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- Mentored 1 lakh+ Students
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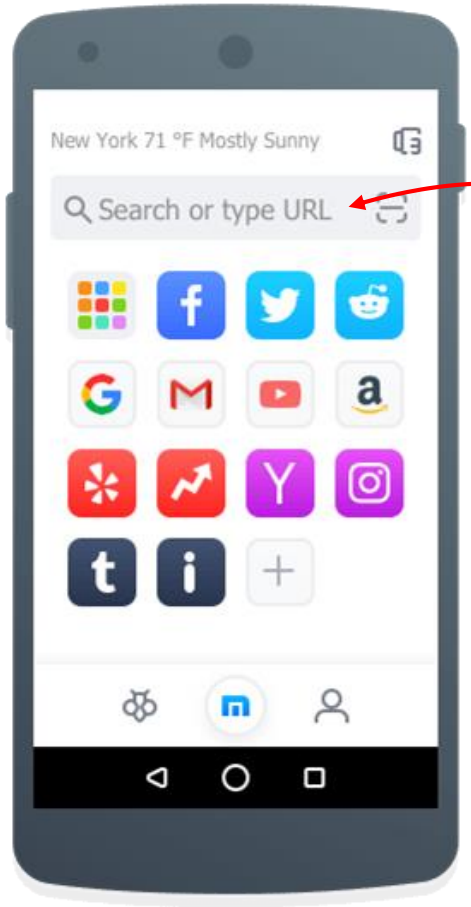
Electrochemistry

LECTURE 1

Topics we will learn today

- Scope of Electrochemistry
- Basic Terms and Definitions
- Electrode Potential and types of electrochemical cells
- Working of Galvanic Cell



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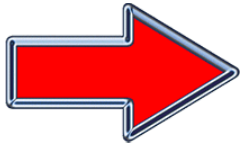

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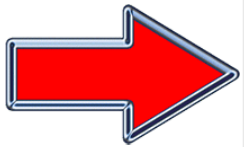

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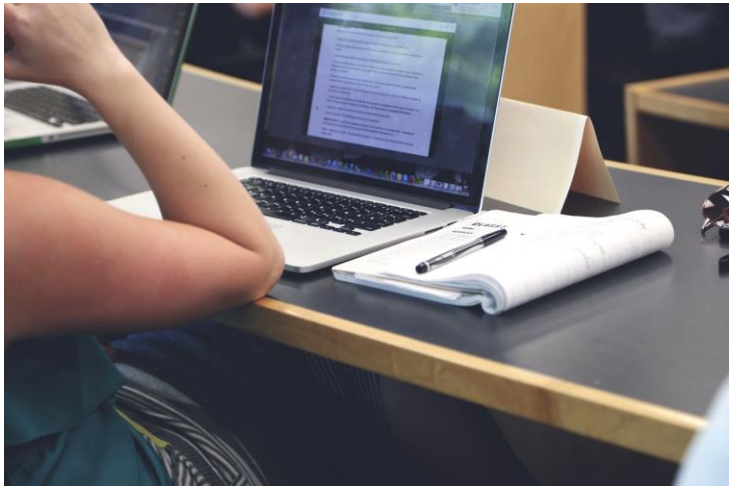
Natural Science viva, *c.*1890

