

تقدم لجنة EiCoM الاكاديمية

دفتر الفاينال لمادة:

أساسيات الكيمياء العامّة العملية

جزيل الشكر للطالبة:

مرح أسود



* Exp. 1 :- "Safety, Equipments and weighing"

~~Researching instruments for accuracy~~ :-

1. grad. cylinder → used to transfer liquids with low accuracy
2. Er. flask → for titration with swirling (تحريك للتفاعل)
3. Beaker → Chemical Reactions (rxns)
4. glass Rod → Beaker للتفاعل الموجود في الـ Beaker
5. Funnel :- قمع
6. test tube :- simple Chemical Reactions
7. spatula :- أداة تستخدم لأخذ كمية من المواد الصلبة مثل "المعلقة"
8. weighing poots :- أداة يوضع على الميزان لتوزين الكمية المرادة
9. Wash bottles :- distilled water يكون فيها
10. Reagent bottles :- Chemical التي يبيء اشغل فيها يكون فيها
11. pipette :- used to transfer liquids with high accuracy ^{دقة} ^{أكثر دقة}
12. pipette filler :- ^{دقة} من الأدوات التي يستخدمها حتى لسحب السوائل مع الـ pipette.
13. Burette :- ^{دقة} للاقتلاف الوسيط بينا وبين الـ pipette
لأن الـ pipette يتوقع فقط 25 ml
أما الـ Burette فيضخ تدريج لحد 50 ml

14. Vol. Flask :- used to ^{لجهاز فيه} prepare ^{مجايل} solution with high accuracy

* Decreasing in trend of accuracy of tools :-

Pipette > Burette > Vol. Flask > grad. cylinder > Beaker > Er. Flask.

* some of safety Rules :-

1. Not allowed in lab: Eating, Drinking, short skirts.

2. Do not return any excess chemicals to the reagent bottles or bottles of solid material.

3. Do not use the chemicals on the side shelves, unless the lecturer told.

4. Don't use your mouth to fill or taste chemical.

5. Use ^{غطاء} fume hood for reactions with toxic gases.

6. Don't ^{تخلص} dispose solids into sink.

7. Don't point the test tube toward u during heating or toward ^{اياه} any person.

8. wear safety glasses and lap coat.

* Weighing :-

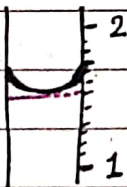
- If balance has two decimal : $5\text{g} \Rightarrow 5.00\text{g} \pm 0.01$ ^{uncertainty}
one decimal : $5\text{g} \Rightarrow 5.0\text{g} \pm 0.1$

$$\begin{array}{r} \text{مثال} \\ + 5.00 \pm 0.01 \\ 6.129 \pm 0.01 \\ \hline \Rightarrow 11.12\text{g} \pm 0.02 \end{array}$$

* لما اكونه بدي اوزنه غبنة داخل ال Beaker قتلد ووا بدي وزنه ار Beaker
 دماي الحالة بعبس على $\frac{0}{T} \pm \frac{tar}{2}$ دهاد بوخذ وزن الصبنة فقط

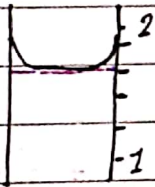
* Volumes

من صبنة نافار
 القراية من
 التقعر



والبسمة كانه التدرج 0.1 \rightarrow التدرج $\frac{0.1}{2}$
 $\Rightarrow 1.60 \text{ ml} \pm \frac{0.1}{2}$
 تدرج الصبنة بالحجوم

$$\therefore 1.60 \text{ ml} \pm 0.05$$

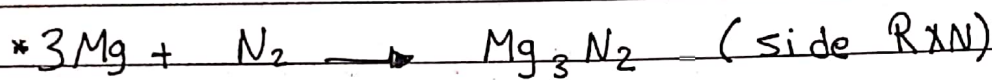
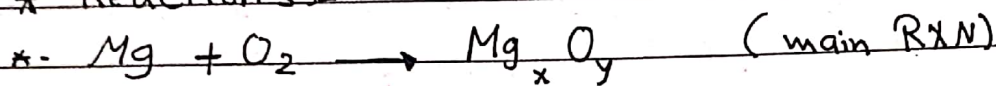


التدرج صبنة 0.2 \rightarrow $\frac{0.2}{2}$
 $= 1.60 \text{ ml} \pm 0.1$

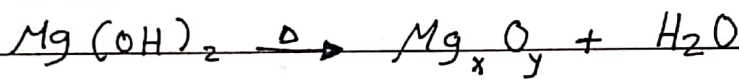
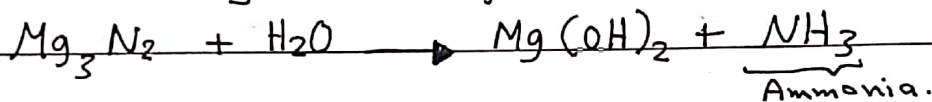
Exp. 2 / Empirical Formula of a compound.

Empirical Formula :- simplest whole number ratio of atoms in compound

* Reaction :-



* Avoiding the side RXN :-



$$\text{Moles} = \frac{\text{Mass}}{\text{Molar Mass}}$$

1:- Heating before starting :- to remove the moisture

2:- Don't weight the crucible when its hot.
its gives wrong accurate.

3:- Don't cover the crucible widely :-
its burns Mg brightly

4:- Adding a few water drops :-
To decompose Mg_3N_2

* What is the effect of Mg:O Mole ratio if:-

- Mg_3N_2 Not decomposed completely \Rightarrow Increased \uparrow
- Mg_3N_2 decomposed completely \Rightarrow No effect
- Carbon deposited on the crucible surface \Rightarrow Decrease \downarrow
- Carbon not deposited on the crucible surface \Rightarrow No effect
- Magnesium oxide ash is not dried completely \Rightarrow Decrease \downarrow
- Magnesium oxide ash is dried completely \Rightarrow No effect.
- Air is not sufficient to react with all the Mg \Rightarrow Increase \uparrow
- Air is sufficient to react with all the Mg \Rightarrow No effect.
- Nonvolatile and unreactive impurities in the crucible during oxidation \Rightarrow Decrease \downarrow
- Nonvolatile and unreactive impurities in the crucible from the beginning \Rightarrow No effect.
- if the balance reads ± 0.02 g for any reading \Rightarrow No effect
- Rapid oxidation of Magnesium \Rightarrow Increase \uparrow

what is the effect of O: Mg Mole ratio if? * لو كان الأوكسجين

مزيداً من الأوكسجين

سؤال
 Q :- 0.1000 g sample containing C (FM=12), H (FM=1) and O (FM=16) only was burned in air and produced 0.1910 g of CO₂ and 0.1172 g of H₂O
 What is the empirical formula of the compound??

