



Republic of Iraq Ministry of Higher Education & Scientific research Al-Mustaqbal University Science College Biochemistry Department

# **Introduction in Chemistry**

# For

**First Year Student** 

Lecture 2

# By

Dr. Karrar M. Obaid

2024-2025

# **Periodic Table of the Element**

### **Periods and Groups**

*The* periodic table is a tabular arrangement of the chemical element , organized on the basis of their atomic numbers , electron configurations (electron shell model) and recurring chemical properties.

The first reasonably successful attempt was made by **Dimitri Mendeleev** in 1869. He had the idea of arranging elements in order of increasing atomic mass, and, most importantly, found that elements with similar chemical and physical properties occurred periodically. He placed these similar elements under each other in columns.

In 1914, **Henry Moseley** determined that a better arrangement was in order of increasing atomic number, giving us the periodic table we have today.

We can define the periodic table as an arrangement of elements in order of increasing **atomic number** placing those with similar chemical and physical properties in columns.

The basic structure of the periodic table is its division into rows and columns, or periods and groups. A **period** consists of the elements in any one horizontal row of the periodic table. A **group** consists of the elements in any one column of the periodic table. The first period of elements consists of only hydrogen (H) and helium (He). The second period has 8 elements, beginning with lithium (Li) and ending with neon (Ne). There is then another period of 8 elements, and this is followed by a period having 18 elements, beginning with potassium (K) and ending with krypton (Kr). The fifth period also has 18 elements. The sixth period actually consists of 32 elements, but in order for the row to fit on a page, part of it

appears at the bottom of the table. Otherwise the table would have to be expanded, with the additional elements placed after barium (Ba, atomic number 56). The seventh period, though not complete, also has some of its elements placed as a row at the bottom of the table.

	1 IA 1 1.0079			RELATIVE ATOMIC MASS (1)			Me	🖬 Metal 📓 Semimetal 📓 Nonmetal							.pritan sper			2 4.007
1	H GR		UP IUPAC	IIIA G	ROUPCAS	A5	sali metal saline earth m	etal	The Chalcogens element			13 IIIA	14 IVA	15 VA			HELUM	
2	Li	Be	5	YMBOL -	B		Tre	ansition metal ] Lanthanide ] Actinide	STAN	DARD STATE	gas (25 °C; 101 ) Fe - solid	(Pa)	B	C	N	0	F	Ne
3	11 22.990 Na	12 24.305 Μσ	/	ELEMENT NAM		/ /	1-7	1	Ga · liquid Til: - synthotic			ie	13 26.982 Al	.982 14 28.086	15 30.974 P	16 32.065	17 35.453	18 39.9- Ar
	SODIUM	MAGNESIUM	3 1118	4 IVB	5 V8	6 VIB	7 VIIB	8	VIIIB -	10	11 18	12 118	ALUMINUM	SILICON	PHOSPHORUS	SULPHUR	CHLORINE	ARGON
	19 39.098	20 40.078	21 44.956	22 47.867	23 50.942	24 51.996	25 54.938	26 55.845	27 58.933	28 58.693	29 63.546	30 65.39	31 69.723	32 72.64	33 74.922	34 78.96	35 79.904	36 83.
4	K	Calcium	SCANDIUM	Ti	V	Сг	Mn	Fe	CO	Ni	Cu	Zn	Gallaum	Germanium	AS	Se	BROMINE	KRYPTO
1	37 85.468	38 87.62	39 88.906	40 91.224	41 92.906	42 95.94	43 (98)	44 101.07	45 102.91	46 106.42	47 107.87	48 112.41	49 114.82	50 118.71	51 121.76	52 127.60	53 126.90	54 131
5	RUBIDIUM	Sr	Y	Zr	ND	MO	TC	RUTHENIUM	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
	55 132.91	56 137.33	57-71	72 178.49	73 180.95	74 183.84	75 186.21	76 190.23	77 192.22	78 195.08	79 196.97	80 200.59	81 204.38	82 207.2	83 208.98	84 (209)	85 (210)	86 (2
6	CS	Ba	La-Lu Lanthanide	HAFNIUM	Ta	W	Re	OSMIUM	Ir	Pt	Au	Hg	TI	Pb	Ві	POLONIUM	At	RADO
	87 (223)	88 (226)	89-103	104 (261)	105 (262)	106 (266)	107 (264)	108 (277)	109 (265)	110 (281)	111 (272)	112 (285)		114 (289)				
7	Fr	RADRUM	Ac-Lr Actinide	IRII RUTHERFORDUM	IDID DUBNIUM	SEABORGIUM	IBIN	IHIS HASSIUM	MIC			UNUNBIUM		puU	1			
1	/	2	1		1		1						0	1	-			
(1) Pure Appl. Chem., 73, No. 4, 667-683 (2001) 57, 138,91, 58, 140, 12, 59, 140, 01, 60					60 144 24	1 144 24 61 (145) 62 150 36 63 151 95 64 157 25 65					Copyright C 1998-2003 EniG (							
Relative atomic mass is shown with five significant figures. For elements have no stable nuclides. Whe value enclosed in brackets indicates the mass number of the tongest-lived			with five e no stable brackets gest-fived	La	Ce	Pr	Nd	IPm	Sm	Eu	Gd	Tb	Dy	Но	Er	Tm	Yb	Lu
However three such elements (Th, Pa, and U) ACTINID					ANUM CERUM PRAECONIUM NEODYMUM PROMETHUM SAMARUM EUROPIUM GADOLINUM TERBIUM (DYS NIDE								DYSPROSIUM	HOLMIUM	ERBIUM	THULIUM	TTERBIUM	LUTET
do h	vave a charact position, and for	eristic terrestric these an atomi	al isotopic cweight is	89 (227)	90 232.04	91 231.04	92 238.03	93 (237)	94 (244)	95 (243)	96 (247)	97 (247)	98 (251)	99 (252)	100 (257)	101 (258)	102 (259)	103 (2
1000				Ac	Th	Pa	U	NID	IPm	Amo	Cim	TBIK	CI	TES	TRimo	Mid	No	IL
								- The		A LALAS	- Large				~ 000			1

