



Electricals 4 You
لجنة الهندسة الكهربائية

لجنة الهندسة الكهربائية | الجامعة الهاشمية

تلخيص

Chemistry Lab

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/groups/Electricals4You



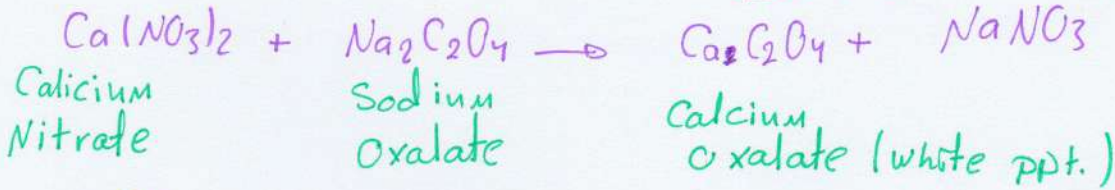
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Expt 4 Tests For Cations and Anions

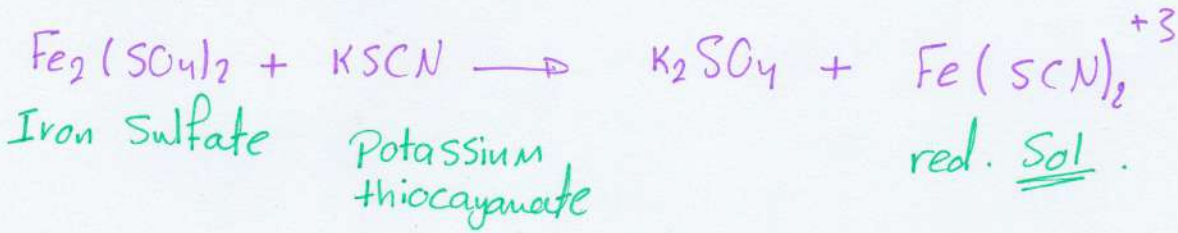
There is no quiz for the exp.

Cations →

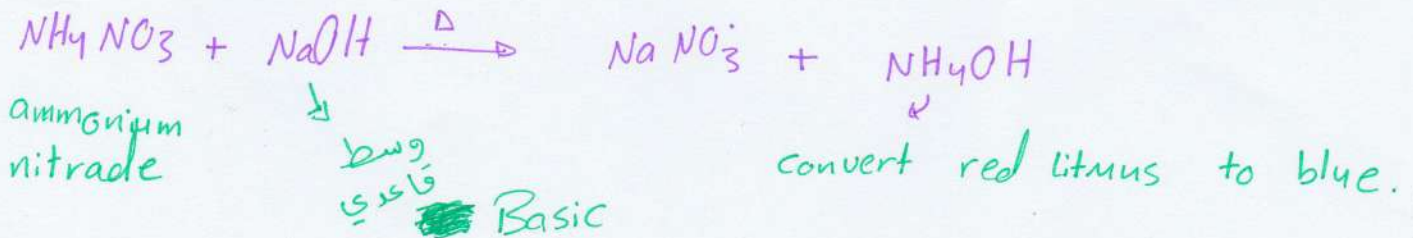
[1] Ca^{+2} , Calcium test



[2] Fe^{3+} , Ferric test

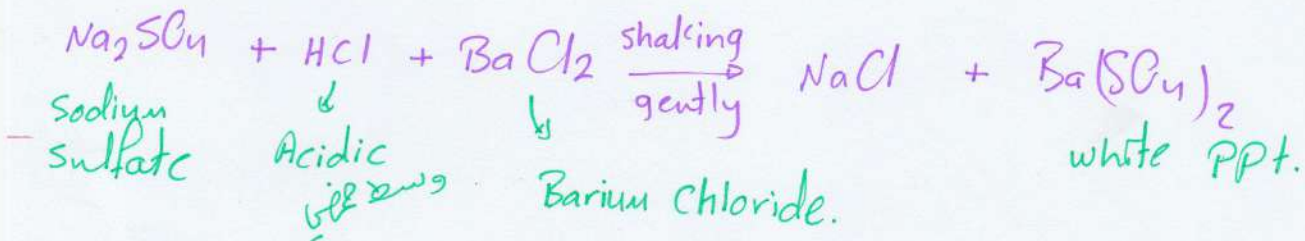


[3] NH_4^+ ammonium test

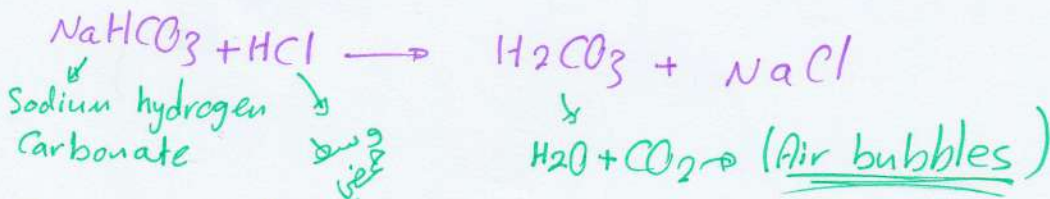


Anions →

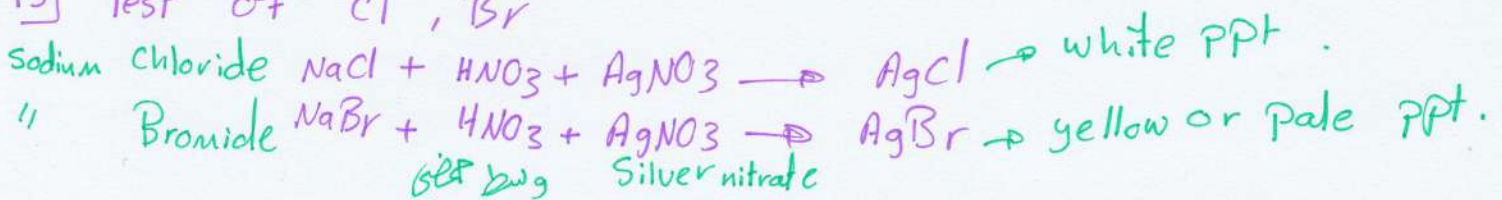
[1] SO_4^{-2} (sulfate test)



[2] HCO_3^- - test



[3] Test of Cl^- , Br^-



* المطلوب من هذه التجربة هو فقط المكتوب أدناه.
* المحاللات ليست محفوظة لكن المطلوب أسماء المركبات وكيفية الكشف.
والكواسني ولون الناتج والوسط الموضح فيه فقط.

Exp 6:- Molar Mass of a volatile liquid.