CO₂ ⇒ (2*16) + (1*12) = 44
 H₂O ⇒ (2*1) + (1*16) = 18

Moles = $\frac{\text{Mass}}{\text{Molar Mass}}$

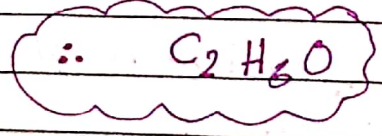
C = $\frac{0.1910}{44} \times ① = 0.0043$ = 1 * 2 = 2
 H = $\frac{0.1172}{18} \times ② = 0.01302$ = 3 * 2 = 6

$\div 0.0043$
 = 1 * 2 = 2
 = 3 * 2 = 6

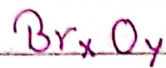
Mass O = 0.100 - (0.0043 + 0.01302) = 0.08268

O = $\frac{0.08268}{16} = 0.00516$ = 1.2

$\div 0.0043$



Ex :- A 2g sample of bromide oxide is converted to 2.936 g of AgBr, calculate the EF of the oxide.



$$\text{Mass of O} = 2 - \text{Mass of Br.}$$

$$\text{Mole AgBr} = \frac{2.936}{187.78} = 0.0156 \text{ mol}$$

$$1 \text{ moles from AgBr} \rightarrow \text{0.0156}$$

$$1 \text{ moles Br} \rightarrow x$$

$$x = 0.0156 \text{ Mol}$$

$$\text{Moles Br} = \frac{\text{Mass}}{\text{M. Mass}} \rightarrow \text{Mass} = 80 \times 0.0156 = 1.25$$

$$\therefore \text{Mass of O} = 2 - 1.25 = 0.75$$

$$\text{O} = \frac{0.75}{16} = 0.046$$

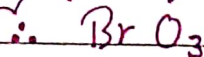
$$\text{Br} = \frac{1.25}{80} = 0.0156$$

$$\text{O} = 3$$

$$0.0156$$

حذف القيمة *

$$\text{Br} = 1$$



Ex 3 :- Limiting Reaction (L.R)

L.R :- Reactant that is consumed firstly in the Chemical rxns and determine amount of product.

Actual yield :- amount of product that is produced actually in the lab.

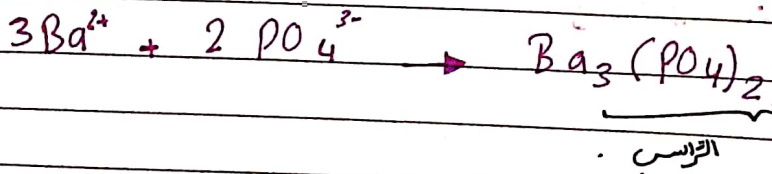
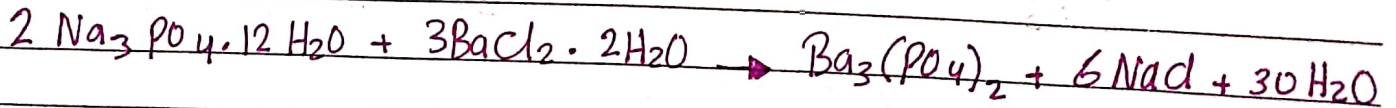
Theoretical yield :- amount of product that is ~~produced~~ expected to be produced

$$\% \text{ yield} = \frac{\text{Actual yield}}{\text{Theoretical yield}} \times 100 \%$$

* ^{التزيب} supernatant :- The clear solution over (Above) ppt.

ppt :- contains (Excess + products)

* This RXN is endothermic ^{تأخذ الحرارة}



صافي
المعادلة
الأيونية

* If the product is not dried completely, Act. yield inc \uparrow , and
So % yield inc \uparrow

* Coarse filter paper is used ~~to~~ will cause the loss of product
which means Act. yield dec \downarrow and % yield dec \downarrow

* Washing of ppt with acid \Rightarrow loss of product due to solubility
of product with acid \Rightarrow Act. yield dec \downarrow \Rightarrow % yield dec

* Not sufficient washing of ppt with water \Rightarrow excess presents
 \Rightarrow Act. yield inc \uparrow \Rightarrow % yield inc \uparrow

* post ~~lab~~ Lab parts ..

- What is the effect on the actual yield of the $\text{Ba}_3(\text{PO}_4)_2$

1. Using a coarse paper \Rightarrow decrease.
2. Insufficient washing of the ppt \Rightarrow increasing.
3. Using Acidic to wash the solution \Rightarrow decrease.
4. The ppt wasn't dried completely \Rightarrow increase.

- What is the effect of heating the solution on the particle
size of $(\text{Ba}_3(\text{PO}_4)_2)$ ppt? It makes a conglomeration.

Q:-

- Don't boil the solution :-
To minimize the loss of the mass.
- Using distilled water :-
To provide the reactions of the unknowns.
- The RXN in the L.R Exp isn't endothermic? False.
- In appt of $Ba_3(PO_4)_2$ the factor that might lead to decrease the percentage yield is?

Using a filter paper with coarse porosity.

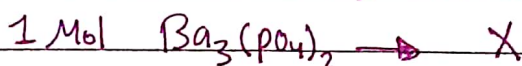
Ex: A mixture containing 40 g of $Na_3PO_4 \cdot 12H_2O$ and 30 g of $BaCl_2 \cdot 2H_2O$ is dissolved in water, an precipitate of $Ba_3(PO_4)_2$ weighing 22.65 g is produced calculate the % yield of $Ba_3(PO_4)_2$.

