a) Atomic Structure and Mixtures

b) Periodic Table

c) Structure and Bonding

d) Quantitative Chemistry

e) Chemical Changes

f) Energy Changes

Group 1(Alkali Metal)

4.1.2.1 The periodic table

4.1.2.2 Development of the periodic table

4.1.2.3 Metals and non-metals

4.1.2.4 Group 0

4.1.2.5 Group 1

4.1.2.6 Group 7

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GROUP 1 : Alkali Metals

Elements	Symbol	Electronic Configuration	Properties
Lithium	$_{3}Li^{7}$	2,1	Least Reactive in the series
Sodium	$_{11}Na^{23}$	2,8,1	More reactive than lithium but less reactive then sodium
Potassium	$_{19}K^{39}$	2,8,8,1	More reactive than sodium
Rubidium	$_{37}Rb^{85}$	2,8,8,18,1	Highly reactive
Caesium	$_{55}Cs^{133}$	2,8,8,18,18,1	Too reactive
Francium	$_{87}Fr^{223}$	2,8,8,18,18,32,1	Unstable radioactive reactive

REACTIVITY INCREASES DUE TO INCREASE IN TENDENCY OF LOOSING ELECTRONS

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GROUP 1: Alkali Metals Physical Properties

- They are highly reactive
- Reactivity increases down the group. — because tendency to loose one electron increases down the group due to increase increase in size and decrease in nuclear charge
- They loose one electron and form +1 ions.
- They are stored in kerosene or oil to prevent them reacting from air and water
- They are soft, silvery and shinny.
- They look dull in air as they react with oxygen and form oxide which coats their surface
- Lithium is less reactive and francium is highly reactive.
- They have low melting and boiling point and the melting and boiling point decreases down the group.

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Group 1: Alkali Metals Chemical Properties

[M = Li, Na, K]

REACTION WITH WATER

Reacts with water to metal hydroxide

→ $2M + H_2O \rightarrow 2MOH + H_2$

→ Metal hydroxide are alkali therefore the pH increases. Reactivity increases down the group so potassium reacts violently

→ Fizzing is produced due to the formation of hydrogen.

eg - $2Li_{(s)} + H_2O_{(l)} \rightarrow 2LiOH_{(aq)} + H_{2(g)}$

REACTION WITH OXYGEN

→ Reacts with oxygen to form a metal oxide

$2M + O_2 \rightarrow M_2O$

→ Metal goes dull in air due to this reaction.

$4Li_{(s)} + O_{2(g)} \rightarrow 2Li_2O_{(s)}$

REACTION WITH HALOGENS

→ React with halogens to form metal halides

$2M + X_2 \rightarrow 2MX$ [X = F, Cl, Br, I]

→ Metal halides are while solids but dissolve in water to form colourless solutions.

$2Li_{(s)} + F_{2(g)} \rightarrow 2LiF_{(s)}$

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REACTION WITH WATER

LITHIUM	SODIUM	POTASSIUM
$2Li_{(s)} + 2H_2O_{(l)} \rightarrow 2LiOH_{(aq)} + H_{2(g)}$	$2Na_{(s)} + 2H_2O_{(l)} \rightarrow 2NaOH_{(aq)} + H_{2(g)}$	$2K_{(s)} + H_2O_{(l)} \rightarrow KOH_{(aq)} + H_{2(g)}$
Floats in water due to less denisty than water	Floats in water due to less denisty than water	Floats in water due to less denisty than water
Fizzes due to the formation of hydrogen gas.	Fizzes due to the formation of hydrogen gas.	Fizzes due to the formation of hydrogen gas.
Shape is retained while reacting and gets smaller.	It melts into a call while reacting.	Melts into a ball, catches fire and produces a lilac flame.

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WHY REACTIVITY OF GROUP 1 INCREASES DOWN THE GROUP ?

→ The Reactivity of Group 1 increases down the group as the tendency to loose an electron increases down the group.

React by loosing electron

To loose an electron small nuclear charge greater size of atom and greater shielding is required

FACTORS AFFECTING TENDENCY TO LOOSE AN ELECTRON

→ Nuclear Charge → Great the size of the atom, the outer electron becomes further away from the nucleus decreasing the nuclear charge

→ SHIELDING → More the number of inner electrons due to increases in number of shell greater will be the shielding of the outer electron from the nuclear charge

→ SIZE OF ATOMS → Greater the size of the atom, the outer electron will become further away from the nucleus resulting in decreases in nuclear charge

Down the group the atom size increases due to increase in number of electron shells. This results in the outer electron being further away from the nucleus.
As the outer electron becomes further away from the nucleus the nuclear charge decreases. Increase in number of shells also increases the shielding and shields the outer electron from the nuclear charge.
Therefore, the tendency of atom to loose an electron increases down the group resulting in increase in reactivity down the group.