⇒ In this exp. we will compute the Molar Mass using:-

$$PV = nRT$$

$$PV = \frac{\text{Mass}}{M.M} RT \Rightarrow P = \text{atmospheric pressure (atm)} \Rightarrow 1 \text{ atm} = 760 \text{ mmHg} \\ = 760 \text{ torr} \\ = 101.325 \text{ kPa}$$

$$V = \text{Volume of Vapor (L)} \Rightarrow 1 \text{ L} = 1000 \text{ mL}$$

$$n = \text{number of moles} = \frac{\text{mass (g)}}{M.M \text{ (g/mol)}}$$

$$R = \text{gas constant} = 0.0821 [\text{atm} \cdot \text{L} / \text{K} \cdot \text{mol}]$$

$$T = \text{temperature of boiling water K}$$

$$K^{\circ} = C^{\circ} + 273$$

1) Calculation part:-

تعويض مباشر في القانون مع مراعاة استخدام الوحدة المذكورة في القانون أعلاه.

ExA1) A flask weighs 40.1305g when clean, dry, evacuated, 138.2410g when filled with water (density = 0.9970 g/mL) and 40.2487g when filled with a gaseous substance at 470.4 torr and 96°C. What is the molar mass (g/mol) of the gas? [R = 0.0821 L.atm/mol.K]

$$\text{Solution} \Rightarrow PV = \frac{\text{mass}}{M.M} RT$$

$$P(\text{atm}) = 470.4 \text{ torr} \times \frac{1 \text{ atm}}{760 \text{ torr}} = 0.61895 \text{ atm}$$

$$V(L) = \frac{\text{Mass water}}{\text{density}} \Rightarrow \text{Mass water} = \text{Mass flask filled with water} \\ - \text{Mass empty flask} \\ = 138.2410 - 40.1305 \\ = 98.1105 \text{ g}$$

$$V = \frac{98.1105 \text{ g}}{0.9970 \text{ g/mL}} = 98.4057 \text{ mL} = 0.0984057 \text{ L}$$

$$\text{Mass (g)} = \text{Mass Flusk with substance} - \text{Mass empty flusk}$$

(gaseous substance)

$$= 40.2487 - 40.1305 = 0.1182 \text{ g.}$$

$$R = 0.0821$$

$$T = 96 + 273 = 369 \text{ K}$$

⇒ Now:-

$$PV = \frac{\text{Mass}}{M.M} RT \Rightarrow M.M = \frac{\text{Mass} \cdot R \cdot T}{PV}$$

$$= \frac{(0.1182)(0.0821)(369)}{(0.61895)(0.0984057)}$$

$$= 58.79 \text{ g/mole}$$

* We can rearrange the equation to calculate density:-

$$PV = \frac{\text{Mass}}{M.M} RT \Rightarrow \frac{P(M.M)}{RT} = \frac{\text{Mass}}{\text{Volume}} \Rightarrow D = \frac{P(M.M)}{RT}$$

D: Density (g/L)

PRE LAB:-

1) For which of the following compounds can we determine its molar mass using the method described in this experiment? Give reasons. Benzene (b.p. 78°C), Glycerol (b.p. 180°C)

Solution → دائماً نختار المادة التي درجة غليانها أقل من الماء فشان تبخر قبل ما يغلي الماء.

Benzene (78°C) because its boiling pt lower than water.b.p.

2) A cylinder contains compressed hydrogen gas and the mass of the hydrogen is 20 g, what mass of oxygen would be contained in an identical cylinder at the same temperature and pressure?

Solution →

since the cylinder is identical $\Rightarrow V_O = V_H$

using Avogadro's principle: $\frac{n_H}{V_H} = \frac{n_O}{V_O} \Rightarrow n_H = n_O$

$$n_H = 20 \text{ g} \times \frac{1 \text{ mol}}{1 \text{ g}} = 20 \text{ mol} = n_O$$

$$\text{Mass O} = 20 \text{ mol} \times \frac{16 \text{ g}}{1 \text{ mol}} = 320 \text{ g}$$

2) Procedure part :-

- why should the Erlenmeyer flask be dry?
→ to avoid changing the mass of the substance.
- why we should make a small hole through the aluminum foils? to avoid the explosion of the flask.
- Does it effect if we change the quantity of the water? No, M.M is independent on the quantity of the water.
يعني لو مكاني كان عنوي 5ml من الماء و صارو 10ml بيختلف اشي؟
الجواب لا، لأنني ما باخذ الحجم من الماء الموجود، ببساطة ليتبخر و بس
يخلص تبخر باخذ حجم البخار وليس السائل.
- Why we are putting a few boiling stones (boiling chips) in the liquid? to decrease the bubbles of the boiling so we can avoid explosion.
- why should we heat the beaker slowly?
To avoid fast evaporation
مضان ما تخلص المادة بسرعة
وبالتالي ما تتم عملية ال Vaporization كاملة.
- why should we dry the outside of the aluminum foil completely, after finish heating?
To have an accurate reading of the mass.

Questions:-

Q₁) Describe the effect of the following factors (whether increase, decrease, or has no effect) on the calculated molar mass of the volatile liquid.

a. IF the flask was not dried well before the weighing.
 a. decrease ~~b. increase~~ c. No effect.

$$M.M = \frac{\text{Mass}}{PV} \cdot RT \Rightarrow \text{was not dried well} \Rightarrow \text{mass} \uparrow \therefore M.M \uparrow$$

b. IF the volume of the flask is bigger than the recorded volume.

يعني V المحسوبة أقل.

$$V \downarrow, M.M \uparrow$$

~~a. increase~~ b. decrease c. No effect.

c. IF the temperature of the boiling water was mistakenly less than the true value.

a. increase ~~b. decrease~~ c. No effect.

$$T \downarrow, M.M \downarrow$$

d. IF the density of the volatile liquid was mistakenly greater than the true value.

$$M.M = \frac{D}{P} RT, D \uparrow, M.M \uparrow$$

~~a. increase~~ b. decrease c. No effect.

Q₂) what is the mass of vapor of volatile liquid (M.Wt. = 85 g/mol)

which completely fill a 184 ml flask at 94.0 °C and 675.05 torr?

a. 0.211 g b. 0.632 g ~~c. 0.461 g~~ d) 0.344 g.

Solution $\Rightarrow$

$$\text{Mass} = \frac{PV M.M}{RT} = \frac{\left(\frac{675.05}{760}\right)(0.184)(85)}{0.0821(94+273)} = 0.461 \text{ g}$$

Exp 8:- Colligative properties:- Molar Mass Determination.

Objective:- To determine the molar mass of a non-volatile, non electrolyte by observing the difference between the freezing points of a solvent and a solution.

non-volatile $\rightarrow$ غير متطايرة, non-electrolyte $\rightarrow$ غير متفككة.

$\rightarrow$ when we add a non-volatile solute to a solvent it changes the physical properties of the solvent:-

- 1) Freezing pt (F.P) $\Rightarrow$ decreasing (Freezing pt depression) ^{الانخفاض}
- 2) Boiling pt (B.P) $\Rightarrow$ increasing (Boiling pt elevation) ^{ارتفاع}
- 3) Vapor pressure (V.P) $\Rightarrow$ decreasing (Vapor pressure lowering) ^{انخفاض}

$\Rightarrow$ Freezing pt depression, Boiling pt elevation & Vapor pressure lowering are called Colligative properties.