The groups are usually numbered. The numbering frequently seen in North America labels the groups with numerals and A's and B's. In Europe a similar convention has been used, but some columns have the A's and B's interchanged. To eliminate this confusion, the International Union of Pure and Applied Chemistry (IUPAC) suggested a convention in which the columns are numbered 1 to 18.

#### 1. Metals

- ➢ solids at room temperature (except Hg).
- ➢ metallic luster.
- ➤ malleable and ductile.

good conductors of heat and electricity

#### 2. Non-metals

- ➢ gases or solids at room temperature (except Br₂).
- ➤ variety of color and appearance.
- $\succ$  brittle solids.
- ➢ insulators (poor conductors.

## 3. Metalloids (semimetal)

- ➤ intermediate in properties between metals and non-metals.
- ➢ solids at room temperature.
- ▶ many have more than one structure (one metallic, the other non-metallic).
- $\succ$  some are semi-conductors.

#### Main Group Elements (Vertical Groups)

- Group 1(IA) Alkali Metals
- Group 2(IIA) Alkaline Earth Metals
- Group 13(IIIA) Boron Family
- Group 14(IVA) Carbon Family
- Group 15(VA) Nitrogen Family
- Group 16(VIA) Oxygen Family (Chalcogens)
- Group 17(VIIA) Halogens
- Group 18(VIIIA) Noble Gases

# **Other Groups (Vertical and Horizontal Groups)**

- Group 3-12(IB-8B) Transition Metals
- Period 6 Group Lanthanides (Rare Earth Elements)

• Period 7 Group - Actinides

# **Chemical bonds**

A chemical bond is an attraction between atoms.

## What are atoms and compounds always trying to achieve?

Atoms form chemical bonds to achieve a fill valence shell of

electrons. This may be achieved in two ways:

1- An exchange of electrons between metal and non-metal atoms.

2- Sharing of electrons between non-metal atoms.

# Ionic Bond

- An ionic bond is the electrostatic attraction between oppositely charged ions.
- Ionic bonds involve electron transfer (one atom loses electrons and another gain them).
- The atom that loses electrons becomes a cation (a positive ion).
- The atom that gains electrons becomes an anion (a negative ion).



- An ionic bond usually occurs between a metal and a nonmetal.
- Ionic bonds are found in ionic compounds ex. NaCl, Al<sub>2</sub>O<sub>3</sub>, KBr, MgCl<sub>2</sub>.



## **Covalent Bond**

• It is a strong bond formed between two atoms by sharing two valence electrons, one from each atom.

• A covalent bond usually occurs between two **non-metals** atoms.



Covalent bonds are found in molecular elements(ex  $H_2$ ,  $F_2$ ,  $Cl_2$ ,  $O_3$ ). And molecular compounds (ex  $H_2O$ ,  $CO_2$ ,  $C_3H_8$ , HF).



#### **Coordinate bond**

• It's a type of **covalent** bond that formed when one atom **donates both of the shared electrons** to the other atom to make the bond.



This is different from a covalent bond because both electrons **come from one atom or molecule** but are **shared as in a typical covalent** bond.



### **Metallic bond**

Is the type of bonding found in metallic crystals, that formed by the **attraction** between the **metal positive ion and delocalized electrons.** 



• The free movement of electrons make metals good conductors of heat and electricity.

• Aluminum more conduct electricity more than magnesium because it has more electrons delocalized.



### Hydrogen bond

• A chemical bond that hydrogen atom of one molecule is attracted to an electronegative atom, especially **nitrogen** (**N**), **oxygen** (**O**) **or fluorine** (**F**) atom, usually of another molecule.

• It is a **weak** attraction, where it's **weaker** than **covalent**, **ionic** and **metallic** bonds.

• Is very important, where this type of bond occurs in both inorganic molecules (such as water) and organic molecules (such as DNA).



### Van der Waals Bonds

The dipoles involved in Van der Waals bonding come from fluctuations in the symmetry of the electron distribution surrounding the nucleus of an atom. Very weak interactions (2-4 kJmol<sup>-1</sup>), very short-range, non-directional attractive forces between molecules or atoms. Example: Ni atom



# **Type of Van der Waals Bonds**

- 1- dipole-dipole interactions
- 2-ion -dipole interactions.
- 3- London dispersion forces.
- 4-induced dipole-induced interaction.

#### **Factors affecting Van der Waals interactions**

- 1- the distance between the atoms.
- 2- the nature of the atoms involved.
- 3- the environment around the atoms.