ملخص كيمياء تحضيري

Ch 4

إعداد

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chapter 4

Stoichometry

Stoichometry: It is numerical relationships between the amount of reactants and products
علاقة عددية بين كمية المتفاعلات والنواتج.

- it determine the amount of reactants necessary to form amount of product
  تحديد كمية المتفاعلات اللازمة لتكوين النواتج
- predicts the amount of products that will form in the chimical reaction.
  التنبأ بكمية النواتج المتكونة في التفاعل الكيميائي.

mole to mole conversion

$$C_3H_8 + 5O_2 \longrightarrow 3CO_2 + 4H_2O$$

How many moles of water are produced from 2.72 mole of propane in excess oxygen.

$C_3H_8 \longrightarrow 4H_2O$

1 mole $\longrightarrow$ 4 mole

2.72 $\longrightarrow$ X

$$X = \frac{4 \times 2.72}{1} = 10.9 \text{ mole of water}$$

mass to mass Conversion

$C_3H_8 + 5O_2 \longrightarrow 3CO_2 + 4H_2O$

what mass of CO_2 is produced when 7.7g gram of C_3H_8 react with O_2.

$C_3H_8 \longrightarrow 3CO_2$

1 mole $\longrightarrow$ 3 mole

molar mass of C_3H_8 $\longrightarrow$ 3 (molar mass of CO_2)

$3 \times 12 + 8 \times 1 \longrightarrow 3(12 + 2 \times 16)$

44 gram $\longrightarrow$ 132 gram

7.7g gram $\longrightarrow$ X

$$X = \frac{7.7g \times 132}{44} = \underline{23.3 \text{ gram } CO_2}$$

طريقة ثانية

$$7.7 \text{ g } C_3H_8 \times \frac{1 \text{ mole}}{44 \text{ gram } CO_2} \times \frac{3 \text{ mole } CO_2}{1 \text{ mole } C_3H_8} \times \frac{44 \text{ g } CO_2}{1 \text{ mole } CO_2}$$

$$= \underline{23.3 \text{ gram } CO_2}$$

Percent Yeild

(3)

- Percent Yeild = $\frac{\text{Acutal Yeild}}{\text{Theriotcal Yeild}} \times 100$

- Acutal (practical) Yeild:- الناتج الفعلي

It is the amount of product actually produced in achemical reaction. كمية النواتج الفعلية الناتجة من التفاعل.

- Theretical Yeild:- الناتج النظري

It is the Calculated amount of product in the chemical reaction. كمية النواتج المحسوبة من التفاعل الكيميائي وتعتمد على المادة المحددة للتفاعل

depend on amount of Limiting reactant.

* Acutal yeild less Than Theoretical yeild *

الناتج الفعلي أقل من الناتج النظري.

Example

what is the Percent yeild for reaction if it's Theortical yeild is 160 gram and it's acutal yeild is 40 gram.

Percent yeild = $\frac{\text{Acutal yeild}}{\text{Theoritcal}} \times 100$

$= \frac{40}{160} \times 100 = 25\%$

$2Al + 3Cl_2 \longrightarrow 2AlCl_3$ (4)

In This balanced equation :-

Calculate The Theoretical yeild of product (g) if we started The reaction with 7.5 gram of Al and 24.8 gram of Cl_2.

$$7.5\ g\ Al \times \frac{1\ mole\ Al}{Mm\ of\ Al} \times Conversion\ Factor \times \frac{Mm\ AlCl_3}{1\ mole\ AlCl_3}$$

$$7.5\ g\ Al \times \frac{1\ mole\ Al}{27\ g\ Al} \times \frac{2\ mole\ AlCl_3}{2\ mole\ Al} \times \frac{133.5\ g\ AlCl_3}{1\ mole\ AlCl_3}$$

$$= \boxed{37\ gram\ AlCl_3}$$

$$24.8\ g\ Cl_2 \times \frac{1\ mole\ Cl_2}{Mm\ Cl_2} \times Conversion\ Factor \times \frac{Mm\ AlCl_3}{1\ mole\ AlCl_3}$$

$$24.8\ g\ Cl_2 \times \frac{1\ mole}{71\ g\ Cl_2} \times \frac{2\ mole\ AlCl_3}{3\ mole\ Cl_2} \times \frac{133.5\ g\ AlCl_3}{1\ mole\ AlCl_3}$$

$$= \boxed{31\ gram\ AlCl_3}$$

Cl_2 → it is The least amount So it is limiting reactant and Theortical yeild.