$$\text{Moles of } PO_4^{3-} = \frac{40}{380.2} = 0.1052$$

بناظرها صيغة المول الجزيئي
 $\Rightarrow \frac{0.1052}{2} = 0.0526$
(2) عدد الجزيئات

$$\text{Moles of } Ba^{+2} = \frac{36}{244.2} = 0.1228$$

هو المول الجزيئي
 $\Rightarrow \frac{0.1228}{3} = 0.0409$



$$X = 0.04093 \text{ mol}$$

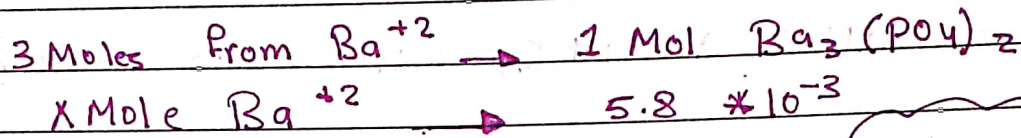
$$\% \text{ yield} = \frac{22.65}{24.65} * 100\% = 91.88\%$$

$$0.04093 = \frac{\text{Mass}}{24.65}$$

$$\text{Mass} = 24.65$$

Ex: 10 g of unknown mixture containing $\text{Na}_3\text{PO}_4 \cdot 12\text{H}_2\text{O}$ and $\text{BaCl}_2 \cdot \text{H}_2\text{O}$ is dissolved in distilled water. The mass of $\text{Ba}_3(\text{PO}_4)_2$ precipitated is 3.5 g, calculate the % of each salt present in the mixture if the BaCl_2 is the LR?

$$\frac{3.5}{602.2} = 5.8 \times 10^{-3}$$



$$X = 0.0174 \text{ Mol}$$

$$0.0174 = \frac{\text{Mass}}{244.2} \rightarrow \text{Mass of } \text{Ba}^{+2} = 4.25$$

$$\% \text{Ba}^{+2} = \frac{4.25}{10} \times 100\% = 42.25\%$$

$$\% \text{PO}_4^{-3} = 100\% - 42.25\% = 57.75\%$$

سؤال

Ex: Given the following equation $3A + B \rightarrow C + D$ by reacting 1 mole of A with 1 mole of B which the LR and why??

$$A = \frac{1}{3} = 0.33$$

المواد المتفاعلة
المواد المتبقية لتفاعل

$$B = \frac{1}{1} = 1$$

$$0.33 < 1 \rightarrow A \text{ is LR}$$

we have react 1 Mol from A and we need 3 Mol.

Exp 4 :- Identification of cpds by physical Properties.

الذائبة - solution = solute + solvent

1) Solubility :- like dissolves in like polar in polar and non polar in polar.

polar + non polar \rightarrow In soluble (immiscible) لا يذوب

2) Density = $d = \frac{m}{V}$ (pipette 10 ml and weight it, then you can calculate the density at the unknown)

3) Boiling Point = B.p = temp at which (V.P)_{liq} = atmospheric pressure.

* Normal B.P : temp at which (V.P)_{liq} = 1 atm = atm pressure

Polar	Non polar	solvent + solute \rightarrow Result
Acetone	Cyclohexane	Polar + pola \rightarrow soluble
2-butanone	Cyclohexane	n.p + n.p \rightarrow soluble
Ethanol	Heptane	Polar + n.p \rightarrow In soluble
Ethylacetate	n-hexane	
Isopropanol	1-hexene	
Methanol		
n-propanol		

* At B.p temp remains constant until the entire volume at the liq, has been converted to vapor.

B.P. \ll vapour pressure

* when air bubbles escape rapidly from the capillary tube, the $(V.P.)_{liq} > atm. pressure$, $Temp > B.P$ and the temp that is taken will be higher than the true value at B.P.

* When the liq enters the capillary tube the $atm. pressure > (V.P.)_{liq}$ and if H_{emp} is taken, it will be lower than B.P (the true value)

* The temp is taken while (not before or after) the liq enters the capillary tube, at this moment $(V.P) \approx atm. pressure$ nearly.

* If some of the unknown adheres (cling) in the pipette while density procedure is done
• mass dec \downarrow , density dec \downarrow (lower than the true value)

Q :-

1. What physical property measurable in the experiment distinguishes cyclohexane from cyclohexane? Boiling point.

2. Using apparatus described in this experiment when should the boiling point of a liquid be recorded?

when the bubbles cease to escape and before the liquid re-enters the capillary tube.

3. How does atmospheric pressure affect the boiling point of a liquid? Directly.

4. How do intermolecular forces affect the boiling point of a liquid? Directly.

5. Boiling point of a solution larger than boiling point of solvent?
Because it has stronger intermolecular forces.

6. If several drops of liquid unknown cling to the pipette wall after delivery, will the density of the unknown be reported too high or too low?

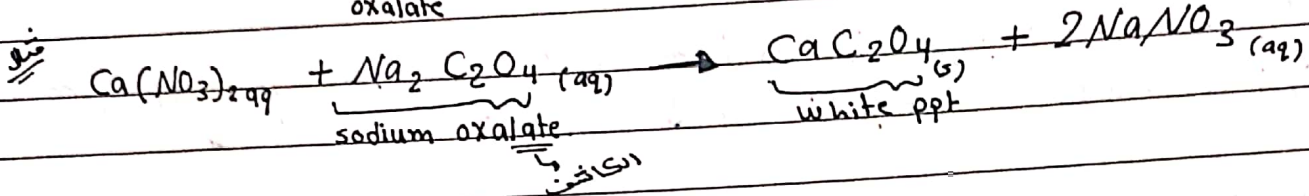
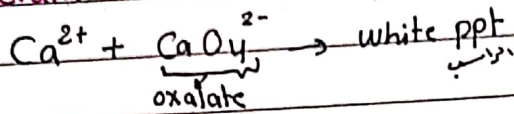
Too low. Mass will decrease then density will decrease.

7. Can you predict when $V_P = P_{atm}$ theoretically?
NO.

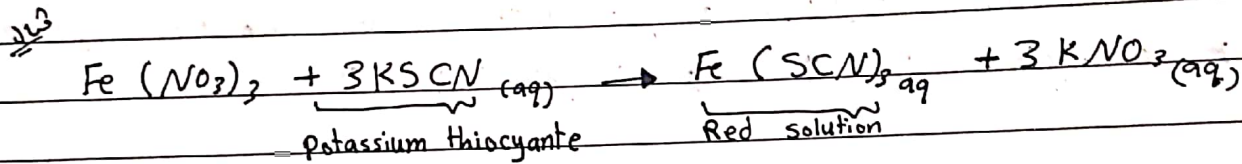
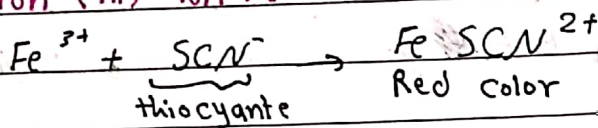
Exp. 5 :- Cation and anions tests

