Group II & Group VII knowledge organiser

1. Physical properties

Trends in group II, Beryllium is not typical of the group and it is not considered here.

Symbol	Z	Atomic radius (nm)	Melting point (K)	1st ionisation energy (kJ/mol)	Density ρ
Mg	12	0.160	650	738	1.74
Ca	20	0.197	842	590	1.54
Sr	38	0.215	777	550	2.60
Ba	56	0.218	727	503	3.52

2. Reactivity with water

Reactivity with water INCREASES down the group.
Magnesium reacts slowly with liquid water, but rapidly when heated in the presence of steam.

3. Hydroxides and sulphates - solubility

Hydroxides – $M(OH)_2$	Sulphates – MSO_4
• Varying solubility in water. • Solubility INCREASES as you descend the group. • pH of the hydroxide in water varies. • pH increases as you descend the group.	• Colourless solids • Solubility DECREASES as you descend the group. • Thermal Decompose to form MO(s) and CO_2(g).

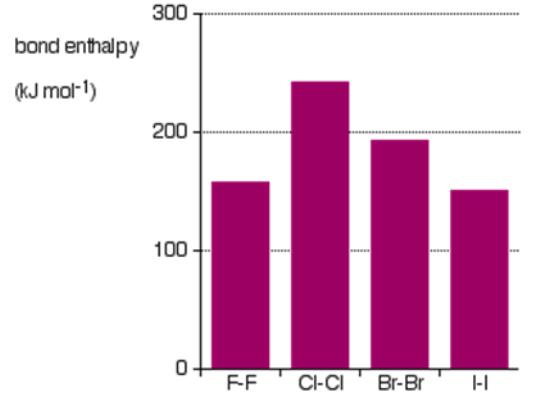
4. Application of group II compounds

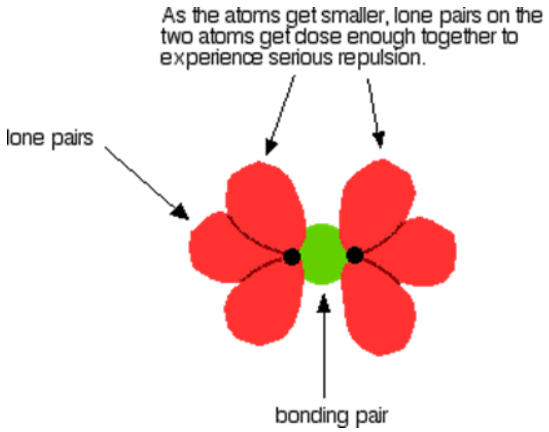
Chemical	Common name	Applications
$Mg(OH)_2$	Milk of magnesia	Treat indigestion, heartburns and wind.
$Ca(OH)_2$	Slaked lime	Neutralise fields and polluted lakes.
$BaSO_4$	Barium meal	Contrast medium for gut X-ray.

Group II & Group VII knowledge organiser

1. Keywords

Mean bond Enthalpy:	The average enthalpy change when one mole of a specific bond is broken in a range of different gaseous compounds.
Displacement:	A displacement reaction is a type of reaction in which part of one reactant is replaced by another reactant.
Electronegativity:	The power of an atom to attract the electrons in a covalent bond.





2. Physical properties

Trends in group VII. A number of properties of Fluorine are untypical, this mainly stem from the fact that the mean bond enthalpy of the F-F bond is unexpectedly low. This is due to electron repulsion.

Symbol	Z	Electronegativity	Atomic (covalent) radius (nm)	Melting point (K)	Boiling point (K)
F	9	4.0	0.071	53	85
Cl	17	3.0	0.099	8172	238
Br	35	2.8	0.114	266	332
I	53	2.5	0.133	387	457

3. Physical states

The physical state of the halogens are summarised below.

Symbol	In pure form	In non-polar solvents	In water
F	Pale yellow gas	(Reacts with solvents)	(Reacts with water)
Cl	Pale green gas	Pale green solution	Pale green solution
Br	Dark red liquid	Orange solution	Orange solution
I	Grey solid	Purple solution	Insoluble

4. Oxidising abilities – Displacement reactions

The oxidising ability of the halogens decreases down the group.
You cannot investigate the oxidising ability of Fluorine in aqueous solution because it reacts with water.

	F^-	Cl^-	Br^-	I^-
F_2	-	yes	yes	yes
Cl_2	no	-	yes	yes
Br_2	no	no	-	yes
I_2	no	no	no	-

Group II & Group VII knowledge organiser

1.Keywords

Disproportionation:	a reaction in which a substance is simultaneously oxidized and reduced, giving two different products..
Precipitate (ppt):	deposited solid formed in a so-lution.

2. Reducing strength

The reducing ability of the halide ions increases down the group.

Symbol	Atomic radius (nm)
F^-	0.133
Cl^-	0.180
Br^-	0.195
I^-	0.215

4. Reaction with silver ions

All metal halides (but fluoride) react with silver ion to form an insoluble precipitate. Dilute nitric acid is added before the reaction to get rid of any carbonate or hy-droxide impurities.

$Ag^+(aq) + X^-(aq) \rightarrow AgX(s)$

Symbol	Observation	Halide salt solubility
Cl^-	White ppt	Dilute NH_3
Br^-	Cream ppt	Concentrated NH_3
I^-	Pale yellow ppt	Insoluble in NH_3

3. Reaction with concentrated sulphuric acid

Solid halides react with concentrated sulphuric acid giving different products based on their reducing powers.

Summary table

Chemical reactions.	Reaction A	Reaction B	Reaction C	Reaction D	Observations
Products	$MeHSO_4$	SO_2	S	H_2S	
Cl^-	√	×	×	×	•Steamy fumes (HCl) •Ppt ($MeHSO_4$)
Br^-	√	√	×	×	•Steamy fumes (HBr) •Brown fumes (Br_2) •Pungent gas (SO_2)
I^-	√	√	√	√	•Steamy fumes (HI) •Black ppt (I_2) •Rotten egg smell (H_2S) •Yellow ppt (S)

Reaction A	$MeX(s) + H_2SO_4(l) \rightarrow MeHSO_4(s) + HX(g)$	Types of reaction
Reaction B	$2H^+(aq) + 2X^-(aq) + H_2SO_4(l) \rightarrow SO_2(g) + 2H_2O(l) + X_2(l)$	Acid-base
Reaction C	$6H^+(aq) + 6X^-(aq) + H_2SO_4(l) \rightarrow S(s) + 4H_2O(l) + 3X_2(s)$	Acid-base and redox
Reaction D	$8H^+(aq) + 8X^-(aq) + H_2SO_4(l) \rightarrow H_2S(g) + 4H_2O(l) + 4X_2(s)$	Acid-base and redox

5. Reactivity of chlorine

Reactivity with water:	
$Cl_2(g) + H_2O(l) \rightleftharpoons HCl(aq) + HClO(aq)$ "chlorine water"	Disproportionation reaction
Reactivity with water in sunlight:	
$2Cl_2(g) + 2H_2O(l) \rightarrow 4HCl(g) + O_2(g)$	Goes from pale green to colourless
Alternative chlorination of swimming pools:	
$NaClO(s) + H_2O(l) \rightleftharpoons Na^+(aq) + OH^-(aq) + HClO(aq)$	Water is kept slightly acidic
Reactivity with alkali:	
$Cl_2(g) + 2NaOH(aq) \rightarrow Cl^-(aq) + NaClO(aq) + H_2O(l)$	Disproportionation reaction