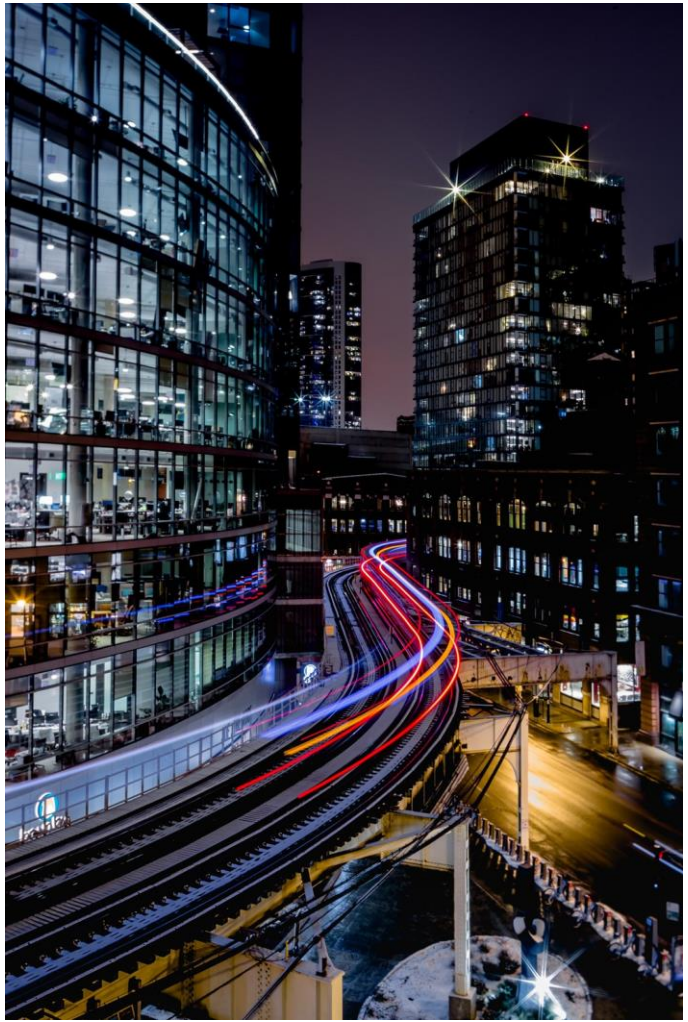
Examiner: What is Electricity?

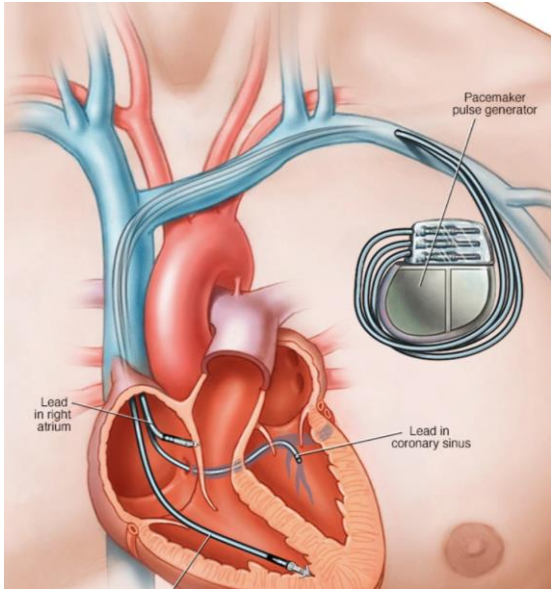
Candidate: Oh, Sir, I'm sure I have learnt what it is—I'm sure I *did* know—but I've forgotten.

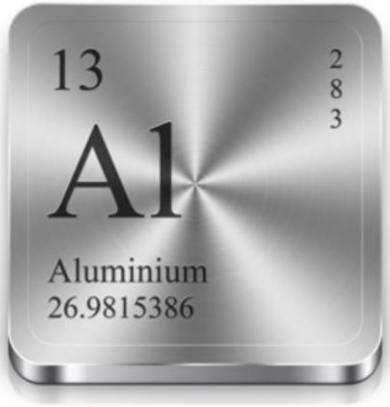
Examiner: How very unfortunate. Only two persons have ever known what Electricity is, the Author of Nature and yourself. Now one of the two has forgotten.

Source: Falconer Madan, *Oxford Outside the Guide-Books*, 1923.
Quoted in: *The Oxford Book of Oxford*, Jan Morris, OUP, 1978.






