

Chapter "7"

Quantum numbers:

1. Principle Quantum Number: "n" (مقدار)

- refers to Energy and size
- Smaller n smaller Energy
- n can be any positive value but it can't be zero
- $n = 1 \dots \infty$ but $n \neq 0$

n	1	2	3	4
letter	K	L	M	N

→ Energy For atoms:

Single e: only depends on n
 more than one e: it depends on n and L

ex: H / Li⁺ / He⁺

Fe
 ↑E ↑L

- large n large orbital size
- orbitals with same n → same shell

n = shell

2. Angular momentum Q.N: "l"

- refers to the shape of the orbital
- [0, n-1]

l	0	1	2	3	4
letter	s	p	d	f	g

- Shell n → has n different kinds of orbitals (sub shell)

n = subshell

s ○
 p ∞
 d ∞

3. Magnetic Q.N: "m_l"

- refers to the orientation
- (-l, 0, l)
- l sub shell has "2l+1" orbitals

4. Spin Q.N: "m_s"

- refers to the orientation of the spin axis
- 1/2 or -1/2

Note:

- All orbitals in same subshell have the same Energy
- p → n=2
- d → n=3
- f → n=4

Chapter "8"

Pauli Exclusion Principle:

no two electrons can have the same four quantum numbers

building up Principle (Aufbau Principle)

1s 2s 2p 3s 3p 4s 3d 4p 5s 4d 5p 6s 4f 5d 6p 7s

lowest energy orbitals are filled first.

1s											1s
2s											2p
3s	d	d	d	d	d	d	d	d	d	d	3p
4s	3d										4p
5s	4d										5p
6s	5d										6p
7s	6d										7p
											4f
											5f

Note:

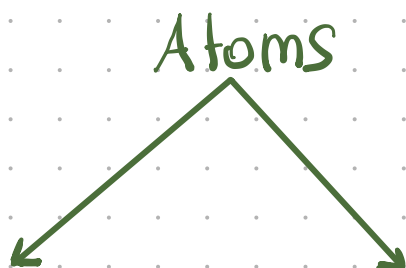
- s → 2e
- p → 6e
- d → 10e
- f → 14e

Exceptions:

- Cr: $[Ar] 4s^2 3d^4$
: $[Ar] 4s^1 3d^5$
- Cu: $[Ar] 4s^2 3d^9$
: $[Ar] 3d^{10} 4s^1$
- group: the largest n
: period: $\sqrt{8}$

Hunds Rule:

States that the lowest energy arrangement of electrons in a subshell is obtained by putting electrons into separate orbitals of the subshell with the same spin before pairing electrons



Paramagnetic sub.