$\Rightarrow$ And they are governed by number, rather than type
 يعني ذاتها Quantitative بتحدد على الكمية وليس على النوع.

$$\Rightarrow \Delta T_f = K_f m = K_f \cdot \frac{(\text{g mass solute})}{\text{m.m solute} \cdot \text{kg solvent}} = \frac{K_f * \text{وزن المذاب بالجرافات}}{\text{وزن المذيب بالـ Kg} \times \text{مولر المذاب}}$$

Freezing pt depression $\rightarrow$ نفاي التجربة رج نركز على
Boiling pt elevation. أكثر من

$\Rightarrow K_f$ and K_b are the molar Freezing pt and boiling pt constants for the solvent. (Given)

$$\Rightarrow m: \text{molality} = \frac{\text{moles solute (mole)}}{\text{mass solvent (kg)}}$$

* IF we have an electrolyte solute $\rightarrow$ مذاب يتفكك
we will have a Van't Hoff Factor (i) $\rightarrow$ معامل التفكك.
which leads to:- ^{For non-electrolyte i=1.}

$$\Delta T_f = i K_f m \Rightarrow \text{بمعنى لو كانت المادة متفككة يعني إنو الفرق في درجة الحرارة (الانخفاض) يزداد.}$$

* لازم نغير بين درجة الحرارة T_f وبين الانخفاض في درجة الحرارة ΔT_f
 $\Delta T_f = T_i - T_f \Rightarrow$ ازدياد الانخفاض في درجة الحرارة ΔT_f
يعني نقصان في درجة الحرارة النهائية $\downarrow T_f$

Pre Lab:

- 1) Students prepared two cyclohexane solutions having the same mass of solute. However student 1 used 13g of cyclohexane, student 2 used 15g. which student will observe the larger Freezing pt. change? Explain

$$\Delta T_f = K_f \frac{\text{Mass (solute)} \rightarrow \text{كتلة المذاب}}{M.M \text{ (Mass Solvent)} \rightarrow \text{كتلة المذيب}} \Delta T_f$$

$$\Delta T_f \text{ student 1} > \Delta T_f \text{ student 2}$$

Since Mass solvent 1 < Mass solvent 2.

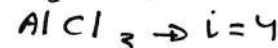
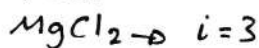
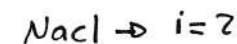
- 2) A 0.597 g sample of a non-electrolyte dissolves in 20.0 g of cyclohexane. The Freezing point depression is 3.62°C . What is the molar mass of the non-electrolyte? (K_f for cyclohexane is $20.0^\circ\text{C Kg/mol}$).

Solution $\Rightarrow$

$$\Delta T_f = K_f \frac{\text{mass solute (g)}}{M.M \text{ solute} \times \text{Mass Solvent (kg)}}$$

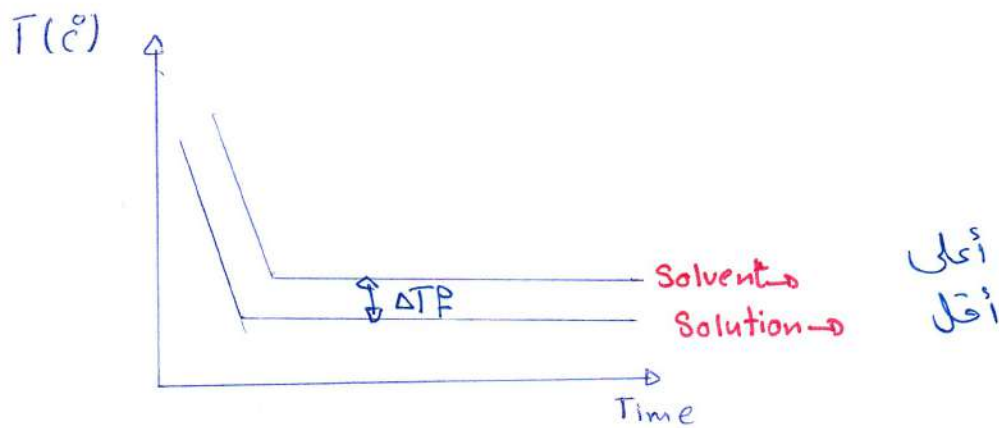
$$M.M = \frac{20 \times 0.597}{3.62 (20 \times 10^{-3})} = 164.92 \text{ g/mol}$$

i For some solutes:-



Procedures part:-

- Why should we keep moving the solution when it Freezes?
To avoid super cooling. منع من انخفاض درجة الحرارة كثير
- Cooling curve :- Freezing pt depression as a function of time.
- The temperature remains constant at the Freezing pt. untill the Freezing is almost complete.



Post Lab:-

- 1) If the solution's Freezing pt is erroneously read 0.2°C lower than it should be, will the unknown's calculated molar mass be too high or too Low? Explain!

$$\text{Solution} \Rightarrow \Delta T_F = T_{\text{solvent}} - T_{\text{solution}} = \frac{K_F \text{ mass solute}}{M.M \text{ solute} \times \text{mass solvent}}$$

$$T_{\text{solution}} \downarrow \Rightarrow \Delta T_F \uparrow$$

$$\Delta T_F \uparrow \Rightarrow M.M \downarrow \quad \infty \quad \text{Molar Mass will decrease.}$$

- 2) How will the freezing pt. change of cyclohexane be affected (compared with the freezing pt. change by a non-Volatile, non-associating and non-dissociating solute) by:-

غير مرتبط
(الوجه، عندي
ارتباط معي)

غير متفكك
 $i=1$

- (a) A non-volatile solute that dissociates? Explain!

عندما يكون عندي معامل تفكك i

$$\text{Solution} \Rightarrow \Delta T_F = i K_F m \rightarrow i \uparrow \Rightarrow \Delta T_F \text{ increase.}$$

- (b) Two solutes that react according to the equation.



$i=2 \quad i=1 \Rightarrow$ هون معامل ارتباط كانت $i=2$ صار $i=1$

$$\Delta T_F = i K_F m \Rightarrow i \downarrow \Rightarrow \Delta T_F \text{ decrease.}$$

3) If some solute adheres to the test tube's wall in part B.1, is the freezing point change greater or less than it should be? Explain!

في التجربة لما صطينا المذاب مشان يذوب ونقيس درجة التجمد بيسألني إذا التصق جزء من المذاب سورج ياتر على مقدار الانخفاض؟

Solution $\rightarrow \Delta T_F = \frac{i K_F (\text{Mass solute})}{M.M (\text{Mass solvent})} \Rightarrow$ Mass solute $\downarrow$
 $\therefore \Delta T_F$ will decrease.
 (Be less than it should be).

* ما نسي نفتر بين ΔT_F و T_F .

Questions:-

Which statements of the following statements are T and which of them are F?

1. (T) IF the test tube contains an insoluble impurity, then the calculated molar mass will be no effected.

$$\Delta T_F = \frac{i K_F \times \text{Mass solute}}{M.M \times \text{Mass solution}}$$
 لأنه هون بس بحسب الكتلة اللي ذابت اللي ما ذابت ما الي فيها.

2. (T) IF the thermometer reading is always 1.5 °C higher than the correct temperature, the calculated molar mass will be not effected.
 له لانه رح تقرأ 1.5 أعلى لما أقيس المذيب الحال و 1.5 أعلى لما أقيس المحلول لما أخذ القوت. يورج مع بعض المشكلة لو اختلف القراءة عند وحدة منهم بس.

3. (F) The Freezing pt of the solution had been incorrectly read 0.6 °C higher than the true Freezing pt, the calculated Molar Mass will be lower than actual.

$$\Delta T_F = T_{\text{solvent}} - T_{\text{solution}}$$

$$T_{\text{solution}} \uparrow \Rightarrow \Delta T_F \downarrow$$

$$\Delta T_F = \frac{K_F \cdot \text{mass}(g)}{M.M \cdot \text{mass}(kg)}$$

$$\Delta T_F \downarrow \Rightarrow M.M \uparrow$$

4) (F)

$$\Delta T_f = i K_f \frac{\text{moles}}{\text{Mass}_{\text{solvent}}}$$

↖ باء ↗

The Freezing pt. depression of 0.20 mole of NaCl in 10 g of water is lower than the Freezing pt depression of 0.20 mole $C_{10}H_8$ in 10.0 g of water.

$$\begin{matrix} i_{NaCl} = 2 \\ i_{C_{10}H_8} = 1 \end{matrix} \rightarrow \Delta T_f NaCl > \Delta T_f C_{10}H_8$$

Q₂) A solution of 3.33 g of unknown in 50 g of water Freezes at $-0.773^\circ C$, What is the molecular weight of the unknown? $K_f = 1.86^\circ C/\text{molal}$
M.M?

$$T_f \text{ solvent} = T_f \text{ water} = 0$$

$$\Delta T_f = 0 - (-0.773) = i \frac{K_f (\text{mass solute})}{M.M_{\text{solute}} \times \text{Mass solvent}}$$

$$M.M = \frac{1 (1.86) (3.33)}{0.773 (0.05)} = 160$$

- a) 120
- ✓ b) 160
- c) 80
- d) 100

→ ΔT_f is always +ve

وإذا ما كانت موجبة بأغلب
الحالات المحللة

Objective:- To measure heat of reaction.

Calorimetry $\rightarrow$ It's the measurement of heat change.

Calorimeter $\rightarrow$ It's a device that used to measure the heat of the (reaction) (rxn).

$\hookrightarrow$ There are several kinds of "heats of reactions" such that $\rightarrow$ 1) heat of solution
2) heat of neutralization.

$$\Delta H_{\text{reaction}} = \Delta H_{\text{solution}} + \Delta H_{\text{neutralization}}$$

$$\Delta H_{\text{rxn}} = \Delta H_{\text{sol}} + \Delta H_n$$

heat of solution $\rightarrow$ heat flows during a process of solution.
OR $\rightarrow$ amount of heat required all released to form a solution.

heat of neutralization $\rightarrow$ amount of heat required all released to make a neutralization.

heat of reaction $\rightarrow$ It's the total heat $\Delta H_n + \Delta H_{\text{sol}}$.

$\Delta H_{\text{rxn}} \rightarrow$ يمكن حسابها عملياً $\Delta H_n \rightarrow$ لا يمكن حسابها عملياً

$\Delta H_{\text{sol}} \rightarrow$ يمكن حسابها عملياً

* توضيح للي بصير فوق :-



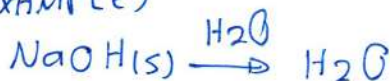
قاعدة + حمض $\rightarrow$ ملح + H_2O

أنا بدي أعمل تفاعل التفاعل اللي هو

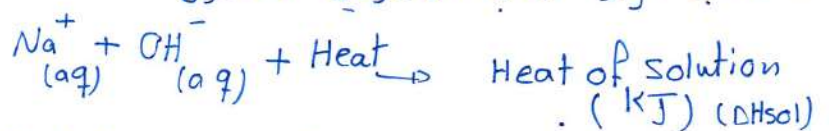
و بدي أحسب الحرارة الناتجة من هذا التفاعل بين ما بقدر أحسبها مباشرة.

كيف نحسبها ؟

EXAMPLE)



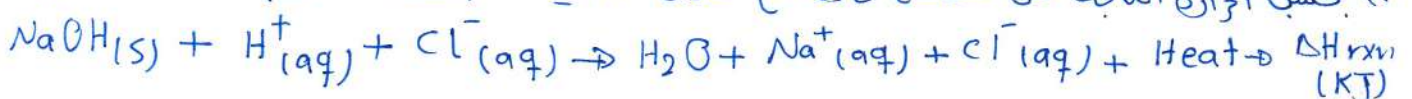
2) $\Rightarrow$ يكون



1) بحسب الحرارة الناتجة من ذوبان المحلول

حلول الناتجة

2) بحسب الحرارة الناتجة من تفاعل قاعدة مع حلول الناتجة



$\Delta H_{rxn} \rightarrow$ حرارة المخلول + حرارة تفاعل التبادل

$$\Delta H_n = \Delta H_{rxn} - \Delta H_{sol} \quad , \quad \Delta H_{rxn} > \Delta H_n \rightarrow \Delta H_{sol}$$

$$\Delta H = (-) \text{Mass of Solution (g)} \times \text{specific heat } \left(\frac{J}{g \cdot ^\circ C} \right) \times \Delta T (^\circ C)$$

Solute + Solvent

$$\Delta H = () J$$

or $\Delta H = (-) \frac{\text{mass solution.}}{\text{moles of solute}} \times \text{specific heat} \times \Delta T (^\circ C) \times 10^3$

$$\Delta H = () \frac{\text{mass}}{\text{M.M}} KJ/mol$$

$\Delta H \rightarrow -Ve \quad (T_P > T_i) \rightarrow$ exothermic (طارد للحرارة) $\rightarrow$ Flows out of the system. (بالنوع)
 $\Delta H \rightarrow +Ve \quad (T_P < T_i) \rightarrow$ endothermic (ماص للحرارة) $\rightarrow$ Flows into the system.

* Specific heat: Amount of heat required to raise the temperature of 1 g mass by $1^\circ C$. (بالتفاعلات)

* $\Delta T \rightarrow$ change in temperature.

Example 1) A 2.00 g sample of solid CsOH is dissolved in 200.0 mL of water in a colorimeter. The temperature of the water was raised from 22.3 to $23.4^\circ C$, calculate the heat of the solution in KJ/mol . (assume the specific heat of the solution to be $4.184 J/g^\circ C$ and the density of the solution to be $1 g/mL$)?

solve ΔH_{sol}

solution $\rightarrow \Delta H = - \text{Mass}_{\text{solution (g)}} \times \text{specific heat} \times \Delta T$

$$\Delta T = T_P - T_i = 23.4 - 22.3 = 1.1^\circ C$$

$$\text{specific heat} = 4.184$$

$$\text{mass solution} = \text{mass solute} + \text{mass solvent.}$$

$$= 2g + 200g = 202g$$

$$m = d \times V \text{ only}$$

$$= 1(200) = 200g$$

$$\Delta H = -(202)(4.184)(1.1) = -930 J$$

in $KJ/mol \Rightarrow \Delta H = \frac{-930}{(2/149.9)} \times 10^{-3} = -70 KJ/mol.$ ΔH_{sol}

mass CsOH/M.M

Example 2) A 2.00 g sample of solid CsOH reacted with 200.00 mL of aqueous solution of hydrogen chloride (HCl) in a calorimeter, the temperature of the solution increased from 22.3 to 24.3 °C. calculate the heat of reaction in KJ/mol? (Assume the specific heat of the solution to be 4.184 J/g°C and the density of the solution to be 1.00 g/mL)

جول
في
درجة
C
ΔH_{rxn}

$$\text{Sol} \rightarrow \Delta H = - \text{mass}_{\text{solution}} \times \text{specific heat} \times \Delta T$$

$$= - (2 + 200) \times 4.184 \times (24.3 - 22.3)$$

$$= - 1700 \text{ J}$$

$$\text{in KJ/mol} = \frac{-1700}{\left(\frac{2}{149.9}\right)} = -130 \text{ KJ/mol} \rightarrow \Delta H_{\text{rxn}}$$

→ From the previous 2 examples:

$$\Delta H_u = \Delta H_{\text{rxn}} - \Delta H_{\text{sol}} = -130 - (-70) = -60 \text{ KJ/mol.}$$

Explo Electrochemistry

→ Any chemical rxn. involves the transfer of e^- s from one substance to another is an Oxidation-Reduction Rxn.

← التفاعلات التي يتم فيها انتقال الإلكترونات من مادة إلى أخرى تسمى تفاعلات التأكسد والإختزال.

↳ Oxidation → loss of e^- s

↳ Reduction → gain of e^- s.

↳ A galvanic cell exists when the Oxidation & reduction steps in the rxn takes place, so that e^- s transfer from the reducing agent (substance which is oxidized) to the oxidizing agent

↳ E_{cell} consists of ^{قطب} cathode, ^{مصعد} anode, ^{قنطرة ملحية} salt bridge & Voltmeter.

Cathode: electrode at which ^{reduction} ~~oxidation~~ occurs (+ve electrode)

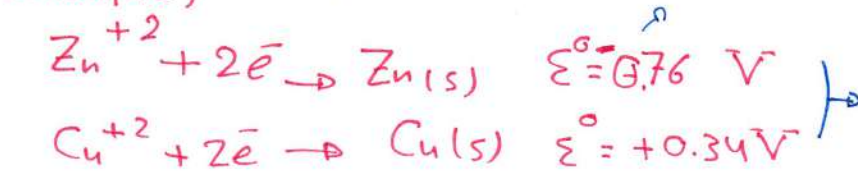
Anode: electrode at which oxidation occurs (-ve electrode)

↳ e^- s flow from anode to cathode.

← لما يصير عندي تفاعل تأكسد وإختزال رح تنتقل عندي الإلكترونات من القطب السالب إلى القطب الموجب.
المصعد إلى المربط.
العامل المؤكسد إلى العامل المؤكسد المختزل.

القطب يلي صار عليه التأكسد إلى القطب يلي صار عليه الإختزال.
داخل ما يسمى بالخلية الجلفانية.

أقل ٥٠ يعكس المعادلة ويغير الإشارة

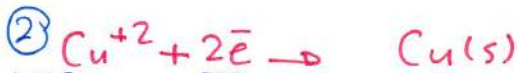


هون دايقا بيعطيني جهد الإختزال
أنا بتطلع على الأضغ ويعكس إشارته
ومعادلته تكون هاد هو الجهد التأكسد
والثاني يكون طرف الإختزال

الإلكترونات بالتوازي نصف الأكسدة

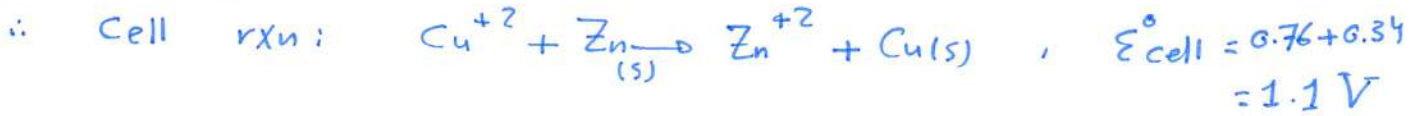


$\epsilon^{\circ} = 0.76 V$ (Anode)



$\epsilon^{\circ} = 0.34 V$ (cathode)

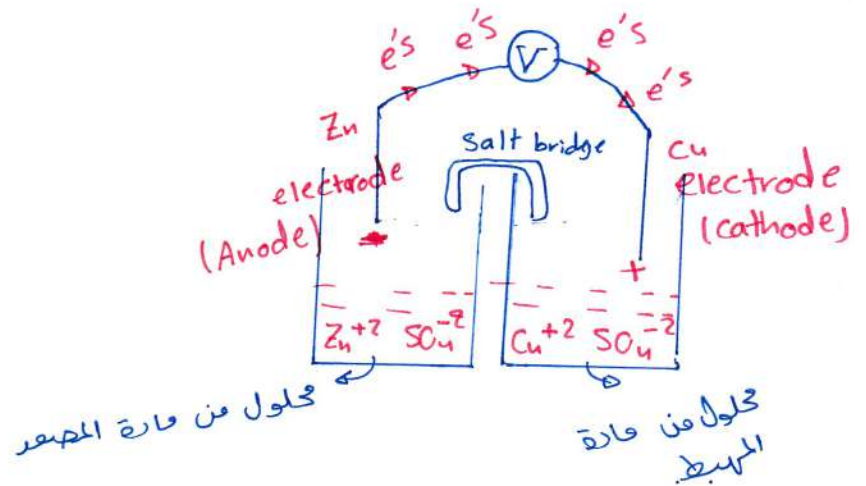
نصف الإختزال بالإلكترونات بالتوازي



↳ ① The first half-reaction is the oxidation half cell

↳ ② The second half-reaction is the reduction half cell.

→ The galvanic cell:-



In the previous example.

$\epsilon^{\circ}_{Cu^{+2}/Cu} > \epsilon^{\circ}_{Zn^{+2}/Zn}$

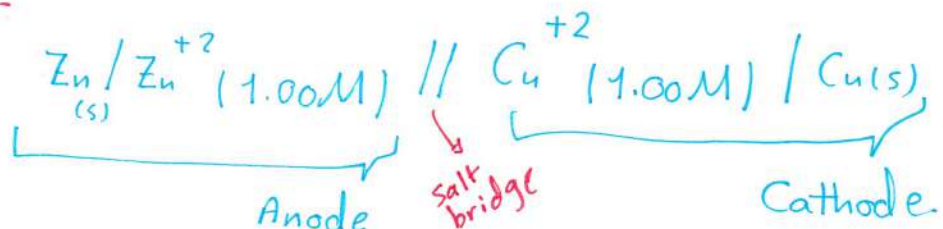
بما أن $\epsilon^{\circ}_{Cu^{+2}/Cu}$ أكبر من $\epsilon^{\circ}_{Zn^{+2}/Zn}$ ، إختزال Cu^{+2}/Cu هو
 ∴ $Cu^{+2}/Cu \rightarrow$ reduction half
 $Zn/Zn^{+2} \rightarrow$ Oxidation half.

Also we should note:-

if $\epsilon^{\circ}_{cell} > 0 \Rightarrow$ Rxn is spontaneous in the written direction

if $\epsilon^{\circ}_{cell} < 0 \Rightarrow$ Rxn is non-spontaneous in the written direction

The previous cell rxn. can be represented by the following Line cell:-



→ The salt bridge is usually a tube that is filled with standard electrolyte soln. Such as KCl , KNO_3 --- etc and the purpose of it is to compensate the ions migration by providing the soln. that has a cation migration by cations.

← تعويض النقص في أيونات الملول.

↳ In the previous example (E° value were taken from a standard potential table at standard conditions: $25^\circ C$, 1 atm & $1M$)

↳ E_{cell} at conditions rather than the standard conditions can be calculated by Nernst equation:-

$$E_{\text{cell}} = E_{\text{cell}}^\circ - \frac{2.303 RT}{n F} \ln Q$$

$$= E_{\text{cell}}^\circ - \frac{0.0592}{n} \log Q \text{ (at } 25^\circ C \text{)} \leftarrow \text{هنا الذي نستخدمه}$$

($R = 8.314 \text{ J} \cdot \text{mol}^{-1} \cdot \text{K}^{-1}$, $F = \text{Faraday's Const} = 96500 \text{ C/mole } e^-$
 $n = \text{no of } e^- \text{ mole}$)

Q :- The product of molar concentration of products divided by the product of molar concentrations of reactions, if there was a gas so we use the partial pressure of that gas.

$$Q = \frac{[\text{محلول ضرب تركيز النواتج}]}{[\text{محلول ضرب تركيز المتفاعلات}]}$$

① لو كان عندي غاز P باخذ بدل من التركيز.

② المواد التي باخذها التراكيز بين أو الضغط

Exp7, Determination of the Molar Volume of Hydrogen gas.

$$\text{Molar Volume} = \bar{v} = \left(\frac{\text{Volume of gas (L)}}{\text{moles of gas (mole)}} \right) = \frac{V}{\text{moles}}$$

L/mole

الظروف
المعيارية

STP → $T = 0^\circ\text{C} = 273\text{ K}$, $P = 1\text{ atm} = 760\text{ torr}$
 $V = 22.4\text{ L} \rightarrow$ For water (only)

$\bar{v} = 22.4\text{ L/mole} \rightarrow$ STP

Gases Laws:-

1) Boyle's Law →

$$P_1 V_1 = P_2 V_2$$

$$P \propto \frac{1}{V}$$



(درجة الحرارة ثابتة)

2) Charles's Law →

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$V \propto T$$

(الضغط ثابت)

3) The Combined gas Law →

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

لما بدى أعمل حساباتي باستخدام عملية البتر بوجود الماء راح أحسب الضغط الكلي يلي هو ضغط الماء + ضغط الغاز يلي بدى أجمعه

$$P_{\text{total}} = P_{\text{H}_2\text{O}} + P_{\text{gas}}$$

بس أنا بحسباتي راح أستخدم ال P_{gas} مكان الملع أي

شي، الو علاقة فيه اللي هو

$$P_{\text{gas}} = P_{\text{total}} - P_{\text{H}_2\text{O}}$$

PreLab:-

A student at the Hashemite university wants to determine experimentally the volume occupied by one mole of H_2 gas at STP. She reacts 0.1471 g of Zn with excess $HCl(aq)$ and collects 56.09 ml of gas over water at $22^\circ C$ and 757.8 torr. The vapor pressure of water at $22^\circ C$ is 19.8 torr.

1- Use data given above to calculate

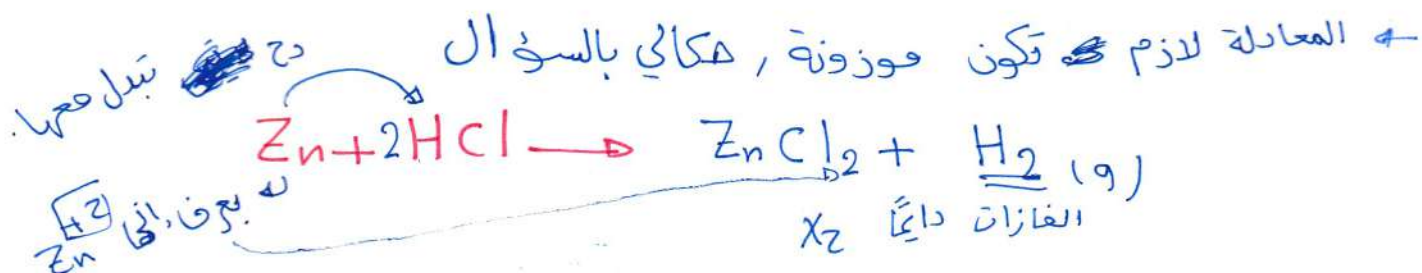
(i) The volume occupied by one mole of dry H_2 at $22^\circ C$, 760 torr

(ii) The volume occupied by one mole of dry H_2 at STP

This is Molar Volume $\bar{V}$

Sol $\rightarrow$ (i)

① حتى حسب $\bar{V} = \frac{V_{gas}}{n_{gas}}$ لازم جيب n من المعادلة $\leftarrow$ من قانون الغازات



H_2 بيلعها

$$0.1471 \text{ g Zn} \times \frac{1 \text{ mol Zn}}{65.4 \text{ g Zn}} \times \frac{1 \text{ mol H}_2}{1 \text{ mol Zn}}$$

من الجدول الدوري

$$= 2.249 \times 10^{-3} \text{ mol H}_2$$

$$V_{1H} = 0.0569 \text{ L} \quad T_1 = 22 + 273 = 295 \text{ K}$$

$$\frac{P_{1\text{gas}} V_{1\text{gas}}}{T_1} = \frac{P_{2\text{gas}} V_{2\text{gas}}}{T_2} \quad \leftarrow \text{هنا نستخدم قانون الغازات المثالية}$$

