ملخص درس الخلايا الفولتية – Inspire

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موقع المناهج ⇦ المناهج الإماراتية ⇦ الصف الثاني عشر ⇦ كيمياء ⇦ الفصل الأول ⇦ ملخصات وتقارير ⇦ الملف
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المزيد من مادة كيمياء:	ملفات ا كتب للمعلم ا كتب للطالب ا اختبارات الكترونية ا اختبارات ا حلول ا عروض بوربوينت ا أوراق عمل منهج انجليزي ا ملخصات وتقارير ا مذكرات وبنوك ا الامتحان النهائي ا للمدرس

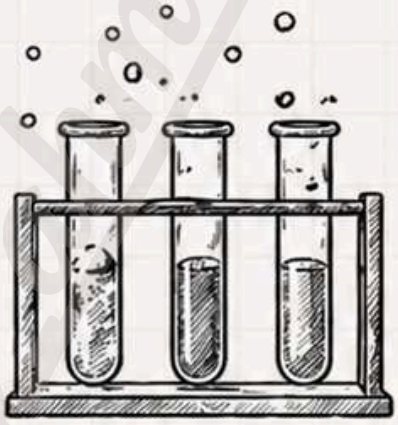
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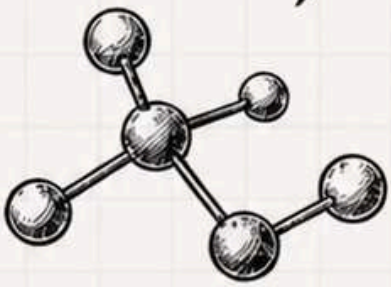
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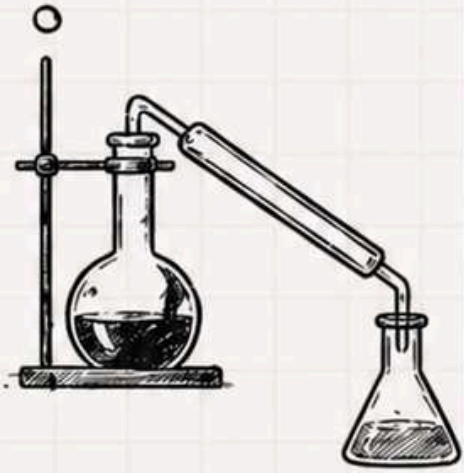
Voltaic Cells Lesson

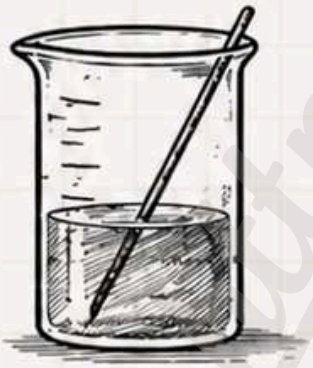
Summary

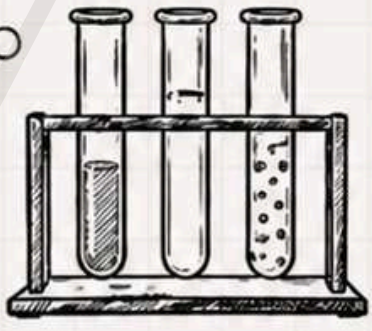
Chemistry Grade 12

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Voltaic (Galvanic) Cells

1- Definition :

A voltaic cell is an electrochemical cell that converts chemical energy into electrical energy through a spontaneous redox reaction.

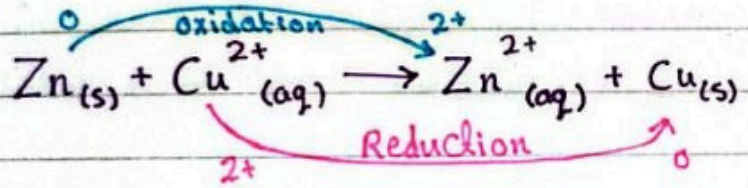
- The reaction occurs naturally (no external energy required).
- Electrical current is generated due to the flow of electrons through an external circuit.

2- Redox Reactions :

A voltaic cell is based on Redox Reactions.

Oxidation ⟶ loss of electrons ⟶ oxidation number increases.

Reduction ⟶ Gain of electrons ⟶ oxidation number decreases.



3- Structure of a voltaic Cell :

A Complete voltaic cell consists of :

- Two electrodes :
  - ↳ Conduct electricity
  - ↳ Usually metals : (Zn, Cu, etc.)
- Two Electrolyte Solutions :
  - ↳ Contain ions involved in the reaction.
- External Wire :
  - ↳ Allows electron flow
- Salt Bridge
  - ↳ Allows ion movement
  - ↳ Maintains Charge balance

Feature	Anode	Cathode
Reaction	Oxidation	Reduction
Electrons	Produced	Consumed
Charge	Negative	Positive
Mass	Decreases	Increases
Oxidation Number	Increases	Decreases

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4- Electron Flow and Current:

Electrons flow: Anode ⇝ Cathode

Conventional current: Cathode ⇝ Anode

Electrons travel only through the external circuit (wire).

