OL Academy

CHEMYIOI

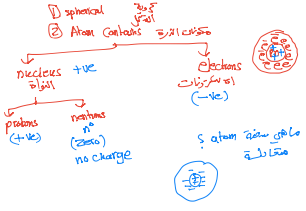
Chapter 2

الذرات الايونات الجزيئات

Atoms, Ions, and Molecules

Chapter-2: ATOMS MOLECULES AND IONS

- ATOMS[ذرات]: The smallest bits of a matter
  الصغر وأصغرهم
  Defines as the basic unit of substance that can enter into chemical combination
- ELEMENTS [عناصر] : Simplest form of matter



n° → inside nucles

p⁺ → inside nucles

ē → outside nucles

Nu → center of atom

- Charge of ē = charge of p⁺

  $-1 = +1$

  $-2 = +2$

- mass of n = mass of p

  $1.67262 \times 10^{-24} = 1.67262 \times 10^{-24}$

n > e

p > e

PARTICLE	CHARGE UNIT
e	-1
p	+1
n	0

- The atoms can be identified by the number of protons and neutrons

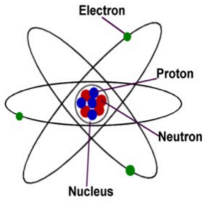
العدد الذري → العدد الاصغر

- ATOMIC NUMBER(Z):- no.of protons in the nucleus $Z = P$

- MASS NUMBER (A) :- total no.of protons and neutrons

العدد الكتلي → العدد الأكبر

$$A = P + n$$



Representation of an atom $^{A}_{Z}X$

$Z = n(p)$

$A = Z + n(p)$

==n(e) = n(p) for neutral atom==

mass number ← A

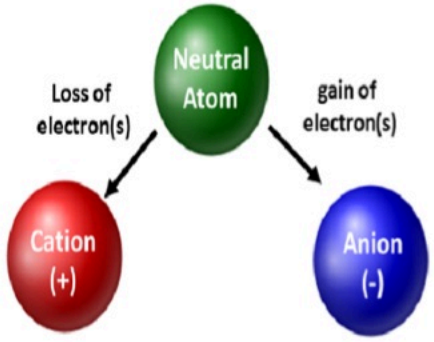
Atomic number ← Z

$^{A}_{Z}X$

❖ Ions[الأيونات] :- An ion is an atom or a group of atoms that has a net positive or negative charge

Na

Na^+



CATION (+)	ANION (-)
LOSS e Has + ve charge	GAIN e Has – ve charge

❖ Representation of a cation $^{A}_{Z}X^{y+}$

n(e) for cation = Z-y

+ → loss ē

− → gain ē

❖ Representation of an anion $^{A}_{Z}X^{b-}$

n(e) for anion = Z+b

Na → e = p

Na^{+} → e

Q1) Multiple Choice

1.1) How many protons, neutrons, and electrons are, respectively, there in $^{59}Co^{2+}$?

(a) 32, 27, 24 (b) 27, 32, 25 (c) 32, 27, 25

(d) 27, 32, 29 (e) 27, 32, 24

p = Atomic number

ē n

1.2) How many electrons and neutrons are there in $^{51}V^{2+}$?

(a) 23 electrons and 30 neutrons

(b) 21 electrons and 28 neutrons

(c) 48 electrons and 68 neutrons

(d) 18 electrons and 26 neutrons

(e) 46 electrons and 66 neutrons

51 V 2+
23

mass = p + n
51 = 23 + n
n = 28

check
e = p + (+2)
e = 23 + 2
e = 21

1.3) The element which has 27 protons, and 32 neutrons is ?

a) Co

b) Fe

c) Mn

d) Si

e) Al

1.4) The number of electrons, protons protons and neutrons present in $^{27}Al^{3+}$ is respectively ?

a) 10,13,27

b) 13,13,14

c) 14,10,13

d)10,13,14

e) 14,10,13

1.5) How many electrons and neutrons are there in $^{138}Ba^{2+}$?

(a) 54 electrons and 81 neutrons (b) 54 electrons and 82 neutrons

€ 58 electrons and 81 neutrons (d) 56 electrons and 683 neutrons

€ 54electrons and 80 neutrons

1.6) How many electrons and neutrons are there in $^{207}Pb^{2+}$?

