* General chem *

Ch.1

Luminous intensity → units → candela (cd)

exa	10^{18}
peta	10^{15}
tera	10^{12}
hecto	10^{2}
deka	10
atto	10^{-18}

عدد S.F يساوي ضرباً مع الناكد يعني هذا الناكد بنسبة ١٠٠٪
S.F = infinite number of S.F

*** Rules for counting significant figures :-**

1. Non zero integers count as significant figures (45×10^{-3} → 2 S.F)
2. Zeros :-
   - a. leading zeros → not count (zeros at the left sind from the non zeros)
   - b. captive zeros → count (between non zero) 0.0048 → 2 S.F
   - c. Trailing zeros → count if the number contains decimal point (at the right end of the number) 0.04080 → 3 S.F

9000. → 4 S.F / 9.300 → 4 S.F / 150 → 2 S.F

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* Accuracy :- related to how much your figures closed to correct value
* precision :- " " " " " " " to each other

*** Temperature :**

$T_K = T_c + 273.15$ / $T_c = \frac{5}{9}(T_F - 32)$

ch.2

- atom : electrons + Protons + neutrons

- nucleus :- small / extremely dense : account for almost all of the atom's mass

- Istopes :- Same number of protons but different numbers of neutrons
  ↳ identical chemical properties because the chemistry of an atom is due to its valence (e^-)

- الـ atomic mass لأي عنصر في الجدول الدوري لا اكثر من تظهر بيتم وضعها حسب الـ avareg atomic mass

avareg atomic mass = (atomic mass × نسبة تواجد %)$_{istope①}$ + ـ ـ ـ ـ ـ

- Atomic Number ⇒ $Z = P$
- Mass Number / atomic mass ⇒ $A = P + n$

- إذا طلب السؤال انه أوجد الايزتوب هو العنصر من الجدول الدوري فنبحث عنه حسب عدد Z وليس A

- Chemical Bonds :-

1. covalent bond :- between atoms by sharing electrons to form molecules (non of atoms should be metal) (H_2O)
2. Ionic bond :- force of attraction betwee oppositely charged ions ($NaCl$)

$No / Cl_2 / Co$ → diatomic molecule.

NO / CO → heterogeneous diatomic molecule.

$Cl_2 / O_2 / N_2$ → homogeneous " " .

H_2O → heterogeneous molecule

cation (metal) : positive ion
anion : Negative ion (non-metal)