* - Cations :-

1. Calcium ion Ca^{2+}

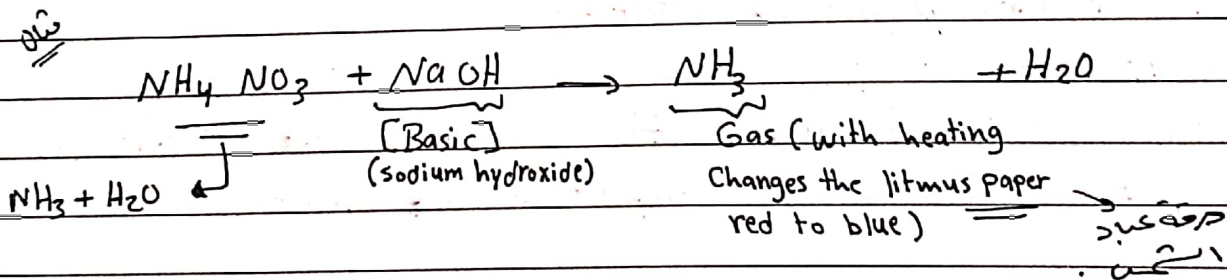
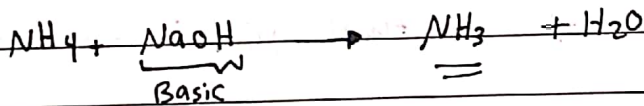


2. Iron (III) ion Fe^{3+}



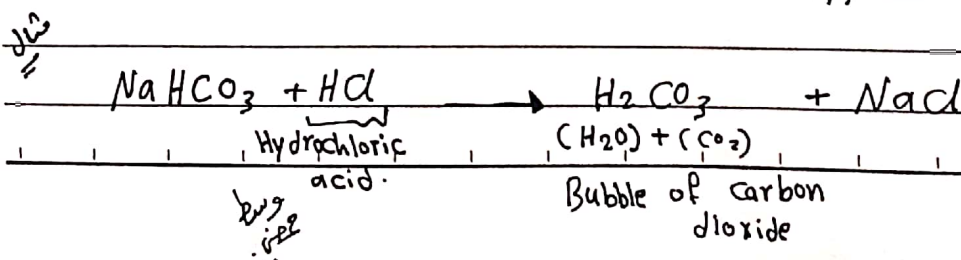
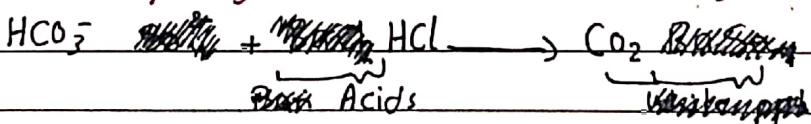
3. Ammonium ion NH_4^+

(مطلوب الايون فقط)

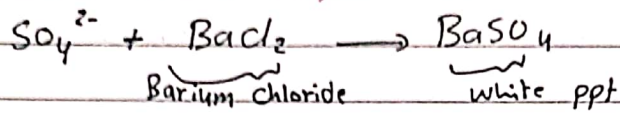


* - Anions :-

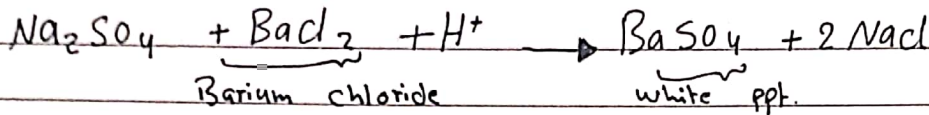
1. Hydrogen carbonate ion HCO_3^-



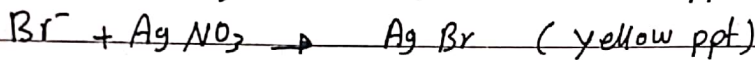
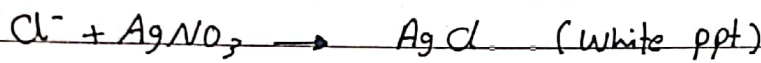
2. Sulfate ion $(SO_4)^{2-}$



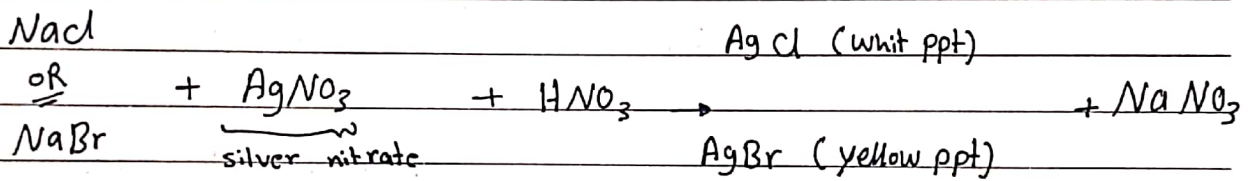
Ex



3. Chloride and Bromide ion Cl^- and Br^-



Ex :-



Ex :-

	$AgNO_3$	$BaCl_2$	CO_3^{2-}
AB	+ve Yellow ppt	-ve	+ve
CD	-ve	+ve	+ve

AB: $CaBr_2$

CD: $CaSO_4$

Exp 6 :- Molar Mass of volatile liquid :-

Avogadro's principle :- Each equal volumes of gases at the same temperature and pressure contain equal number of particles (Molecules).

* Ideal Gas Law :-

$$\begin{array}{c}
 \text{atm} \quad \text{L} \quad \text{Mol} \quad \text{atm} \cdot \text{L} / \text{Kelvin} \cdot \text{mol} \\
 \uparrow \quad \uparrow \quad \uparrow \quad \uparrow \\
 P \cdot V = n \cdot R \cdot T \rightarrow \text{Kelvin} \\
 \text{Mass} \quad \downarrow \\
 \text{Molar Mass}
 \end{array}
 \Rightarrow
 \begin{array}{c}
 \text{Molar Mass} = \frac{mRT}{UP} \\
 \downarrow \\
 \text{Density}
 \end{array}$$

$1 \text{ atm} = 760 \text{ mmHg}$ $K^\circ = C^\circ + 273$ $1 \text{ L} = 1000 \text{ mL} = 1000 \text{ cm}^3$
--

Ex:-

A flask weighs 40.1305g when clean, dry, evacuated
 138.241g when filled with water ($D = 0.997 \text{ g/mL}$) and
 40.2487g when filled with gaseous substance at 470.4 torr
 and 96°C, what is the molar mass (g/mol) of the gas? $R = 0.0821$

$$40.2487 - 40.1305 = 0.1182 \quad \begin{array}{l} \uparrow \\ m \cdot R \cdot T \end{array} \quad \begin{array}{l} \uparrow \\ 96^\circ\text{C} + 273^\circ\text{C} = 369 \text{ K} \end{array}$$

$$\text{Molar Mass} = \frac{m \cdot R \cdot T}{V \cdot P}$$

$$V = \frac{m}{D} = \frac{138.241 - 40.1305}{0.997} = 0.61 \quad \begin{array}{l} \uparrow \\ V \cdot P \end{array} \quad \begin{array}{l} \uparrow \\ \frac{470.4}{760} \end{array}$$

$$\text{M.m} = 58.7$$

* For which of the following compounds can we determine its M.M using the method described in this exp and why??