Solutions

Solution :-

It is homogenous mixure of two or more substances.

هو مخلوط متجانس يتكون من مادتين او اكثر

↳ Solvent :- مذيب ⇒ present in large amount.

↳ Solute :- مذاب ⇒ all other materials present.

as Salty Solution → Salt in wate ملح في ماء

Salt → Solute الملح هو المذاب

Water → Solvent الماء هو المذيب

Solution Concentration

$$\text{Molarity } M = \frac{\text{amount of Solute (mole)}}{\text{Volume of solution (L)}}$$

M = mole / litre

unit of Molarity ← M = Mol / L وحدة قياس المولارية مول / لتر

Example :- What is the Molarity of solution contain 230 g. of $Al_2(SO_4)_3$ in 5.5 litre water

D لتركيز كم مول في 230 g

$$\rightarrow 230\ g\ Al_2(SO_4)_3 \times \frac{1\ mole\ Al_2(SO_4)_3}{342\ g\ Al_2(SO_4)_3} = 0.67\ mole$$

$$\rightarrow \text{Molarity} = \frac{\text{mole of solute}}{\text{Volume of solution}} = \frac{0.67}{5.5} = 0.12\ mol/L$$

* How many liters of 0.125 M NaOH contain 0.255 mol NaOH

(6)

$$\text{Molarity } M = \frac{\text{moles of solute}}{\text{Volume}}$$

$$\therefore \text{Volume} = \frac{\text{moles of solute}}{\text{Molarity}} = \frac{0.255}{0.125} = 2.04 \text{ L}$$

Solution dilution

To make solution of lower concentration from high concentrated solution (stock solution) ⟹

- more solvent is added. زيادة المذيب
- The amount of solute doesn't changed كمية المذاب لا تتغير

$$M_1 V_1 = M_2 V_2$$

Example :- How would you prepare 200 ml of 0.25 M NaCl solution from a 2.0 M solution ?

$$V_1 = \frac{M_2 V_2}{M_1} = \frac{200 \times 0.25}{2} =$$

25 mL

Types of aqueous Solution

Salt in water (Normal Saline) (NaCl and H_2O)

It is ionic compound when dissolved in water ⟶ dissociation to ions (Na^+ & Cl^-)

هو مركب أيوني عند ذوبانه في الماء يتأين

- Called electrolyte
- able to conduct electricity

توصيل الكهرباء

Sugar in water (glucose solution) ($C_6H_{12}O_6$ and H_2O)

It is a molecular compound when dissolved in water ⟶ Not dissociated.

لا يتأين

- Non electrolyte
- Not conduct electricity

لا توصل الكهرباء

Electrolyte

It is the substance when dissolved in water conduct electricity.

هي المادة التي عند ذوبانها في الماء تتوصل الكهرباء

Strong electrolyte	Non electrolyte	Weak electrolyte
- Complete ionization (dissociated) تأين كلي	- No ionization لا تتأين	- Partially ionization تأين جزئي
- Conduct electricity توصل الكهرباء	- Not conduct electricty لا توصل.	- Conduct electricty
- Strong acids: HCl , HBr	Polar molecular substances as glucose and alchole	- Weak acid: - HF - CH_3COOH
- Strong bases.		- Weak bases
- Ionic Salts.		

Acids and bases

Acids

- Substance That give H^+ in aqueous solution

المادة التي تعطي ايون الهيدروجين الموجب عندذوبانها في الماء

- Sour taste
- Turn litmus Paper to red

تغير ورقة عباد الشمس إلى اللون الاحمر

- Feel like water

Common acids

- HCl
- HBr
- HI
- HNO_3
- H_2SO_4
- H_3PO_4
- CH_3COOH

Bases

- substance That give OH^- in aqueous solution

المادة التي تعطي ايون الهيدروكسيد السالب عند ذوبانها في الماء.

- bitter taste.
- turn litmus Paper to blue

تغير لون ورقة عباد الشمس إلى اللون الازرق

Slippary feeling.

Common bases

- NaOH
- KOH
- $Ca(OH)_2$
- NH_3

Neutrlization reaction
Acid - Base reaction
تفاعلات التعادل

Acid	+ base	→ Salt	+ Water
حمض	قاعدة	ملح	ماء

$HCl + NaOH \longrightarrow NaCl + H_2O$

$HI + Ba(OH)_2 \longrightarrow BaI_2 + H_2O$

(acid) (base) (Salt) (water)

Redox reaction
oxidization - Reduction reaction
تفاعلات الأكسدة والاختزال

oxidation
أكسدة

* loss of electrons
عملية فقد الالكترونات
* Increase in oxidation state
زيادة في حالة الأكسدة

oxidizing agent العامل المؤكسد
agent that oxidizing another substance.