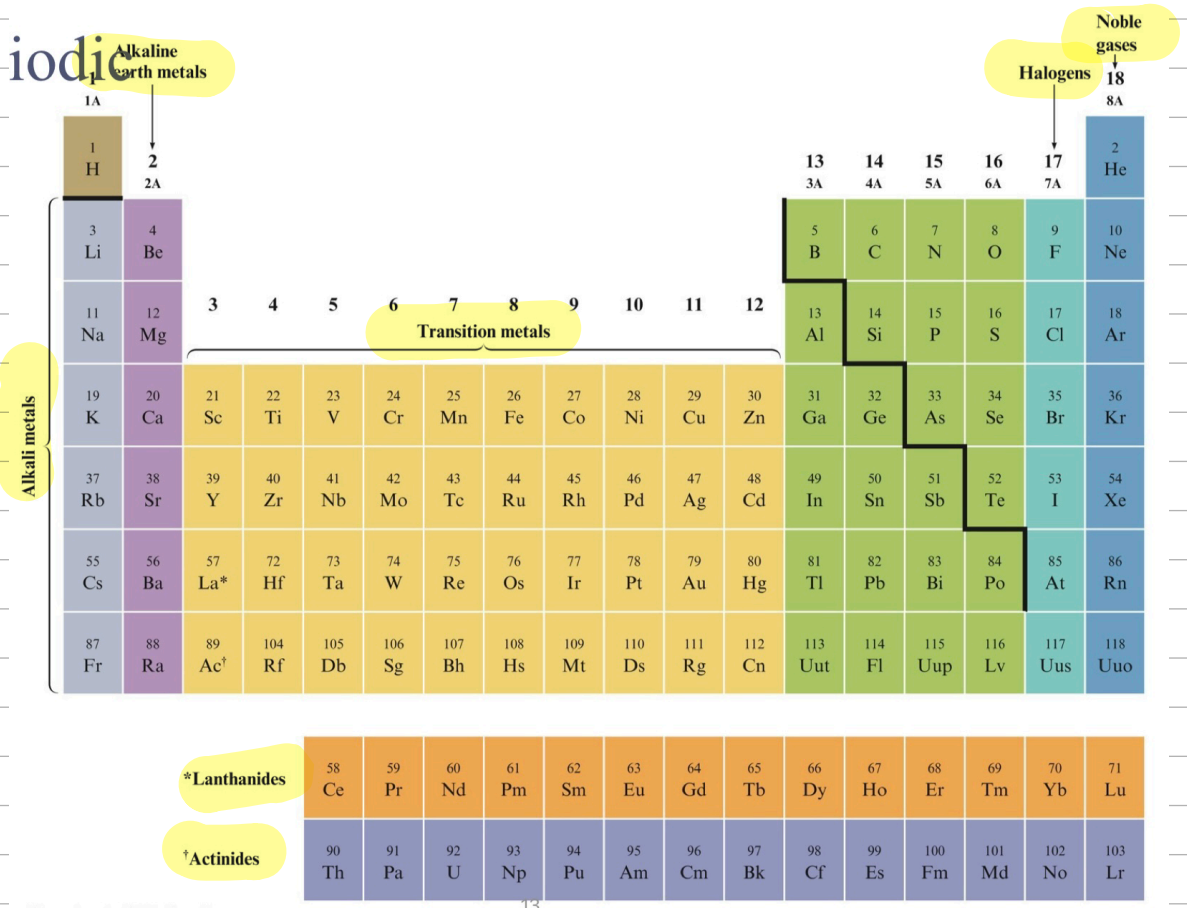
*periodic table :-

- Groups/Families :- elements in the same vertical columns ; have similar chemical properties

e.g. → Alkaline metals / Alkaline earth metals / Halogens / noble gases

- periods :- horizontal rows of elements

metals : (representative + transition + lanthanides + actinides) elements



* Naming compounds :-

- Binary compound :- composed of two elements

1. Binary ionic compounds :- - metal + non-metal → Type I and II
   - Ionic compounds with polyatomic ions

* Type I :- NaCl → Sodium chloride

* Type II :- metals in these compounds form more than one positive charge (Fe +2, +3)

PbO_2 → lead (IV) oxide

FeS → Iron (II) sulfide

* Ionic compounds with polyatomic ions

Name	Formula
ammonium	NH_4^+
nitrite	NO_2^-
nitrate	NO_3^-
sulfite	SO_3^{2-}
sulfate	SO_4^{2-}
hydrogen sulfate (aka: bisulfate)	HSO_4^-
thiosulfate	$S_2O_3^{2-}$
oxalate	$C_2O_4^{2-}$
hydroxide	OH^-

IUPAC Name	older name	Formula
copper(I)	cuprous	Cu^+
copper(II)	cupric	Cu^{2+}
iron(II)	ferrous	Fe^{2+}
iron(III)	ferric	Fe^{3+}
lead(II)	plumbous	Pb^{2+}
lead(IV)	plumbic	Pb^{4+}
mercury(I)	mercurous	Hg_2^{2+}
mercury(II)	mercuric	Hg^{2+}
tin(II)	stannous	Sn^{2+}
tin(IV)	stannic	Sn^{4+}

Name	Formula
phosphite	PO_3^{3-}
phosphate	PO_4^{3-}
hydrogen phosphate	HPO_4^{2-}
dihydrogen phosphate	$H_2PO_4^-$
perchlorate	ClO_4^-
chlorate	ClO_3^-
chlorite	ClO_2^-
hypochlorite	ClO^-
bromate	BrO_3^-
iodate	IO_3^-

Name	Formula
acetate acetate	CH_3COO^- $C_2H_3O_2^-$
carbonate	CO_3^{2-}
hydrogen carbonate (aka: bicarbonate)	HCO_3^-
chromate	CrO_4^{2-}
dichromate	$Cr_2O_7^{2-}$
permanganate	MnO_4^-
peroxide	O_2^{2-}
cyanide	CN^-
cyanate	OCN^-
thiocyanate	SCN^-