Benzene (B.P = 78°C) / Glycerol (B.P = 180°C)

بنزين (نقطة غليان = 78°C) / جليسرول (نقطة غليان = 180°C)
البنزين: الجزيئية

* Why should the Erlenmeyer flask be ^{جاف} dry?
To ^{لجنب} avoid changing the mass of the substance.

* Why we should make a small ^{ثقب} hole through the aluminum foil?
To avoid the ^{انفجار} explosion of the flask.

* Does it effect if we change the ^{كمية} quantity of the water?
No, M.M is independent on the quantity of the water.
مستقل

* Why we are putting a few ^{الحجار المغلية} boiling stones in the liquid?
To decrease the ^{مقارن} bubbles of the boiling so we can avoid explosion.
انفجار

* Why should we heat the ^{الخافق} beater ^{ببطء} slowly?
To avoid ^{السرعة} fast ^{التبخر} evaporation.

* Why should we dry the ^{السطح الخارجي} outside of the aluminum foil ^{قائمت} completely after finish ^{العملية} heating?
مقاومة

To have an accurate reading of the mass.
دقيقة قراءة

Describe the effect on the calculated Molar Mass of the volatile liquid (increase, decrease, No effect).

1. If the flask isn't dried completely from outside before weighing? Mass increase \uparrow so M.M increase. \uparrow

2. If the density of the volatile liquid was mistakenly greater than the true value? Increase \uparrow

3. If the temp of the boiling water was mistakenly less than the true value? Decrease \downarrow

4. If balance reads lower than the true value?
No effect.

If the volume of the flask is bigger than the recorded volume? Increase. \uparrow

If amount of volatile liquid isn't enough in the flask but V will be considered as filled and the mass of vapor will be lower? Decrease \downarrow

EXP 7 :- Determination of the Molar volume of Hydrogen Gas.

* Molar volume = \bar{V} = volume occupy per mol.

$$\bar{V} = \frac{\text{Vol of Gas (L)}}{\text{moles of Gas (mol)}} = \frac{L}{\text{moles.}}$$

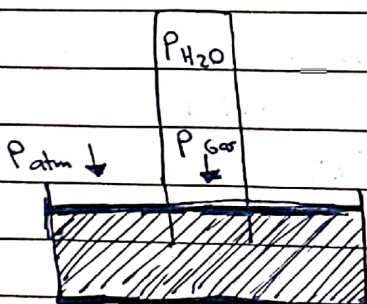
* one mole of any ideal gas at STP will occupy volume = 22.4L

* STP: Standard Temperature Pressure

Temperature = $0^\circ\text{C} = 273\text{K}$ / Pressure = 1atm = 760 torr



$$[\text{mol of Mg} = \text{mol of H}_2 = \frac{\text{mass Mg}}{\text{M.M Mg}}]$$



$$P_{\text{tot}} = P_{\text{H}_2\text{O}} + P_{\text{Gas}} \\ \downarrow \\ P_{\text{H}_2}$$

$$\therefore P_{\text{tot}} = P_{\text{atm}} \rightarrow \text{لا يكون نفس المستوى}$$

* if two stoppered flask contains 2 liters of gas at STP so each gas sample has the same P Number of molecules.

* Gases Law:-

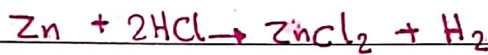
القانون الغازية

① Boyle's law:- $P_1 V_1 = P_2 V_2 \Rightarrow$ Temp must be constant.

② Charles's Law:- $\frac{V_1}{T_1} = \frac{V_2}{T_2} \Rightarrow$ العلاقة طردية تبون العنظ

③ Gay-Lussac's Law:- $\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$

Ex:-



A student wants to determine experimentally the volume occupied by one mole of H₂ gas at STP, she reacts 0.1471g of Zn with excess HCl and collects 56.09 ml of gas over water at 22°C and 757.8 torr, the VP of water at 22°C is 19.8 torr, Find:-

① The volume occupied by one Mole of dry H₂ at 22°C, 760 torr?

$$= \frac{P_{tot} - P_{H_2O}}{P_1} \cdot \frac{V_1}{T_1} = \frac{P_2}{P_2} \cdot \frac{V_2}{T_2}$$

$$= \frac{757.8}{760} - \frac{19.8}{760} \cdot \frac{56.09}{1000} = \frac{760}{760} = 1$$

$$= 0.99 - 0.0260 \quad T_1 = 22 + 273 = 295 K \quad T_2 = 22 + 273 = 295 K$$

$V_2 = 0.054 L$

$\therefore \text{mol of Zn} = \text{mol of H}_2 = \frac{\text{Mass}}{\text{M.M}} = \frac{0.1471}{65.4} = 2.24 \times 10^{-3} \text{ mol.}$

$\bar{V} = \frac{\text{Vol of Gas}}{\text{moles of Gas}} = \frac{0.0560}{2.24 \times 10^{-3}}$

② Volume occupied by one mole of dry H₂ at STP :-

$$1 - 0.0260 \cdot \frac{56.09}{1000} = \frac{P_2}{P_2} \cdot \frac{V_2}{T_2}$$

$$22 + 273 = 295 K \leftarrow T_1 \quad T_2 = 273 K$$

$V_2 = 0.054 L$

$\bar{V} = \frac{V}{\text{mol}} = \frac{0.054}{2.24 \times 10^{-3}} = 24.1$

EXP 8 : Colligative properties : Molar Mass Determination.