(a) 84 electrons and 125 neutrons

(b) 82 electrons and 125 neutrons

(c) 80 electrons and 125 neutrons

(d) 82 electrons and 207 neutrons

(e) 82 electrons and 127 neutrons

1.7) The sum of protons and electrons in Sr_3P_2 compound is

a) 160

b) 170

c) 180

d) 190

e) 288

$P_{Sr} = 38$

$P_P = 15$

$(38)\times 3 + (15)2 =$

$114 + 30 = 144$

$144 \times 2 = 288$

1.8) The sum of number of protons and electrons in $^{56}_{26}Fe^{3+}$ is ?

(a) 46

(b) 47

(c) 48

(d) 49

(e) 51

1.9) The no. of protons, electrons and neutrons present in $^{65}Zn^{2+}$ is ?

a) 30,30,35

b) 32,30,35

c) 30,28,35

d) 28,30,35

e) 35,28,30

1.10) What is the total number of protons and electrons in Zr^{+4} ?

a) 90 b) 45 c) 58 d) 110 e)

1.11) The element which has 25 protons, and 30 neutrons is ?

a) Co

b) Al

c) Fe

d) Mn

e) Si

Mn → 54.9

Q2) Fill in the blanks

a) The number of electrons in Mn^{4+} is .....

b) The number of electrons in K^{+} ion is .....

c) The atomic number of an atom which has 48 neutrons and 45 electrons is .....

d)The number of electrons in N^{3-} is .....

e) The number of electrons in Ni^{2+} is .....

f) The number of protons in N^{3-} is .....

g) The number of protons in Li^{+} ion is .....

h) The atomic number of an atom which has 35 neutrons and 33 electrons is .....

i) The number of protons in K^{+} ion is .....

j) The atomic number of an atom which has 51 neutrons and 40 electrons is .....

k) The number of protons in Ca^{2+} is .....

Q3) Fill in the table below

No. of electrons	16		10
No. of protons	16		7
Symbol of atom/ion		Ba^{2+}	

No. of electrons	18	18	10
No. of protons	16	20	7
Symbol of atom/ion			

P=e

P+n

ISOTOPES [النظائر]:- Atoms that have the same atomic no. but different mass number (Isotopes play similar chemical properties)

$^{1}_{1}H$ hydrogen-1 (protium)

$^{2}_{1}H$ hydrogen-2 (deuterium)

$^{3}_{1}H$ hydrogen-3 (tritium)

P = Atomic number

Uranium has 2 isotopes Known as

Uranium -235 ^{235}U

Uranium -238 ^{238}U

	$^{12}_{6}C$	$^{13}_{6}C$	$^{14}_{6}C$
p	6	6	6
e	6	6	6
n	mass = p+n 12 = 6 + n 12 − 6 = n n = 6	n = 7	n = 8

PROBLEMS:

p n e

Q2.1. Calculate no.of protons ,neutrons ,and electrons

a) $^{20}_{11}Na^{-}$ b) $^{22}_{11}Na^{+}$ c) $^{17}_{8}O$ d) Carbon-14 e) $^{63}_{29}cu$

a: p=11, 20=11+n, n=9, e=11

b: p=11, 22=11+n, n=11, e=11

c: p=8, 17=8+n, 17-8=n, n=9

Q2.2. What is the atomic number of an element if one of its isotopes has 117 neutrons and mass no.195?