* Binary covalent compounds (Type III) :- formed between 2 non-metals

Ch.3

- the reference for atomic masses is ^{12}C because its atomic masses exactly 12 a.u

- the ratio of the mass of an istope to ^{12}C by mass spectrometer

avogadro's number

* 1 mole of substance = 6.022×10^{23} units of that substance

1 mole(C) = 6.022×10^{23} catoms = 12.01g(C)

mass for 1mole of substance = atomic mass

1 mole of an element = 6.022×10^{23} atoms = atomic mass

For elements → $n = \frac{\text{mass}}{\text{atomic mass}}$

1 mole of a compound = 6.022×10^{23} molecules = M.M

For molecule → $n = \frac{\text{mass}}{M.M}$ → Molar Mass

$$\%mass = \frac{\text{mass of element in compound}}{\text{mass of compound}} \times 100\%$$

Exercise: calculate the mass percent of ethanol (C2H5OH)?

$$C_2H_5OH + 3O_2 \longrightarrow 2CO_2 + 3H_2O$$

$M.M(C_2H_5OH) = 2(12.011) + 6(1) + 16 = 46.022$

$mass(C_2H_5OH) = 46.022 \times 1 = 46.022g$

$M.M(O_2) = 16 \times 2 = 32 \rightarrow mass = 32 \times 3 = 96$

mass of compound = $46.022 + 96 = 142.022$

$$\%mass(C_2H_5OH) = \frac{\text{mass}(C_2H_5OH)}{\text{mass of compound}} \times 100\%$$

$$= \frac{46.022}{142.022} \times 100\% = 32.405\%$$

imp. note :- coefficients can not be fractions, although they are usually given as lowest integer multiples.

mass of reactants = mass of products

- Stoichiometric mixing :- all reactants are consumed and converted into products
- non - stoichiometric mixing :- Limiting reactant

when the reaction is 1:1 then the lower number of moles is the L.R but when the reaction is not 1:1 then simple calculation is needed to find out the L.R

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percentage yield :- an important indicator of the efficiency of a particular laboratory or industrial reaction.

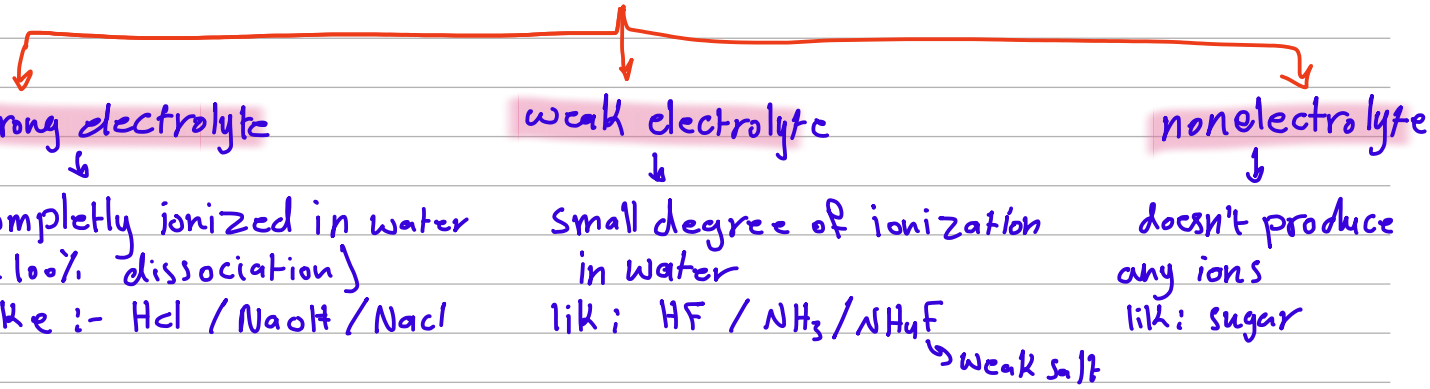
من الحسابات ← actual yield

$$\text{Percent yield} = \frac{\text{actual yield}}{\text{theoretical yield}} \times 100\%$$

theoretical yield ← من التجربة (المختبر)

ch4

* **electrolyte** :- substance that when dissolved in water produces a solution that conducts electricity,
↳ depends on the amount of ions



$$M = \frac{n}{V}$$

Dilution :- adding water to a concentrated or stock solution to achieve the molarity desired for a particular solution.