diamagnetic substance

At least one unpaired electron

All electrons are paired

تزداد electron affinity

يقل نصف القطر طاقة التأين تزداد

يزداد نصف القطر
طاقة التأين
تقل electron affinity

1 IA		Transition Metals d subshell fills										13 3A 14 4A 15 5A 16 6A 17 7A						18 8A																			
1 H 1s ¹		2 2A												5 B 2s ² 2p ¹		6 C 2s ² 2p ²		7 N 2s ² 2p ³		8 O 2s ² 2p ⁴		9 F 2s ² 2p ⁵		10 Ne 2s ² 2p ⁶													
3 3A		4 4A		5 5A		6 6A		7 7A		8 8B		9 9B		10 10B		11 11B		12 12B		13 Al 3s ² 3p ¹		14 Si 3s ² 3p ²		15 P 3s ² 3p ³		16 S 3s ² 3p ⁴		17 Cl 3s ² 3p ⁵		18 Ar 3s ² 3p ⁶							
19 K 4s ¹	20 Ca 4s ²	21 Sc 3d ¹ 4s ²	22 Ti 3d ² 4s ²	23 V 3d ³ 4s ²	24 Cr 3d ⁵ 4s ¹	25 Mn 3d ⁵ 4s ²	26 Fe 3d ⁶ 4s ²	27 Co 3d ⁷ 4s ²	28 Ni 3d ⁸ 4s ²	29 Cu 3d ¹⁰ 4s ¹	30 Zn 3d ¹⁰ 4s ²	31 Ga 4s ² 4p ¹	32 Ge 4s ² 4p ²	33 As 4s ² 4p ³	34 Se 4s ² 4p ⁴	35 Br 4s ² 4p ⁵	36 Kr 4s ² 4p ⁶	37 Rb 5s ¹	38 Sr 5s ²	39 Y 4d ¹ 5s ²	40 Zr 4d ² 5s ²	41 Nb 4d ⁴ 5s ¹	42 Mo 4d ⁵ 5s ¹	43 Tc 4d ⁵ 5s ²	44 Ru 4d ⁷ 5s ¹	45 Rh 4d ⁸ 5s ¹	46 Pd 4d ¹⁰	47 Ag 4d ¹⁰ 5s ¹	48 Cd 4d ¹⁰ 5s ²	49 In 5s ² 5p ¹	50 Sn 5s ² 5p ²	51 Sb 5s ² 5p ³	52 Te 5s ² 5p ⁴	53 I 5s ² 5p ⁵	54 Xe 5s ² 5p ⁶		
55 Cs 6s ¹	56 Ba 6s ²	Lanthanides		72 Hf 5d ² 6s ²	73 Ta 5d ³ 6s ²	74 W 5d ⁴ 6s ²	75 Re 5d ⁵ 6s ²	76 Os 5d ⁶ 6s ²	77 Ir 5d ⁷ 6s ²	78 Pt 5d ⁹ 6s ¹	79 Au 5d ¹⁰ 6s ¹	80 Hg 5d ¹⁰ 6s ²	81 Tl 6s ² 6p ¹	82 Pb 6s ² 6p ²	83 Bi 6s ² 6p ³	84 Po 6s ² 6p ⁴	85 At 6s ² 6p ⁵	86 Rn 6s ² 6p ⁶	87 Fr 7s ¹	88 Ra 7s ²	Actinides		104 Rf 6d ² 7s ²	105 Db 6d ³ 7s ²	106 Sg 6d ⁴ 7s ²	107 Bh 6d ⁵ 7s ²	108 Hs 6d ⁶ 7s ²	109 Mt 6d ⁷ 7s ²	110 Uun 6d ⁸ 7s ²	111 Uuq 6d ⁹ 7s ²	112 Uut 6d ¹⁰ 7s ²	113 Uuq 7s ² 7p ¹	114 Uuq 7s ² 7p ²	115 Uup 7s ² 7p ³	116 Uuh 7s ² 7p ⁴	117 Uus 7s ² 7p ⁵	118 Uuo 7s ² 7p ⁶
		Inner Transition Metals f subshell fills																																			
57 La 5d ¹ 6s ²	58 Ce 4f ¹ 5d ¹ 6s ²	59 Pr 4f ³ 6s ²	60 Nd 4f ⁴ 6s ²	61 Pm 4f ⁵ 6s ²	62 Sm 4f ⁶ 6s ²	63 Eu 4f ⁷ 6s ²	64 Gd 4f ⁷ 5d ¹ 6s ²	65 Tb 4f ⁹ 6s ²	66 Dy 4f ¹⁰ 6s ²	67 Ho 4f ¹¹ 6s ²	68 Er 4f ¹² 6s ²	69 Tm 4f ¹³ 6s ²	70 Yb 4f ¹⁴ 6s ²	71 Lu 4f ¹⁴ 5d ¹ 6s ²	89 Ac 6d ¹ 7s ²	90 Th 6d ² 7s ²	91 Pa 5f ² 6d ¹ 7s ²	92 U 5f ³ 6d ¹ 7s ²	93 Np 5f ⁴ 6d ¹ 7s ²	94 Pu 5f ⁶ 7s ²	95 Am 5f ⁷ 7s ²	96 Cm 5f ⁷ 7s ²	97 Bk 5f ⁹ 7s ²	98 Cf 5f ¹⁰ 7s ²	99 Es 5f ¹¹ 7s ²	100 Fm 5f ¹² 7s ²	101 Md 5f ¹³ 7s ²	102 No 5f ¹⁴ 7s ²	103 Lr 5f ¹⁴ 7s ² 7p ¹								

- the atomic radius tends to decrease with increasing atomic number with each period and it increase with period number

- high values of first ionization energy → noble gases

- very low of first ionization energy → group 1

Exception:

• $B < Be + Al < Mg \rightarrow 3A < 2A$

• $O < N + S < P \rightarrow 6A < 5A$

ionization energy: the minimum energy needed to remove the highest energy e from neutral atom in gaseous state

Note:

اشارة بقاد دائما +

Electron affinity: the energy required to remove an e from negative ion

Exception:

4A > 5A

6A + 7A → have the largest EA

E.A اقل

تتصرف فيها باليسر

2.95

Chapter "9"

* ionic bond is a chemical bond formed by the electrostatic attraction between positive and negative ion

* Lattice energy: change in energy that occurs when an ionic solid is separated into isolated ions in gas phase.

x Iso electronic: refers to different species having the same number and configuration of e^-

covalent bond:

A chemical bond formed by the sharing of a pair of electrons between atoms

Electronegativity: is the measure of the ability of an atom in a molecule to draw bonding e^- to itself.