* when an ^{مناب غير متطاير} anon-volatile solute is dissolved in certain amount of solvent, some of physical properties of solvent is changed such as :-

1) ^{الانخفاض} Freezing point [FP] → Decreases / Depression ↓

2) ^{الارتفاع} Boiling point [BP] → Increases / Elevation ↑

3) Vapor pressure [VP] → Decreases ↓

* FP: Temp at which the solid and liq states are present at equivalent at the atmospheric pressure.

* Decreasing in f.p of solvent is called f.p depression, (f.p.d) and represents by $\Delta T_f \Rightarrow (f.p)_{\text{solu}} - (f.p)_{\text{solvent}}$.

* As amount of solute was dissolved in solvent increase ↑ ⇒ Freezing point decrease ↓ and Freezing point depression increase ↑.

$\Delta T_f \propto m$ → علاقة طردية

$$\Delta T_f = K_f * m$$

مولية

^{مولية} m: $\frac{\text{Moles solute}}{\text{Mass solvent}} = \frac{\text{mol}}{\text{kg}}$

$$\Delta T_f = K_f * \frac{(\text{mass / M.M}) \text{ solute}}{\text{Mass solvent (kg)}}$$

$$\Rightarrow \text{M.M. solute} = K_f * \frac{\text{mass solvent}}{\Delta T_f} * \text{mass solute}$$

K_f ∴ FPD ^{ثابت} constant for solvent ^{الوحدة} → $\frac{C^\circ}{m} = \frac{C^\circ * Kg}{mol}$

* Freezing point of solution lower than freezing point of pure solvent

* If we have an electrolyte solute we will have vant hoff factor (i) ^{فان هوف}
 $\Delta T_f = i * K_f * m$

* ΔT_f ∝ $\frac{1}{\text{Mass solvent}}$
 * ΔT_f ∝ $\frac{1}{\text{Mass solvent}}$
 * ΔT_f ∝ $\frac{1}{\text{Mass solvent}}$

* Why should we keep moving the solution when it freezes?? To avoid super cooling.

* How will the FP change in this cases?

1) A non-volatile solute that dissociates? **Increase ↑**

2) Two solutes that react according to the equation?
 $A + B \rightarrow C$
decrease ↓

3) if equation is $C \rightarrow A + B$?? **Increase ↑**

* If the solution FP is erroneously read $0.2 C^\circ$ ^{بخطأ} (lower than it) should be will the unknowns calculated M.M be too low or high? ^{$F_{p, sol} \downarrow$}

$\Delta T_f = F_{p, sol} - F_{p, pure}$
 ∴ M.M Too low
 $M.M \text{ solute} = K_f \text{ Mass solvent}$
 $\Delta T_f \propto \text{Mass solvent}$
 $\Delta T_f \propto \text{Mass solvent}$

* If thermometer reads $0.2\text{ }^{\circ}\text{C}$ [lower than OR higher than] the correct temp the calculated Molar Mass will be not effected? True

* الكتل الموجود في نفس الجهاز ، فالقياس يكون ثابت لذلك لا تتغير الكتلة المولية

* If the test tube contains an insoluble impurity ^{غير قابل للذوبان} then the calculated Molar Mass will be no effected (تم حيت ذوبان لذلك لم يتكون محلول لذلك لا يتأثر)

* In the experiment of determination of the molar mass of a nonvolatile solute, K_f represents? Freezing point depression constant for the solvent.

Ex: A solution of 3.125 g of erythritol in 75.2 g of water freezes at $-0.773\text{ }^{\circ}\text{C}$, what is the molecular weight of erythritol? $K_f = 1.86\text{ }^{\circ}\text{C}/\text{mol}$

$$\text{M.M}_{\text{solute}} = 1.86 * \frac{3.125}{(0 - -0.773) * (75.2/1000)} = 100$$

Ex: Mass of solute = 4.25 g , mass of water = 50 g , freezing point of pure water = $0.10\text{ }^{\circ}\text{C}$, freezing point of solution = $-2.30\text{ }^{\circ}\text{C}$, $K_f = 1.86\text{ }^{\circ}\text{C}/\text{m}$ Calculate the M.M of the solute?

$$\text{M.M}_{\text{solute}} = K_f * \frac{\text{Mass Solute}}{\Delta T_f * \text{Mass solvent (kg)}}$$

$$= 1.86 * \frac{4.25}{(0.10 - -2.30) * (50/1000)} = 65.875$$

* التفاضل القلعة بدرجة التليان :

$K_B =$ BPE constant for solvent

$$\Delta T_b = \underset{\text{solvent}}{BP} - \underset{\text{solution.}}{BP}$$

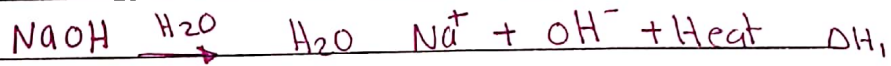
$$\Delta T_b = K_B \times m$$

[جدول لدرجة ال (i) لدرجة التليان]

Name	i
NaCl	1
MgCl ₂	2
AlCl ₃	3
درجات التليان	1

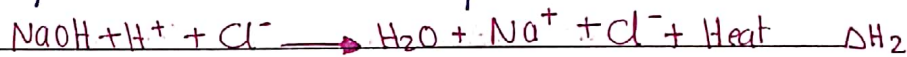
Exp. 9 :- Calorimetry

* Heat of solu :- amount of heat ^{المنجزة} required or released ^{المنجزة} when (ΔH_{solu}) a certain amount of solute is dissolved in certain amount of solvent.



* Heat of solu = ΔH_{solu}

* Heat of Neutralization :- ^{حرارة تفاعل التبادل} Amount of heat that is released from the neutralization of acids by bases of constant pressure



- ΔH_{nut} can not be determined experimentally, It can be determined from the difference between the combined heat of solu and neutralization and heat of solu.

$$\Delta H_{\text{nut}} = \Delta H_{\text{rxn}} - \Delta H_{\text{solu}}$$

$$\Delta H_{\text{rxn}} > \Delta H_{\text{nut}}$$

$$\Delta H_{\text{rxn}} > \Delta H_{\text{solution}}$$

$$\Delta H = \text{mass. (g)}_{\text{solution}} * \text{sp. heat} \left(\frac{\text{J}}{\text{g} \cdot ^\circ\text{C}} \right) * \Delta t \text{ (} ^\circ\text{C)} = \text{---- J}$$

sp. heat = specific heat = amount of heat required to raise temp of one gram of sample by 1°C .

