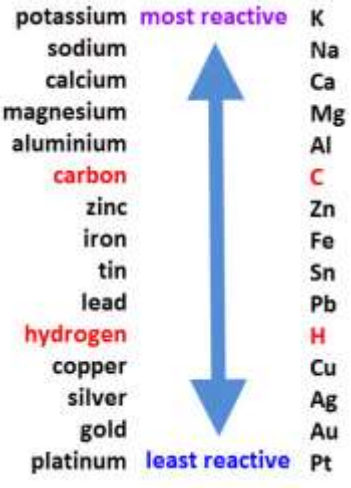
1DM3 = 1 LITRE/ 1000CM3

CONCENTRATION = mass of solute (g)/ mass of solution

CLOSED REACTIONS – enclosed in a box, nothing can escape therefore mass will read the same as before reaction occurred

UN-ENCLOSED REACTIONS – gas can escape during reaction therefore mass can decrease due to it being elsewhere

IONIC COMPOUNDS DISSOLVED IN WATER –



- Water can be ionised too
- H+ and OH- ions present in water
- Products formed at electrodes depend on whether water ions discharge more easily than salt ions
- Ionic compound with metal more reactive than hydrogen will be replaced with H+ (produced instead of metal) due to being discharged more difficultly

Sodium chloride -> Na+ more reactive than H+ therefore H+ replaces Na+ and goes to negative electrode, Na+ stays in solution

CC11A – REACTIVITY

REACTIVITY SERIES – list of metals in order of reactivity, most reactive at the top

SPECTATOR IONS – ions that remain the same during a reaction

HALF EQUATIONS – way of representing the change of electrons (from ionic equation)

DISPLACEMENT REACTION – whereby a more reactive metal takes place of a less reactive metal compound, being a redox reaction (both oxidation and reduction occur)

Metals + cold water -> hydrogen + metal hydroxide

Metals + steam -> hydrogen + solid metal oxide

Metals + dilute acid -> hydrogen + salt solution (first name from metal, second from acid)

Metal	Reaction with cold water	Reaction with steam	Reaction with dilute acid	Tendency of metal atoms to form cations
potassium	react with cold water to form hydrogen and a metal hydroxide		react violently	increasing ability of metal atoms to form positive ions
sodium				
calcium			react to form hydrogen and a salt solution	
magnesium	react very slowly, if at all, with cold water	but react with steam to form hydrogen and a metal oxide		
aluminium				
zinc				
iron				
copper	do not react with cold water or steam		do not react	
silver				
gold				

Equation – $Zn + CuSo_4 \rightarrow Cu + ZnSo_4$ (zinc displaced copper)

Ionic – $Zn + Cu^{2+} + So_4^{2+} \rightarrow Cu + Zn^{2+} + So_4^{2-}$

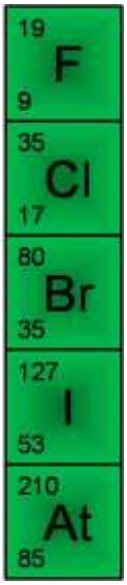
$Zn + Cu^{2+} \rightarrow Cu + Zn^{2+}$

Half-equation – $Zn \rightarrow Zn^{2+} + 2e$ (OXIDATION)

$Cu^{2+} + 2e \rightarrow Cu$ (REDUCTION)

CC13B - GROUP 7

Group 7 = halogens



- All have seven electrons on outer shell, meaning they gain one to become stable (1-)
- Bad conductors
- Diatomic structure (two atoms held by single, covalent bond)
- Often used as disinfectants/bleach/cleaning products
- Reactivity decreases as you go down series due to the increased distance making the electrostatic force of attraction stronger
- harder to break and weaker reactivity (due to trying to gain electron)

(Fluorine, chlorine, bromine, iodine, astatine)

HALOGEN	RELATIVE SIZE	MELTING POINT	BOILING POINT	STATE AT ROOM TEMP
Fluorine	-1	-220	-118	Gas
chlorine	0	-101	-34	Gas
Bromine	1	-7	59	Liquid
Iodine	2	144	184	Solid

- React with metals forming ionic compounds/salts (contain halide ions – x^-)

$Cl_2(g)$ + Mg(s) → MgCl(s)
chlorine + magnesium → magnesium chloride

$F_2(g)$ + 2Na(s) → 2NaF(s)
fluorine + sodium → sodium fluoride

Reactions with hydrogen –

- Halogens react with non-metals by sharing electrons and forming covalent compounds
- These gases are extremely soluble in water and dissolve to produce acids (aqueous)
- Halogen + hydrogen = hydrogen halides
- Can convert hydrogen halide to its acid by dissolving it in water