Pacemaker pulse generator
Lead in right atrium
Lead in coronary sinus


13
2
8
3
Al
Aluminium
26.9815386

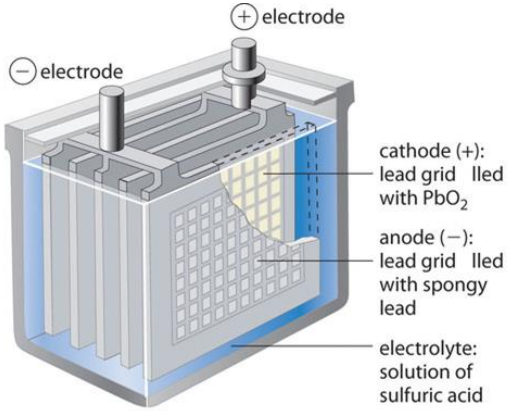

BEFORE


AFTER

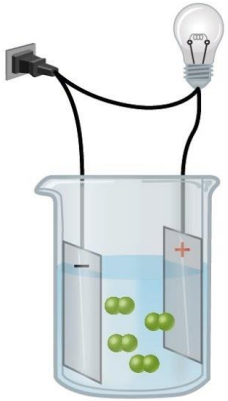
- Electrical energy on the move
- Electrolysis of water
- Lead storage battery of your bike or car
- Pure water is insulator but salt water conducts electricity
- Once upon a time, Al was costlier than Gold
- Handheld equipments and pacemakers

I think we ought to expand our view of what electrochemistry is about. It's not just electrode potentials and electrolysis. its half of modern inorganic chemistry - P. W. Atkins

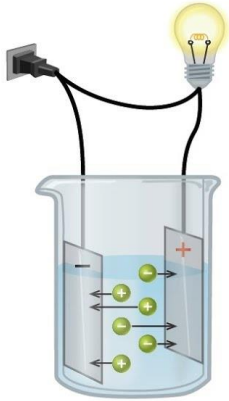
Electrochemistry is the branch of chemistry concerned with the interconversion of chemical & electrical energies.



Lead storage battery



Pure water

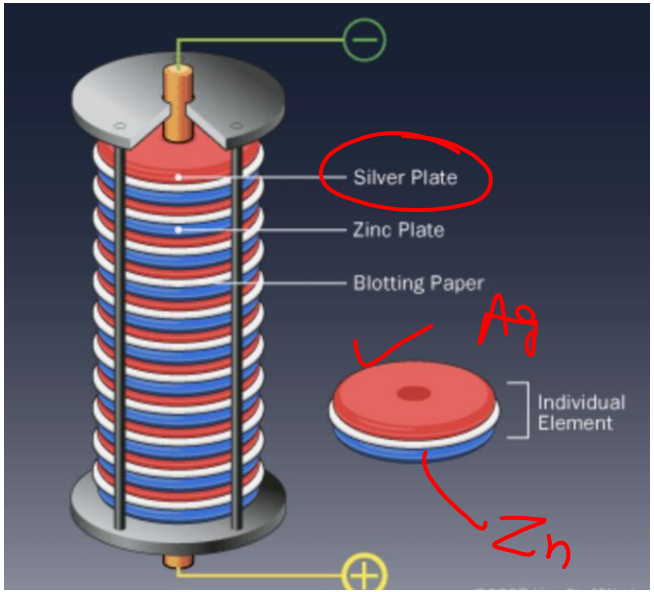


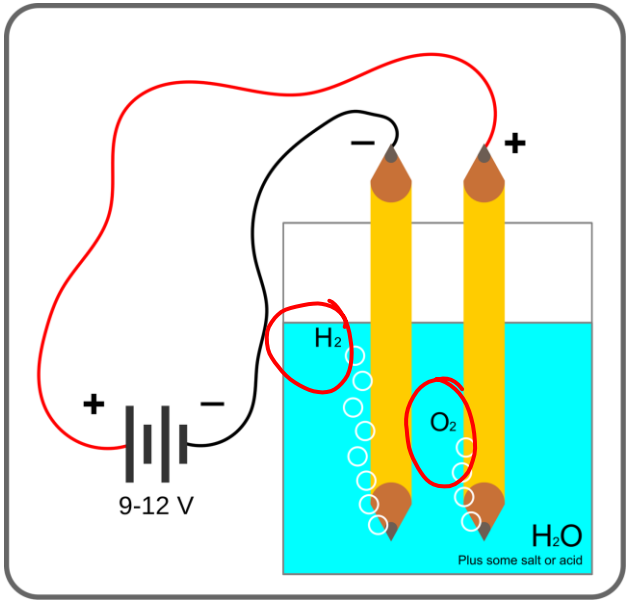
Salt water

1793 - Alessandro Volta discovered that electricity could be produced by placing two dissimilar metals on opposite sides of a moistened paper.