Reduction
اختزال

* gain of electrons
عملية اكتساب الكترونات

Decrease in oxidation state

Reducing agent العامل المختزل
agent that reduce another substance.

Common examples of redox reaction (11)

- Rusting of iron تفاعل صدأ الحديد

$$4Fe + 3O_2 \longrightarrow 2Fe_2O_3$$

- Combustion of hydrogen تفاعل احتراق الهيدروجين

$$2H_2 + O_2 \longrightarrow 2H_2O$$

- Combustion of octane. احتراق الأوكتان

$$2C_8H_{18} + 25O_2 \longrightarrow 16CO_2 + 18H_2O$$

Rules for assigning oxidation state

- Free element ⟶ 0 (Zero)
- monoatomic ion ⟶ charg on it.
  - $Na^+ \longrightarrow 1$
  - $Cl^- \longrightarrow -1$
- The sum of the oxidation states of all atoms is
  - ⟶ neutral molecules = 0
  - ⟶ An ion = charge on ion.

Examples

What is the oxidation number of (N) in

NH_3

$N + 3X1 = 0$

$N = \underline{-3}$

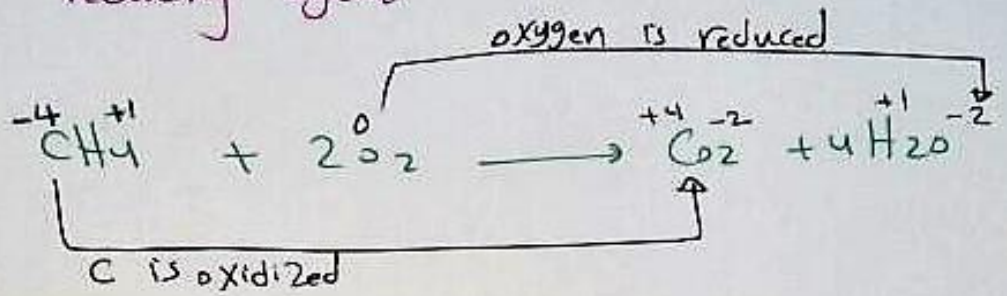
$NH_4^{(+1)}$

$N + 4X1 = 1$

$N = \underline{-3}$

* $CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$

Which The substance is oxidizing agent and reducing agent.

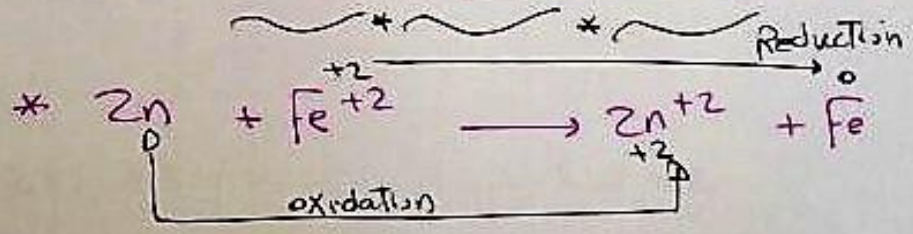


Carbon is oxidized as it lass electrons (increase in oxidation number) الكربون هو العنصر الذي تأكسد لأنه فقد الإلكترونات لذلك سمي بالعامل المختزل.

So it is The reducing agent (CH_4)

oxygen is reduced as it (gain electron) or decrease in oxidation number الأكسجين هو العنصر الذي اختزل لأنه كسب الإلكترونات لذلك سمي بالعامل المؤكسد.

So it is The oxidizing agent



- oxidizing agent is Fe^{+2}.
- Reducing agent is Zn.

- What is the oxidation number of Cr in each compound. (13)

(a) Cr_0

$Cr + (-2) = 0$

$Cr = \underline{2}$

(b) Cro_3

$Cr - 2X3 = 0$

$Cr = 6$

(c) $Cr_2 o_3$

$Cr_2 - 2X3 = 0$

$Cr_2 = 6 \quad \therefore Cr = 3$

- what is the oxidation number of S in

H_2S

$2X1 + S = 0 \quad \therefore S = \underline{-2}$

SO_4^{-2}

$S - 2X4 = -2 \quad \therefore S = 8 - 2 = \underline{6}$