atomic = p

mass = p+n

195 = ?? + 117

p = 78

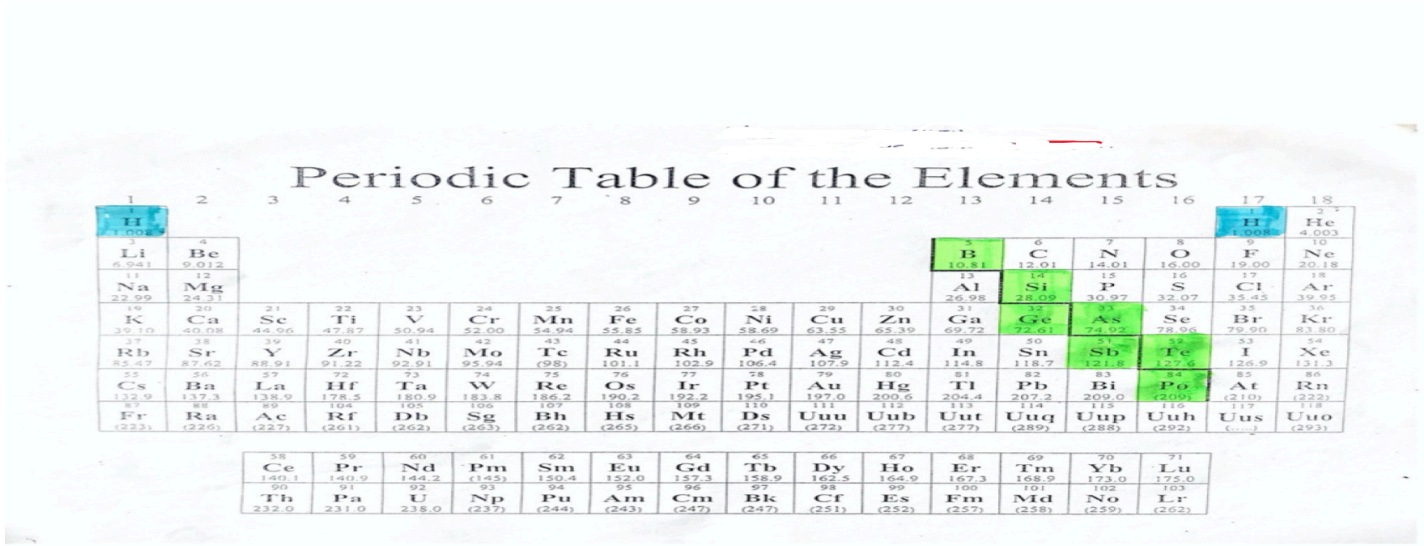
195

78?? X

Q2.3.

Element /ions	n (p)	n (e)	n (n)
$^{27}_{13}Al$			
$^{27}_{13}Al^{3+}$			
$^{80}_{35}Br^{-1}$			
$^{80}_{35}Br$			
$^{12}_{6}C$			
$^{13}_{6}C$			
$^{14}_{6}C$			

ISOTOPES



أعمدة

Groups → number of Valence ē

مجموعات

18

يدل على عدد الكترونات

H → ١ → ١ عدد الكترونات

Li → ١ → ٢

صفوف

periods

الدورات

7

يدل على مستويات الطاقة

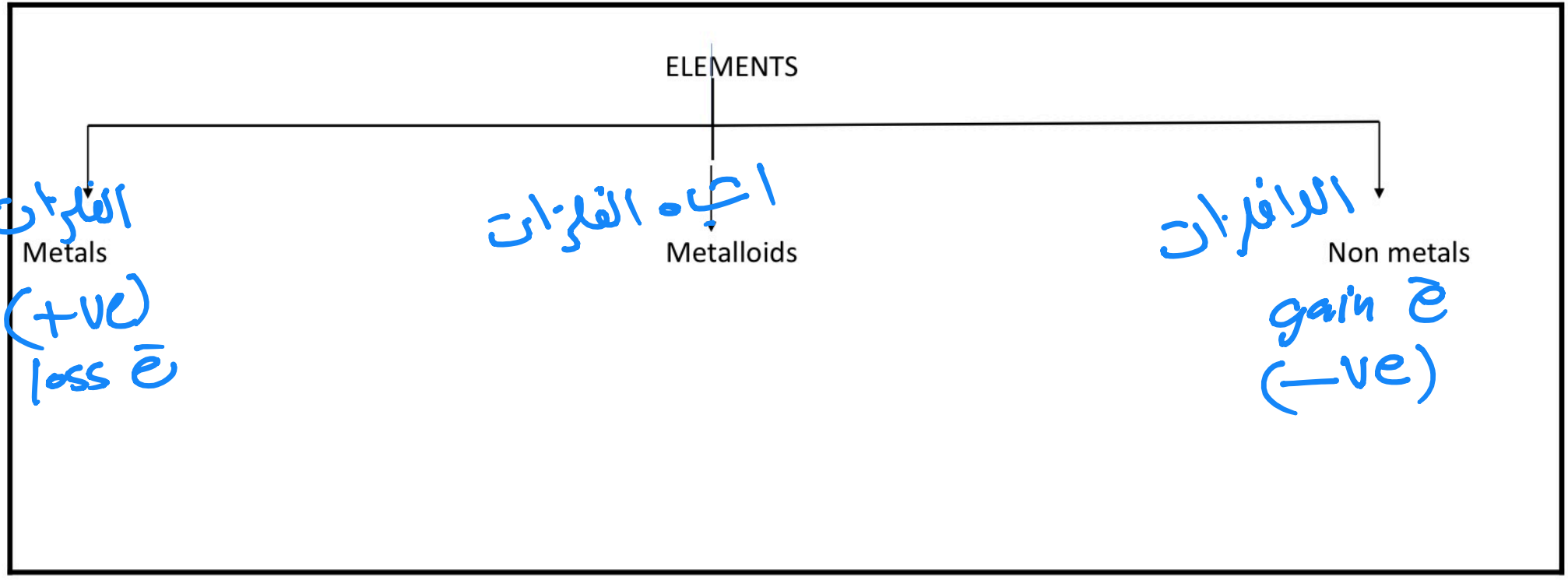
energy level

ē

H → n=1

Li → n=2

Cl → n=3


ELEMENTS
Metals
(+ve)
loss ē
Metalloids
Non metals
gain ē
(−ve)