السؤال أعطاني الضغط البخاري (Over water) المجموع فوق الماء.
بلي هو

$$P_{\text{total}} = P_{H_2O} + P_{H_2}$$

$$19.8 \text{ torr} \quad \leftarrow \text{عطاني بالضغط}$$

$$P_{H_2} = 757.8 - 19.8 = \underline{738} \text{ torr.}$$

هنا نستخدم قانون الغازات المثالية

$$\frac{P_{1H_2} V_{1H_2}}{T_1} = \frac{P_{2H_2} V_{2H_2}}{T_2}$$

$$P_{2H_2} = 760 \text{ torr}$$

$$T_2 = 295 \text{ K.}$$

$$\frac{738 (0.0569)}{295} = \frac{760 (V_2)}{295} \Rightarrow V_2 = 54.4 \text{ mL.}$$

$$\bar{V} = \frac{54.4 \times 10^{-3}}{2.249 \times 10^{-3}} = 24.188 \text{ L/mole}$$

Sol 2 (ii) →

$$P_{1H} = 738 \text{ torr}$$

$$V_{1H} = 0.0569 \text{ L}$$

$$T_1 = 295 \text{ K}$$

$$P_{2H} = 760 \text{ torr}$$

$$V_{2H} = ?$$

$$T_2 = 273$$

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2} \Rightarrow V_2 = \frac{738 (0.0569) (273)}{295 (760)}$$

$$= 50.4 \times 10^{-3} \text{ L} = 50.4 \text{ mL}$$

$$\bar{V} = \frac{V}{n} = \frac{50.4}{2.249} = 22.4 \text{ L/mol}$$

↪ at STP

2) Name the gas Laws which you used in your calculations?

1- Boyle's law , 2- Charles' Law

3- The combined gas law.

Example) Sample of KClO_3 decomposed producing O_2 gas that collected over water, The volume of the gas is 0.25 L at 26°C and 765 mmHg as total pressure, How many grams of KClO_3 was decomposed? , M.M of $\text{KClO}_3 = 122.6$
 $P_{\text{H}_2\text{O}}$ at $26^\circ\text{C} = 25 \text{ mmHg}$

Sol $\rightarrow$ $PV = \frac{n}{O_2} RT$

$$P_{\text{O}_2} = P_{\text{total}} - P_{\text{H}_2\text{O}} = 765 - 25 = 740 \text{ mmHg} = \frac{740}{760} \text{ atm}$$

$$V_{\text{O}_2} = 0.25 \text{ L}$$

$$\frac{740}{760} (0.25) = n_{\text{O}_2} (0.0821) (26 + 273)$$

$$n_{\text{O}_2} = 9.916 \times 10^{-3} \text{ mol O}_2$$

$$9.916 \times 10^{-3} \text{ mol O}_2 \times \frac{2 \text{ mol O}}{1 \text{ mol O}_2} \times \frac{1 \text{ mol KClO}_3}{3 \text{ mol O}} \times \frac{122.6 \text{ g KClO}_3}{1 \text{ mol KClO}_3} = 0.81 \text{ g}$$



← انتجت معادلة بس، انتجت المعلومة ←

→ Test banks :-

Page 4)

Q₁) A solution of 1.25 g of erythritol in 50 g of water freezes at -0.773°C , what is the molecular weight of erythritol? $K_f = 1.86^{\circ}\text{C/molal}$

- 1) 120 ☒ 2) 60 3) 80 4) 100 5) 160

$$\Delta T_f = K_f \cdot \frac{\text{mass Solute (g)}}{\text{M.M} \times \text{mass Solvent (kg)}} \rightarrow \text{M.M} = \frac{1.86 (1.25)}{(0 + 0.773) (0.05)} = 60.15$$

Q₂) In which of the following cases, the calculated molar mass of a volatile liquid will be lower than the actual value :-

- ☒ 1) The measured volume of the vapor was mistakenly larger than the true value. $V \uparrow \text{ M.M} \downarrow$
- 2) The temperature used in the calculations was higher than the actual boiling pt. of water under lab. conditions. $T \uparrow \text{ M.M} \uparrow$
- 3) The flask was not dried well before weighing. $\text{mass} \uparrow \text{ M.M} \uparrow$
- 4) The measured atmospheric pressure was less than the actual pressure. $P \downarrow \text{ M.M} \uparrow$
- 5) The measured density of the vapor was more than the actual one. $D \uparrow \text{ M.M} \uparrow$

$$\text{M.M} = \frac{\text{mass} RT}{PV} = \frac{DRT}{P}$$

Q₃) A conical flask weighs 40.1305 g when clean, dry, evacuated, 138.2410 g when filled with water at 25 C and 40.2487 g when filled with a gaseous substance at 300 torr and 96 C. What is the molar mass (g/mol) of the gas?

- ☒ 1) 92.2 2) 63.2 3) 27.4 4) 35.7 5) 42.5

$$\text{mass solute} = 40.2487 - 40.1305 = 0.1182 \text{ g}$$

$$\text{Volume water} = 138.2410 - 40.1305 = 98.1105 \text{ ml}$$

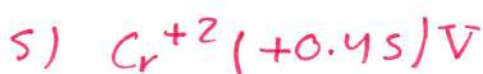
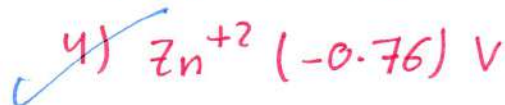
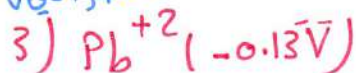
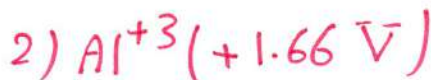
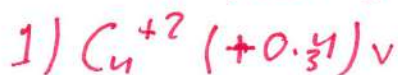
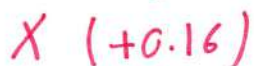
Assume density 1g/ml

$$P = \frac{300}{760}$$

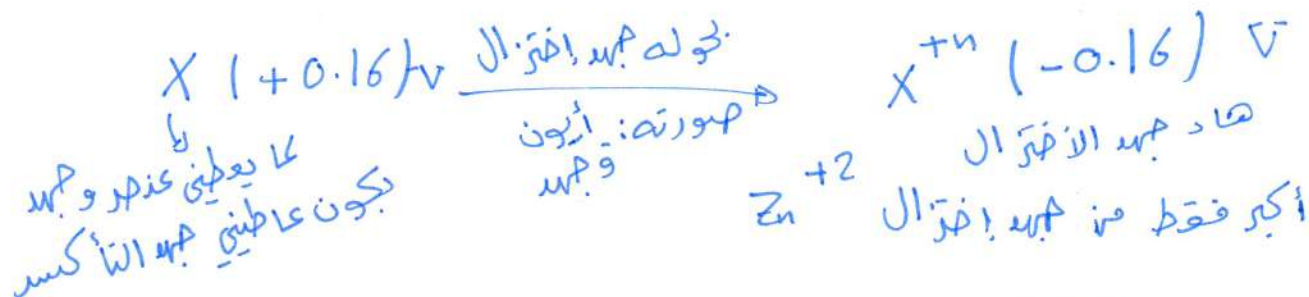
$$\text{M.M} = \frac{\text{mass} RT}{PV} = 92.2$$

