RECTIVITY OF GROUP-1 METALS

Group-I elements other than hydrogen are called alkali metals. Generally Hydrogen is placed at the top of this Group-1, but it is not alkali metal. The alkali metals are highly reactive elements because they loose one electron to form +1 ion with non metals. The alkali metals reacts with oxygen, water, and with halogens.

Name	Atomic number	Symbol	Electron configuration	Ionic form	Atomic mass	
Lithium	3	Li	[He] $2s^1$	Li^+	6.941	
Sodium	11	Na	[Ne] $3s^1$	Na^+	22.99	
Potassium	19	K	[Ar] $4s^1$	K^+	39.10	
Rubidium	37	Rb	[Kr] $5s^1$	Rb^+	85.47	
Caesium	55	Cs	[Xe] $6s^1$	Cs^+	132.9	
Frantium	87	Fr	[Rn] $7s^1$	--	223	
* Fr - Radio active metal						

Due to high reactivity the alkali metals are generally not found in free state in nature. These metals are stored in mineral oils generally otherwise they react with oxygen or with the air/moisture.

The reactivity of alkali metals increases down in the group. The increasing order of the metals as per reactivity is Li < Na < K < Rb < Cs.

Sodium is much reactive than Lithium. Potassium is more reactive than Sodium. Rubidium is much more reactive than Potassium. The most reactive metal is Caesium.

Note: Highest reactive metal is Frantium. But it is a radio active metal. It is unstable. So except Frantium, we treat Caesium as the most reactive metal in Group-I (Alkali metals).

Caesium has the highest electro positive property. All are present in Group-I of s-block in Modern periodic table of elements. All alkali metals have very similar properties. They are all shiny, soft and highly reactive. All are good conductors of heat and electricity. They are usually soft and can easily cut with a knife. Lithium is the hardest alkali metal. The softness increases when we go down the group.

Li, Na, K are the only metals which are float less dense than water. Lithium is the least dense metal. They can float on water. Also they have less melting and boiling points. (Cs, Ga and Hg are the three elements that are liquids at room temperature.)

Name	Melting Point (^oC)	Boiling Point (^oC)	Density (gm/cm^3)	Electro Negativity
Lithium	180.54	1342	0.534	0.98
Sodium	97.72	883	0.968	0.93
Potassium	63.38	759	0.89	0.82
Rubidium	39.31	688	1.532	0.82
Caesium	28.44	671	1.93	0.79
Frantium	~27	~677	~1.87	~0.7
* Fr - Radio active metal				

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Reaction with Water :

All alkali metals react with water to form alkali hydroxide and liberate Hydrogen gas. They react with water to form a strong base. It is an exothermic reaction. The energy is enough to ignite hydrogen gas resulting in an explosion. The general equation for this reaction is

$$2\ M\ (s) + 2\ H_2O \rightarrow 2\ MOH\ (aq) + H_2\ (g)$$

Lithium reacts with water vigorously. It generates heat slowly. Sodium reacts with water violently. It produce heat faster. The energy is enough to ignite hydrogen gas resulting in an explosion. Potassium reacts with water more violently. Rubidium reacts with water explosively. It reacts immediately with everything spitting out of the container. It is dangerous. Caesium reacts with water more explosively. It is very dangerous. It can react very immediately and possibly shattering the container. Also caesium reacts with ice at temperatures above -116^oC. CsOH is a strong base and attacks glass.

So as we go down from Li to Cs in Group-1 , we need to put less energy into the reaction to get a positive ion formed. The energy will be recovered later on. But gas to be supplied initially. This is going to be related to the activation energy of the reaction.

The lower the activation energy the faster the reaction.

Name	Activation energy	First Ionization Potential	Total energy
Lithium	161	519	680
Sodium	109	494	603
Potassium	90	418	508
Rubidium	86	402	488
Caesium	79	376	455
Frantium	--	--	--
* Fr - Radio active metal			

Reaction with Oxygen / Air :

All alkali metals react with oxygen to form their metallic oxides. Generally the less reactive alkali metals form their oxides having general formula M_2O. The moderate reactive alkali metals form their peroxides having general formula M_2O_2. The most reactive alkali metals form their super oxides having general formula MO_2. K, Rb and Cs form super oxides.