Metals : [المعادن]	Metalloids:[الفلزات]	Non- metals:[اللافلزات]
Good conductor of heat and electricity Eg: Copper, Silver etc	Shows properties intermediate between those of metals and non-metals Eg: Boron ,Silicon, etc	Poor conductor of heat and electricity Eg: Oxygen, Fluorine etc

❖ The Periodic Table :-[الجدول الدوري]

A chart in which elements having similar chemical and physical properties are grouped together

❖ Horizontal rows are known as Periods: There are 7 periods in the Periodic table

❖ Vertical columns are known as Groups : There are 18 groups in the Periodic table

Group 1- Known as Alkali metals

Group2-Known as Alkaline earth metals

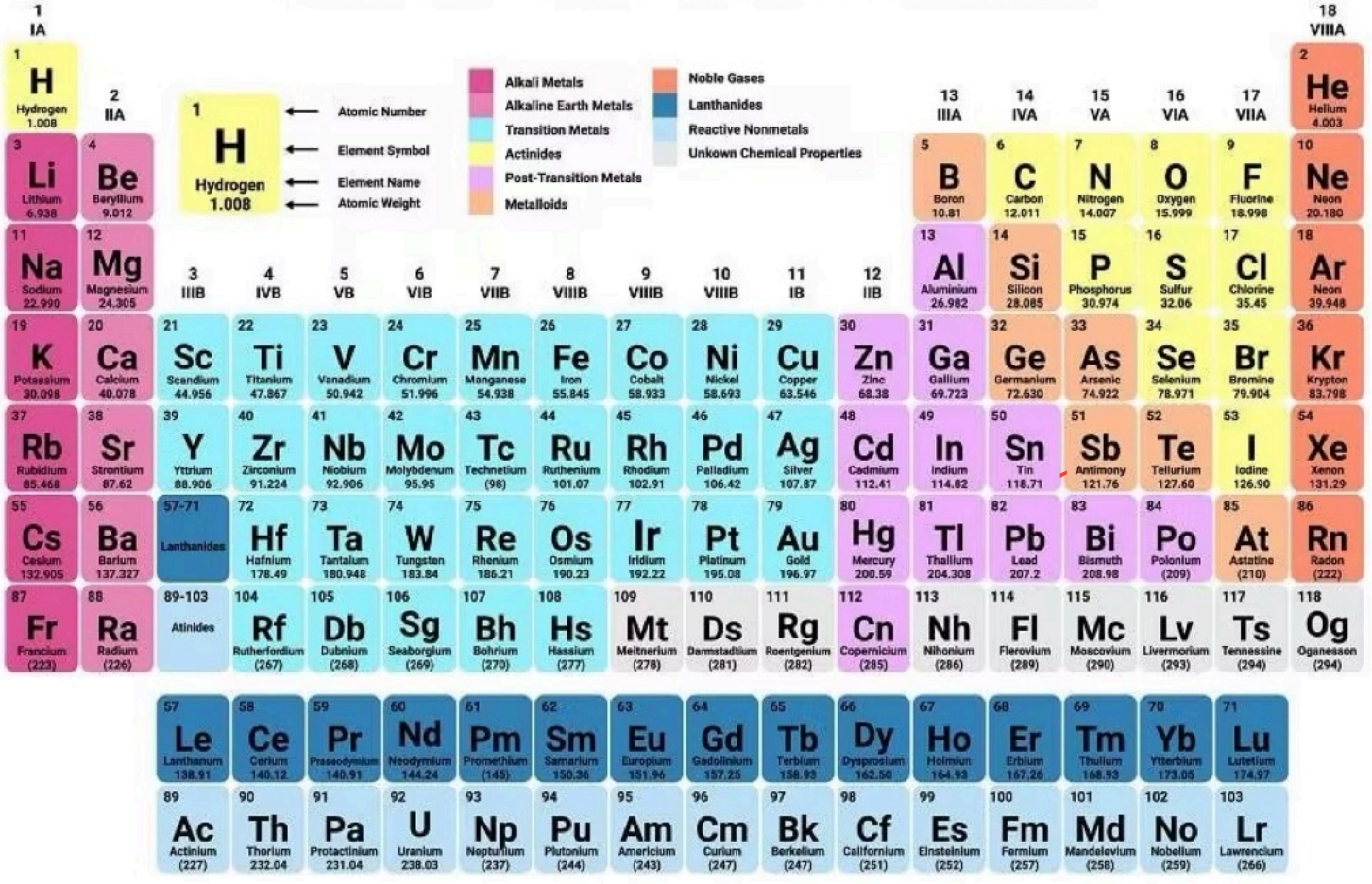
المجموعات والفترات في الجدول الدوري

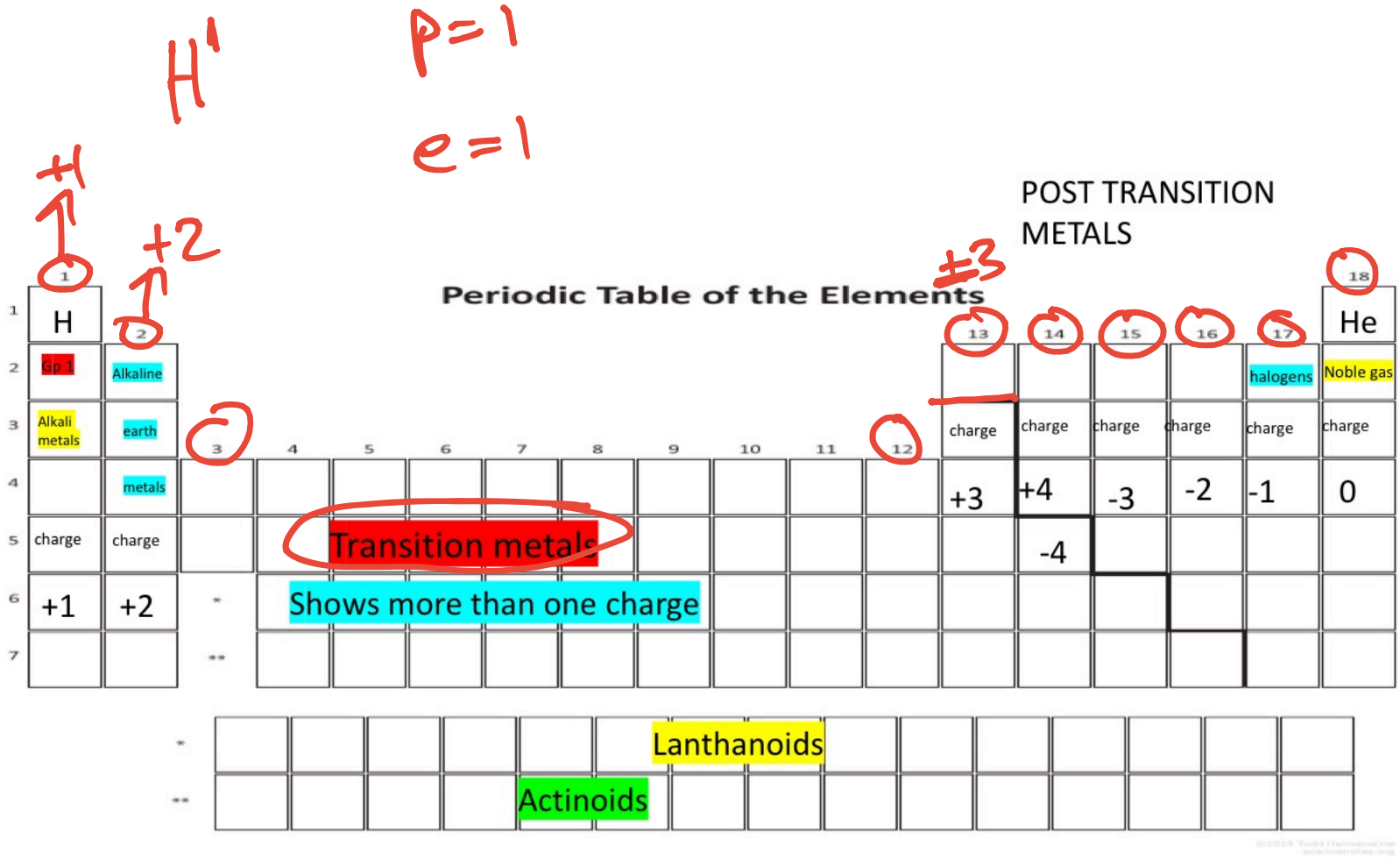
Group 3-12 - Known as Transition elements