Q4) Among the following, which element can reduce

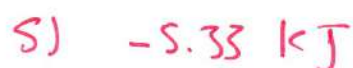
له صار اختزال
سؤال العنصر الذي أكسب؟



هون بدى أدور على العنصر اللي جرد اختزاله أقل من جرد اختزال X
لأنه مع الاختزال الأكبر اللي يكون ذهب الاختزال والأصغر
رج تكون ذهب التأكسد بس بدى أنيب



Q5) Calculate the amount of heat liberated by dissolving 0.03 mol of $AlCl_3$ (M.wt = 133.33 g/mol) in 100 g water? If you know that the heat of solution is -321 kJ/mol



ΔH بوحدة kJ/mol

سؤال مباشر أعملها لك

حولها ل ΔH (kJ)

$$\Delta H = \Delta H_{\text{kJ/mol}} \times \text{X mol}$$

$$= -321 \times 10^3 \times 0.03 = -9.63 \text{ kJ}$$

Q6) In the Freezing point depression experiment, which of the following factors will increase the calculated molar mass of the solute:-

- 1) The solute has been totally dissolved in the solvent. $\rightarrow$ No effect.
- 2) The solution Freezing pt was erroneously lower than it should be. $\Delta T_f = T_{\text{solvent}} - T_{\text{solution}} \rightarrow \Delta T_f \uparrow, \text{M.M} \uparrow$
- 3) Some of the solvent evaporated during the experiment. $\text{mass solvent} \downarrow, \text{M.M} \uparrow$
- 4) Some solute adheres to the test tube. $\text{Mass} \downarrow, \text{M.M} \downarrow$
- 5) None of the above.

$$\text{M.M} = \frac{K_f \cdot \text{mass solute}}{\text{Mass solvent} \cdot \Delta T_f}$$

Q7) In the concentration cell, which of the following statements is not correct?

- 1) Electrons will flow from the lower concentration to the higher one.
- 2) The anode is the lower concentration electrode.
- 3) The standard potential is one. $\rightarrow$ Zero
- 4) The two half cells contain the same solution that differ in the concentrations only.
- 5) The cathode is the higher concentration electrode.

* هاد السؤال مهم ركزو على الخيارات الأخيرة 1, 2, 4, 5

Q8) A 1g sample of solid (NaOH, Mwt. = 40 g/mol) is dissolved in 100 mL of water in a Calorimeter the temperature of water was raised from 22.3°C to 23.8°C, Calculate the heat of the solution in kJ/mol ($S_p = 4.184 \text{ J/g}^\circ\text{C}$, and density of the solution 1g/mL)

- 1) -25.46 2) -9.19 3) -12.07 4) -17.97 5) -35.5

$$\Delta H = \frac{-\text{Mass solution} \times S_p \times \Delta T}{\text{Moles solute}} = \frac{-(100+1) \times 4.184 \times (23.8-22.3)}{1/40} = -25.46$$

Q9) If the Freezing point of the solution had been incorrectly read 0.3°C higher than its true Freezing point and the Freezing point of the pure solvent was correctly read, the effect on the calculated molar mass of the unknown is

- 1) Too high because change in temperature direct Proportional to molar mass.
- 2) Too Low because change in temperature direct Proportional to molar mass.
- 3) Too low because change in temperature inversly Proportional to molar mass
- 4) Too high because change in temperature inversly Proportional to molar mass.
- 5) No effect because the temperature does not change Significantly

$$\Delta T_f = T_{\text{solvent}} - T_{\text{solution}} \uparrow$$

$\Delta T_f \downarrow$

$$M.M = \frac{\text{Mass}_{\text{solute}} \cdot K_f}{\Delta T_f \cdot \text{Mass}_{\text{Solvent}}}$$

inversly

$$\Delta T_f \downarrow, M.M \uparrow$$

Q10) Among the Following, the weakest oxidizing agent is

- 1) Cu^{+2} (+0.34V)
- 2) Al (-0.66V)
- 3) Pb^{+2} (-0.13V)
- 4) Zn^{+2} (-0.76V)
- 5) Cr^{+2} (-1.45V)

مستقل اقوان
فقط كالم
مهم اقل

- Cu^{+2} (+0.34V)
- Al^{+3} (+0.66V)
- Pb^{+2} (-0.13V)
- Zn^{+2} (-0.76V)
- Cr^{+2} (-1.45V)

افضل
عالم مذكر
اقل
افضل

The Sulfate ion can be detected by:-

1. Adding BaCl_2 Solution in acidic media and a white ppt. will appear.
2. Adding BaCl_2 Solution in basic media and a white ppt. will appear.
3. Adding HCl Solution, a gas will change the wet red litmus to blue.
4. Adding NaOH Solution, a gas will change the wet blue litmus to red.
5. Adding NaOH Solution, ammonia smell can be detected.

Ans: 1

Q15) The Cl^- can be detected by:-

1. Sodium oxalate
2. Potassium thiocyanate
3. Silver nitrate + acid
4. Barium chloride + acid
5. Hydrochloric acid.

Ans: 3

Q16) When an unknown react with sodium ^{NaOH} hydroxide solution, it evolved a gas which convert the wet red litmus paper to blue. The resulted aqueous layer from the previous reaction was ~~the~~ treated with hydrochloric acid solution and carbon dioxide ^{H_2CO_3} evolved immediately as a result of reaction, The unknown is:-

1. CaCl_2
2. $\text{Ca}(\text{HCO}_3)_2$
3. NH_4Cl
4. NH_4HCO_3

Ans: 4

Q17) An unknown salt give a gas that convert the litmus Paper from red to blue when detected with sodium hydroxide and a pale yellow precipitate when reacted with silver nitrate in acidic media. The formula of the salt is:-

1. CaBr_2
2. $\text{Fe}_2(\text{SO}_4)_3$
3. NH_4HCO_3
4. FeBr_3
5. NH_4Br

Ans: 5

Q18) The iron (III) ion can be detected by:-

Ans: 2

1. Adding BaCl_2 solution, in acidic media and a white ppt. will appear.
2. Adding KSCN solution, and a red color will appear.
3. Adding HCl solution, a gas will change the wet red litmus paper to blue.
4. Adding NaOH solution, a gas will change the wet blue litmus paper to red.
5. Adding KSCN solution, and a white color will appear.