THE FOLLOWING PAGES CONTAIN GROUP 1&7 TRENDS and PERIOD 3 TRENDS. PLEASE KNOW THE HIGHLIGHTED MATERIAL.

Similarities / differences of chemical properties in same group:

A. Reaction of Grp 1 (Alkali) metals and water

$$2Na(s) + 2H_2O(l) \longrightarrow H_2(g) + 2NaOH$$

$Na^+ OH^-$

$Na(s) \longrightarrow Na^+ + 1e^-$ IE ∝ Reactivity

electron loss = oxidation (oxidized)

Grp 1	IE
Li	520
Na	496
K	419

Reactivity Increases

IE Decreases

Reaction is a loss of a valence electron so, as IE decreases, the reactivity of Grp 1 metals increases.

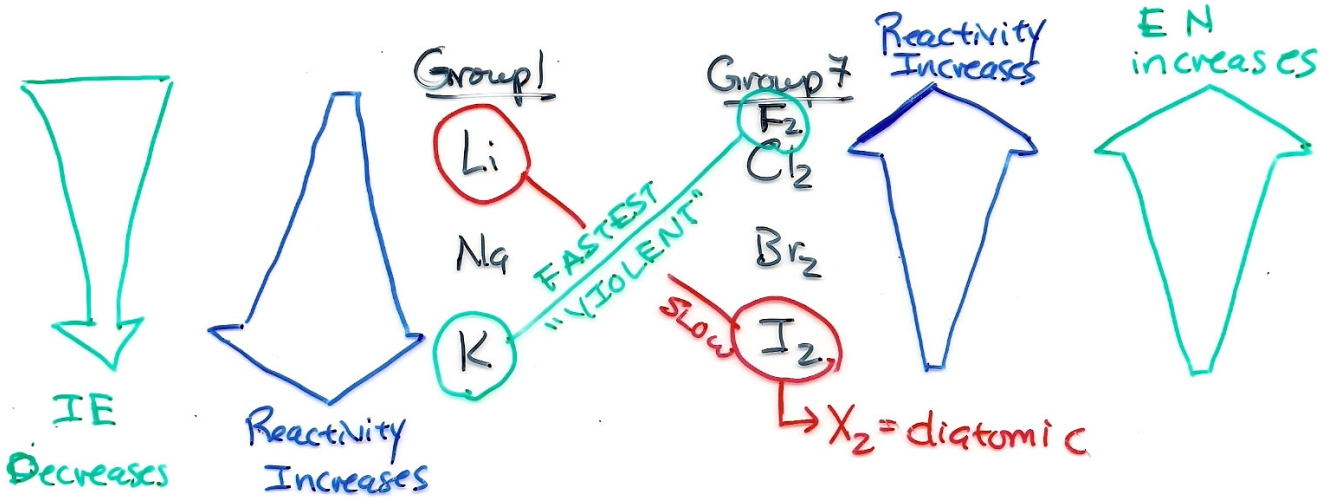
B. Reaction of Group 1 (Alkali) metals + Group 7 (Halogens)

$2Na(s) + Cl_{2(g)} \longrightarrow 2NaCl$

Group 1 | Group 7 | salt

$Cl_2 + 2e^- \longrightarrow 2Cl^-$ (gain e- = reduction) $Na^+ Cl^-$

$Na \longrightarrow Na^+ + 1e^-$ (lose e- = oxidation)



Lose e-: Reactivity $\propto \frac{1}{IE}$ Gain e-: Reactivity $\propto$ EN

C. Halogens + Halides

F_2

Cl_2 – Clear/greenish

Br_2 – orange

I_2 – brick red

Solutions

+

$Cl^-_{(aq)}$

$Br^-_{(aq)}$

$I^-_{(aq)}$

Clear solutions

∴ KBr = potassium bromide

You don't have a rxn unless you have a change!!

① $KCl_{(aq)} + I_{2(aq)} \longrightarrow$ No Rxn

clear — brick red

② $2KI^-_{(aq)} + Cl^\circ_{2(aq)} \longrightarrow I^\circ_{2(aq)} + 2KCl^-_{(aq)}$

clear — clear — brick red — clear

$2I^- \longrightarrow I_2 + 2e^-$ (losing e- = oxidation)

$Cl_2 + 2e^- \longrightarrow 2Cl^-$ (gaining e- = reduction)

A. Cl_2 is oxidising the I^- (iodide).

B. Cl_2 is taking electrons from the I^- (iodide).

↑ EN ∝ Take e- ∝ Reactive

Since EN decreases down group 7, any halogen will oxidise (remove e- from) any halide BELOW it on the table.