Group17- Known as Halogens

Group 18-known as Noble gas/rare gas

Periodic Table of the Elements

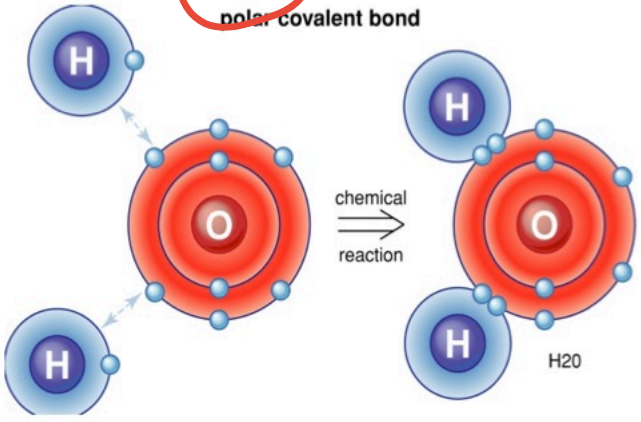


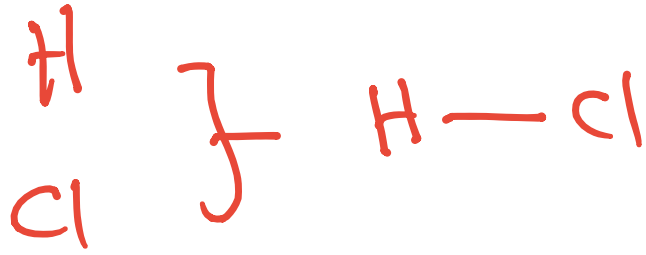

H+1
p=1
e=1
+1
+2
±3
POST TRANSITION METALS
Periodic Table of the Elements
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
H
He
Gp 1
Alkaline
earth
metals
Alkali metals
halogens
Noble gas
charge
charge
charge
charge
charge
charge
charge
charge
+1
+2
+3
+4
-3
-2
-1
0
-4
Transition metals
Shows more than one charge
*
**
Lanthanoids
Actinoids

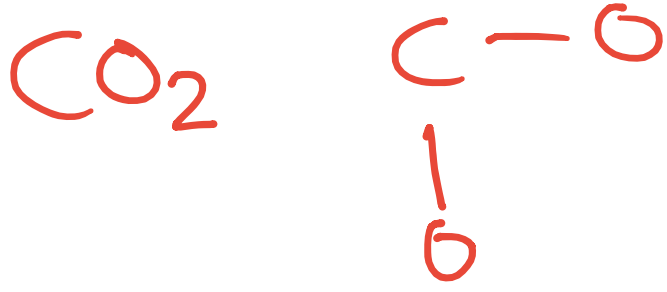
Molecules:[-الجزيئات]

A molecule is an arrangement of two or more atoms which are held by chemical bond[رابطة كيميائية]

Eg:Formation of H_2O molecule







❖ Diatomic molecules:- which contain two same/different atoms

جزيئات ثنائية الذرة]

H-H O-O HCl , HF

Eg:-H_2 O_2,N_2 and group 17 elements –F_2,Cl_2,Br_2,I_2 -[contain same atoms]

HCl,CO, HBr [contain different atoms]

❖ Polyatomic molecules: جزيئات متعددة الذرات

Molecules contain more than two same /different atoms

Eg: O_3,H_2O, NH_3

O_3 PH_3

CO_2

الصيغة الكيميائية

Chemical Formula

Empirical أولية

Molecular الجزيئية

CH

C_2H_2O

KO_2

KCl

$C_{\frac{2}{2}}H_{\frac{4}{2}} = CH_2$ 1:2

$K_{\frac{2}{2}}O_{\frac{2}{2}} = KO$ 1:1

$C_{\frac{3}{3}}H_{\frac{6}{3}} = C_1H_2$

1:2

- IONS:- الأيونات
  an ion is an atom or a group of atoms that has net positive or negative charge