* dilution of water does not alter the number of moles of solute.

moles of solute before dilution = moles of solute after dilution

$$n = n$$

$$M_i V_i = M_f V_f$$

- Types of chemical reactions :-

1. Precipitation reactions :- one of the products is insoluble
2. Acid–Base reactions :- neutralization reactions (حمض + قاعدة)
3. oxidation – Reduction reactions (redox reactions) :- involve electron transfer

* the number of ions حساب

number of ions = number of moles × avogadro's number

* Rules for Solubility :-

1. NO_3^- / NH_4^+ / alkaline metal (group 1A) → salts are soluble.
2. Cl^- / Br^- / I^- → salts are soluble.
   except : (Ag^+ , Pb^{+2} , Hg_2^{+2})
3. Most sulfate (SO_4^{-2}) salts are soluble.
   except : $BaSO_4$, $PbSO_4$, Hg_2SO_4 , $CaSO_4$
4. $BaCrO_4$ insoluble
5. Most OH^- , S^{-2} , CO_3^{-2} , CrO_4^{-2} , PO_4^{-3} salts are insoluble
   except :- (group 1A , NH_4^+) → in rule number (1)

* في ال ionic equation ال solid وال liquid بنزلهم بدون ما نفككهم

* في ال net ionic equation بنزيل ال spectator ions (الأيونات المتفرجة)

* For a strong acid / strong base reaction the net ionic equation is always :

$$H^+_{(aq)} + OH^-_{(aq)} \longrightarrow H_2O_{(l)}$$

* weak acid / strong base or weak base / strong acid reactions :

ex.

Molecular eqn: $CH_3COOH_{(aq)} + NaOH_{(aq)} \longrightarrow H_2O_{(l)} + CH_3COONa_{(aq)}$

ionic eqn : $CH_3COOH_{aq} + Na^+_{aq} + OH^-_{aq} \longrightarrow H_2O_{(l)} + CH_3COO^-_{aq} + Na^+_{aq}$

لا نفصلها بهذه الصورة ($CH_3COO^- + H^+$) لعدم تفككها كليًا

Net ionic eqn : $CH_3COOH_{(aq)} + OH^-_{(aq)} \longrightarrow H_2O_{(l)} + CH_3COO^-_{(aq)}$

Rules for Assigning Oxidation States

- Oxidation state of an atom in an element = 0
- Oxidation state of monatomic ion = charge of the ion
- Oxygen = -2 in covalent compounds (except in peroxides where it = -1) H2O2
- Hydrogen = +1 in covalent compounds (except in hydrides, -1) NH_3
- Fluorine = -1 in compounds
- Sum of oxidation states = 0 in neutral compounds
- Sum of oxidation states = charge of the ion in ions
- [LiH, NaH] H2CO3, MnO4-

* Oxidation :- increase in oxidation state , it happens by loss of electrons (Reducing agent)

* Reduction :- decrease " " " , " " " gain of electron (oxidizing agent)

Ch.5

- the atmospheric pressure is measured by barometer
- the pressure of a gas confined in a container is measured by manometer (car tire , home gas cylinder)

*** properties of gases :-**

1- uniformly fill any container and take its shape.
2. easily compressed .
3- Mixes completely with any other gas .
4- Exerts pressure on its surroundings.

$$P = \frac{\text{force}}{\text{area}}$$

$P \longrightarrow N/m^2 = \text{pascal (pa)}$

$1\ atm = 101.325\ Kpa = 101.325\ pa = 1.01329\ bar = 760\ mmHg$
$= 760\ torr = 14.7\ lb/in^2$

* Ideal gas law :-

$$PV = nRT \quad , R = 0.0\&206\ L.atm/mole.K$$

(constant) ثابت يختلف عن هذه القيمة
وهنا يعتمد على وحدة (P)

$$\frac{P_i V_i}{T_i} = \frac{P_f V_f}{T_f}$$

- Standard Molar volume of an Ideal gas (SMV) :-

for 1mole of an ideal gas at (0)c and 1 atm , the volume of the gas is 22.42 L

- STP :- 0 C° , 1 atm

$$\text{density} = d = \frac{\text{mass}}{V}$$

$$d = \frac{nM\,P}{RT}$$

* the total pressure exerted is the sum of the pressure that each gas would exert if it were alone under the same conditions of V, T, n.