Name	Colour	Flame colour when burns in air	Ash colour	Reaction Process	
Lithium	Silvery white	Pinkish red	White	Rapidly	A freshly cut chunk of these metals are silvery, but tarnishes in a minute to give a grey surface.
Sodium	Silvery white	Yellow orange	White	Vigorously	
Potassium	Silvery white	Lilac	White	More vigorously	
Rubidium	Silvery white	Yellowish violet	Light Yellow	Violently	
Caesium	Silvery Yellow	Bluish violet	Orange	More violently	
Frantium	--			Explosively	
* Fr - Radio active metal					

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Some oxides formulae are:

Li_2O					
Na_2O	Na_2O_2				
K_2O	K_2O_2	KO_2			
Rb_2O	Rb_2O_2	RbO_2	Rb_6O	Rb_9O_2	
Cs_2O	Cs_2O_2	CsO_2	CsO_3	Cs_3O	Cs_3O_2
	Cs_4O	Cs_7O	Cs_7O_2	$Cs_{11}O_3$	

All are in silver colour except caesium. Caesium is in silvery yellow colour. (Only three metals have colour. They are Copper, Gold and Caesium). As all the alkali metals are more reactive, they tarnish rapidly in air due to oxidation by atmospheric moisture and oxygen.

So the alkali metals were kept / stored under an inert atmosphere or under mineral oils. Generally Lithium, Sodium, Potassium are kept in Kerosene. Lighter alkali metals react vigorously and heavier alkali metals reacts more vigorously. Rubidium preserved under inert gas like Argon. Caesium can be preserved in vacuum.

Reaction with Acids :

All alkali metals react with acids to liberate Hydrogen gas.

For example Caesium reacts with Dil. H_2SO_4 to release hydrogen gas.

$$2\ Cs + H_2SO_4 \rightarrow Cs_2SO_4 + H_2$$

Reaction with Halogens :

All alkali metals react with halogens (F, Cl, Br, I) to produce their halides. Alkali halides except LiF soluble in water.

Ex: $2\ Cs + F_2 \rightarrow 2\ CsF$

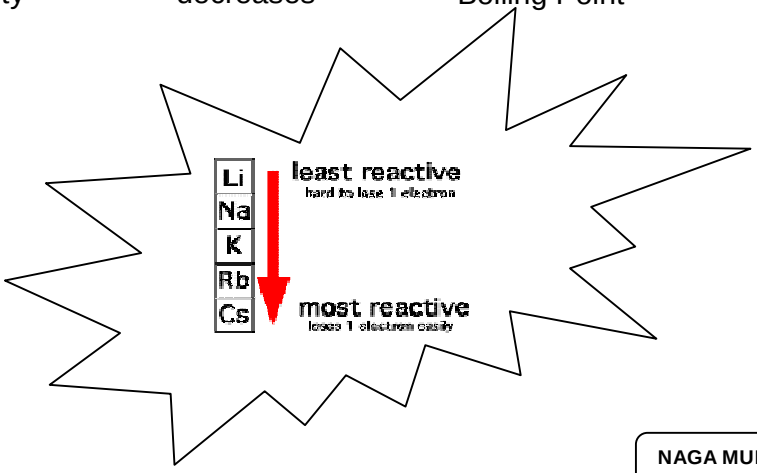
$2\ Cs + Cl_2 \rightarrow 2\ CsCl$

$2\ Cs + Br_2 \rightarrow 2\ CsBr$

$2\ Cs + I_2 \rightarrow 2\ CsI$

Changes in atomic properties in Group-1 from top to bottom :

Atomic number	-	increases	Electro positivity	-	increases
Number of electrons	-	increases	Electro Negativity	-	decreases
Number of orbits	-	increases	Metallic Property	-	increases
Atomic radius	-	increases	Reactivity	-	increases
Ionization energy	-	decreases	Melting Point	-	decreases
Electron Affinity	-	decreases	Boiling Point	-	decreases



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