* ΔH can have +ve or -ve sign

The sign is added and depends on Δt

$$\Delta t = t_f - t_i = \text{---} ^\circ\text{C}$$

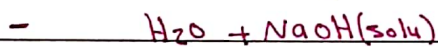
* If $t_f > t_i$ \Rightarrow rxn is exothermic rxn and a (-ve) sign should be added to the value of ΔH that is calculate.

* If $t_f < t_i$ \Rightarrow rxn is endothermic rxn and a (+ve) sign should be added to the value of ΔH that is calculate.

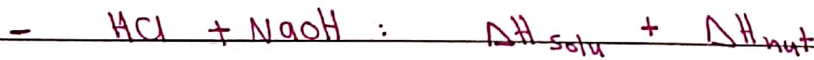
$t_f > t_i \Rightarrow$ increasing in temp \Rightarrow Exo $\Delta t = +ve / \Delta H = -ve$
 $t_f < t_i \Rightarrow$ decreasing in temp \Rightarrow Endo $\Delta t = -ve / \Delta H = +ve$

* The heat of solution should be calculated while the calorimeter is closed tightly

NaOH that is used in the exp is hygroscopic, so that it should be weighted and use it fast



$$\Delta H_{soln} = m_{soln} \times sp\ heat \times |\Delta t| = \dots J$$



$$\Delta H_{rxn} = \Delta H_{soln} + \Delta H_{nut}$$

Heat per mole of A $\Rightarrow \Delta H = \dots J/mole$

Heat per gram of A $\Rightarrow \Delta H = \dots J/g$

* ΔH is quantitative property (depends on amount not nature)

Ex:- A 2g sample of solid CaOH is dissolved in 200 ml of water in a calorimeter, the Temperature of the water was raised from 22.3°C to 23.4°C , Calculate the Heat of solution in kJ and find the Heat of the neutralization if you know the specific heat of the solution to be $4.184 \frac{\text{J}}{\text{g}^\circ\text{C}}$ and the density of the solution to be 1 g/ml ??

$$\Delta H = -\text{Mass solution} * \Delta T * \text{specific Heat}$$

$\Delta T = 23.4 - 22.3 = 1.1$
 $\rightarrow 4.184$

* Density = $\frac{\text{Mass}}{V} \Rightarrow \text{Mass} = V * D$
 $= 200 * 1 = 200 \text{ g}$

Mass of solution = $200 + 2 = 202 \text{ g}$

$\Delta H = -929.7 \text{ J}$

Heat per mole $\rightarrow \frac{\Delta H}{[\text{moles of solute CaOH}]}$

Moles = $\frac{\text{Mass}}{\text{M.M}} = \frac{2}{149.9} = 0.0133$

\therefore Heat per mole = $\frac{-929.7}{0.0133} * 10^{-3} = -69.68 \frac{\text{kJ}}{\text{mol}}$

$\Delta H_{\text{neutralization}} = \Delta H_{\text{rxn}} - \Delta H_{\text{solution}}$

$\Delta H_{\text{neut}} = -127.1 - (-69.1) = -58$

Exp 10:- Electrochemistry :-

* ^{أكسدة} Oxidation :- ^{يفقد} Loss of e's

* ^{اختزال} Reduction :- ^{يكتسب} Gain of e's

^{العامل المؤكسد} Oxidizing Agent :- substance that is Reduced
المادة التي يبدل لها اختزال.

^{العامل المختزل} Reducing Agent :- substance that is Oxidized
المادة التي يبدل لها تأكسد.

* Oxidation - Reduction RXN :- Any Chemical rxn involves the transfer of e's from one substance to another.

* The Oxidation - Reduction RXN cause the transfer of e's which can be detected by Voltmeter.
حرك الفولتميتر دلالة على وجود تيار.

* لكي نعرف كيف ستتحرك الالكترونات يجب علينا معرفة المادة التي سوف تفقد المادة التي تكتسب
وعليه التأكيد تمت بالظروف القياسية وهي

1 atm, 25°C, 1M ^{مولارية}

* التركيز يؤثر على كمية الالكترونات المنتقلة وايضا زيادة التيار والقلية (علاقة طردية)

والتي تم توصيلها من الاطراف وجعلها [H] والقلية للهيدروجين متساوي صفر



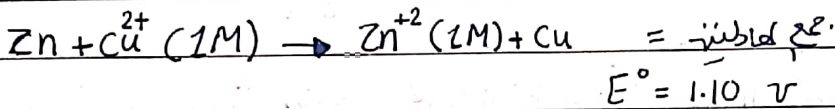
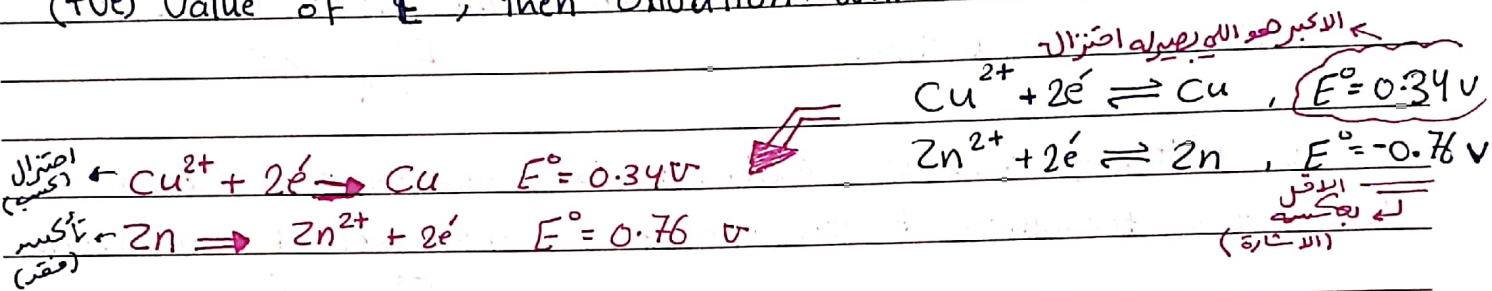
E° :- Voltage of the half cell at the standard condition

* The redox of substances and transfer of e's can be represented by Galvanic Cell.

* The Component of Galvanic Cell :-

1) Substances to be oxidized and reduced.