- MONOATOMIC IONS:- Contain only one atom

  Eg;- Na^{+}, Cl^{-}, H^{+}, Mg^{2+}, Fe^{3+}

Na^{+} N_2 H_2

- Polyatomic ions: two or more atoms combine to form an ion that has net positive or negative charge
  Eg:- OH^{-}, NH_4^{+}, NO_3^{-}

- Chemical compounds : is a substance formed when two or more chemical elements are chemically bonded together Eg:- Water, Carbondioxide

- Types of compounds

- Ionic Compounds مركب أيوني
  (usually) formed from when a metal react
  With a non-metal(or a poly atomic ion)

  metal + nonmetal

  Ionic Bond
  electron transfer

  NaCl / Al_2O_3

  Na.....Cl

  $MgCl_2$ / LiH

covalent/Molecular compounds مركب تساهمي
Formed when two non-metals react with each other

Covalent Bond

تشارك الالكترونات

H:Cl

nonmetal + nonmetal

- Metal + Non-metal → ionic compound (usually)
- Metal +polyatomic ion → ionic compounds(usually)
- Non-metal + non- metal → Molecular compounds(usually)
- Hydrogen +non-metal → Molecular compounds(usually)

group 1

PROBLEMS:

Q2.4. Give an alkalimetal of period 4

K