→ Mulliken electronegativity: $\chi = \frac{IE + EA}{2}$

→ Pauling electronegativity: bond enthalpies

metals are the least electronegative
non metals are the most electronegative

Electronegativity $> 2 \Rightarrow$ ionic bond

↑ electronegativity ↑

← electronegativity ←

1 IA																	18 VIIIA									
1	2											9	10													
H Hydrogen 1.008	He Helium 4.0026																	Ne Neon 20.1798								
3	4											5	6	7	8	9	10									
Li Lithium 6.941	Be Beryllium 9.0079	B Boron 10.811	C Carbon 12.011	N Nitrogen 14.007	O Oxygen 15.999	F Fluorine 18.998	Ne Neon 20.1798											Ar Argon 39.948								
11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	
Na Sodium 22.990	Mg Magnesium 24.305	Al Aluminum 26.982	Si Silicon 28.086	P Phosphorus 30.974	S Sulfur 32.06	Cl Chlorine 35.453	Ar Argon 39.948	K Potassium 39.098	Ca Calcium 40.078	Sc Scandium 44.956	Ti Titanium 47.88	V Vanadium 50.942	Cr Chromium 51.996	Mn Manganese 54.938	Fe Iron 55.845	Co Cobalt 58.933	Ni Nickel 58.69	Cu Copper 63.546	Zn Zinc 65.38	Ga Gallium 69.723	Ge Germanium 72.64	As Arsenic 74.922	Se Selenium 78.96	Br Bromine 79.904	Kr Krypton 83.80	
37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	
Rb Rubidium 85.468	Sr Strontium 87.62	Y Yttrium 88.906	Zr Zirconium 91.224	Nb Niobium 92.906	Mo Molybdenum 95.94	Tc Technetium 98	Ru Ruthenium 101.07	Rh Rhodium 102.91	Pd Palladium 106.42	Ag Silver 107.87	Cd Cadmium 112.41	In Indium 114.82	Sn Tin 118.71	Sb Antimony 121.76	Te Tellurium 127.6	I Iodine 126.905	Xe Xenon 131.29	Ba Barium 137.33	La Lanthanum 138.905	Ce Cerium 140.12	Pr Praseodymium 140.908	Nd Neodymium 144.24	Pm Promethium 145	Sm Samarium 150.36	Eu Europium 151.964	Gd Gadolinium 157.25

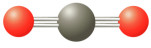
In general, the enthalpy of reaction is (approximately) equal to the sum of the bond enthalpies for bonds broken minus the sum of the bond enthalpies for bonds formed.

Chapter "10"

① AX₂:

Linear:

- 2 Bonding pairs
- 180°



② AX₃:

Trigonal Planar: *3 axial 2 basal*

- 3 Bonding pairs
- 120°



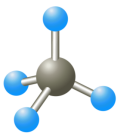
AX₂E:

- Bent
- 2 Bonding
- 1 Non-bonding
- < 120°

③ AX₄:

Tetrahedral: *5 axial 4 basal*

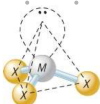
- 4 pairs
- 109.5°



AX₃E:

Trigonal Pyramidal:

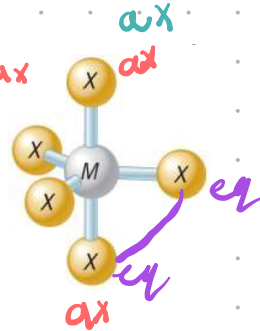
- 3 Bond
- 1 Nonbond
- < 109.5°



④ AX₅:

Trigonal bipyramidal:

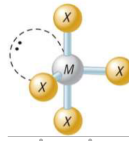
- 5 Bond
- 90/120/180



AX₄E:

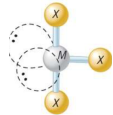
- < 90°
- ax-ax=180°

Distorted Tetrahedron or Seesaw



AX₃E₂:

- Tshape
- 90°



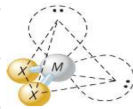
AX₂E₃:

- linear
- 180°

AX₂E₂:

Bent:

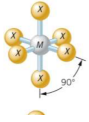
- 2 Bond
- 2 non Bonding
- < 109.5°





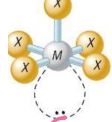
Octaheedral

• 180 90



Pyramidal

• 90

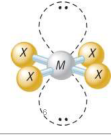


square



Square Planar

• 90/180



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