For each rxn:

a) Say if it will work or not.

b) If it does work, complete the equation and specify the color change.

① $Br_{2(aq)} + KCl_{(aq)} \longrightarrow$

② $Cl_{2(aq)} + KBr_{(aq)} \longrightarrow$

Note to self: "oxidising ability"

Electronegativity: attraction of an atom for the electrons shared in a bond ("how much an atom wants an e-")

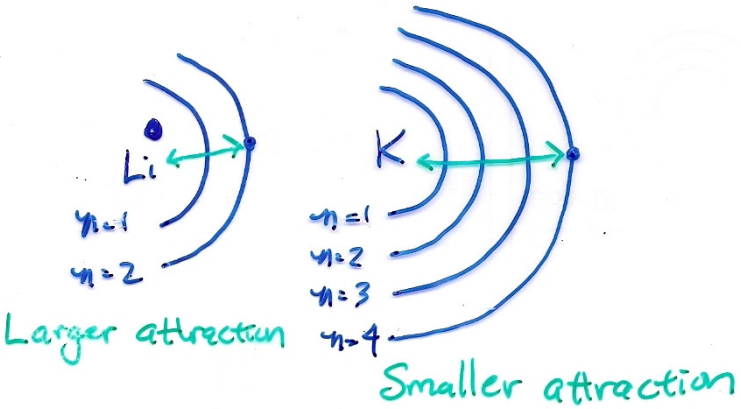
0 – 4.0 "Pauling EN units" {"electron greed"

- 0 → Don't want electrons
- 4.0 → REALLY want electrons

Group 1		Group 7
Li		F
Na		Cl
K	DECREASING	Br
		I

IE = getting rid of an e- EN = attracting an e-

As you go down a group the distance from the nucleus to the valence increases because each new element has one additional main level of electrons. This causes less and less attraction for valence electrons and EN decreases.



Ionic Radius: radius of the most stable ion

Group 1

$Li \rightarrow Li^+ + 1e^-$

$Na \rightarrow Na^+ + 1e^-$

$K \rightarrow K^+ + 1e^-$

Decreases

Group 7

$F + 1e^- \rightarrow F^-$

$Cl + 1e^- \rightarrow Cl^-$

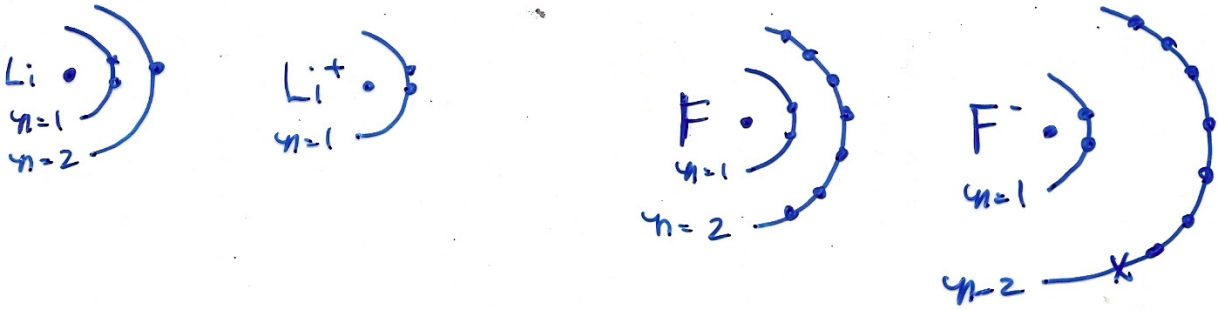
$Br + 1e^- \rightarrow Br^-$

$I + 1e^- \rightarrow I^-$

Increases

Ionic radius is smaller than the atomic radius because, when the single valence electron is lost, a main energy level is lost as well.

Ionic radius is larger than atomic radius because gaining an electron causes additional electron-electron repulsion and ion grows in size.