The Reduction occurs for the half Cell that has a higher (+ve) value of E° , then oxidation will be for the other Cell



* كمية الجح يجب ان تكون الالكترونات المقودة والأكسدة متساوية، وإذا غير متساوية يجب تعويضهم. بيان فنحن نأخذ الحد الأدنى ولا نزيد الجهد لأنها لا تعتمد على الكمية

2) Electrodes : الأقطاب

Cathode :- Electrode at which reduction occurs (+ve e's)

Anode :- Electrode at which oxidation occurs (-ve e's)

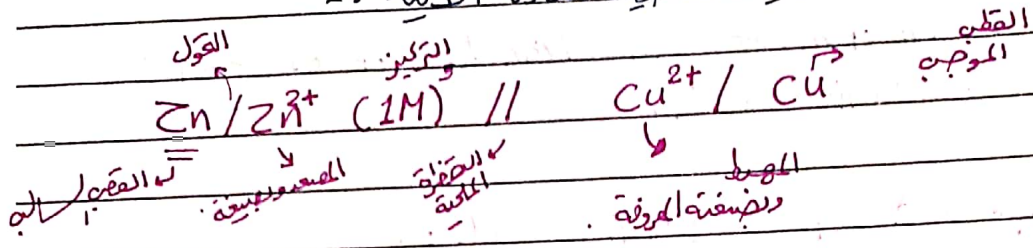
* Always in galvanic cell e's flow from Anode to Cathode.

3) Salt bridge :- U-tube that is filled with saturated electrolyte solution such as KCl, KNO₃ مشبع
 القنطرة الكهوية

* The purpose of the salt bridge :- Compensation the transfer of ions. تعويض انتقال الأيونات

(Line Cell) :-

* في اختصار، تكتب الخلية الكهروكيميائية عن طريق المعادلة الآتية :-



* A Spontaneous reaction :- is a reaction that favors the formation of products at the conditions under which the reaction is occurring.

$E^{\circ}_{cell} > 0$

* A Non spontaneous reaction :- is a reaction that does not favor the formation of products at the given set of conditions

$E^{\circ}_{cell} < 0$

* في حال اردنا ان نحري حسابات في الظروف احسن القياسية :-

$$E_{cell} = E^{\circ} - \frac{0.0592}{n} \log Q$$

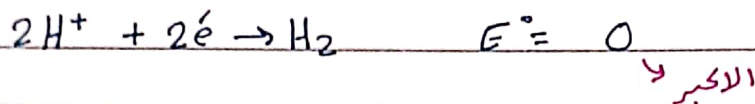
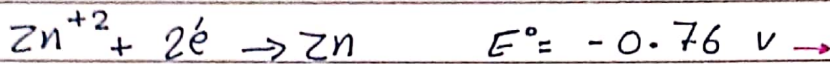
moles of e's ↓

Q :- The product of Molar concentration of products divided by the product of molar concentrations of reactions

$$Q = \frac{\text{Molar concentration of products}}{\text{Molar concentration of reactions}}$$

* المواد التي راح آخذها التركيز او الضغط هو المائل او الغازات ديفعل المواد الصلبة نأخذ الضغط

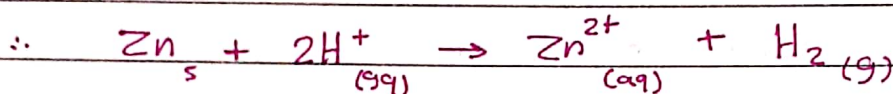
Ex:- Calculate the standard potential of the cell consisting of the Zn/Zn²⁺ half-cell and the SHE. What will the emf of the cell be if [Zn²⁺] = 0.45 M, P_{H₂} = 2.0 atm, [H⁺] = 1.8 M?



الأقل إذا انعكس

طبعًا اختلاف التراكيز دلالة على أنه الظروف غير قياسية

الأكبر

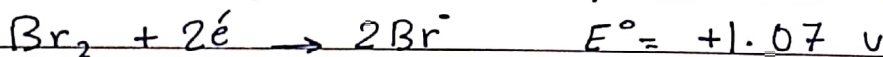


$$E^\circ = 0.76 \text{ V}$$

$$Q = \frac{[\text{Zn}^{2+}] P_{\text{H}_2}}{[\text{H}^+]^2} \Rightarrow Q = \frac{0.45 \times 2}{(1.8)^2} = 0.28$$

$$E_{\text{cell}} = 0.76 - \frac{0.0592}{2} \log 0.28 = 0.78$$

* Which species in each pair is a better oxidizing agent?



العامل المؤكسد هو الذي يصير له اختزال وهو العنصر الأقل

* Which species in each pair is a better Reducing Agent?



العامل المختزل هو الذي يصير له تأكسد وهو العنصر الأقل

* Concentration cell :- A cell may be constructed from two half cells have the same solution but different in concentration of both.

[المعد والمهبط نفس المادة ولكن المحاليل مختلفة بالتركيز]

$E^{\circ} = 0 \rightarrow$ نفس المادة

* حركة الالكترونات من التركيز الأقل الى الأعلى

$$E_{cell} = E^{\circ} - \frac{0.0592}{n} \log \frac{[A_{dil}]^{+n}}{[A_{conc}]^{+n}}$$

↓ zero
n
توقف
[A_{dil}]⁺ⁿ
[A_{conc}]⁺ⁿ
لتركيز

Ex:- Calculate the emf of the following concentration cell
 $Mg_{(s)} | Mg^{2+} (0.24 M) || Mg^{2+} (0.53 M) | Mg_{(s)}$

$E^{\circ}_{cell} = 0 V$

$$E_{cell} = E^{\circ} - \frac{0.0592}{n} \log \frac{[A_{dil}]^{+n}}{[A_{conc}]^{+n}}$$

$Q = \frac{[Mg^{2+}]_{ox}}{[Mg^{2+}]_{red}}$

$= \frac{0.24 M}{0.53 M} = 0.45 \rightarrow$

$E = zero - \frac{0.0592}{2} \log (0.45)$
 $= +0.010 V$

Ex:- $H_2 (0.1 atm) | H^+ (0.02 M) || Cu^{2+} (0.25 M) | Cu_{(s)}$

E° for $Cu^{2+} | Cu = 0.34$



$E_{cell} = E^{\circ} - \frac{0.0592}{n} \log Q \Rightarrow Q = \frac{(0.02)^2}{(0.25) * (0.1)} = 0.016$

$E_{cell} = 0.34 - \frac{0.0592}{2} \log (0.016) = 0.39$