$$P_{total} = P_1 + P_2 + P_3$$ في حال كان مجموعة من الغازات في نفس الـ container

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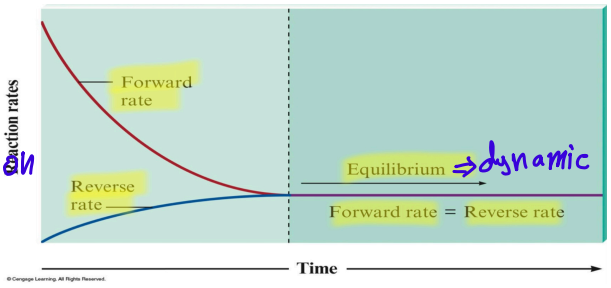
Ch .13

* After the equilibrium is reached, none of the reactants or products has a concentration of zero

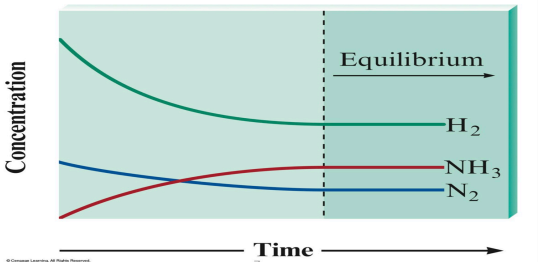
* Chemical Equilibrium :-
A state of the system where the concentration of all products and reactants remain constant with time.



$$jA + kB \longrightarrow mC + nD$$

$$K = \frac{[C]^m \cdot [D]^n}{[A]^j \cdot [B]^k}$$ equilibrium expression

concentration decreases ← $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ → increases



* في حالة التفاعل العكسي $K' = \frac{1}{K}$

-when a balanced equation for a reaction is multiplied by a factor of (n)

$$K' = K^n$$

$$xX_{(g)} + yY_{(g)} \rightleftharpoons zZ_{(g)} + wW_{(g)}$$

$$K_p = \frac{P_Z^z \cdot P_W^w}{P_X^x \cdot P_Y^y} = K(RT)^{\Delta n_g}, \quad \Delta n_g = n_p - n_r$$ بس في حالة المواد الغازية

* $\Delta n_g = 0 \Rightarrow K_p = K$ * $\Delta n_g > 0 \Rightarrow K_p > K$
* $\Delta n_g < 0 \Rightarrow K_p < K$

- Homogeneous equilibria :- involve the same phas.
* تكون المواد الناتجة والمتفاعلة لها نفس الحالة الفيزيائية (s , g , aq)

- Heterogeneous equilibria :- involve more than one phase.

* the position of a heterogeneous equilibrium doesn't depend on the amount of pure solid or liquids present because their concentrations are constant.

$$2KClO_{3(s)} \rightleftharpoons 2KCl_{(s)} + 3O_{2(g)} \quad , P_{O_2} = 3.1 \text{ atm}$$

$K_p = P_{O_2}^3$, $\Delta n_g = 3$, $K_p > K$, $K = [O_2]^3$

* $K > 1$ means that at equilibrium the reaction system consist of mostly products or the equilibrium lies to the right.

* $K < 1$ means that " " " " " " mostly reactants or " " " to the left.

- Reaction Quotient (Q) :- used when all of the initial concentration are non-zero.

* $Q = K$ → (just at equilibrium) , no shift will occur
* $Q > K$ → the system shifts to the left . After equilibrium consuming products and forming reactants , until equilibrium is achieved
* $Q < K$ → " " " " right . Before " " reactants " " products " " " .

- K will change depending upon the temperature.

* Endothermic reaction :- energ is a reactant , K increase , shift to right
* Exothermic reaction :- " " a product , K decrease , shift to left

- Pressure effect K when at least one of the reactants is gas
- Addition of inert gas doesn't affect the equilibrium position.

Ch. 14

- **Arrhenius:-**
  - acids :- produce H^+
  - bases :- produce OH^-

- **Bronsted – Lowry:-**
  - acids :- proton (H^+) donor
  - bases :- proton (H^+) acceptor

HA A^- → acid/base conjugate pair

Conjugate acid/base pair are related by one proton tranfer

- **Lewis:-**
  - acids :- electron pair acceptor
  - bases :- electron pair donor

- **Strong acid:-**
  Ionization equilibrium lies far to the right.
  Yields a weak conjugate base. ضعيف جدًا جدًا

- **Strong base:-** → يعني القوة
  yield a weak conjugate acid.

- **Weak acid:-** weak base ← يعني القوة
  Ionization equilibrium lies far to the left.
  The weake the acid, the stronger its conjugate base

- water is amphoteric (auto ionization) : behaves either as an acid or as a base.

$K_w = [H^+].[OH^-] = 1 \times 10^{-14}$ at 25 C°

- $[H^+] = [OH^-] \Rightarrow pH = 7$ (neutral)
- $[H^+] > [OH^-] \Rightarrow pH < 7$ (acidic)
- $[H^+] < [OH^-] \Rightarrow pH > 7$ (basic

- If the equilibrium lies to the right, $K_a / K_b > 1$
  لأنه تركيز النواتج بكون أعلى
- " " " " " left, $K_a / K_b < 1$
  لأنه تركيز المتفاعلات يكون أعلى

$$K_a = \frac{[H_3O^+][A^-]}{[HA]} \quad , \quad K_b = \frac{[OH^-][BH^+]}{[B]}$$

- The number of decimal places in the log is equal to the number of Significant figures in the original number.

$$[H^+] = 1.0 \times 10^{-9}\ M$$ ← 2 S.F

$$pH = 9.00$$ ← 2 decimal places

$pH = -\log [H^+]$, $pOH = -\log [OH^-]$, $pH + pOH = 14$

* إذا سأل عن محلول الحمض قوي / قاعدة قوية يتكون

- في حالة الحمض القوي : القاعدة المرافقة / H_2O / H^+ - في حالة القاعدة القوية : الحمض المرافق / H_2O / OH^-

* Two factors for acidity in binary compounds :-

1. Bond polarity : كلما زادت القطبية (الفرق في الكهروسلبية) يزيد قوة الحمض

2. Bond Strength : كل ما زادت يتعل قوة الحمض لهيلد الحمض القوي مثل HCl يتكون الرابطة مابين H^+ و Cl^- ضعيفة جدا فيسهل من تفككها

* Oxyacids :- H − O − X (HOCl , HOBr)

- كلما زادت عدد ذرات الـ O يزيد قوة الحمض (لأنه O يتعل على زيادة القطبية)
- كما زادت قدرة X على انها تجذب الـ e نحوها يزيد قوة الحمض (لأنه يؤدي إلى زيادة الفرق في الكهروسلبية).

فهم متن دفتر *

* Oxides :-

- Acidic oxides (acid Anhydrides) :- O − X is Strong and covalent. (SO_2 , NO_2 , CO_2)

- يتفاعلوا مع الـ H_2O فيتكون حمض وهو الذي يجعل المحلول حمضي

$$SO_2(g) + H_2O(l) \longrightarrow H_2SO_3(aq)$$

يتفكك لينتج (H^+)

- Basic oxides (basic Anhydrides) : O-X bond is ionic has a very low electronegativity (K2O , CaO)

- يتفاعل مع الماء H2O وبتكون قاعدة وهي التي تجعل المحلول قاعدي

$$K_2O_{(s)} + H_2O_{(l)} \longrightarrow 2KOH_{(aq)}$$

يتفكك لينتج (OH^-)

- Buffer Solutions resist a change in pH

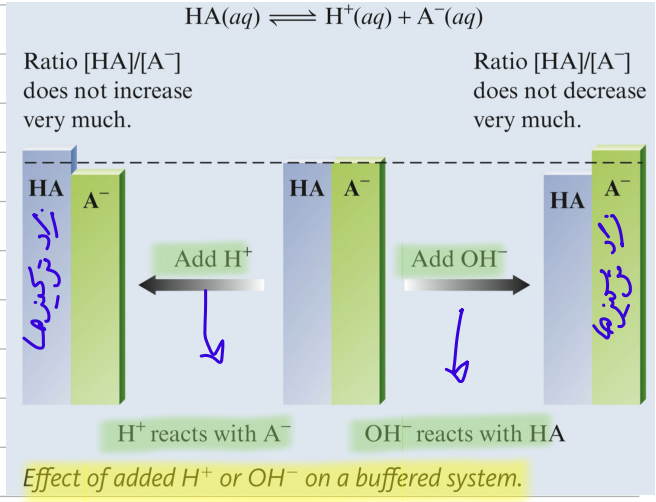
Buffer :- weak acid and its conjugate base
weak base and its conjugate acid

