

### Alkaline Earth Metals Group II (IIA)

Element		Electronic structure
Beryllium	${}^4\text{Be}$	$[\text{He}] 2s^2$
Magnesium	${}^{12}\text{Mg}$	$[\text{Ne}] 3s^2$
Calcium	${}^{20}\text{Ca}$	$[\text{Ar}] 4s^2$
Strontium	${}^{38}\text{Sr}$	$[\text{Kr}] 5s^2$
Barium	${}^{56}\text{Ba}$	$[\text{Xe}] 6s^2$
Radium	${}^{88}\text{Ra}$	$[\text{Rn}] 7s^2$

The second group of metals was called alkaline earth metals because it enters the structure of the earth's crust.

#### General properties

- 1- All (G2) elements have two S-electron in their outer shell therefore they are divalent ثنائية التكافؤ
- 2- Forming colorless ionic compound.
- 3- Less basic than group 1.
- 4- The diagonal relationship with Al and B (IIIA).
- 5-The divalent cation possess the electronic structure of the noble gas.

The following table illustrate the main important difference between G1 and G2.

- 1.Group I elements always mono divalent while group II element are divalent.
2. Atomic radi  $r_A$  of  $G2 < G1$  due to decrease of atomic size.
- 3.The density of  $G2 > G1$  due to decrease in atomic size حجم الذري.
4. I.P.  $G2 > G1$  .

5. The compounds of G2 are more heavily hydrated than G1 .

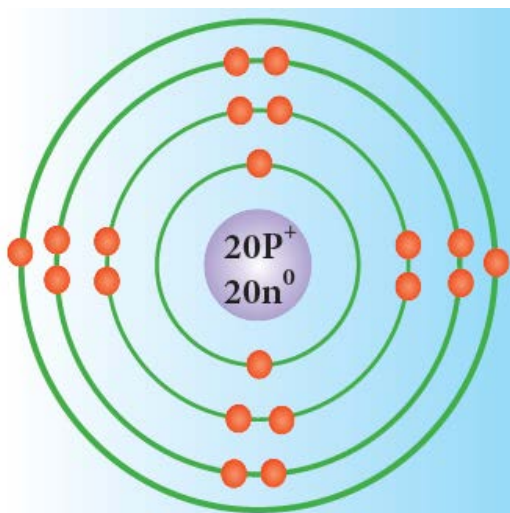
6. Na and K are the most abundant element in G1 while Mg and Ca are the most abundant element of G2.

## Calcium

Atomic number = 20

Mass number = 40

عدد الالكترونات	رقم الغلاف (n)	رمز الغلاف
2	1	K
8	2	L
8	3	M
2	4	N



## Chemical properties

There is no calcium free in nature because of its effectiveness and present united with other elements, consisting of fixed compounds including carbonates and others.

## Calcium: reactions of elements

### 1. Reaction of calcium with air

Calcium metal burns in air to give a mixture of white calcium oxide, CaO, and calcium nitride, Ca<sub>3</sub>N<sub>2</sub>.



### 2. Reaction of calcium with water

Calcium reacts slowly with water. The reaction forms calcium hydroxide, Ca(OH)<sub>2</sub> and hydrogen gas (H<sub>2</sub>).



### 3. Reaction of calcium with the halogens

Calcium is very reactive towards the halogens fluorine, F<sub>2</sub>, chlorine, Cl<sub>2</sub>, bromine, Br<sub>2</sub>, or iodine, I<sub>2</sub>, and burns to form the dihalides calcium(II) fluoride, CaF<sub>2</sub>, calcium(II) chloride, CaCl<sub>2</sub>, calcium(II) bromide, CaBr<sub>2</sub>, and calcium(II) iodide, CaI<sub>2</sub> respectively.



### 4. Reaction of calcium with acids

Calcium metal dissolves readily in dilute or concentrated hydrochloric acid to form solutions containing the aquated Ca(II) ion together with hydrogen gas, H<sub>2</sub>.



## Elements of Group IIIA

The elements of this group are Boron (B), Aluminum (Al), Gallium (Ga), Indium (In) and Thallium (Ti).

															18 VIII A																
1 IA													13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	2 He													
1 H	2 IIA											5 B	6 C	7 N	8 O	9 F	10 Ne														
3 Li	4 Be											11 Na	12 Mg	3 IIIB	4 IVB	5 VB	6 VIB	7 VIIB	8 ← VIII B →	9 IIB	12 IIB	13 Al	14 Si	15 P	16 S	17 Cl	18 Ar				
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr														
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe														
55 Cs	56 Ba	57 La	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn														
87 Fr	88 Ra	89 Ac	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Uun	111 Uuu	112 Uub																				
																		58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu
																		90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Ir

### General properties

1. The presence of three electrons in the outer shell of their atoms so that the equivalent is three (+3).
2. Elements of this group are metals except boron, which is a semi-metal.
3. Ionizing energy of these elements is less than the ionization energy of the second group because the elements of this group contain one electron in the secondary shell P after a saturated secondary shell. The second group elements are  $ns^2$ , their outer shell.

As the atomic number increases, the energy of ionizing its atoms decreases due to its large atomic volume.

4. The basic properties of the elements of this group increase and the acidity decreases as the atomic number increases. The boron oxide is acidic, aluminum oxide is amphotery, and the other elements of this group are alkaline.

## **Boron: reactions of element**

### **1.Reaction of boron with air**

Boron does not react with air at room temperature. At higher temperatures, boron does burn to form boron (III) oxide, B<sub>2</sub>O<sub>3</sub>.



### **2.Reaction of boron with water**

Boron does not react with water under normal conditions.

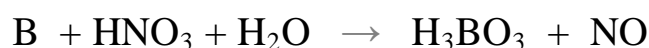
### **3.Reaction of boron with the halogens**

Boron reacts with the halogens fluorine, F<sub>2</sub>, chlorine, Cl<sub>2</sub>, bromine, Br<sub>2</sub> to to form the trihalides boron(III) fluoride, BF<sub>3</sub>, boron(III) chloride, BCl<sub>3</sub>, and boron(III) bromide, BBr<sub>3</sub> respectively.



### **4.Reaction of boron with acids**

Crystalline boron does not react with boiling hydrochloric acid, HCl, or boiling hydrofluoric acid, HF. Powdered boron oxidizes slowly when treated with nitric acid, HNO<sub>3</sub>.



### **5.Reaction of boron with strong base**

Boron react with strong base like sodium hydroxide ( NaOH) produce sodium borate:

