دفتر كيمياء تحليلية

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فكرة .. واقع .. تميز

Day 15 / 9 / 2013. chapter (1).

* Def" → Determination.

The Nature of analytical chemistry.

Quantitative analysis
Def" the relative amount of the species in numerical terms.
(كمية المادة)

Quantitative analysis
estabilished the chemical identity of the species in the sample.
(النوعية)

↓

Separation عملية الفصل.

* [1A] The role of analytical chemistry analytical chemistry applied in :- (Industry, medicine, all sciences...etc).

[1B] Quantitative analytical methods :-

① Gavermetilic method → def" the mass of the analyte.
(تحديد كمية المادة الموجودة بالعينة)

② Volumotric method :- measure the volume of solution containing reagents. (إذا كانت المادة سائلة)

③ Electroanalytical method → measure the electrical properties (resiontants, current, potential...)

④ Spectroscopic method → measure the inter (Xn) between the electromagnatic radiation and the analyte. التفاعل

ممكن يعطيني طاقة (حركة، إشعاعات) (مثل العنصر N) يحتاج إلى محقق ميش
يعطيني الطاقة.

Day 17/ 9 / 2013.

* [1c] Typical Quantitative analysis :- خطوات التحليل الكمي

9 steps :-

① choosing method.

depends on the accuracy I need, Cost, comlexity of sample. (حالة العينة)

② Acquaring the Sample. (جمع العينات).

Homogeneous
Can't be distinguish the component's.

Hetrogeneous.
we can distingush the components.

- Sampling ws collect sample. *أصعب خطوة* جمع عينات

- Assay ws The proces of determining how much agiven sample is the material indicated by it's name.

سمى حسب العنصر الأكثر تواجداً فيها.

③ procesing Sample :-

[a] preparing Samples :-

→ Soled : ↓ size then mix to ensure homogeneous, then stord.

→ liquid : cover and stored. } لوقت التحليل

we cover the liquid to avoid from evaporation.

[b] Defining replicate Samples :- الهدف → 'Reliablity المصداقية'

running the analysis in the same conditions.

[c] preparing Solutions :-

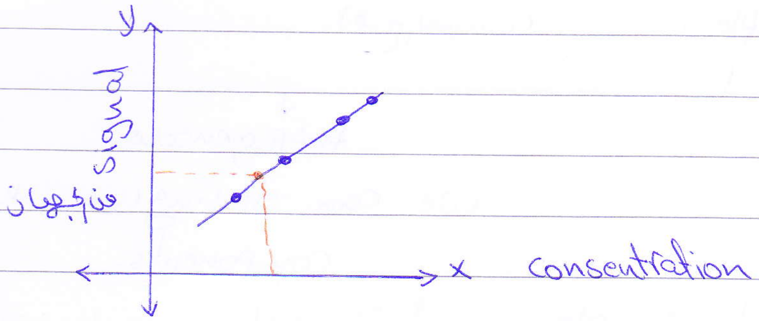
should be homogeneous by : * heating

* stirring. التحريك * Adding acids or bases.

Day 17/ 9 / 2013.

④ Eliminate interferences :- إزالة الشوائب
ex :- precipilate. الرواسب

⑤ Calibrating and measaring [ ] :- consentration
using standard material (known consentration).



$\boxed{C_A = kX}$

C → consentration , k → constant.

⑥ Calculating results → by computer.

⑦ Eveluating results :- by measuring the degree of uncertanity.
(تقييم النتائج)

* II D An integral chemical analysis :-
Role for
Feed back control system.

* e.x :- Det" the [glucose] in blood for diabitic patient ? سكري

soln :- ① Desired is blood glucose level < 95 mg/dL.
② Measure the glucose in blood level of your patient.
③ ↑ 95 mg/dL give the patient insuline.
④ Test again after x time.
⑤ "controle" ≡ Feedbake . (cycle analysis) التحليل الدوري

Day 19 / 9 / 2013. Chapter (4).

* Calculations Used in Analytical chemistry ...

* 4A-1 :- Some important terms of measurnments .

Table 4-1 S I units

Quntity	unit	ab
mass	kilogram	kg
lingth	meter	m

اختصار

* 4A-2 :- The distinction between mass and waight .

- mass → measure of the amount of matter.
- weight → is the force of gravitational attraction between matter and Earth.

** $W = mg$

w : weight . - m : mass - g : acceleration due to the gravity.

* 4A-3 :- Mole ($\mathcal{M}$) : The mass in grame of 1 mole of substance.

** $$\text{Mole} = \frac{\text{Mass (g)}}{\text{Molar Mass (g/mole)}}$$

* e.x :- How many moles and ml moles of CH_3COOH (Acitic) are contained in (2) g ?

$$\mathcal{M} = \frac{2}{(12*2)+(4)+(2*16)} = \frac{1}{30} \leadsto \#\ \text{Moles} = \boxed{0.0333}\ \text{mole}$$

$$= \boxed{33}\ \text{ml mole.}$$

Day 19 / 9 / 2013.

* How many grams of Na^+ (22.99 g/mol) are containd in (25)g Na_2SO_4 (142.0 g/mol) ??

solu :- $\boxed{1}$ # mol Na_2SO_4 $= \frac{25\ g}{142\ g/mole} = \boxed{0.176}$ mole Na_2SO_4

$\boxed{2}$ 1 mole $Na_2SO_4 \longrightarrow 2$ mole Na^+

$0.176 \longrightarrow X \rightsquigarrow X = \boxed{0.352}$ mol Na^+

$0.352 = \frac{X}{22.99} \longrightarrow X = \boxed{8.1}$ g Na^+.

* $\boxed{4B}$:- Solutions and their [ ] :-

$\boxed{4B-1}$:- [ ] of solution.

** Molar concentration $= \frac{\#\ of\ mole}{Volume\ (L)} = M$.

* e.x :- calculate the Molar concentration of ethanol in an aq. solution contain (2.3)g of C_2H_5OH (46.07 g/mol) in 3.5 L solution ??

solu :- ① [ ] $= \frac{\#\ mole}{V} = \frac{(2.3\ g) / (46.07\ g/mol)}{3.5\ (L)}$

$= \boxed{0.0143}$ M.

Day 22/ 9 /2013

* Analytical molarity :- The total # of moles of solute in 1 L of solution. نفترض ان كلها تفكك

* Equilibrium molarity :- The molar concentration of particular species in asolution at equilibrium. . التفكك جزئي

* e.x :- Calculate the analytical and equilibrium [ ] of the solute species in a eq. solutions that contain (285 mg) of Cl_3CCOOH (163.4 g/mol) in (10 ml) the acetic acid is 73% ionized in H_2O ??

Solu: ① 285 mg = 0.285 g.

$M = 163.4$ g/mol. , $V = 0.01$ L.

[A] Analytical $[\ ] = \frac{\#\ mole}{V(L)} = \frac{(0.285)/(163.4)}{0.01}$

$= \boxed{0.1744}$ mol/L (M).

[B] $HA \rightleftharpoons H^+ + A^-$

eq. $[\ ] = 0.1744 * \frac{73}{100} = \boxed{0.127}$ mol/L $= [A^-] = [H^+]$.

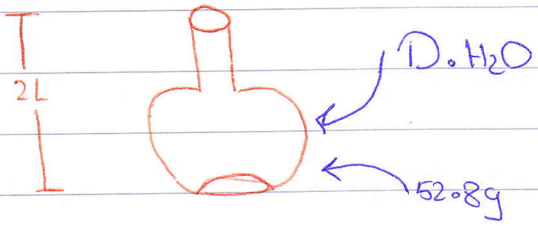
* e.x :- Describe the preparation of 2.00 L of 0.108 M of $BaCl_2 \cdot 2H_2O$ (244.3 g/mol) ??

Solu :- ① $M = \frac{\#\ mol}{V} \rightsquigarrow \#\ mol = M * V$

$= 0.108 * 2 = \boxed{0.216}$ mol

② $\#\ mol = \frac{mass}{molar\ mass} \rightsquigarrow mass = 0.216 * 244.3$

$= \boxed{52.8}$ g.



Day 22/ 9 /2013.

* % Concentration:-

① w/w (weight %) = $\frac{\text{mass solute}}{\text{mass solution}} * 100\%$

② v/v (volume %) = $\frac{\text{volume solute}}{\text{volume solution}} * 100\%$

unitless

③ W/V (weight/volume) = $\frac{\text{weight solute (g)}}{\text{volume solution (ml)}} * 100\%$

* Only weight independs on Temperature.

وزن المذاب لايتأثر بالحرارة

* e.x:- 5% $AgNO_3$ wt/v ?

يعني 5 g $AgNO_3$ dissolves in 100 ml H_2O.

* e.x:- 70% HNO_3 wt/wt ?

يعني 70 g HNO_3 dissolves in 100g Solution.

ملاحظة * part per million , part per billion :-
(ppm) , (ppb).

** $\boxed{[\,]\,ppm = \frac{\text{mass of solute}}{\text{mass of solution}} * 10^6}$ ⇝ 1 ppm = $\frac{mg}{L}$ ملي غرام

** $\boxed{[\,]\,ppb = \frac{\text{mass of solute}}{\text{mass of solution}} * 10^9}$ ⇝ 1 ppb = $\frac{\mu g}{L}$ مايكروغرام

* e.x :- What is the molarity of K^+ in asolution that contain 63.3 ppm of $K_3Fe(CN)_6$ (329 g/mol) ?

Solu :- ① 63.3 ppm $= \frac{63.3\ mg}{L} \longrightarrow \frac{mol}{L}$?

$$\frac{mol}{L} = \frac{mass / molar\ mass}{L} = \frac{0.0633\,g / 329.3\,g/mol}{L}$$

$$= \boxed{1.922 * 10^{-4}}\ mol/L\ (M).$$

② $[K^+] = 3 * 1.922 * 10^{-4} = \boxed{5.77 * 10^{-4}}\ M.$

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* Solution - Diluent volume ration.. تخفيف المحاليل

1:4 HCl → This mean 1 volume HCl in 4 volume H_2O.

* (حجم المحلول (solution) = حجم المذاب (solute) + حجم المذيب (solvat) مثال 1:4 يكون الحجم

المحلول = 5) *

---

* p-function or p-value :-

$P_x = -\log [x]$.

* e.x :- Calculate the p value for each ion. in asolution contain $2.00 * 10^{-3}$ M NaCl and $5.4 * 10^{-4}$ M HCl ??

Solu :- NaCl → $2 * 10^{-3}$
HCl → $5.4 * 10^{-4}$

① Na^+, Cl^-, H^+, Cl^-

② $P_{Na} = -\log [Na^+] = -\log [2 * 10^{-3}] = \boxed{2.699}$.

$pH = -\log [H^+] = -\log [5.4 * 10^{-4}] = \boxed{3.27}$.

$[Cl^-]_1 + [Cl^-]_2 = (2 * 10^{-3}) + (5.4 * 10^{-4}) = \boxed{2.54 * 10^{-3}}\ M$

$P_{Cl} = -\log (2.54 * 10^{-3}) = \boxed{2.595}$.

Day 24 / 9 / 2013.

* $\boxed{413-2}$: Density and specific gravity :-

* Density → mass of substance per unit volume.

* Specific gravity → The ratio of the mass of substance to the mass of an equal volume of H_2O at 4°c (S.G).

بافتراض وزن لمادة الماء.

* Density H_2O = 1 *.

* unit D : g/ml , kg/L.

* e.x:- Calculate the molar concentration of HNO_3 (63 g/mol) is asolution that has aspicific gravity 1.42 and 70.5% HNO_3 (w/w)??

قانون →

solu:- ** $M = \frac{\% * 10 * \text{Density}}{M.Wt.}$

$M = \frac{70.5 * 10 * 1.42}{63 \text{ g/mol}} = 15.89 \simeq \boxed{16}$ M

التخفيف * Dilution :- $M * V_{\text{concentrated}} = M * V_{\text{diluted}}$

* e.x:- How to prepare 100 ml of 6 M HCl from concentrated solution has S.G 1.18 and 37% (w/w) HCl (36.5 g/mol)?

solu:- ① $M = \frac{37 * 10 * 1.18}{36.5} = \boxed{12.0}$ M

② $M * V_{\text{conc}} = M * V_{\text{dilu}}$

$\frac{\cancel{12} * V}{\cancel{12}} = \frac{\cancel{6} * 100}{2\cancel{12}} \longrightarrow V_{\text{conc}} = \boxed{50}$ ml

Day 26 / 9 / 2013.

* [4C] :- Chemical stoichiometry :-

* [4C_1] :- Empirical formula and molecular fromula :-

[1] Empirical formula → Is the simplest whole # ratio of atom.

[2] M.formula → specific the # of atom.

أستيك أسيد * e.x :- ① $C_2H_4O_2$

فازلين ② $C_3H_6O_3$

جلوكوز ③ $C_6H_{12}O_6$

} Molecular formula

↓

CH_2O E. formula. ← [illegible]

[3] Structural formula.

* [4C_2] :- Stoichiometry Calculation :-

انتبه [illegible] للموازنة *e.x :- $Na_2CO_{3(aq)} + 2AgNO_{3(aq)} \rightarrow Ag_2CO_{3(s)} + 2NaNO_{3(aq)}$

ⓐ Which mass of $AgNO_3$ (169.9 g/mol) is needed to convert 2.33 g of Na_2CO_3 (106 g/mol) to Ag_2CO_3?

Solu:- ① check the valence equation.

② # of mole $Na_2CO_3 = \frac{mass}{M.mass} = \frac{2.33\ g}{106\ g/mol} = \boxed{0.02198}$ mol

③ 1 mole Na_2CO_3 → 2 mole $AgNO_3$

0.02198 → X

X = $\boxed{0.0439}$ mol $AgNO_3$.

④ mass $AgNO_3$ = M. mass * # mols

= 169.9 * 0.0439 = $\boxed{7.47}$ g.

Day 26 / 9 / 2013.

[b] What mass of Ag_2CO_3 (275.7 g/mol) will be formed?

mass = M.Wt * # mols

= 275.7 * 0.02198 = $\boxed{6.06}$ g Ag_2CO_3.

limiting Reactant.

* e.x:- What mass of Ag_2CO_3 (275.7 g/mol) is formed when 25 ml of 0.2 M $AgNO_3$ mixed with 50 ml of 0.08 M Na_2CO_3??

$$Na_2CO_3 + 2\,AgNO_3 \rightarrow Ag_2CO_3 + 2\,NaNO_3.$$

Solu:

① # mole $AgNO_3$ = M*V

= 0.2 * 25 * 10^{-3} = $\boxed{0.005}$ mol

② # mol Na_2CO_3 = 0.08 * 50 * 10^{-3}

= $\boxed{0.004}$ mol.

③ 1 mol $Na_2CO_3 \rightarrow$ 1 mol Ag_2CO_3

0.004 $\rightarrow$ X

# of mol Ag_2CO_3 = $\boxed{0.004}$ mole X

④ 2 mol $AgNO_3 \rightarrow$ 1 mol Ag_2CO_3

0.005 $\rightarrow$ X

# of mol Ag_2CO_3 = $\boxed{0.0025}$ mole ✓ L.R.

* limiting Reactant $AgNO_3$ *

⑤ Mass Ag_2CO_3 = # mol * M.Wt.

= 0.0025 * 275.7

= $\boxed{0.689}$ g.

* Errors in chemical Analysis:-

* mean ≡ Average.
* Error → Difference between the mean value and the true value ≡ Degree of uncertainity.

عدم التحقق

* $\boxed{5-A}$ Some important terms:-

Run Always (2-5) 'Replicate' analysis إعادة عمل التجربة أكثر من مرة تحت نفس الظروف.

لـ التجربة

* Replicate → same conditions *

* $\boxed{5A-1}$ The mean and the median:- الوسط، الوسيط

** mean $(\bar{x})$ = $\dfrac{\text{Summation of replicate measurment}}{\#\text{ of measurment}} = \dfrac{\sum x_i}{N}$

* Median :- Is the middle result when replicate data are arranged ↑ تصاعدي , ↓ تنازلي.

* هي القيمة المتوسطة بعد ترتيب القيم تصاعدياً أو تنازلياً *

* e.x:- Calculate the mean and the median of:

19.4 19.5 19.8 19.6 20.1 20.3

Solu:-

① mean = $\dfrac{\sum x_i}{N} = \dfrac{19.4+19.5+19.8+19.6+20.1+20.3}{6} = 19.78 \simeq \boxed{19.8}$

② median : $\cancel{19.4}$ $\cancel{19.5}$ 19.6 19.8 $\cancel{20.1}$ $\cancel{20.3}$

$= \dfrac{19.6 + 19.8}{2} = \boxed{19.7}$

→ If you have :- ~~19.4~~ ~~19.5~~ 19.6 ~~19.8~~ ~~20.1~~

∴ median = $\boxed{19.6}$.

* [5A-2] precision :-

تعريف def :- How clossess of results run in the same conditions to each other.

* To express it :- التعبير عنها

[1] Standard deviation. الانحراف المعياري

[2] Variance. مقدار التغير معامل التغير [3] coefficient of variation.

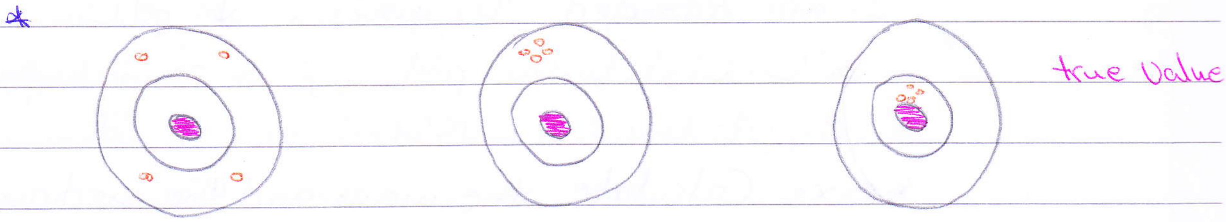
** deviation (di) = $| x_i - \bar{x} |$.

→ x_i :- القيمة التي تم حسابها. و $\bar{x}$:- القيمة الأصلية

* [5A-3] Accuracy :-

def :- The closseness of the measurment to the true value.

*



القيم بعيدة عن القيمة الأصلية No accuracy	✗	✓
القيم بعيدة عن بعضها No precision	✓	✓

* To express accuracy :-

[1] Absolute error (E) القيمة المطلقة :-

** $E = X_i - X_t$

→ X_t : true value.

Day 28/9 /2013.

[2] Relative error (Er):-

$$** \; Er = \frac{x_i - x_t}{x_t} * 100\% \quad \Big\} \begin{matrix} +ve \\ -ve \end{matrix} \text{ or}.$$

*[5A-4] Types of error in experimental data:-

خطأ عشوائي [1] Random error (indetermine) :- affect the precision.

[2] Systematic error (determined) :- affect accuracy.

خطأ فادح [3] Gross error (Human error) :- This leads to result that too high or too low from the true value.

دخيل [4] Outlier :- one result shoos to be differ markedly from others.

---

* [5B] :- Systematic errors:-

* [5B-i] :- Sources of systematic error.

3 types of error:-

من الآلة [1] Instrumental :- from instrument.

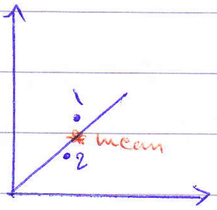
عند تفسير الطرق [2] Method error :- from chemical and physical analytical system

[3] personal error.

*Systematic error leads to bias:-
deviation from the mean (-ve, +ve).

.(+ve) أعلى من القيمة

.(-ve) أقل من القيمة



* [1] Instrumental error:-

Day 1 / 10 / 2013.

→ from pipet, buret ... (volumetric plask).
→ Tempt. change.
To eliminate the error comes from the instrument : make calibration.

[2] Method error:-
→ Decomposition of organic sample.
→ small exces in reagent.

[3] personal error:-
→ Comes from eyes error.

* [5B-2]:- The effect of systematic error on analytical result:

* systematic error maybe ① constant ② proportional.
① constant dosen't depend on the size of sample.
& serious :- when sample size ↓.

يكون الخطأ كبير لما يكون حجم العينة صغير

* e.x:- Titration. تغير اللون.
② proportional error : ↑ or ↓ according to the size of sample.
→ comes from the interferences.

* [5B-3]:- Delection of systematic error.
* Instrument : correct by calibration.
* personal error:- pay attention.
note → Some errors (corrosion, mistreatment). — by time
تآكل (الصدأ) ، سوء استخدام

Day 1 / 10 / 2013.

* [5B-4] : Delection of systematic method error:-

* [1] Standard refrence material :- Sample with known concentration. (SRM).

* If there is a difference between SRM concentration you measured and the true concentration → error.

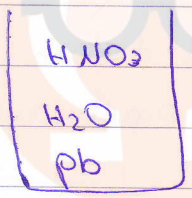
اذا كان هناك فرق كبير : يوجد خطأ

[2] Independent analysis : when you don't have SRM → change method. نفتش الظروف اذا لم يوجد SRM .

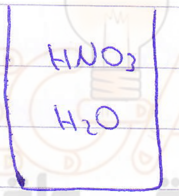
[3] Blank def" :

Blank :- contain all reagents in real sample except analyte.

* e.x:



Sample [pb] = 0.4



Blank [pb] = 0

$[pb]_{real} = [pb]_{sample} - [pb]_{Blank}$.

* Sample matrix:- All the constituents in the sample.

كل شيء موجود بالعينة .

[4] Variation is sample size:-

when size ↑ of measurment the effect of error ↓.

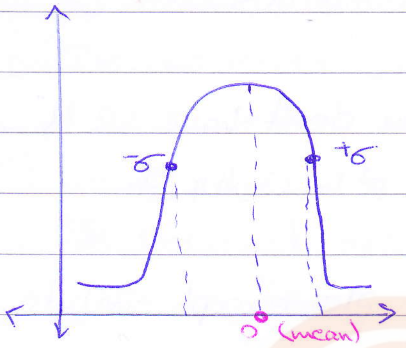
Day 3 / 10 / 2013 chapter (6).

* Random errors in chemical analysis:

* [6A] The nature of random errors:

Random error exist in every measurment and couse uncertanity:

* [6A-1] Random error sources :-



normal distribution (Gaussian distribution):- Curve shows symetrical distribution data around mean.

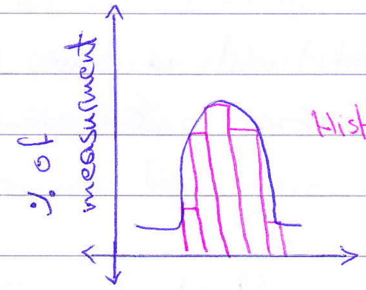
u: uncertanity: deviation from the mean. البعد عن القيمة الحقيقية.

* [6A-2] Distribution of experimental data:-

*e.x: we want to calibrate 10.0 ml Pipet. we run 50 trial.

Solu: [1] ① Mean ② median. ③ Max, min
④ standard deviation. ⑤ spreat (highest, lowest) results.

[2]



[3] Table.

Volume	# in range	% In range
9.69-9.971	3	6
⋮	⋮	⋮
	50	100%

حتى نوصل ل ١٠ آخر قيمة في pipet.

عدد التجارب

Day 3 / 10 / 2013.

* Source of error :-

قراءة خاطئة ① visual judgment. ② Temp. الميزان ③ Balance reading.

④ Variation in the angle of pipet. وجود ميلان عند امساك ال pipet.

* $\boxed{6B}$ Statistical treatment of random error:

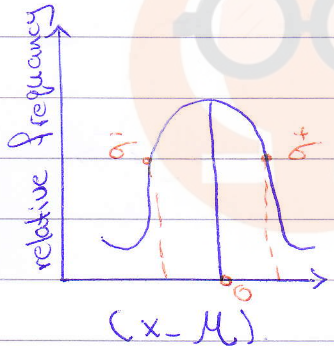
no new information will be created in statistical treatment.

* $\boxed{6B-1}$ Sample and population:-

* population → collection of all measurment.

Sample → Subset (فرع) of measurment.

* $\boxed{6B-2}$ properties of Gaussian distribution curve:-



σ → population standard deviation.

μ → population mean.

x → data value.

y → $\dfrac{e^{-(x-\mu)^2/2\sigma^2}}{\sigma\sqrt{2\pi}}$ → غير مهم (للعلم)

* The population Mean (μ) and the Sample mean ($\bar{x}$):-

** Sample mean = $\frac{\Sigma x}{N}$ = ($\bar{x}$) ⟹ N: number of measurment in Sample set.

** Population mean = (μ) = $\frac{\Sigma x_i}{N}$

⇓

N: # of measurment in the Population.

قاعدة

* وإذا لم يكن عندي ولا أي نوع من خطأ تكون

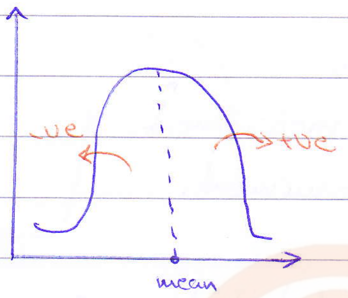
* True value = mean

Day 6 / 10 / 2013

* The population standard deviation (σ):-

** $$\sigma = \sqrt{\frac{\Sigma (x_i + \mu)^2}{N}}.$$

* Note :-



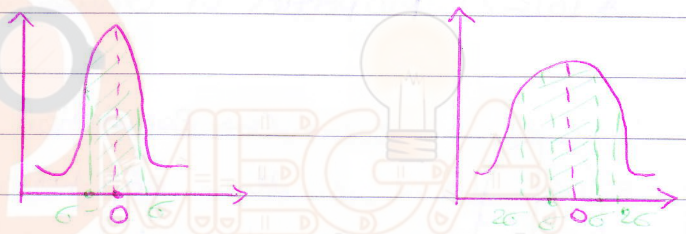
The normal error curve:-

① Symmetrecal around mean

② Mean is the central point. (المركز)

③ When deviation ↑, frequency ↓.

④ Area under Gaussion curve:-



→ When area ↑, σ ↑.

* [σB-3] The sample standard deviation, A measure of preacision:-

** $$S = \sqrt{\frac{(\Sigma x_i - \bar{x})^2}{N-1}}.$$

* $x_i - \bar{x}$ = deviation (erorr. هونفسه σ ونفسه)

$N-1$ = degree of freedom. مقيد بقيمة محددة

* Q :- Why use S ?? Why replace (N) by (N-1) ?

Solu:- If (N-1) not used (s) will be less than the true value.

* I.e :- (S) will have (-ve) bias. تزداد نسبة الخطأ.

* S^2 = variance = squar of standard deviation.

* Alternative expression for standard deviation (S.D) :-

$$S = \sqrt{\frac{\Sigma x_i^2 - \frac{(\Sigma x_i)^2}{N}}{N-1}}.$$

*e.x :- 5 samples of Blood, got these results of pb:- 0.752, 0.756, 0.752, 0.751, 0.760 ppm, Calculate the ① Mean + ② S.D ??

Solu :- ① $\text{Mean} = \frac{\Sigma x_i}{N} = \frac{0.752 + 0.756 + 0.752 + 0.751 + 0.760}{5}$

$\text{Mean} = \boxed{0.754}$

② $S.D = \sqrt{\frac{\Sigma (x_i - \bar{x})^2}{N-1}} = 0.00377 \simeq \boxed{0.004}$.

x_i	$(x_i - \bar{x})$	$(x_i - \bar{x})^2$
0.752	$-2*10^{-3}$	$4*10^{-6}$
0.756	$2*10^{-3}$	$4*10^{-6}$
0.752	$-2*10^{-3}$	$4*10^{-6}$
0.751	$-3*10^{-3}$	$9*10^{-6}$
0.760	$6*10^{-3}$	$3.6*10^{-5}$
0.754	$1*10^{-3}$	$5.7*10^{-5}$

* Note :- $N \to \infty$, then :- يعني قيمة N كبيرة جداً.

$\bar{x} = \mu$, $S = \sigma$.

Day 6/10/2013.

* Standard error of the mean:-

** $S_m = \frac{S}{\sqrt{N}}$.

*e.x :- Mean = 3 , $S_m = 0.1$

3 ∓ 0.1

انتبهي * To ↑ precision by afactor 10 , requir (100) times measurment.

* The coefficient of variation (CV), Relative standard deviation (RSD):-

** $CV = \frac{S}{\bar{x}} * 100\%$.

* Reliability of (S) as ameasur of precision:-

N↑ , S becomes better astimator of σ.

* pooling data (combining data) to improve the reliability of (S).

* subset :- group of set.

Conditions:- ① same sources for all measurment.

② same analysis.

** $S_{pooling} = \sqrt{\frac{\Sigma(x_i - \bar{x})_1^2 + (x_i - \bar{x})_2^2 + \dots}{N_1 + N_2 + \dots N_T}}$.

* e.x :- Calculate Spooling ?

بيجي مثله بالامتحان
عالأكيد

Solu:-

Day 8/ 10 /2013.

Time	[Glucose] mg/L	mean	$\Sigma(x_i-\bar{x})^2$
month 1	1108, 1122, 1075, 1099, 1115, 1083, 1100.	1100.3.	1687.43
month 2	992, 975, 1022, 1001, 991.	996.2	1182.80
month 3	788, 805, 779, 822, 800.	798.8	1086.80
month 4	799, 745, 750, 774, 777, 800, 758.	771,9	2950.86

$$\rightsquigarrow S_{pooling} = \sqrt{\frac{1687.43 + 1182.80 + 1086.80 + 2950.86}{24 - 4}}$$

نقسم على (عدد النقاط - عدد الأسطر)

$$= 12.58 \simeq \boxed{19} \ mg/L.$$

* $\boxed{6B-5}$ Variance and other measurment of precision:

$\boxed{1}$ Variance (S^2):

$$** \ S^2 = \frac{\Sigma(x_i-\bar{x})^2}{N-1} = \frac{\Sigma (d_i)^2}{N-1}$$ → deviation.

$S \rightsquigarrow$ Has the unit of the data.

$S^2 \rightsquigarrow$ " " Square unit " " " .

$\boxed{2}$ (RSD): Relative standard deviation.

$$** \ RSD = \frac{S}{\bar{x}}.$$

Day 8 / 10 / 2013.

** $RSD\% = \frac{S}{\bar{x}} * 100\%$.

** $RSD_{ppt} = \frac{S}{\bar{x}} * 1000$.

[3] CV :- Correlation of variation :-

** $CV = \frac{S}{\bar{x}} * 100\%$.

[4] spread (w) :- الانتشار

spread ⤳ highest value - lowest value.

* e.x :-

x_i	$x_i - \bar{x}$	$(x_i - \bar{x})^2$
0.752	-0.002	$4*10^{-6}$
0.756	0.002	$4*10^{-6}$
0.752	-0.002	$4*10^{-6}$
0.751	0.003	$9*10^{-6}$
0.760	0.006	$3.6*10^{-6}$
0.754		$5.7*10^{-5}$

Calculate :- ① Variance ? ② RSD_{ppt} ? ③ CV ? ④ w ??

Solu :- [1] Variance :-

$$S^2 = \frac{\sum (x_i - \bar{x})^2}{N-1} = \boxed{1.4*10^{-5}}.$$

[2] $$RSD_{ppt} = \frac{S}{\bar{x}} * 1000 = \frac{\sqrt{1.4*10^{-5}}}{0.754} * 1000$$

$$= \boxed{4.96}.$$

Day 8 / 10 / 2013.

[3] $CV = \frac{\sqrt{1.4*10^{-5}}}{0.754} * 100\% = \boxed{0.5\%}$.

[4] $W = 0.760 - 0.751 = \boxed{0.009}$.

* [6c] Standard deviation of calculate results:-

[1] standard deviation of sum or difference:-

$$y = a(\mp S_a) + b(\mp S_b) - c(\mp S_c)..$$

$$** S_y = \sqrt{(S_a)^2 + (S_b)^2 + (S_c)^2}.$$

* e.x: $y = 0.5(\mp 0.02) + 4.10(\mp 0.03) - 1.97(\mp 0.05)$

Calculate the standard deviation $(S_y) = ?$

Solu:- [1] $0.5 + 4.10 - 1.97 = \boxed{2.63}$.

[2] $S_y = \sqrt{(0.02)^2 + (0.03)^2 + (0.05)^2} = \boxed{0.06}$.

[3] $2.63(\mp 0.06)$ .. حل مسألة

Day 10 / 10 /2013.

للقسمة أو الضرب * $\boxed{\sigma c-2}$ Standard deviation of product or quotient :-

$$y = \frac{a * b}{c}$$

$$** \ \frac{Sy}{y} = \sqrt{\left(\frac{Sa}{a}\right)^2 + \left(\frac{Sb}{b}\right)^2 + \left(\frac{Sc}{c}\right)^2}$$

*e.x:- Calculate the S.D of :- $\frac{4.10(\mp 0.02) * 0.005(\mp 0.0001)}{1.97(\mp 0.04)}$?

Solu:- $\frac{4.10 * 0.005}{1.97} = 0.010406 \ (\mp ?)$

$$\frac{Sy}{y} = \sqrt{\left(\frac{0.02}{4.10}\right)^2 + \left(\frac{0.0001}{0.005}\right)^2 + \left(\frac{0.04}{1.97}\right)^2} \ \text{نحسب} \ \frac{Sy}{y} = \boxed{0.0289}$$

$$Sy = 0.0289 * 0.010406 = \boxed{0.000301}$$

$$\Longrightarrow 0.10406 (\mp 0.000301).$$

---

*$\boxed{\sigma c-3}$ in exponential calculation:-

$$y = a^x.$$

$$** \ \frac{Sy}{y} = x\left(\frac{Sa}{a}\right).$$

*e.x:- $V = \frac{4}{3} \pi r^3$, if $d = 2.15$ cm. (القطر) with $Sd = \mp 0.02$ cm, What is the standard deviation of volume = ?

Solu:- ① $V = \frac{4}{3} \pi (2.15/2)^3 = \boxed{5.20} \ cm^3 = V.$

② $\frac{Sy}{y} = x\left(\frac{Sa}{a}\right) \longrightarrow \frac{Sy}{y} = 3 * \left(\frac{0.02}{2.15}\right) = \boxed{0.0279}$

$$S V = 0.0279 * 5.20 = \boxed{0.145}$$

$$\Longrightarrow 5.2 (\mp 0.1)$$

Day 10 / 10 / 2013.

* $\boxed{6C-4}$ S.D of logarithms and antilogarithms:-

** logarithms :- $\boxed{S_y = 0.434 \frac{S_a}{a}}$.

** antilogarithms :- $\boxed{\frac{S_y}{y} = 2.303\, S_a}$.

* e.x:- Calculate S.D :-

$y = \log[2.00 (\mp 0.02) * 10^{-4}] \rightsquigarrow y = -3.699 (\mp ?)$

$S_y = 0.434 \left(\frac{0.02}{2.00}\right) = \boxed{0.004}$

$\longrightarrow y = -3.699\ (0.004)$.

* مهم مثال ص 129 *

---

* $\boxed{6D}$ Reporting computed data:-

* you have to follow the S.f :-

* $\boxed{6D-2}$ S.f :-

[1] Sum and difference :- في الجمع والطرح .

* e.x:- $3.4 + 0.020 + 7.31 = 10.730 \approx \boxed{10.7}$.

⟸ نأخذ أقل عدد من الأرقام بعد الفاصلة.

[2] product and Quotient :- في القسمة والضرب

* e.x:- $\frac{24 * 4.52}{100.0} = 1.084 \approx \boxed{1.08}$.

---

* logarithms + antilogarithms :-

[1] In log. :- keep as many digits to the right of the (يمين) decimal point as there are in the original.

Day 10/ 10 / 2013.

* e.x:- Round log $4.000 * 10^{-5}$ = $\boxed{-4.3979}$.

4 s.f ∴ الجواب رح يكون فيه 4 أرقام بعد الفاصلة.

[2] Antilog:- keep as many digits as there are to the right of D.point in the original #.

* e.x:- Antilog 12.⑤ = $\boxed{3 * 10^{12}}$

1 ∴ الجواب النهائي رح يكون مكوّن من رقم واحد فقط (حسب عدد الأرقام بعد الفاصلة).

* [GD-3] Rounding Data:-

Always to the nearest even #.

* e.x:- Round 61.555 = $\boxed{61.56}$.

* [GD-4] Explessing Results of chemical computation:-

Always rounding off at the end.

Day 20/ 10 / 2013.

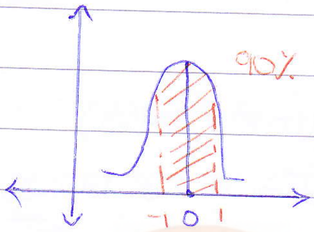
* Chapter (7) *
Ch.4 بالكورس

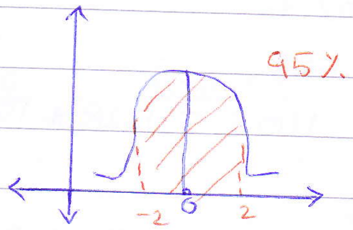
* Statistical Data treatment and evalution:-

* **7A** Confidence interval (C.I):-

Defn:- The range of values within which the population mean (μ) is expected to lie within acertain probability.

* **7A-1** finding C.I when σ is known:-





نسبة خطأ ∓ 10%

∓ 5%

* كلما زادت المساحة تحت المنحنى تزداد C.I وتقل نسبة الخطأ *

* Confidence level (CL):-

Is the probability that the true mean lies within acertain interval.

* Signficence level:-

The probability that aresult is outside the C.I.

$$** \boxed{CI \text{ for } \mu = x \mp \sigma}$$

$$* * \boxed{CI \text{ for } \mu = \bar{x} \mp \frac{z\sigma}{\sqrt{N}}}$$

* e.x:-

Day 20/ 10/ 2013

*e.x:- Determine the 80% and 95% CI for ⓐ 1108 mg/L . ⓑ the mean value 1100.3 of 7 measurment assume that

$\sigma = x$ يعني

$s = 19$ is agood estimator of σ ?

Info $\underline{z}$ tabulated.

80%	95%
1.28	1.96

At 80% :-

ⓐ $z = 1.28$

$CI = 1108 \mp 1.28 * 19 \quad = (1108 \mp 24.3)$

أي القيمة الواقعة بين (+) أو (−) تكون صحيحة.

ⓑ $CI = 1100.3 \mp \frac{1.28 * 19}{\sqrt{7}} \quad = \quad (1100.3 \mp 9.19)$

At 95% :-

ⓐ $z = 1.96$

$CI = 1108 \mp 1.96 * 19 \quad = (1108 \mp 37.24)$

ⓑ $CI = 1100.3 \mp \frac{1.96 * 19}{\sqrt{7}} \quad = \quad (1100.3 \mp 14.07)$

---

* [7A-2] : Finding the C.I when σ is unknown :- t_statistics.

** $\boxed{t = x - \frac{\mu}{s}}$ for single measurment.

** $\boxed{t = \frac{\bar{x} - \mu}{s/\sqrt{N}}}$ For N measurment.

** $\boxed{CI \text{ for } \mu = \bar{x} + \frac{ts}{\sqrt{N}}}$

Day 20/ 10 / 2013.

* t values are tabulated at $(n-1) \equiv$ degree of freedom.

* e.x:- Analysis of Alcohol contained in sample:- 0.084, 0.089, 0.079. Calculate the 95% CI. $S = 0.005\%$ is agood estimator for σ ?

Solu:- $CI = \bar{x} \pm \frac{ts}{\sqrt{N}}$.

* $\bar{x} = \frac{0.089 + 0.084 + 0.079}{3} = \boxed{0.084}$.

* $S = 0.005$

* at 95% look at t-value :- $t_{N-1} = 4.3$

* $CI = 0.084 \pm \frac{4.3 * 0.005}{\sqrt{3}} = \boxed{0.012}$.

Range = $(0.084 \mp 0.012) \longrightarrow (0.072 \text{ to } 0.096)$

---

* $\boxed{7D}$ Detection of gross error :-

قيمة شاذة Out lies :- the result of an undected gross error.

⟹ Deside :- If we have to retailn it or reject it.

* Apply Q-test :-

* Steps :-

① Arrange the data ↑. رتب القيم تصاعدياً.

② Calculate $Q_{exp} = \frac{|\text{suspected value} - \text{closest value}|}{\text{Max. value} - \text{min. value}}$ الاقرب للقيمة المشكوك فيها

③ At CI. Det" $Q_{critical}$ (tabulated).

④ If $Q_{exp} > Q_{crit}$, reject the suspected value.

اذا تجاوزت القيمة الشاذة نحذفها.

Day 22/ 10/ 2013

*e.x:- Analysis of CaO% yield : 55.95 , 56.00 , 56.04 , 56.08 , 56.23 . The last value is questionable. Does it should be rejected or retained at 95% ?

solu:-

① 55.95 , 56.00 , 56.04 , 56.08 , 56.23.

② $Q_{exp} = \frac{|56.23-56.08|}{56.23-55.95} = \boxed{0.54} = Q_{exp}$.

③ at 95% from table, n=5 , $Q_{critical} = \boxed{0.71}$

④ $Q_{exp} < Q_{crit}$, So keep the value.

$$\left.\begin{matrix} 7D-2 \\ 7D-3 \end{matrix}\right\rangle \text{Rules}$$

* 7D-2, 7D-3 > Rules

دراسة ذاتية (قراءة)

Day 22/ 9 /2013.

* Chapter (9) *

* Aquoeus solutions and Chemical (RXN):-

* $\boxed{\text{9A}}$ Classifying solutions of electrolytes:-

* electrolytes :- Solute from ions when dissolves in H_2O and conduct electricity...

electrolytes 2 types

Strong electrolyte	Weak electrolyte.
Ionized completly	Ionized partially.
$\longrightarrow$	$\rightleftharpoons$
يكون التفكك باتجاه واحد (التفاعل)	يكون التفكك باتجاهين (غير مكتمل)

* Table (9-1) مهم *

* $\boxed{\text{9A-2}}$:-

* Acids + Bases :-

$$\left.\begin{array}{l}\text{Acid} \rightarrow \text{proton donar} \\ \text{Base} \rightarrow \text{proton acceptor.}\end{array}\right\}\ \text{Bronsted.}$$

* Salt :- product from Acid + Base.
* Conjugate acid & conjugate base:-

$$\underbrace{\text{Acid} \rightleftharpoons \text{Base}}_{\text{conjugate base.}} + \text{proton}$$

$$\text{Base} + \underbrace{\text{Proton} \rightleftharpoons \text{Acid}}_{\text{conjugate acid.}}$$

Day 22/ 10 /2013-

* Neutrilization RXN :-

$Acid_1 + Base_2 \rightleftharpoons Base_1 + Acid_2$

conjugate conjugate

لو كان يتفاعل باتجاه واحد ينتج ملح + ماء

*e.x :- $NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$

Base Acid Acid Base

---

*[9A-3] :- Amphiprotic species :- مرة حمض ومرة قاعدة

species prosses both acidic & basic propeites.

*e.x :- $H_2PO_4^- + H_3O^+ \rightleftharpoons H_3PO_4 + H_2O$

Base acid acid base.

$H_2PO_4^- + OH^- \rightleftharpoons HPO_4^{-2} + H_2O$

Acid base base acid.

[illegible]

عليه شحنتين (+) و(-) * Zwitterion :- Species bears both (-ve) and (+ve) charge.

*e.x :- $NH_3^+CH_2COO^-$.

*e.x :- Amphiprotic Solvents :- CH_3OH.

---

* [9A-4] Autopyrolysis :- (Self Ionization):-

* يتفاعل مع نفسه لتكوين شحنة موجبة منه وأخرى سالبة

*e.x :- $CH_3OH + CH_3OH \rightleftharpoons CH_3OH_2^+ + CH_3O^-$.

Day 22/ 10 /2013.

* [9A-5] Strength of Acids & Bases :-

* figure (9-2) :-

$HClO_4$
HCl
H_3PO_4
⋮

↑ تزداد القوة.

*** H.W :-

$HClO_4$:- per chloric Acid.
H_2SO_4
ClO_4^- :- per chlorate :-
SO_4^{-2}

* [9B] :- Chemical equilibrium :-

Def" :- ratio [ ] of reactant & product.

* Equilibrium Constant expression:. Algebraic equation.

* [9B-1] The equilibrium state :-

principle of chatelier:- position of eq. always shelft in such adirection as to relieve astress to the system.

* [9B-2] Equilibrium Constant expression [K]:-

$$wW + xX \rightleftharpoons yY + zZ.$$

w, x, y, z :- # of moles.

$$** \quad k = \frac{[Y]^y[Z]^z}{[W]^w[X]^x}.$$

Day 24/ 10 /2013.

* Notes:- ① If a species is:- pure liquid, solid or in excess no term of species appear.

* اذا كانت المادة s , L لا تدخل في حساب K *

② K Depends on T.

* [9B-3] Types of eq. Constant:-

① K_w :- dissociation of H_2O.

② K_{sp} :- Solubility.

③ K_a :- dissociation of Acid.

④ K_b :- dissociation of Base.

* [9B-4] :- Applying the ion product constant for H_2O:-

* e.x:- $2H_2O \rightleftharpoons H_3O^+ + OH^-$.

** $K_w = \frac{[H_3O^+][OH^-]}{[H_2O]^2}$

$K_w = 1 * 10^{-14}$ at $T = 25°C$.

* e.x:- Calculate the hydronium and hydroxide ion [ ] of pure H_2O at 25° C, at 100° C?

$2H_2O \rightleftharpoons H_3O^+ + OH^-$

info K_w at 25° $= 1*10^{-14}$
at 100° $= 49*10^{-14}$

Solu:- At 25° C:-

① $K_w = \frac{[H_3O^+][OH^-]}{[H_2O]^2}$

② $[H_3O^+] = [OH^-]$ لأنه في المعادلة نسبتهم 1:1

$K_w = \frac{[H_3O^+]^2}{\cancel{[H_2O]^2}}$

pure liquid

بطير

Day 24 / 10 / 2013.

$\sqrt{1 * 10^{-14}} = \sqrt{[H_3O^+]^2} \longrightarrow [H_3O^+] = [OH^-] = \boxed{1*10^{-7}}$

At 100° C :-

$k_w = [H_3O^+]^2 \longrightarrow \sqrt{49*10^{-14}} = \sqrt{[H_3O^+]^2}$

$[H_3O^+] = [OH^-] = \boxed{7*10^{-7}}$.

* e.x :- Calculate $[H_3O^+]$ and $[OH^-]$ and pH, pOH of 0.200 M NaOH at 25°C, $k_w = 1*10^{-14}$?

Solu :- ① $[OH^-] = 0.200 + \underbrace{[H_3O^+]}$ → نفس تركيز OH القادم من H_2O

نهمله لأنه قليل جداً بالنسبة للتركيز تبع NOH too small so cancel it.

$\therefore [OH^-] \approx \boxed{0.200}$ M

$pOH = -\log [OH^-] = -\log 0.2 = \boxed{0.699}$.

② $k_w = [OH^-][H_3O^+]$ since we have NaOH

$\frac{k_w}{[OH^-]} = [H_3O^+] \longrightarrow \frac{1*10^{-14}}{0.2} = [H_3O^+]$

$\therefore [H_3O^+] = \boxed{5*10^{-14}}$ M.

$pH = -\log [H_3O^+] = \boxed{13.301}$.

* $\boxed{9B\text{-}5}$ Applying solubility product constant :-

$\boxed{2}$ ksp :-

$Ba(IO_3)_{2(s)} \xrightleftharpoons{H_2O} Ba^{+2} + 2\,IO_3^-$.

$$ksp = \frac{[Ba^{+2}][IO_3^-]^2}{\cancel{[Ba(IO_3)_2]}}$$

pure (s) لأنها طالما

$\therefore ksp = [Ba^{+2}][IO_3^-]^2$.

* QB-5 Applying solubility - product constant:-

$ksp = [Ba^{+2}][IO_3^-]^2$.

* e.x:- How many grams of $Ba(IO_3)_2$ (487 g/mol) can be dissolved in 500 ml of H_2O at 25° C ?

info:- $ksp = 1.57 * 10^{-9}$ at 25° C ?

solu:- ① $Ba(IO_3)_2 \rightleftharpoons Ba^{+2} + 2IO_3^-$

② $ksp = [Ba^{+2}][IO_3^-]^2 = 1.57 * 10^{-9}$ ... ⓐ

$[IO_3^-] = 2[Ba^{+2}]$ ... ⓑ

substitute ⓑ in ⓐ :-

$1.57 * 10^{-9} = [Ba^{+2}] * (2[Ba^{+2}])^2$.

$1.57 * 10^{-9} = 4[Ba^{+2}]^2 \longrightarrow [Ba^{+2}] = \boxed{7.32 * 10^{-4}}$ M.

③ $[Ba^{+2}] = [Ba(IO_3)_2] = 7.32 * 10^{-4}$.

④ $M * V = \frac{mass}{M.mass} \longrightarrow 7.32 * 10^{-4} * 0.5 = \frac{mass}{487}$

∴ mass = $\boxed{0.178}$ g.

---

* The effect of the common Ion on the solubility of ppt:-

* e.x:- Calculate the molar solubility of $Ba(IO_3)_2$ in asolution that is 0.02 M in $Ba(NO_3)_2$??

solu:- ① common ion Ba^{+2} جاي من مصدرين

$[Ba^{+2}] \neq [Ba(IO_3)_2]$.

so → ② $[Ba^{+2}] = 0.02 + [Ba(IO_3)_2]$

$[Ba^{+2}] = 0.02 + \cancel{\frac{1}{2}[IO_3^-]}$

نهمل قيمة صغيرة جداً جداً.

Day 26/ 10 / 2013 -

$\therefore [Ba^{+2}] \approx 0.02$.

③ $ksp = 1.57 * 10^{-9}$ معطاه

$1.57 * 10^{-9} = [Ba^{+2}][IO_3^-]^2$

$1.57 * 10^{-9} = 0.02 [IO_3^-]^2 \longrightarrow [IO_3^-] = \boxed{2.8 * 10^{-4}}\ M$.

④ $[Ba(IO_3)_2] = \frac{1}{2}[IO_3^-] = \boxed{1.4 * 10^{-4}}\ M$.

* $\boxed{9B-6}$ Applying Acid – Base dissociation constant :-

* e.x :- $HNO_2 + H_2O \rightleftharpoons H_3O^+ + NO_2^-$

** $\boxed{ka = \frac{[H_3O^+][NO_2^-]}{[HNO_2]}}$ Acid dissociation constant.

* e.x :- $NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$

** $\boxed{kb = \frac{[OH^-][NH_4^+]}{[NH_3]}}$ Base dissociation constant.

** $\boxed{kw = ka * kb}$ Dissociation constant for conjugate acid + Base.

* e.x :- What is kb for :-

$CN^- + H_2O \rightleftharpoons HCN\ OH^-$; $ka = 6.2 * 10^{-10}$?

Solu :-

$kw = ka * kb$

$1 * 10^{-14} = 6.2 * 10^{-10} * kb \longrightarrow kb = \boxed{1.61 * 10^{-5}}$.

Day 27/ 11 / 2013.

* Hydronium ion [ ] of solutions of weak Acid:-

$HA + H_2O \rightleftharpoons H_3O^+ + A^-$.

* $ka = \frac{[H_3O^+][A^-]}{[HA]}$.

$\longrightarrow \boxed{[H_3O^+] \equiv [A^-]}$ ... ①

** $\boxed{C_{HA} = [A^-] + [HA]}$ ... ② قاعدة (تركيز الحمض الضعيف)

تركيز الحمض الأصلي

** $\boxed{C_{HA} = [H_3O^+] + [HA]}$

** $\boxed{[H_3O^+] = \sqrt{ka * C_{HA}}}$ مهم

* e.x:- Calculate $[H_3O^+]$ in 0.120 M nitras acid $ka = 7.1 * 10^{-4}$?

Solu:- $[H_3O^+] = \sqrt{(7.1*10^{-4})(0.12)} = \boxed{9.2*10^{-3}}$ M.

* كيف بنعرف انو السؤال بنحل على هاد القانون ؟ عندما يطلب $[H_3O^+]$ و يعطيني $[HA]$ و Ka *

* Hydronium ion [ ] of solutions of weak Base:-

* e.x:- $NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$.

$kb = \frac{[NH_4^+][OH^-]}{[NH_3]}$.

Day 27/ 10 / 2013.

* e.x :- Calculate the hydroxide ion [ ] of 0.0750 M NH_3 . Solution , $K_b = 1.75 * 10^{-5}$?

Solu :- $1.75 * 10^{-5} = \frac{[OH^-]^2}{0.0750} \longrightarrow [OH^-] = \boxed{1.15 * 10^{-3}}$ M.

* $\boxed{9C}$ Buffer solution :-

dif" :- resist any change in pH.

consist of conjugate acid / base pair. يتكون من

* e.x :- Acitic Acid / sodium acetate.

* $\boxed{9C-1}$ Calculation of pH of Buffer :-

* pH = -log [H+].

** $\boxed{[H_3O^+] = ka \frac{[HA]}{[NaA]}}$

تركيز $[H_3O^+]$ في محلول buffer مش نعرف
قيمة pH .

* e.x :- What is pH of a solution that is 0.4 M in formic acid and 1 M in sodium formate ?

* Solu :- ① $[H_3O^+] = ka \frac{[\text{Formic Acid}]}{[\text{Sodium formate}]} = \frac{1.84 * 10^{-4} * 0.4}{1.00}$

$= \boxed{7.2 * 10^{-5}}$ M.

② $pH = -\log [7.2 * 10^{-5}] = \boxed{4.14}$ Acid.

* $\boxed{9C-2}$ properties of Buffer :-

* The effect of dilution :- No effect.

* لا يتأثر المحلول بالتخفيف عند وجود buffer فيه ، أي لا تتغير
قيمة pH للمحلول *

Day 27/ 10 / 2013.

* The effect of adding Acids + Bases :-

* e.x:- Calculate the pH Change that takes place when 100 ml of 0.05 M NaOH adding to 400 ml buffer solution (0.2) M NH_3 + (0.3) M NH_4Cl ?.

Solu:- ① $[NH_3] = \frac{\#\text{of mole}}{V} = \frac{(400 * 0.2) + (100 * 0.5)}{500}$

$[NH_3] = \boxed{0.17}$ M.

② $[NH_4Cl] = \frac{(400*0.3) - (100*0.5)}{500} = \boxed{0.23}$ M.

③ $[H_3O^+] = \frac{ka\,[NH_4Cl]}{[NH_3]} = 5.7*10^{-10} * \frac{0.23}{0.17}$

$= \boxed{7.71 * 10^{-10}}$ M.

$pH = -\log [H_3O^+] = -\log 7.71 * 10^{-10} = \boxed{9.11}$ base.

← لأننا أضفنا قاعدة قوية .

Day 29/ 10 /2013.

مهم جداً * The composition of buffer solution as afunction of pH :- α - Value.

** $\boxed{C_T = C_{HOAC} + C_{NaOAC}}$

$C_T \rightarrow$ Total [ ]. , $C_{HOAC} \rightarrow$ [ ] of Aceticacid.
$C_{NaOAC} \rightarrow$ Salt [ ].

** $\boxed{\alpha_0 = \frac{[HOAC]}{C_T}}$ $\alpha_0 \rightarrow$ The fraction of the total [ ] of acid.

** $\boxed{\alpha_1 = \frac{[OAC^-]}{C_T}}$, ** $\alpha_1 + \alpha_0 = 1$.

مهم * Buffer capacity :- Is the number of mole of strong acid or Strong base that (1L) of the buffer can absorb without changing pH. $\Rightarrow$ Always (+ve).

*preparetion abuffer:- يعني بدي وزنه

*e.x :- Describe how you prepare abuffer 500.0 ml, pH = 4.5 from 1.0 M aceticacid and Sodium Acetate ? ka = $1.75 * 10^{-5}$?

$$HOAC \rightleftharpoons H^+ + OAC^-$$

$[H^+]$ بنا نجد Solu:- ① $pH = -\log[H^+] \rightarrow [H^+] = \boxed{3.16*10^{-5}}$ M.

② $ka = \frac{[H^+][OAC^-]}{[HOAC]} \rightarrow [OAC^-] = \boxed{0.553}$ M = [NaOAC]

$\rightsquigarrow$ M * V = # of moles = $\frac{\text{mass}}{\text{molar mass}}$ $\rightsquigarrow$ m = 0.553*0.5*82.034
= $\boxed{22.7}$ g.

الكيميا ~~First~~

Day 29 / 10 / 2013. *Chapter (10)*

* Effect of electrolyte on chemical equilibrium :-

* $\boxed{10A}$ The effect of electrolyte on chemical equilibrium :-
The position of most solution equilibrium depends on the [Electrolyte] :-

*e.x :- $H_3AsO_4 + 3I^- + 2H^+ \rightleftharpoons H_3AsO_3 + I_3^- + H_2O$
If $Ba(NO_3)_2$ added, the color of triiodide becomes less intense, why??
Cause RXN shift to the left.

* Ba رح يتفاعل مع I_3 أي يقل تركيز اللون حتى نعيده لوضعه الطبيعي
نزيد من تركيز المتفاعلات *

* Limiting Value :- عندما يصبح تركيزه بالمحلول يساوي 0.
When [ ] electrolyte reach zero.

* $\boxed{10A-1}$ The effect of ionic charge on equilibrium :-
When adding ionic salt on the RXN, this will ↑ the charges.

* $\boxed{10A-2}$ The effect of ionic strength :-

مهم ** Ionic strength = $(\mu) = \frac{1}{2}([A]Z_A^2 + [B]Z_B^2 + \dots)$.

[A], [B] → Concentration of the species in molarity.
Z_A, Z_B → The charges.

Day 29/ 10/2013.

* e.x:- Calculate the ionic strength of:-
ⓐ 0.1 M Na_2SO_4. ⓑ KNO_3 0.1 M ??

<u>Solu:-</u> ⓐ $Na_2SO_4 \rightarrow 2Na^+ , SO_4^{-2}$

$$\mu = \frac{1}{2}\left((0.1*2*(+1)^2) + 0.1*(-2)^2\right) = \boxed{0.3}\ M$$

≡ Ionic Strength.

ⓑ $KNO_3 \rightarrow K^{+1} , NO_3^-$

$$\frac{1}{2}\left(0.1*(1)^2 + 0.1(-1)^2\right) = \boxed{0.1}\ M.$$

قاعدة *

Type of electrolyte	example	Ionic strength
1:1	NaCl	C
1:2	$Ba(NO_3)_2$	3C
1:3	$Al(NO_3)_3$	6C.

→ C :- concentration.

Day 31/ 10 / 2013.

* [10A-3] The Salt effect :- لا يؤثر اذا كان محلول قوي كفاية.

When $BaSO_4$ in Solution, the effection [ ] of Ba^{+2} ion and SO_4^{-2} becomes less as the ionic strength of medium↑.

* [10-B] Activity coefficient :-

** $\boxed{a_x = [X]\gamma_x}$. $a_x \rightarrow$ activity , $X \rightarrow$ species

$\gamma_x \rightarrow$ activity coefficient.

* Activity Coefficient Always (+ve) above one *

** $\boxed{ksp = a_x^m \cdot a_y^n}$.

* * $\boxed{ksp = [X]^m [Y]^n \cdot \gamma_x^m \gamma_y^n = k\acute{s}p \cdot \gamma_x^m \gamma_y^n}$.

ksp → Thermodinamic Solubility product.

kśp → [ ] Solubility product constant.

وايطلق عليه [illegible]

كال ka و kb

* [10B-1] properties of activity coefficient :-

① At any ionic strength, the activity coefficient of ions of the Same change are equal.

② The activity coefficient of uncharged molecule = [1].

③ In two concentrated solution, activity coefficient depends on Ionic Strength.

④ $\gamma_x < 1$:- تعني أنني خففت المحلول أكثر ما يمكن

Infinite solution. (لا يمكن تخفيفه أكثر).

Day 31 / 10 / 2013.

* 10B-2 The Debye_Hückel equation :-

** $$\boxed{-\log \gamma_x = \frac{0.51 * (Z_x)^2 \sqrt{\mu}}{1+3.3\,\alpha_x \sqrt{\mu}}}$$

$\gamma_x \rightarrow$ Activity coefficient , $Z_x \rightarrow$ charge

$\mu \rightarrow$ Ionic strength, $\alpha_x \rightarrow$ effective diameter in (nm).

مجهولة حسب درجة الحرارة.

* e.x:- Use equation of Debye to calculate the activity coefficient for Hg^{+2} in asolution of an ionic strength of 0.085 μ. Use 0.5 nm for α ?

Solu:- ① $-\log \gamma_x = \dfrac{0.51 (Z_x)^2 \sqrt{\mu}}{1+3.3 \sqrt{\mu}\ \alpha_x}$

$$-\log \gamma_x = \frac{0.51 * (+2)^2 * \sqrt{0.085}}{1+3.3 * (0.5) * \sqrt{0.085}} = \boxed{0.4016}$$

$\therefore \gamma_{Hg^{+2}} = \boxed{0.4}$.

Day 31/ 10/2013.

* $\boxed{10B-3}$ Equilibrium Calculation using activity coefficient:-

*e.x: Use the activity coefficient to calculate the hydronium ion concentration in 0.12 μ HNO_2 that is 0.05 μ in NaCl. What is the relative error by neglecting activity coefficient?

تجاهل

Solu:- ① نجد μ لاستخراج قيمة γ من جدول

$$\mu = \frac{1}{2}\left[0.05 * (1)^2 + 0.05 * (1)^2\right] = \boxed{0.05}\ \mu \equiv \text{Ionic strength.}$$

② $\gamma_{H_3O^+} = 0.85$, $\gamma_{NO_2^-} = 0.81$, $\gamma_{HNO_2} = 1$ لانه بدون شحنه ليس ايون

③ $$k\acute{a} = \frac{[H^+][NO_2^-]}{[HNO_2]} = \frac{ka \cdot \gamma_{HNO_2}}{\gamma_{H_3O^+} \cdot \gamma_{NO_2^-}}.$$

$$= \frac{7.1 * 10^{-4} * 1}{0.85 * 0.81} = \boxed{1.03 * 10^{-3}}.$$

④ $$[H_3O^+] = \sqrt{k\acute{a} \cdot C_{HA}} = \sqrt{1.03 * 10^{-3} * 0.12} = \boxed{1.11 * 10^{-2}}\ \mu.$$

القيمة يلي أنا مستخرجها

⑤ Relative error assuming $[H_3O^+] = 9.2 * 10^{-3}$ μ.

$$E = \frac{9.2 * 10^{-3} - 1.11 * 10^{-2}}{1.11 * 10^{-2}} * 100\% = \boxed{17\ \%}$$

يعني $\boxed{\mp 0.17}$

Day 5 / 11 / 2013. * Chapter (11) *

* Solving proplems for complex system :-

* [11 A] Solving proplem by asystematic (منهجي) method :-

* e.x :- $BaSO_{4(s)} \rightleftharpoons$ ① Ba^{+2} + ② SO_4^{-2}.

SO_4^{-2} + ③ $H_3O^+ \rightleftharpoons$ ④ HSO_4^- + H_2O.

$2H_2O \rightleftharpoons H_3O^+$ + ⑤ OH^-.

* معادلات إ flask ، مادة متفككة (أي شيء عليه شحنة)

⟶ There are (5) species , need to deter minde concentration

* [11A-1] Mass balance equation :-

def" :- Equilibrium [ ] of avarious species in asolution to one another and to the analytical [ ] of solutes.

*e.x :- Write the mass valance expression for 0.01 M solution of HCl that is equ. with an excess of solid $BaSO_4$?

Solu :-

① $BaSO_{4(s)} \rightleftharpoons$ ① Ba^{+2} + ② SO_4^{-2}. — أول خطوة إكل نفككها (دائماً التذويب يكون بالماء).

$SO_4^{-2} + H_3O^+ \rightleftharpoons$ ③ HSO_4^- + H_2O. — نمسك الجزء السالب ونفاعله مع H_3O^+.

$2H_2O \rightleftharpoons$ ④ H_3O^+ + ⑤ OH^- — دائماً هنا الجزء موجود بكل التفاعلات.

② $[Ba^{+2}] = [SO_4^{-2}] + [HSO_4^-]$. — نوجد تراكيز المواد الناتجة من تفكك الملح وهي هنا Ba^{+2} , SO_4^{-2} , HSO_4^-.

③ $[H_3O^+] + [HSO_4^-] = C_{HCl} + [OH^-]$.

$[H_3O^+] + [HSO_4^-] = 0.01 + [OH^-]$.

⟶ Since $[OH^-] = [H_3O^+]$.

Day 10/ 11 / 2013.

* [II A - 2] Change - Balance equation:-

* Solution are neutral:-

** molar [ ] of (+ve) charge = molar [ ] of (-ve) charge.

** # of mole (+ve) charge = # of mole (-ve) charge.

*e.x:- How much change is contributed by 1mole of :- Na^+, Mg^{+2}, Al^{+3} ??

Solu:-

[1] Na^+ :- molar [ ] of (+ve) charge Na^+ = 1 [Na^+].
[2] Mg^{+2} :- " " " " " Mg^{+2} = 2 [Mg^{+2}].
[3] Al^{+3} :- " " " " " Al^{+3} = 3 [Al^{+3}].

---

*e.x:- How to write the charge - balance equation for 0.1 M solution of NaCl ??

Solu:- ⟶

Day 12 / 11 / 2013.

* $\boxed{11A-2}$ Change _ balance equation:-

Solu:- $NaCl + H_2O$

(+ve) Changes $[Na^+], [H^+] \rightarrow [\,]$ of (+ve) charge $= 0.1 * 10^{-7}$.

(-ve) Charges $[Cl^-], [OH^-] \rightarrow [\,]$ of (-ve) charge $= 0.1 * 10^{-7}$.

جمع معادلتين $\longrightarrow [Na^+] + [H_3O^+] = [Cl^-] + [OH^-] = (0.1 + 0.1) * 10^{-7}$.

الأسئلة طويلة * $\boxed{11A-3}$ Steps of solving problems involving several equilibrium:-

① Rite the balance equation.

② Set up quantity being in terms of [ ]eq.

③ write the equ. constant regretion (منحنى).

④ write the mass balance expresions.

⑤ write the change balance expresions.

⑥ Count the # of equations and # of unknowns.

$\rightsquigarrow$ # of equations $\geq$ # of unknowns.

⑦ Make suitable approcimation.

⑧ Solve equations.

⑨ Vaild approximation.

⑩ problem solved.

* computer programs can solve the problems:-

$\boxed{1}$ Excel. $\boxed{2}$ Mathcad. $\boxed{3}$ Mathematica.

Day 12 / 11 / 2013.

* $\boxed{11B-1}$ Solubility of metal hydroxide :-

* e.x :- Calculate the molar solubility of $Mg(OH)_2$ in H_2O ??

Solu :- ① $Mg(OH)_2 \rightleftharpoons Mg^{+2} + 2OH^-$.

$2H_2O \rightleftharpoons H_3O^+ + OH^-$.

② Solubility $[Mg(OH)_2] = [Mg^{+2}]$.

③ مجدول.

$[Mg^{+2}][OH^-]^2 = 7.1 * 10^{-12}$ .... Ⓐ.

$[H_3O^+][OH^-] = 1 * 10^{-14}$ .... Ⓑ.

④ $[OH^-] = 2[Mg^{+2}] + [H_3O^+]$ .... Ⓒ.

⑤ $[OH^-] = 2[Mg^{+2}] + [H_3O^+]$.

⑥ # of unknown :- $[Mg^+]$, $[OH^-]$, $[H_3O^+]$.

⑦ $[H_3O^+] \ll [OH^-]$.

⇝ equation C becomes :-

$[OH^-] = 2[Mg^{+2}]$.

أهم خطوة ⑧ $2[Mg^{+2}] = [OH^-]^2$ .... Ⓓ. ، خطوة ⑧+⑨

حل المعادلات يعني → $[Mg^{+2}] * 4[Mg^{+2}]^2 = 7.1 * 10^{-12}$

بدي ٢ أرقام. ∴ $[Mg^{+2}] = \boxed{1.2 * 10^{-4}}$ M.

⑩ $[OH^-] = 2 * 1.2 * 10^{-4} = 2.42 * 10^{-4}$.

$\frac{Kw}{[OH^-]} = [H_3O^+] = \frac{1*10^{-14}}{2.42*10^{-4}} = \boxed{4.1 * 10^{-11}}$ M.

* $\boxed{11B-2}$ The effect of pH solubility :-

* e.x :- Calculate the molar solubility of calcium oxalate in asolution that buffered with pH = ④ ? → $[H^+] = 10^{-4}$

Info :- $CaC_2O_4 \rightleftharpoons Ca^{+2} + C_2O_4^{-2}$, $K_{sp} = 1.7 * 10^{-9}$.

Day 12 / 11 / 2013.

$H_2C_2O_4 \rightleftharpoons H_3O^+ + HC_2O_4^-$, $k = 5.6 * 10^{-2}$.

$HC_2O_4^- \rightleftharpoons H_3O^+ + C_2O_4^{-2}$, $k_2 = 5.42 * 10^{-5}$.

$2H_2O \rightleftharpoons H_3O^+ + OH^-$, $k = 1 * 10^{-14}$.

Solu:- ① $[Ca^{+2}] = [C_2O_4^{-2}] + [HC_2O_4^-] + [H_2C_2O_4]$

② $[HC_2O_4^-] = \dfrac{[H^+][C_2O_4^{-2}]}{k_2} = \dfrac{1*10^{-4} * [C_2O_4^{-2}]}{5.42 * 10^{-5}}$

∴ $\boxed{[HC_2O_4^-] = 1.85 * [C_2O_4^{-2}]}$ .... $\boxed{1}$

$[H_2C_2O_4] = \dfrac{1.85*10^{-4} * [C_2O_4^{-2}]}{5.6 * 10^{-2}}$

∴ $\boxed{[H_2C_2O_4] = 3.3 * 10^{-3} * [C_2O_4^{-2}]}$ .... $\boxed{2}$

⇝

$[Ca^{+2}] = 3.3*10^{-3} * [C_2O_4^{-2}] + 1.85 * [C_2O_4^{-2}]$

∴ $\boxed{[Ca^{+2}] = 2.85 * [C_2O_4^{-2}]}$

Day 14/ 12 / 2013.

* $\boxed{\text{III-C}}$ Separation of ions by control of the ppt agent :-

* Separation acording to ksp differences:-

*e.x:- Can Fe^{+3} and Mg^{+2} be separated on hydroxide from asolution of 0.1 M ??

Info: ① $K_{sp_1} << K_{sp_2}$ بعطوها بالسؤال (مهم).

② $[Fe^{+3}][OH^-]^3 = 2*10^{-39}$ بنحط معادلة ksp الأقل.

③ Assumption. : نفرض فرض (مُعطى) ثابت لـ (ksp) الأقل.

$1*10^{-4} = [Fe^{+3}] \Rightarrow$ one part in 1000 of ions.

من $1*10^{-4} * [OH^-]^3 = 2*10^{-39}$

$[OH^-] = \boxed{3*10^{-12}}\ M.$

④ $7.1*10^{-12} = [Mg^{+2}][OH^-]^2$ نبدأ بـ (ksp) الثاني.

$7.1*10^{-12} = 0.1\ [OH^-]^2 \longrightarrow [OH^-] = \boxed{8.4*10^{-6}}\ M.$

من السؤال

⑤ نقرر إذا ممكن فصلهم أو لا من هذه الخطوة.

$Fe(OH)_3$ can be separated if $[OH^-] > 3*10^{-12}$ M.

$Mg(OH)_2$ " " " " $[OH^-] > 8.4*10^{-6}$ M.

---

* $\boxed{\text{IIC-2}}$ Sulfide separation:-

sulfide forms (ppt) with heavy metals Cations that ksp $(10^{-10} - 10^{-90})$ or Smaller.

$$[H_3O^+]^2 = \frac{1.2*10^{-22}}{[S^{2-}]}$$

تركيز مادة المترسبة S^{2-}

Day 17/11/2013.

$*$ e.x3:- (CdS) is less soluble than thallium sulfide, find the condition under which (Cd^{+2}) and (Tl^{+}) can be separated with 0.1 M of H_2S?

Solu: write equation :.

$CdS \rightleftharpoons Cd^{+2} + S^{-2}$ ksp $= 1*10^{-27} = [Cd^{+2}][S^{-2}]$.

$Tl_2S \rightleftharpoons 2Tl^{+} + S^{-2}$ ksp $= 6*10^{-22} = [Tl^{+}]^2[S^{-2}]$.

① 1 part of Cd in 1000 been removed.

$1*10^{-27} = 1*10^{-4}[S^{-2}] \rightsquigarrow [S^{-2}] = \boxed{1*10^{-23}}$ M.

② $6*10^{-22} = [0.1]^2[S^{-2}]$

$[S^{-2}] = \boxed{6*10^{-20}}$ M.

③ ppt (Cd^{+2}) will happen $[S^{-2}] > 1*10^{-23}$.

ppt (Tl^{+}) will happen $[S^{-2}] > 6*10^{-20}$.

④ $[H_3O^+]^2 = \frac{1.2*10^{-22}}{6*10^{-20}} = 2.0*10^{-3}$ M.

أخذ قيمتها من ksp الأكبر.

$\therefore [H_3O^+] = \boxed{0.045}$ M.

Day 17/ 11 / 2013. * Chapter (12) *

* Gravimetric methods of Analysis :- - تحاليل مبنية على الكتلة

def" :- Based on mass measurment of a(ppt). that filterated.

* [12A-1] properties of ppt and ppt agent :-

① Easily filtered and washed.

② low soluble. ذائبية قليلة.

③ Unreactive with environment.

④ known composition. يعني آكون عارفه مكونات الراسب بديهيا.

* [12A-2] particle size and filter ability of ppt :-

* factor affecting the particle size of ppt :-

① Tempreture. ② solubility. ③ concentration

④ Rate of mixing.

* Type of particles :-

[1] Colloidal suspension :- الأجزاء المنتشرة بالسائل (مثل حليب).

Tiny particles, invisible to naked eyes (10^{-7} - 10^{-4} cm d I)

- Difficult to be filtered.

[2] Crystalline suspension :-

D I $\geq$ 10 mm, easily filtered and setteled down.

تستقر

* Tyndall effect :- The path of beam through the solution can be seen by eyes.

Day 17 / 11 /2013.

* Super Saturation solution:- فوق الإشباع .
Solution contain highr concentration for Solute.

** Relative super saturation = $\frac{Q-S}{S}$.

Q = [solute] , S = equilibrium solubility . (معطاة)

* Mechanism of (ppt) formation:-
* Nucleation :- min # of atoms , ions join to gether to give astable solid.

* ppt can form in 2 ways:-
① Nucleation. نواة يتجمع حولها .
② Particle growth. نواة يتجمع عليها .
Competition between additional nucleation and exsiting nuclei.

Day 19/ 11 /2013

* Experimental control of particle size :- كيف بدي أتحكم بحجم لذرة ؟

① T ↑ , This will ↑ solubility.

② Good stirring. ③ ↓ [ ]. ④ Control pH.

* [12A-3] Colloidal precipitate :- كيف بدي أزيد حجم الحب يصبح لدي راسب ؟

* (تخثير) Coagulation of colloids :-

We coagulate the particles by:-

① Adding an electrolyte. ② Heating. ③ stirring.

* Adsorption : Bonded to the surface.

⟹ See figure 12-1 ; P 318.

* Ions (-ve) or (+ve) retained on the surface of colloidal particles , their kinds depends on :- [ ] of ion.

↩ هي نفسها تركيز الأيون (الازدحام).

* particle treatment of colloidal ppt :-

Use an acid , "digestion". نتق بإدارة بالحمض (مهضم).

Digestion ⟶ Aproces in which ppt heated in the solution from which it was formed.

* [12A-4] Crystalline ppt :-

Methods of improving particle size :

[1] Use ppt agent.

[2] Adjust pH. [3] Adding hot solution.

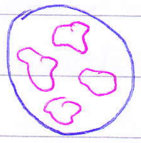
[4] Use dilute solution.

Day 19 / 11 / 2013.

* 12A_5 Copreciptation:- أضيف 2 عن يحول كل ترسيب لمادة لسى احتاجها
proces in which soluble compound are carried out of solution by ppt. I.e (soluble compounds are removed from solution).
يعني أسحب المواد الذائبة في المحلول.

* There are 4 types of coppt:-
① Surface adsorption.
② mixed crystal formation.
③ Occlusion. ④ entropment.

* Surface adsorption:-



⟹ see figure 12-4 ; p 321.
It's cause of contamination in coagulated (جزء صغير) colloide, but not crystallition ppt.
بس لو كان شيء Crystalline ما يتكون الـ Surface adsorption.

* Minimize adsorbed impuriting on colloide:-
① Washing with asolution contain Volatile electrolyte.
نغسله بمادة متطايرة.
② Digestion.

* Reprecipitation:-
① The filterated solid redissolved.
② The first ppt solid carriout contamination, So the second layer is the core. لم ترسب أولاً بسبب وجود مواد متراكمة عليها.

Day 19 / 11 / 2013 .

* Mixed crystall formation:-

Deff'':- Type of coppt in which acontaminat ion replace an ion in the crystall.

* Occlussion and mechanical entrapement:-

Type of Coppt in which a Cpd is trapped within apocket formed.

* Coplecipitate error:-

Might be (+ve) or (-ve).

*e.x:- When Colloidal Agcl adsorbs $AgNO_3$ during chloride analysis. (+ve).

Day 21 / 11 / 2013.

* 12A-6 ppt from Homogeneous solutions:-

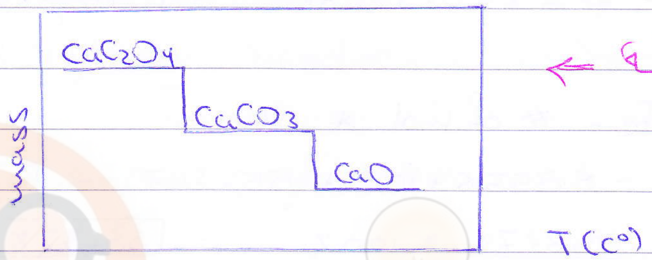
Homogeneous ppt:- when the ppt formed by slow generation of ppt agent homo. through out of solution.

* 12A-7 Drying and agnition ppt:- تسخين

After filtration, ppt is heated to remove solvent and volatile compound.

* Some ppt ingnited to decompose the solid.

*e.x:-



← حسب قوة الرابطة

* Thermovalance → تحليل.

* 12B Caculation of results from Gravimitric data:-

* e.x:- Ca in 200 ml H_2O was determine by ppt the cation CaC_2O_4. The ppt filtered, washed and ignited in crucible of mass = 26.6002 g. The mass of crucible and CaO = 56.077 g/mol was 26.7134 g Calculate [Ca] (40.078 g/ml)?

Solu:- ① mass CaO =

[(mass crucible + CaO) – mass crucible]

$= 26.7134\ g - 26.6002\ g = \boxed{0.1132}\ g.$

② CaO 1:1 $\Longrightarrow$ # mols Ca = # mols CaO $= \frac{0.1132}{56.077} = \boxed{2.018 * 10^{-3}}$ m

③ # mols Ca = M * V $\Rightarrow \frac{2.018*10^{-3}}{0.2\ L} = \boxed{0.01009}\ M$

مهم كثير ④ Concentration g/L = M * M.w

$= 0.01009\ \frac{mol}{L} * 40.078\ \frac{g}{\cancel{mol}} = \boxed{0.404}\ \frac{g}{L}$

* e.x: Iron was analyzed by dissolving 1.1324 g Sample in <u>HCl</u>. The solution was diluted in H_2O Fe (III) was precipitate as $Fe_2O_3 \cdot xH_2O$ by adding NH_3. After feltration, washing, the residue ignited to give 0.5394 g of Fe_2O_3 (159.69 g/mol). Calculate % Fe (55.847) in the sample ??

<u>Solu:-</u> ① # of mol $Fe_2O_3 = \frac{0.5394}{159.69} = \boxed{3.378 * 10^{-3}}$ mol

② In Fe_2O_3, we have 2 mole Fe

⇝ # mole Fe = $2 * 3.378 * 10^{-3} = \boxed{6.7556 * 10^{-3}}$ mole Fe.

③ Mass Fe = # of mol * Mw.

$= 6.7556 * 10^{-3} * 55.847 = \boxed{0.3773}$ g

④ % Fe = $\frac{0.3773}{1.1324} * 100\% = \boxed{33.32\%}$.

---

* $\boxed{12C}$ Application of Gravimetric methods:-

*① Inorganic precipitating agents:-

* e.x:- H_2SO_4, $AgNO_3$, HNO_3, ... Table (12-2).

② Reducing agent.

* e.x:- $H_2C_2O_4$.

①+① سيتم نقاش كل طريقة العنصر

③ Organic precipitating agents:-

| 2 types.

form slightly solable nonionic product coordination compound.

form products that are largely ionic.

Day 24 / 11 / 2013.

* Note :-

Organic reagents yield low soluble compounds contain 2 functional group. each group cepable to bond with a cation.

metal ⇒ This reagent called : chelating agent

The product called :- chelates. مركب معقد

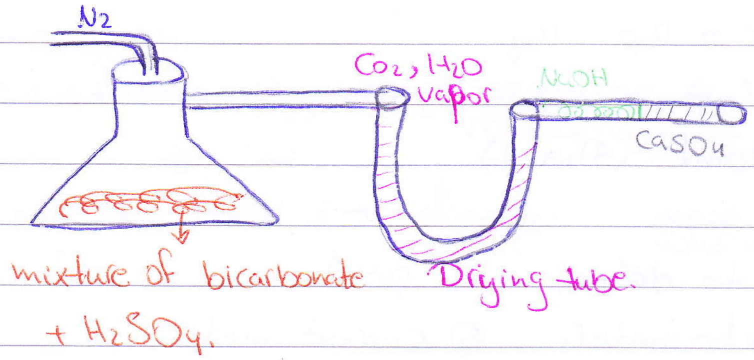
مهمة * Metal chelate :- non polar, low soluble in H_2O, but high soluble in organic liquid.

* e.x :- ① 8-hydroxy quindine (Oxine)... low soluble Chelate.

② Dimethyl glyoxine :- organic ppt agent Ni (II). النيكل فقط.

③ Sodium titra phenyl Burate :- special for Na and ammonium ions.

[illegible] * Volalilization Gravimetry :- To det" H_2O, CO_2.



$CO_2 + NaOH \longrightarrow Na_2CO_3 + H_2O.$

$NaHCO_3 + H_2SO_4 \longrightarrow CO_2 + H_2O + NaHSO_4.$

Day 24 / 11 / 2013. *Chapter (13)*

* Titrimetric methods, precipitation titrimtry:-

def": Analytical methods based on det' the quantity of reagent of known [ ] that required to react completly with the analyte.

*Volumetric titrimetry:-

Measure the volume of standard reagent.

26/11

* $\boxed{13-A}$ Some terms used in volumetric titrimetry:-

مادة معروف تركيزها * standard solution :- reagent with known [ ].

* Titration :- process in which a standard reagent is added to solution of analyte until the RXN between analyte and reagent complete.

* Back titration :- The excess of a standard solution used to consume an analyte is det" with a second standard solution.

لا نراها بالعين المجردة * Equivelence Point :- # of mole Acid = # of mole base.

تغير اللون * End point :- The point when we see the color change.

لهم نفس القيمة

* E_t = titration error = $V_{ep} = V_{eq}$.

→ V_{ep} = end point. (exp) من التجربة.

→ V_{eq} = equivelence point. (theort). من معادلة.

الأدوات * Instrument used to detect end point :-

① Voltmeter. ② Refractometer. ③ Current meter.

* $\boxed{13A-2}$ Primary standard :-

صفات ① High purity. ② Stable. ③ Absence of hydrate (غير رطب)

④ Reasonable solubility. ⑤ Large molar mass.

Day 26 / 11 / 2013.

* 13B Standard Solution :-

① Stable. ② react rapidly with analyte. ③ selective reaction.

الهدف من المعايرة الحصول على التراكيز

* To obtain [ ] in titration :-

[1] Direct method :- weight quantity of primary standard then dissolve it in asolvent then dilute.

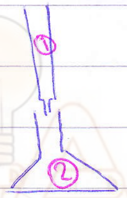
[2] Standardization :-

The titrant (المادة الموجودة بالسحاحة) used to titrate :-

① weight quantity of primary standard.

② " " " Secondary " .

③ Measured volume of standard solution.



~> # mol 1 = # mole 2

$M_1V_1 = M_2V_2$

* 13C Volumetric Calculation :-

** Molarity $= \frac{\# \text{mol}}{V(L)}$.

** Normality $= \frac{\# \text{of equivalence}}{\text{volume}}$ لا نستخدمه حالياً.

** $M \times V = \#$ of moles $= \frac{\text{mass}}{\text{molar mass}}$.

~>

* e.x:- How you prepare 2.0 L of 0.05 M $AgNO_3$ (169.87 g/mol) ??

solu:- ① # of mole = $M \times V$ = 0.05×2 = $\boxed{0.1}$ Mole

② # of mole = $\frac{mass}{M.wt}$ → mass = $0.1 * 169.87$ = $\boxed{16.987}$ g.

---

* e.x:- Standard 0.01 M solution of Na^+ is required to calibrate method to det' metal. How 500 ml of the solution can be prepared from standard Na_2CO_3 (105.99 g/mol)??

solu:- ① # mole = $M \times V$

mole Na = 0.01×0.5 L = $\boxed{0.005}$ mol.

② you have 2 Na^+.

→ # of mol Na = $\frac{0.005}{2}$ = $\boxed{0.0025}$ mol.

③ mass = # of mol × M.wt

= 0.0025×105.99 = $\boxed{0.265}$ g.

---

* e.x:- How would you prepare 50.0 ml of standard solution that is 0.005 M from 0.01 M?

Soln:-

$$M_i V_i = M_f V_f$$

$$\frac{\cancel{0.01}}{\cancel{0.01}} \times V_i = \frac{50.0 \times 0.005}{0.01} \rightarrow V_i = \boxed{25} \text{ ml}$$

Day 28/11/2013.

* $\boxed{13C-3}$ Treating titration data:-

* e.x: 50 ml portion of HCl required 29.71 ml of 0.01963 M $Ba(OH)_2$ to reach the end point. Calculate M of HCl ?

Solu:- ① $2HCl + Ba(OH)_2 \longrightarrow BaCl_2 + 2H_2O$.

نكتب المعادلة ونوزنها

② # of mols $Ba(OH)_2$ = $M \times V$ = $29.71 \times 10^{-3} \times 0.01963$
$= \boxed{5.9 * 10^{-4}}$ mol.

③ 1 mol $Ba(OH)_2$ ⟶ 2 mol HCl
$5.8 * 10^{-4}$ ⟶ x

\# of mol HCl = $\boxed{1.166 * 10^{-3}}$ mol.

④ # mol HCl = $M \times V(L)$ ⟹ $M = \frac{1.166 * 10^{-3}}{0.05} = \boxed{0.0233}$ M

---

* e.x: 0.804 g sample of Fe dissolved in Acid the Iron reduced to Fe^{+2} with 47.22 ml of 0.02242 M $KMnO_4$. Calculate the results of the analysis in % Fe (55.847 g/mol)??

$$MnO_4^- + 5Fe^{+2} + 8H^+ \longrightarrow Mn^{+2} + 5Fe^{+3} + 4H_2O.$$

Solu: ① # mol $KMnO_4$ = $M \times V$ = 0.04722×0.02242
$= \boxed{1.059 * 10^{-3}}$ mol.

② 1 mol MnO_4^- ⟶ 5 mol Fe^{+2}
$1.059 * 10^{-3}$ ⟶ x
$x = \boxed{5.29 * 10^{-3}}$ mol Fe^{+2}.

③ mass = # of mol * Mwt
$= 5.29 * 10^{-3} * 55.847 = \boxed{0.295}$ g

④ % Fe in sample = $\frac{0.295}{6.804} * 100\% = \boxed{36.77\ \%}$

* لما نشوف $KMnO_4$ يعني معايرة *

Day 28/ 11 /2013.

* $\boxed{13D}$ Gravimetric titrimetry :- كتير بمكنة

To det" the mass.

لا نستخدمه (انقرض). ⟶ weight molarity = $\frac{\#\ \text{mole solute}}{\text{kg solution}}$

* Advanteges of weight molarity :-

① No calibration needed.

② Accuracy & precision is higher.

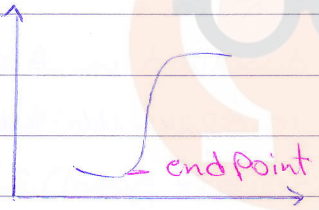
③ Automated.

---

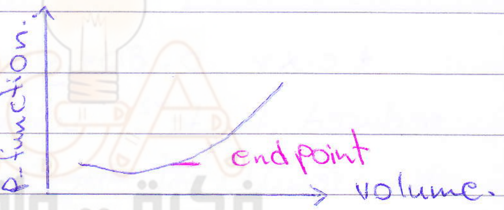
* $\boxed{13E}$ Titration Curve :

* Types :-

① Sigmoidal.

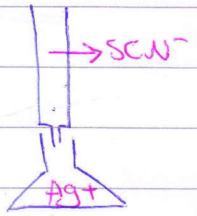


② linear.



* $Ag^+ + SCN^- \longrightarrow AgSCN$.

* $[Ag^+] \downarrow$, $V(SCN^-) \uparrow$.



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* $\boxed{13F}$ ppt titrimetry :- وجود راسب أثناء ما نعاير.

(Argentometric method) : The ppt reagent is $AgNO_3$.

⟶ Used for ppt CN^-, halids, SCN^-.

Day 1 / 12 / 2013.

* e.x : perform Calculation needed to generate atitration curve for 50 ml of 0.05 M NaCl with 0.1 $AgNO_3$ for AgCl, ($Ksp = 1.82 * 10^{-10}$)?

$$Ag^+ + Cl^- \rightleftharpoons AgCl.$$

[1] If 10 ml $AgNO_3$ added? (pre equ. point)

نحل خطوة هونه على جنب ⟶ $M \times V = M \times V \rightsquigarrow 0.05 \times 50 = 0.1 \times V \rightarrow V = 25$ ml

$\rightarrow$ original of mole NaCl $= M \times V = 0.05 \times 0.05 (L) = \boxed{0.0025}$ mol NaCl

$\rightarrow$ # of mol $AgNO_3 = M \times V = 0.1 \times 0.01 = \boxed{0.001}$ mol.

$\rightarrow [NaCl] = \dfrac{\text{original - Added}}{\text{Total volume.}} = \dfrac{0.0025 - 0.001}{(50+10) * 10^{-3}} = \boxed{0.025}\ M$

$\rightarrow [Cl^-] = \boxed{0.025}\ M.$

ksp $\rightsquigarrow [Ag^+] \rightsquigarrow ksp = 1.82 * 10^{-10} = [Ag^+][0.025] = \boxed{7.28 * 10^{-9}}\ M.$

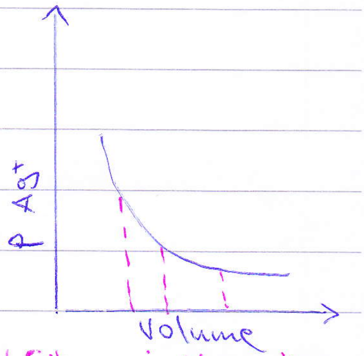
$p[Ag^+] = -\log[Ag^+] = \boxed{8.14}$

[2] At equ. point

$Ag^+ = Cl^- \rightsquigarrow ksp = [Ag^+]^2 = 1.82 * 10^{-10}$

$[Ag^+] = \boxed{1.34 * 10^{-5}}\ M.$

$p[Ag^+] = \boxed{4.87}$



نرسم المنحنى بعد الانتهاء من كل.

أهم نقطة

[3] post-equivelance:-

At 26 ml $AgNO_3$? Ag excess.

** $[Ag^+] = \dfrac{\text{excess - original}}{\text{Volume.}} = \dfrac{(26 * 0.1 * 10^{-3}) - (0.0025)}{(50 - 26) * 10^{-3}} = \boxed{4.167 * 10^{-3}}\ M$

$p = \boxed{2.4}$

excess $\rightarrow$ # of mol for excess

original $\rightarrow$ # of mol for original.

Volume $\rightarrow$ not the total volume. ⟵ لأنني بدي أحافظ على حجم المحلول حول الاتزان.

Day 1 / 12 / 2013.

* Indicators for Argentimetric titration:-

Mohr's method	Fajon's method	Volhard method (Back titration)
*Indicators chromate ion	fluorescein	Iron (III)
* pH:- 7-10	أقرب للمتعادل.	Acidic medium
*To det" halids,CN	⇌ نفس الشيء	⇌ نفس الشيء.
*colors:- Red	Red	Red

Use thiocyanate ion.

⇓

الشيء الذي يميز تجربته.

Day 3 / 12 / 2013.

* Chapter (14) *

* principles of Neutrilization titrations:-

* Neutrilization RXN :- Acid - Base rxn.

* [14A-1] Standard solution :- Solution with known [ ].

* Standard solution of Acids :- prepared by diluting.
HCl, sulfuric Acid, perchloric ?? → strong Acids since the react
(تتفكك كلياً). completly with analyte.

* Standard solution of Base, prepared by solid
NaOH, KOH, $Ba(OH)_2$.

* [14A-2] Acid - Base indecators:- يجب أن يكون ضعيف.
Weak organic Acid or base.

* e.x :-

$$HIn + H_2O \rightleftharpoons H_3O^+ + In^-$$

→ HIn :- Acid indecator.

$$In^- + H_2O \rightleftharpoons InH + OH^-$$

→ In^- :- Base indecator.

دائماً معطى. * $\boxed{ka} = \frac{[In^-][H_3O^+]}{[HIN]} \Rightarrow [H_3O^+] = \frac{ka\,[HIn]}{[In^-]}$.

→ Note :- If $\frac{[HIn]}{[In^-]} \geq 10$ acid color. (لون فاتح)
→ $[H_3O^+] = 10\,ka$.

If $\frac{[HIn]}{[In^-]} \leq \frac{1}{10}$ Base color. $[H_3O^+] = 0.1\,ka$.

** $\boxed{PH = pka \mp 1}$

→

Day 3 / 12 / 2013.

* Titration errors with Acids / Base indicators:-

① Determinate error ; occur when pH at which the indicator changes color differs from pH at eqn. point.
→ make correction using blank k.

② Indeterminate error :- from eyes.

* The errors depend on :-

[1] [Indicator].

[2] Sensitivity of eyes reading.

[3] Change of pH.

* Variables influence the behavior of Indicators :-

① Tempreture. ② presence of organic solvent.

③ μ of the medium ↔ (pH) من ضمنها.

Day 5 / 12 / 2013.

* Titration of strong acids and strong bases:

$[H_3O^+] = C_{strong\ acid} + [OH^-] \approx C_{strong\ acid}$.

$[OH^-] = C_{strong\ base} + [H^+] \approx$ strong base.

*[14B-1] Titrating astrong acid with strong base:

$\boxed{pK_w = pH + pOH}$ *.

$-\log 10^{-14} = \boxed{14}$.

*e.x:- Generate ahypothetical titration curve for titration of 50.0 ml of 0.05 M HCl with 0.1 M NaOH?

ⓐ After the addition of 10 ml reagent ?

solu: $M \times V = M \times V$

$0.05 \times 50 = 0.1 \times V \longrightarrow V_{NaOH} = \boxed{25}$ ml

ⓐ $C_{HCl} = \dfrac{\text{original \# mol HCl} - \text{\# mol NaOH added}}{\text{Total volume}}$.

$C_{HCl} = \dfrac{(0.05 \times 50 \times 10^{-3}) - (0.1 \times 10 \times 10^{-3})}{(0.05 + 0.01)\ L} = \boxed{2.5 \times 10^{-2}}\ M = [H_3O^+]$.

$pH = -\log[H_3O^+] = \boxed{1.60}$

ⓑ After the addition of 25.0 ml reagent ?

$[H^+] = [OH^-] = 1.0 \times 10^{-7}$.

$pH = \boxed{7}$

ⓒ After the addition of 25.10 ml reagent.

$C_{NaOH} = \dfrac{\text{\# mol NaOH added} - \text{\# mol original HCl}}{\text{Total volume}} = \dfrac{(0.025 \times 0.1) - (0.05 \times 0.05)}{(0.05 + 0.0251)}$

$= \boxed{1.33 \times 10^{-4}}$

$pOH = \boxed{3.88} \longrightarrow \therefore pH = 14 - 3.88 = \boxed{10.12}$

* Choosing an indicator :

Bromothymol is the best with the lowest error , low [ ] .

* [14B-2] Titrating astrong base with astrong acid :-

* e.x:- Calculate the pH during titration of 50 ml of 0.05 M NaOH with 0.1 M HCl after the addition of ⓐ 24.5 ml ? ⓑ 25 ml ? ⓒ 25.5 ml ?

solu:-

① $M \times V_{acid} = M \times V_{base}$

$0.1 \times V = 0.05 \times 50 \longrightarrow V = \boxed{25}$ ml end point

ⓐ At 24.5 ml ? (befor end point).

$$C_{NaOH} = \frac{\#\text{ mole original of NaOH} - \#\text{ mole HCl added}}{\text{Total Volume}}$$

$$= \frac{(0.05 \times 50 \times 10^{-3}) - (0.1 \times 24.5 \times 10^{-3})}{(0.05 + 0.0245)} = \boxed{6.71 \times 10^{-4}}$$

$pOH = -\log(6.71 \times 10^{-4}) = 3.17$

$pH = 14 - 3.17 = \boxed{10.83}$.

ⓑ At 25 ml ? (pH = 7 At end point).

ⓒ At 25.5 ml ?

$$C_{H_3O^+} = \frac{\#\text{ mol HCl Added} - \#\text{ mol original}}{\text{Total Volume}}$$

$$= \frac{(0.025 \times 0.1) - (0.05 \times 50 \times 10^{-3})}{(0.05 + 0.0255)} = \boxed{6.62 \times 10^{-4}}\ M$$

$pH = \boxed{3.18}$

Day 8 / 12 / 2013.

* $\boxed{14C}$ Titration curve for weake acids:

*e.x: Generate a curve for titration of 50 ml of 0.1 M Acetic Acid with 0.1 M NaOH? Calculate Intial pH, $ka = 1.75\times10^{-5}$?
1- After the addition of 5 ml ? 2- After the addition of 25 ml ?
3- At the equivalance point ? 4- After addition of 50 ml ?

Solu:-

$[H^+] = \sqrt{ka\, C_{HOAc}} = \sqrt{1.75\times10^{-5}\times 0.1} = \boxed{1.32\times10^{-3}}\, M$

$pH = \boxed{2.88}$.

① $C_{HOAc} = \dfrac{\#\text{ mol HOAc Original} - \#\text{ mol NaOH added}}{\text{Total volume}}$

$= \dfrac{(0.05\times0.1)-(0.005\times0.1)}{(50+5)\times10^{-3}} = \boxed{0.0818}$.

$C_{NaOAc} = \dfrac{0.005\times0.1}{0.055} = \boxed{9.1\times10^{-3}}\, M.$

التركيز = تركيز المضاف
الحجم الكلي .

$ka = [H^+] * 9.1*10^{-3} = 1.75*10^{-5}$

$[H^+] = \boxed{1.58*10^{-4}}\, M$ $\rightsquigarrow$: $pH = \boxed{3.80}$

② $C_{NaOAc} = \dfrac{0.025\times0.1}{(0.05+0.025)} = \boxed{0.033}\, M.$

$ka = 1.75*10^{-5} = [H^+] * 0.033$

$[H^+] = 5.3*10^{-4}\ M.$ $\rightsquigarrow$: $pH = \boxed{3.28}$

③ $\dfrac{kw}{ka} = kb \longrightarrow = \dfrac{1*10^{-14}}{1.75*10^{-5}} \rightsquigarrow kb = \boxed{5.71*10^{-10}}$.

$[OH^-] = \sqrt{kb\times C^{0.1}_{NaOH}}$

$pH = \boxed{8.73}$

* إذا كان المحلول يحتوي على buffer فهما يضيف
H2O لا تتأثر قيمة pH *
* يختار ال indecator حسب قيمة ka *

* Chapter (17) *

* Complexation rxn and titration:-

* $\boxed{17A}$ The formation of complexes:-

Most metal ions react with ē pair donor to form compounds = complexes.

*e.x:- Ammonia, halids, H_2O ⇒ (In organic ligand).

يجب أن يحتوي على زوج ē غير رابط.

* Ligand :- Ion or molecule that forms acovalent bond with acation.

*e.x:- $Cu(II) \xrightarrow{H_2O} Cu(H_2O)_4^{+2}$

العناصر الانتقالية تكوّن مركبات معقدة.

* The # of Covalent bond the cation forms:-

(2,4,6) → دائماً أرقام زوجية.

*Note : Complex might be (-ve) or (+ve) or neutral.

* Complexometric method:-

Titrimetric based on complex formation.

* Chelate :- produced when metal ion coordinates with two or more donor groups of single ligand.

* Marcoro cycle :- metal ion + Cyclic organic compounds.

* Unidentate :- ligand has asingle donor group.

*e.x:- Ammonia.

* $\boxed{17A-1}$ Complexation equilibrium:-

* Equilibria constant:-

$$M + L \rightleftharpoons ML \qquad K_1 = \beta_1 = \frac{[ML]}{[L][M]}.$$

Day 22 / 12 / 2013.

$M + 2L \rightleftharpoons ML_2$. $k_1k_2 = \beta_2 = \frac{[ML_2]}{[L]^2[M]}$.

$M + 3L \rightleftharpoons ML_3$. $k_1k_2k_3 = \beta_3 = \frac{[ML_3]}{[L]^3[M]}$.

فقط للعلم * Alpha Valu:- fraction of total metal concentration existing in the form.

$$** \; \alpha_M = \frac{1}{1 + \beta_1[L] + \beta_2[L]^2 + \dots + \beta_n[L]^n}.$$

$$** \; \alpha_{ML} = \frac{\beta_1[L]}{1 + \beta_1[L] + \beta_2[L]^2 + \dots + \beta_n[L]^n}$$

* $\boxed{17A-2}$ The formation of insoluble species:-

The complexes formed are soluble in solution, but addition of ligand to metal ion results in insoluble:-

$Ag^+ + Cl^- \longrightarrow AgCl$ (insoluble).

Adding large excess of Cl^-, produce soluble species, Such as:- $AgCl_2^-$, $AgCl_3^{-2}$...

ملاحظة * $M_xA_y \rightleftharpoons x\,M^{+y}_{(aq)} + y\,A^{-x}_{(aq)}$

$K_{sp} = [M^{+y}]^x \; [A^{-x}]^y$.

* 17A-3 Ligand that can protonate:-
When they are weak Acid.
* complexation with protonated ligands:-
HL, H_2L ... H_nL.
adding acid to asolution containing M and L, will reduces [ ] of free L.
*e.x:- oxalate H_2Ox.

مهم ** $C_T = [H_2Ox] + [HOx^-] + [Ox^{-2}]$. charge palance equ.

$$\alpha_0 = \frac{[H_2Ox]}{C_T} = \frac{[H^+]^2}{[H^+]^2 + ka_1[H^+] + ka_1ka_2}$$

$$\alpha_1 = \frac{[HOx^-]}{C_T} = \frac{ka_1[H^+]}{[H^+]^2 + ka_1[H^+] + ka_1ka_2}$$

$$\alpha_2 = \frac{ka_1 + ka_2}{C_T}$$

مهم $\rightsquigarrow$ ** $[Ox^{-2}] = C_T \boxed{\alpha_2} \longrightarrow$ القيمة لأكثر مركب (الخالي من H).

* Additional formations Constants:-
pH-constant :- Constant depends on pH.

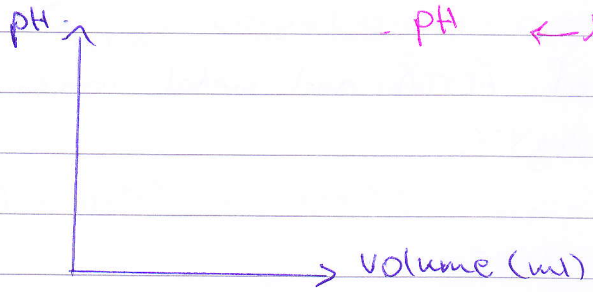
الورقة $\rightsquigarrow$ $k_i' = k_1\alpha$ (نستخدم هنا القانون لما يكون ال const. بنعوض قيمة pH)

Day 24/ 12/2013.

* 17B Titration with inorganic complexing agent :-

فقط لمعرفة طرفي المنحنى : كل محور x عليه volume .

كل محور y ← pH .



* 17C Organic complexing agent :-

They are used to :-

① To convert metal Ions into forms that can be extracted from H_2O into immisible phase. نضع مادة في المحلول تجمع عليها إحدى المادتين وتبقى الأخرى.

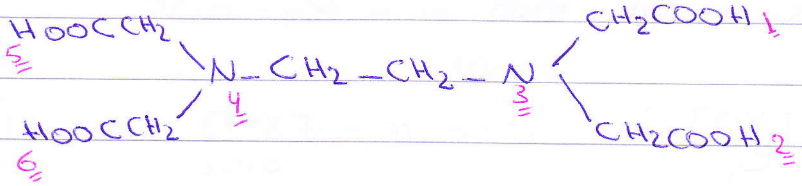
② They are used as masking agent. لتغليف مادة (مادة محددة بالمحلول) عزلها عن المواد المراد إضافتها.

29/12

* 17D Amino carboxylic acid titration :-

* 17D-1 Ethylendiamie tetraacetic acid (EDTA) :- (H4Y) ويرمزله

6 sites for bonding metal Ion.



مواقع ارتباط M .

→ EDTA :- has 4 ka Valuse. حسب عدد ال (COOH).

* Reagents for (EDTA) :-

$Na_2H_2Y . 2H_2O$.

Day 29/ 12/ 2013.

→ 4 ka values :-

H_4Y , H_3Y^- , H_2Y^{-2} , HY^{-3}.

* $\boxed{17D-2}$:- Complexes of EDTA and metal ions:-

$$Ag^+ + Y^{-4} \rightleftharpoons AgY^{-3}.$$

$$Al^{+3} + Y^{-4} \rightleftharpoons AlY^-.$$

* $\boxed{17D-3}$ Equilibrium Calculation involving EDTA:-

** $C_{T_{EDTA}} = [Y^{-4}] + [HY^{-3}] + [H_2Y^{-2}] + [H_3Y^{-3}] + [H_4Y]$.

** $\boxed{\alpha_4 = \frac{[Y^{-4}]}{C_T}} = \boxed{\frac{k_1k_2k_3k_4}{D}}$

* بيجي بالامتحان أكيد

بس كل مرة α محسوبة .

*e.x:- Calculate the $[Y^{-4}]$ in 0.02 M EDTA solution buffered to pH = 10.00 ?

أعطاني قيمة pH متى استخرج قيمة α من جدول

Solu:-

α_4 at pH = 10.0 ⟶ $\alpha_4 = 0.35$.

$$\alpha_4 = \frac{[Y^{-4}]}{C_T} \longrightarrow 0.35 = \frac{[Y^{-4}]}{0.02} \longrightarrow \therefore [Y^{-4}] = \boxed{7 \times 10^{-3}} M$$

*e.x:- Calculate $[Ni^{+2}]$ in asolution prepared by mixing 50.0 ml of 0.03 M Ni^{+2} with 50.0 ml of 0.05 M EDTA pH = 3 ?

Solu:-

Day 29 / 12 /2013.

① $C_{NiY^{-2}} = \frac{M \times V}{\text{Total Volume}} = \frac{50.0 \text{ ml}}{100 \text{ ml}} \times 0.03 = \boxed{0.015}\ M$

② $C_{EDTA} = \frac{(0.05 L \times 0.05) - 0.015 M}{0.1 L} = \boxed{0.01}\ M.$

تركيز ال EDTA الموجود داخل ال complex

③ $[Ni^{+2}] \ll [NiY^{-2}] \longrightarrow [NiY^{-2}] = \boxed{0.015}$

لم ال أمجموع [Ni+2] لأننا أهملناه لصغره.

$C_{EDTA} = 0.01\ M$

$\alpha_4 k = k'$

بعد اشتقاق نتوصل لقانون

$$** \boxed{[Ni^{+2}] = \frac{C_{NiY^{-2}}}{\alpha_4 * C_{EDTA}}}$$

α_4 at pH=3 is $1.05 * 10^{8}$.

$\therefore [Ni^{+2}] = \frac{0.015}{1.05*10^{8} * 0.01} = \boxed{1.4*10^{-8}}\ M.$

Day 31 / 12 /2013.

* [17D-7] Titration methods employing EDTA :-

* Direct titration :-

① Methods based on indicators for the analyte.
40 metal can be det" - with EDTA.

② Methods based on indicators for an added metal ion.
Eriochrome Back T.

* Spectrophometric methods :-

2 Types :- ① Back titration available for Cr III و Co III .

② Displacement method :- الإحلال.

$MgY^{-2} + M^{+2} \longrightarrow MY^{-2} + Mg^{+2}$.

* Masking agent :- Acomplexing agent that react selectively with Component by prevent that component from rxn.

* أهمية تفاعلات الـ (EDTA) :

The det" of H_2O hardness:- عُسر الماء

(وجود عناصر مترسبة في الماء).

Water hardness :- Contain Ca, Mg and heavy metal ions that form ppt with Soap.