- Hendrson-Hasselbalch equation :-

$$pH = pK_a + \log \frac{[A^-]}{[HA]}$$

$$pOH = pK_b + \log \frac{[BH^+]}{[B]}$$

* تعتمد pH الـ buffer على النسبة بين الحمض الضعيف وقاعدته المرافقة وبتظل قيمة الـ pH ثابتة طالما هذه النسبة ثابتة (إذا كان تركيز مكونات الـ buffer أعلى من تركيز H^+ و OH^- الخارجة)

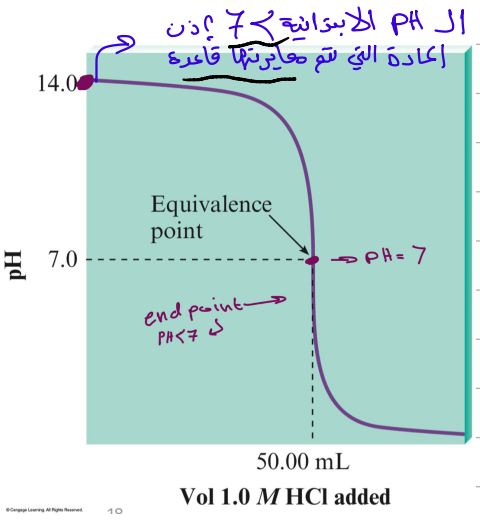


- Titration Curve

* Equivalence (Stoichiometric) point : النقطة التي تتعادل فيها جميع مولات إضافة (سواء حمض / قاعدة) مع الحمض / القاعدة إلي بدنا نعايرها وتكون pH = 7 (في حال كانت المعايرة بين حمض قوي و قاعدة قوية)

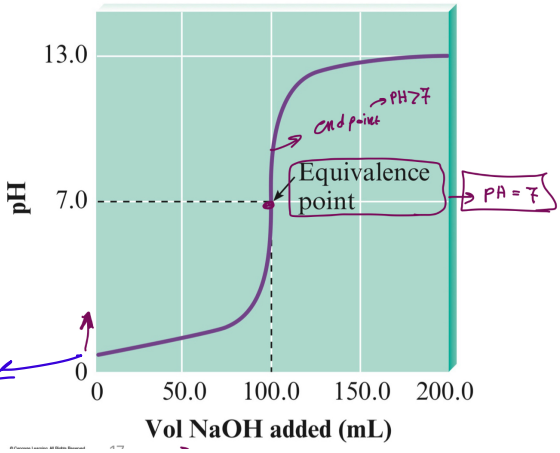
* End point :- هي التي بتحدد انتهاء المعايرة وبتكون قريبة من نقطة التكافؤ ومدى قربها بيعتمد على الدقة في المعايرة

* معلومة إضافية :-
- عند معايرة حمض ضعيف بقاعدة قوية تكون الـ pH عند نقطة التكافؤ > 7
- عند معايرة قاعدة ضعيفة بحمض قوي تكون الـ pH عند نقطة التكافؤ < 7



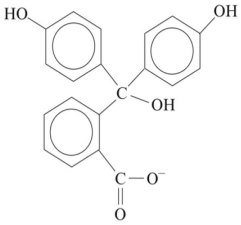
إذن الـ pH الابتدائية > 7
الحادة التي تتم معايرتها قاعدة

end point
PH<7

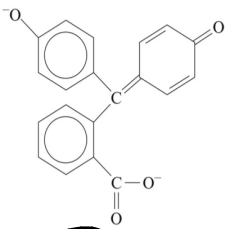


إذن الـ pH الابتدائية > 7
الحادة التي تتم معايرتها هي حمض

phenolphthalein →



Colorless acid form, HIn



Pink base form, In⁻

* Methyl orange :- yellow in basic
red in acidic