5- Salt Bridge:

Functions:

↳ Completes the electrical circuit.

↳ Maintains electrical neutrality.

↳ Prevents Charge buildup.

Ion Movement:

↳ Anions (-) ⇝ Move toward the anode.

↳ Cations (+) ⇝ Move toward the Cathode.

6- Half-Cells:

Each half-Cell contains:

↳ one electrode

↳ one electrolyte

The two half-cells are connected by:

External wire (electron flow).

Salt bridge (ion flow).

7- Half-Reactions

Oxidation (Anode):

$Zn \rightarrow Zn^{2+} + 2e^-$

Reduction (Cathode):

$Cu^{2+} + 2e^- \rightarrow Cu$

8- Overall Cell Reaction

$Zn + Cu^{2+} \rightarrow Zn^{2+} + Cu$

9- Cell Notation:

General Form:

Anode | Anode Solution || Cathode solution | Cathode

Ex. $Zn | Zn^{2+} || Cu^{2+} | Cu$

Rules:

Left side ⇝ oxidation | Right side ⇝ Reduction { single line (|) ⇝ Phase boundary

{ Double line (||) ⇝ Salt Bridge {

10- Types of Electrodes:

Metal - Metal Ion Electrode:

Ex. $Zn|Zn^{2+}$

Inter Electrode (Pt or C):

Used when no solid metal exists

$Pt^{+}|Fe^{2+}, Fe^{3}$

11- Standard Electrode Potential (E°):

↳ Each half-Reaction has a Standard reduction potential

↳ Measured under standard Conditions.

↳ Compared to the Standard Hydrogen Electrode (SHE)

12- Standard Hydrogen Electrode (SHE):

Reference electrode { Potential = 0 V { Used to determine all other electrode potentials.

13- Cell Potential (EMF)

$E^{\circ}_{cell} = E^{\circ}_{cathod} - E^{\circ}_{anode}$

Important Notes:

Always use reduction potentials

Do Not multiply E° values

Reverse sign if the reaction is Reversed.

14- Spontaneity:

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

$E^{\circ}_{cell} < 0 \rightsquigarrow$ Non-Spontaneous

$E^{\circ}_{cell} = 0 \rightsquigarrow$ Equilibrium

15- Relationship with (energy):

$E > 0 \rightsquigarrow \Delta G < 0 \rightsquigarrow$ Spontaneous

$E < 0 \rightsquigarrow \Delta G > 0 \rightsquigarrow$ Non-Spontaneous

16- Concentration Changes:

Half-Cell	Change
Anode	Ion Concentration increases
Cathode	Ion Concentration decreases

Important Notes:

Zn is oxidized ⇝ Electrode mass decreases

Cu^{2+} is Reduced ⇝ Copper deposites

Blue Color fades as Cu^{2+} decreases

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17- Roller Coaster Concept (very Important 🔥)

This Concept helps determine :

↳ Direction Flow of electron Flow

↳ Anode and Cathode

↳ Spontaneity

Idea :

Electrons behave like a roller Coaster moving From high energy to Low energy.

Rule :

Electron Flow From ⇝ Lower reduction potential → Higher reduction potential

For Example

Zn = -0.76 V
Cu = +0.34 V
} Electrons Flow Zn → Cu

Therefore :

Zn → Anode

Cu → Cathode

18- Electrochemical Series :

A Table ranking elements based on reduction potential.

Rules :

Higher in series ⇝ Oxidized easily ⇝ Anode
Lower in series ⇝ Reduced ⇝ Cathode
} Higher E° values ⇝ Cathode
Lower E° ⇝ Anode

19- Special Cases :

1- Inert Electrodes :

↳ Used When no solid metal is present

↳ Only Conduct electrons

2- Concentration Cells :

The same substance, different concentrations

Rules :

Lower Concentration → Anode

Higher Concentration → Cathode

3- No Salt Bridge :

↳ Reaction stops quickly

↳ Because of Charge Buildup

4- Reversing Reactions

↳ Reversing a reaction changes the sign of E

5- Multiply Reactions

↳ Do Not multiply E° values

20- Energy perspective :

Electrons lose energy as they move.

This energy is converted into electrical energy.

21- Common Mistakes :

↳ Confusing anode and cathode

↳ Reversing electron flow

↳ Multiplying E° values

↳ Forgetting salt bridge role

↳ Assuming electrons move in solution.

Feature	Voltaic	Electrolytic
Reaction	Spontaneous	Non-spontaneous
Energy	Produces	Requires
Anode	Negative	Positive
Cathode	Positive	Negative

Final Master Summary :

↳ Voltaic cells generate electricity from spontaneous redox reactions.