Melting Point (T_m): temperature at which pure element melts

Group 1 = METALS

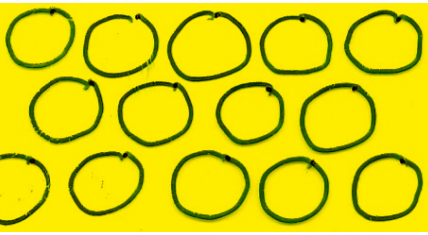
Li
Na
K

A_R ↓ DECREASE

Structure:

↑ "Close-packed structure"

Li 

K 

Larger metal atoms do not pack together so closely and therefore the T_m is lower

Group 7 = NONMETALS

F
Cl
Br
I

↑ INCREASE

↓ $\bar{M}$

Structure: 

"Discrete molecules"

(g) F_2 38 g mol^{-1}

(g) Cl_2 71 g mol^{-1}

(l) Br_2 160 g mol^{-1}

(s) I_2 254 g mol^{-1}

↑ Van der Waals Force = force of attraction between molecules

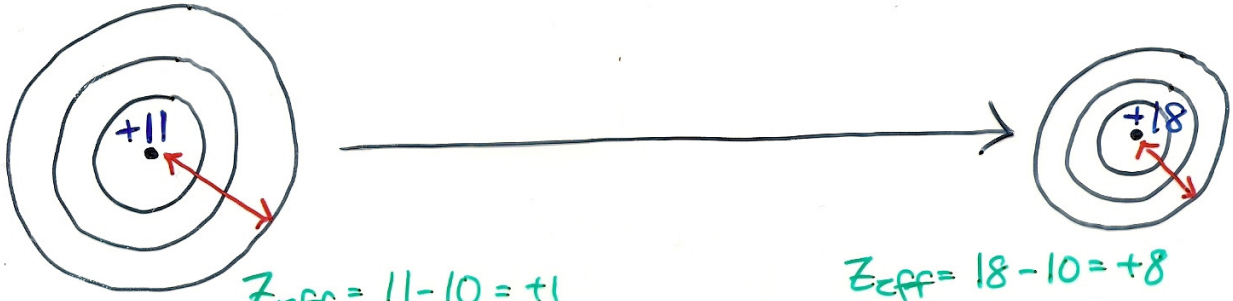
Van der Waals forces increase with molecular mass so heavier molecules have higher T_m

Physical Trends Period 3: Na, Mg, Al, Si, P, S, Cl, Ar

I. Atomic Radius:

a) What is the trend?

b) Why?



Since all period 3 elements have same number of main levels (3), the increase in nuclear charge (Z) will cause the valence shell to be more attracted to the nucleus and ~~size decreases~~ IE increases. EN increases.

II. Ionisation Energy:

a) What is the trend? IE increases from left → right

b) Why?

III. Electronegativity:

a) What is the trend? EN increases ~~from left~~ → right

b) Why?

IE/EN (Increase)
AR (Decreases)
→
AR (Increases)
IE/EN (Decrease)

D. Ionic radius:

METAL			METALLOID	NON METAL		
Na	Mg	Al	Si	P	S	Cl
A_R 186	160	143	117	110	104	99
Na^+	Mg^{2+}	Al^{3+}	Si	P^{3-}	S^{2-}	Cl^-
I_R 98	65	45		212	190	181

Decrease

Loss of valence electrons means loss of 1 level so size decreases

Increase

Gaining electrons causes electron-electron rep. to increase so size increases

Decrease

Nuclear charge increases
(+11 ⟶ +13)

Decrease

(+15 ⟶ +17)

E. Melting Point:

METALS			Metalloid	NONMETALS			
Na	Mg	Al	Si	P_4	S_8	Cl_2	Ar
Tm (K) 371	922	933	1683	317	392	172	84
				124	257	71	40 $\bar{M}$ ($g\,mol^{-1}$)

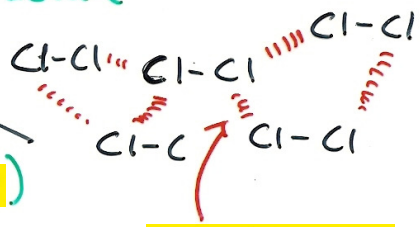
A_R

A_R decreases so atoms are more tightly packed together and this requires more energy to melt

Metallic close-packed structure

Van der Waals forces of attraction increase with mass so heavier molecules have higher Tm.

Covalent molecular structure



VDW must be overcome to melt

Macromolecular Structure

("Giant covalent" structure)

Since each Si is bonded to 4 others the heat required to break the covalent bonds is very large and the Tm high.