Q2.5. Give a metalloid of period 3

Si

Q2.6. Give a metalloid of period 4 group 14

Ge

Q2.7. Give a noble gas of period 5

Xe

m+n

Q2.8. (1)classify the following compounds as ionic or molecular compounds

a) NaCl b) $FeCl_3$ c) SO_2. d) P_4O_{10}

m n → ionic compound

m n → ionic compound

molecular

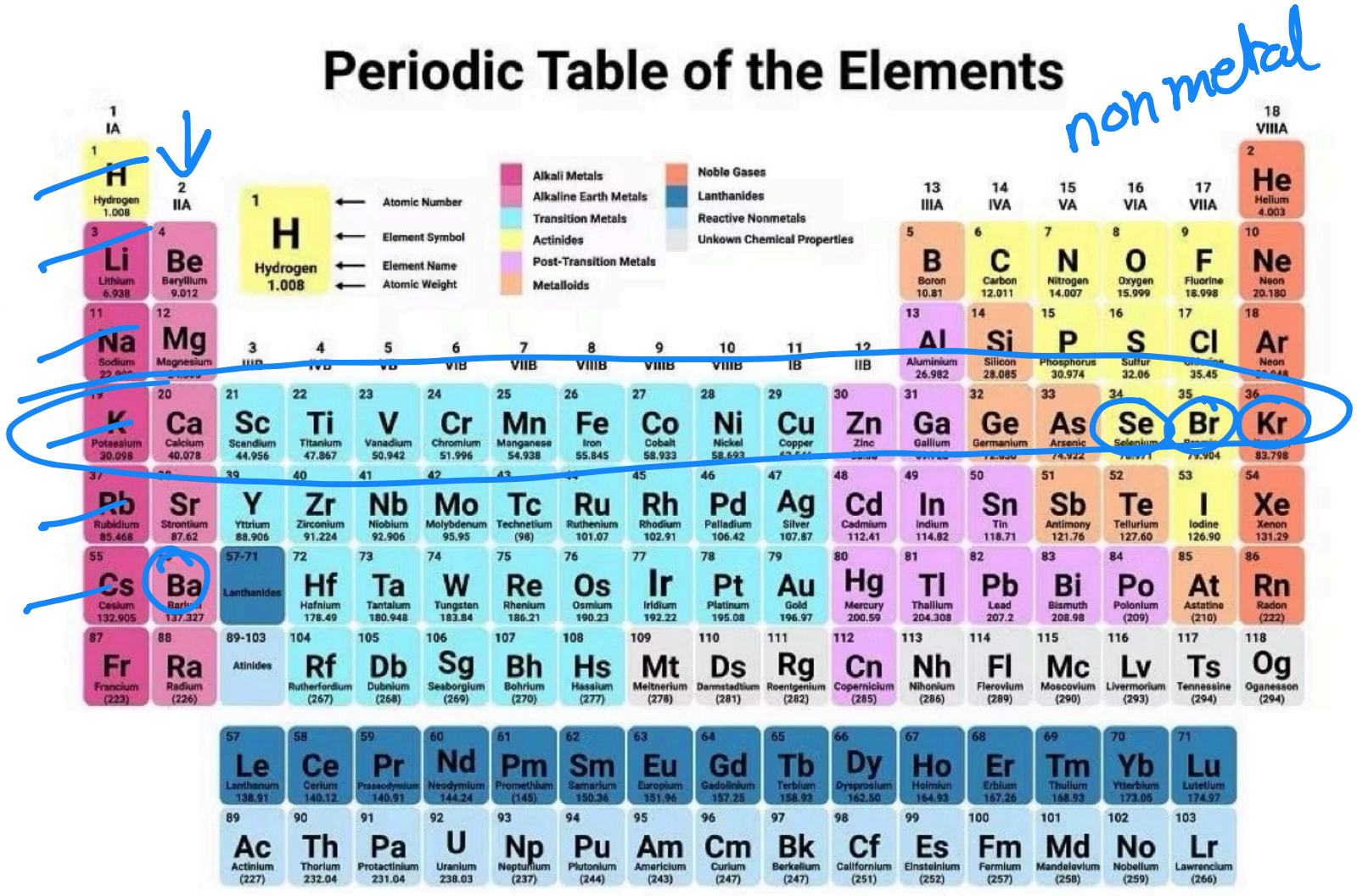
molecular → n+n

Q2.8 (2) Name the metalloid (s) of

a) group 14 period3 b) group 13 c) group15 d) group 16 period 6

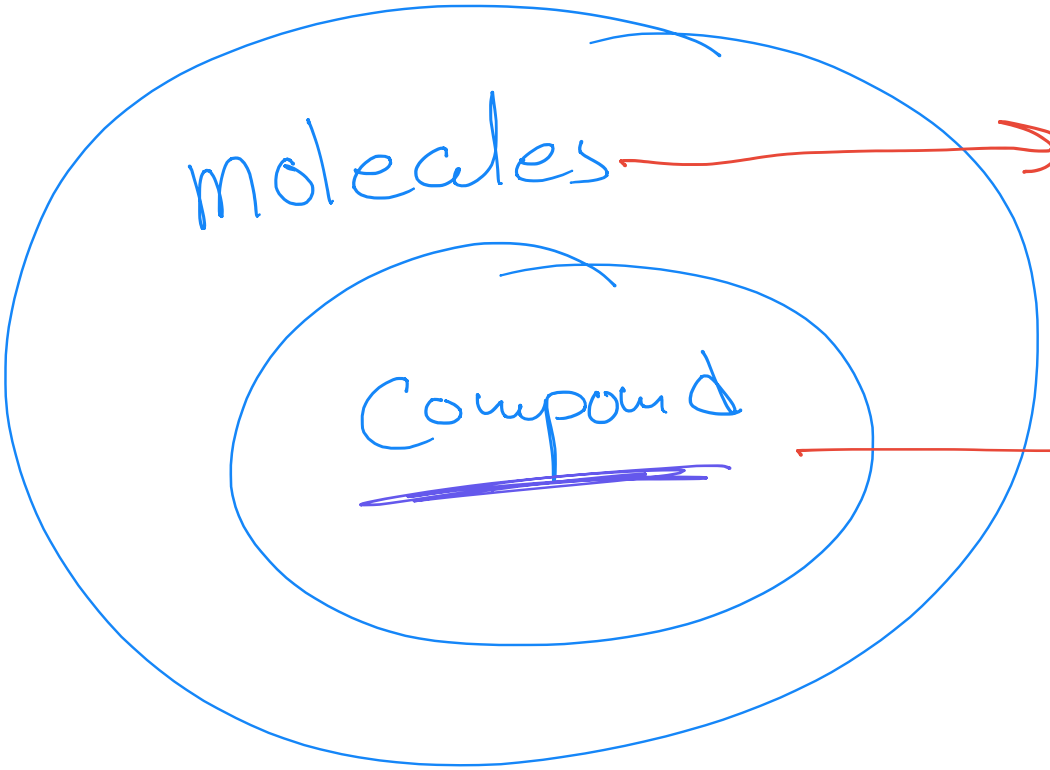
Si B As Sb Po

Periodic Table of the Elements



Use the periodic table to give an example (only one) of

- an alkaline earth metal in period 6 ..... Ba .....
- a metalloid ..... B ..... or ..... Si ..... or ..... Ge ..... or ..... As ..... or ..... Sb ..... or ..... Te .....
- a nonmetal in period 4 ..... Se ..... or ..... Br ..... or ..... Kr .....
- a halogen in period 3 ..... Cl .....



2 or more element
O_2 P_4

2 or more different element

H_2O
$NaCl$

$CaCl_2$
$NaCl$

All compounds is molecules but not all molecules is compounds.