"$H_2 + Cl_2 = 2HCl$" – hydrochloric acid (aqueous when dissolved in water)

Test for chlorine –

- Turns blue litmus paper red, then white
- Turns bleach white

Halogen	Symbol	State	Colour	Colour of vapour
Fluorine	F	gas	Pale yellow	Yellow
Chlorine	Cl	gas	Pale green	Green
Bromine	Br	liquid	Orange / brown	Orange
Iodine	I	solid	Grey-black crystals	Purple

CC13C - HALOGEN REACTIVITY

Halogens + metal = halide salts

DISPLACEMENT REACTION – whereby a more reactive element replaces a less reactive element in a compound (more reactive halogen replaces less reactive to form halide compound)

"Chlorine + sodium bromide = bromide + sodium chloride"

REDOX REACTION – reaction in which both oxidation and reduction occurs – (OIL,RIG)

OXIDATION – the loss of electrons + gain of oxygen

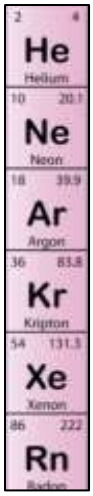
REDUCTION – the gain of electrons

"2Na (s) + Br_2 (g) = 2NaBr (s)"

- *Sodium oxidised, lost electron to bromine, bromine reduced, gained electron from sodium*

Halogen	Effect on iron wool
fluorine	bursts into flames
chlorine	glows brightly
bromine	glows dull red
iodine	changes colour

CC13D - GROUP 0 – NOBEL GASES



- 8 electrons in outer shell – no delocalised electrons
- Monatomic (singular atoms)
- Inert (non-reactive) – no electrons to lose or gain
- Non-metals
- Low boiling and melting points
- Bad conductors of electricity (no free electrons to move around)
- Reactivity remains the same throughout series
- As you move down series, density increases due to more outer shells
- Used to be group zero however helium didn't fit into requirement
- Weren't in first periodic table due to being so unreactive, couldn't be detected

1. KYRPOTON – used in fluorescent lights, photography flash and lasers (reacts with fluorine)
2. ARGON – used in wine barrels to prevent wine oxidising (more dense than air)
3. HELIUM – used in weather balloons and airships(low density so floats and non-flammable)
4. NEON – long lasting illuminated signs (produces red/orange light when current passed through)

CC14A - RATES OF REACTION

CHEMICAL REACTION - when one or more reactants form one or more products

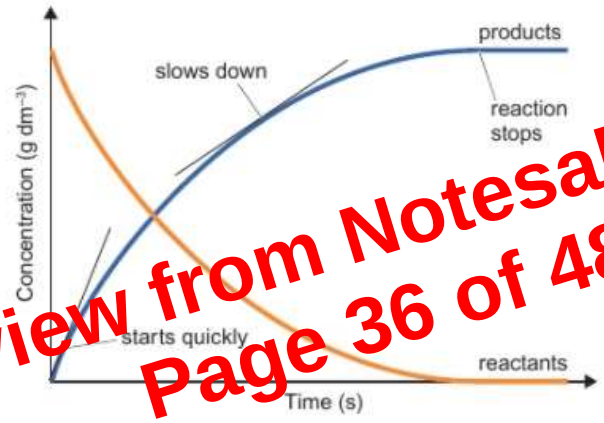
RATE OF REACTION - speed of which reactants are turned into products (frequency of collisions and amount of energy needed)

Chemical reactions –

- Colour change
- New product formed (precipitate – two soluble substances producing insoluble solid)
- Effervescence (gas formed)
- Irreversible
- Temperature change

(No mass lost or gained in reaction, only rearranged)

- Rusting/eroding = slow reaction
- Explosions/ potassium & water = quick reaction



- Steeper the slope – faster the reaction (gradient)
- No slope/flat line – all energy used up and reaction complete
- Greatest speed of reactant in beginning due to highest concentration of reactants available
- Concentration of reactants decrease whilst products increase
- Reactions don't proceed at steady rate
- Gas syringes used to measure rate of reaction as traps product and measures production in given time

CC14B - FACTORS THAT AFFECT RATE OF REACTION

- For reaction to occur, atoms of reactants must collide with one another with enough energy

ACTIVATION ENERGY – minimum amount of energy required for a reaction to occur