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GROUP 7 : Halogens (Salt Forming)

Element	Symbol	Electronic Configuration	State at room temperature
Fluorine	$_{9}F^{19}$	2,7	Yellow Gas
Chlorine	$_{17}Cl^{35}$	2,8,7	Green Gas and pale green in solution
Bromine	$_{35}Br^{80}$	2,8,18,7	Volatile brown liquid Yellow in solution
Iodine	$_{53}I^{127}$	2,8,18,18,7	Volatile purple solid Brown in solution
Astatine	$_{85}At^{210}$	2,8,18,32,18,7	Radioactive

REACTIVITY DECREASES DUE TO DECREASE IN ELECTRON AFFINITY

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GROUP 7 : Halogens : Physical Properties

- They are non metals
- They gain an electron to form -1 ions.
- They have low melting and boiling points
- Their melting point increases down the group due to increases in intermolecular forces.
- They are found in pairs and exist as diatomic molecules (X_2)
- They are poisonous and smelly
- Their reactivity increase down the group
- Their density increases down the group.
- They are poor conductors of heat and electricity

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HALOGEN REACTION

X [F, Cl, Br, I)

REACTION WITH HYDROGEN

→ They react with hydrogen to form hydrogen halides.

$$X_{2(g)} + H_{2(g)} \longrightarrow 2HX_{(g)}$$

→ Reactivity decreases down the group so fluorine and chlorine reacts explosively and bromine and iodine reacts at higher temperature in the presence of catalyst.

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REACTION WITH METALS

→ They react with metals to form ionic compounds. In Ionic compounds, halogens gain one electron from the metals to form -1 ions and attain noble gas electronic configurations.

eg $Na_{(s)} + Cl_{2(g)} \longrightarrow NaCl_{(s)}$

$Mg_{(s)} + Cl_{2(g)} \longrightarrow MgCl_{2(s)}$

DISPLACEMENT REACTION

- The more reactive halogen displaces the less reactive halogen from its salt
- As the reactivity decreases down the group, the halogen at the top can take the position of the halogen at the bottom in its compounds and will displace the less reactive halogen.

eg $Cl_2 + 2NaBr \longrightarrow 2NaCl + Br_2$ [Yellow solution formed]

- Cl_2 (more reactive)
- 2NaBr (salt of less reactive halogen than Chlorine)
- 2NaCl [chlorine being more reactive has taken the position of less reactive bromine in its compounds)
- Br_2 [bromine being less reactive than chlorine has been displaced by chlorine)

F
Cl
Br
I
Decreasing reactivity

$Cl_2 + 2NaF \longrightarrow$ No reaction.

- F_2 → can displace all halogens
- Cl_2 → can displace all halogen except fluorine
- Br_2 → can displace only iodine

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WHY REACTIVITY OF GROUP 7 DECREASES DOWN THE GROUP ?

React. by electron

→ The Reactivity of Group 7 decreases down the group as the electron affinity or tendency to gain the electron decreases down the group.

FACTORS AFFECTING TENDENCY TO GAIN AN ELECTRON

To gain an electron, smaller nuclear charge smaller size and less shielding is required.

→ Nuclear Charge +

Smaller the size of the atom, greater will be the force of the nucleus as the electron will be closer to the nucleus.

→ SHIELDING →

Less electrons and shells, smaller will be the shielding which will in turn increase the nuclear charge.

→ SIZE OF ATOMS →

Greater the size of the atom, the outer electron will become further away from the nucleus resulting in decreases in nuclear charge

Down the group the atom size increases due to increase in number of electron shells. As a result the nuclear charge decreases.

The size of the atom also increases down the group which makes the nuclear charge weaker

The electron shells also increases which decreases the effective nuclear charge on the incoming electron.

Due to all these factors, the nuclear charge decreases which decreeases the tendency of gaining electrons down the group of halogen making them less reactive.

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NEXT STEP !!!

- Check the Specification
- Do Exam questions on this chapter

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