↳ Oxidation occurs at the anode (negative)

↳ Reduction occurs at the cathode (positive)

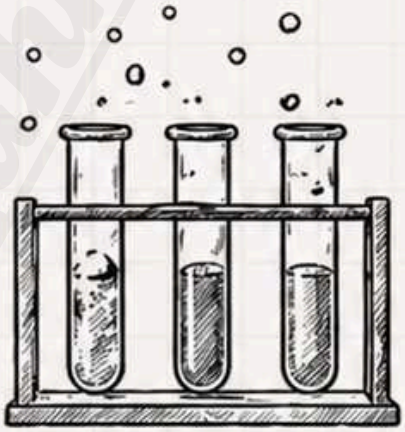
↳ Electrons flow through the wire from anode to cathode

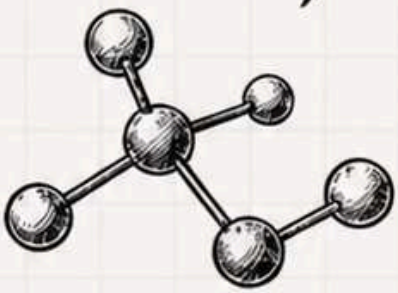
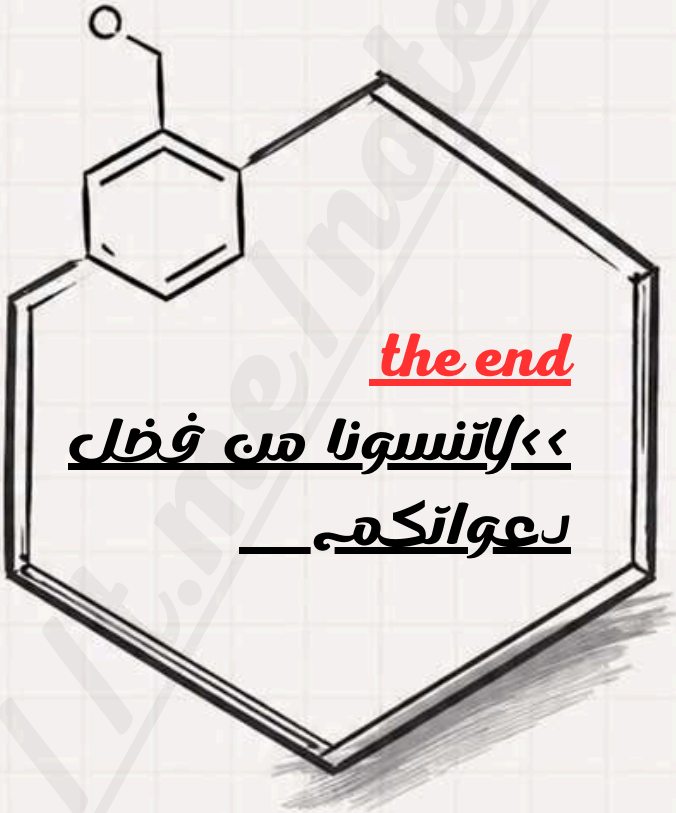
↳ Ions move through the salt Bridge

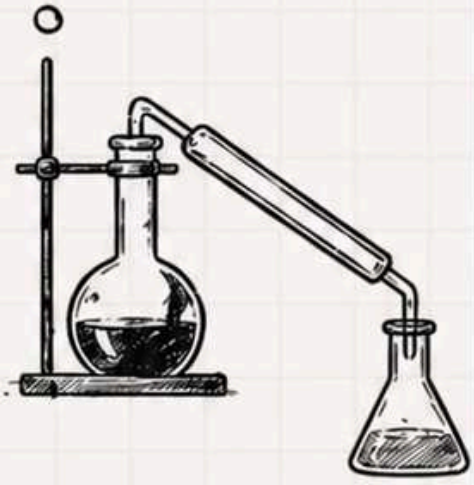
↳ Cell potential determines spontaneity

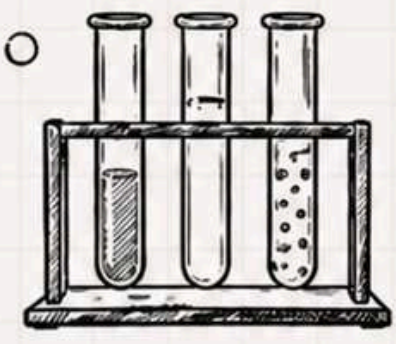
↳ Roller Coaster Concept explains electron flow direction.

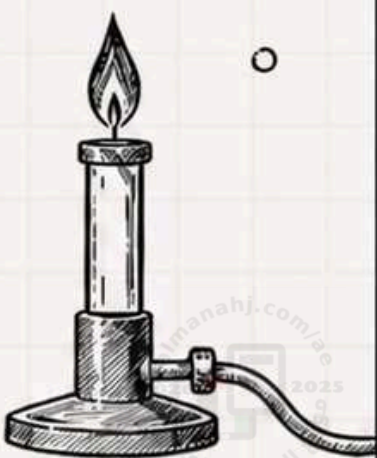
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the end

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