1800 - Nicholson & Carlisle showed that electric current could decompose water into O_2 & H_2.

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





Basic Definitions

Oxidation: Loss of electrons / Gain of a more E.N. atom / Loss of a less E.N. atom

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

Reduction: Gain of electrons / Gain of a Less E.N. atom / Loss of a more E.N. atom

$Ag^+ + e^- \rightarrow Ag$

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

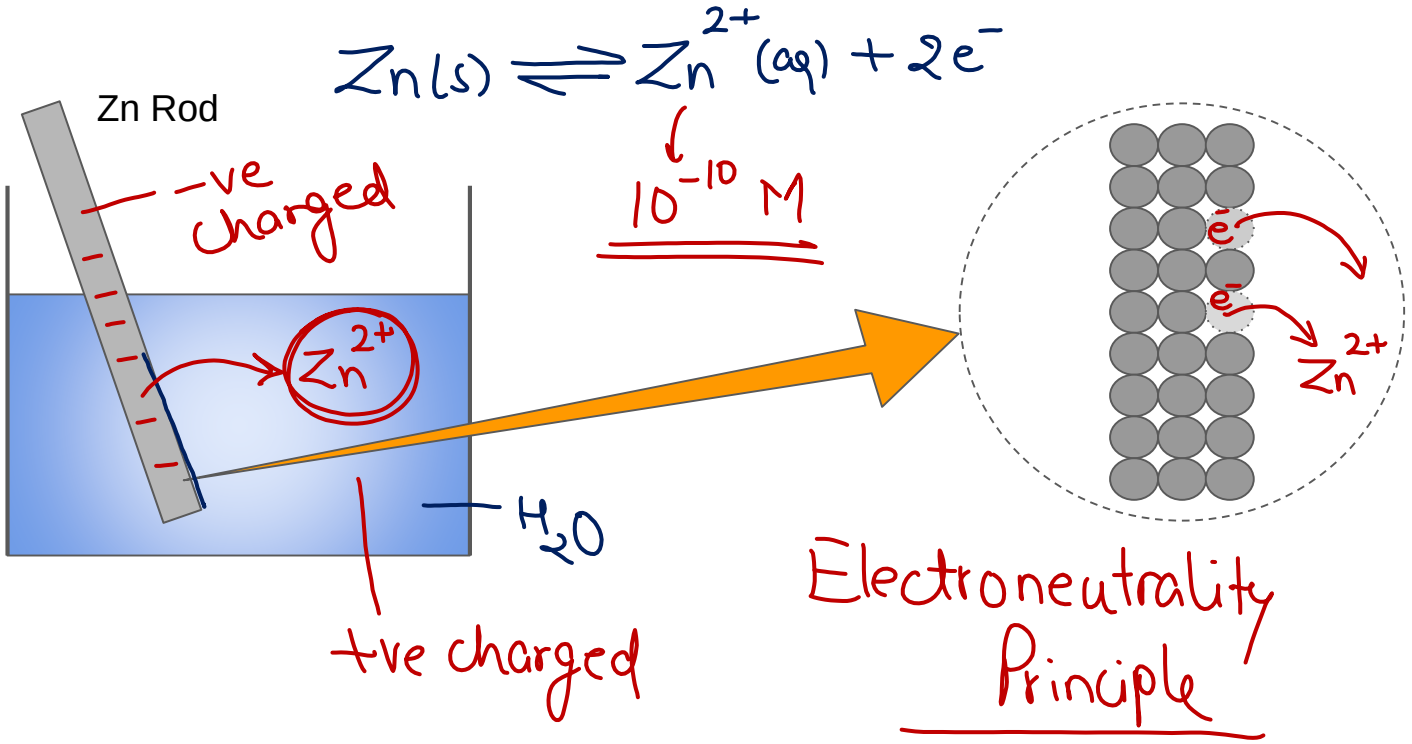
Ion: is an atom / molecule that has acquired an electrical charge.

Electrolyte: A solution that contains ions is called an electrolyte solution.
Electrolyte is an ionic conductor & different from electronic (metallic) conductor.

Electrode: surface at which oxidation or reduction takes place.

- Active
- Inert

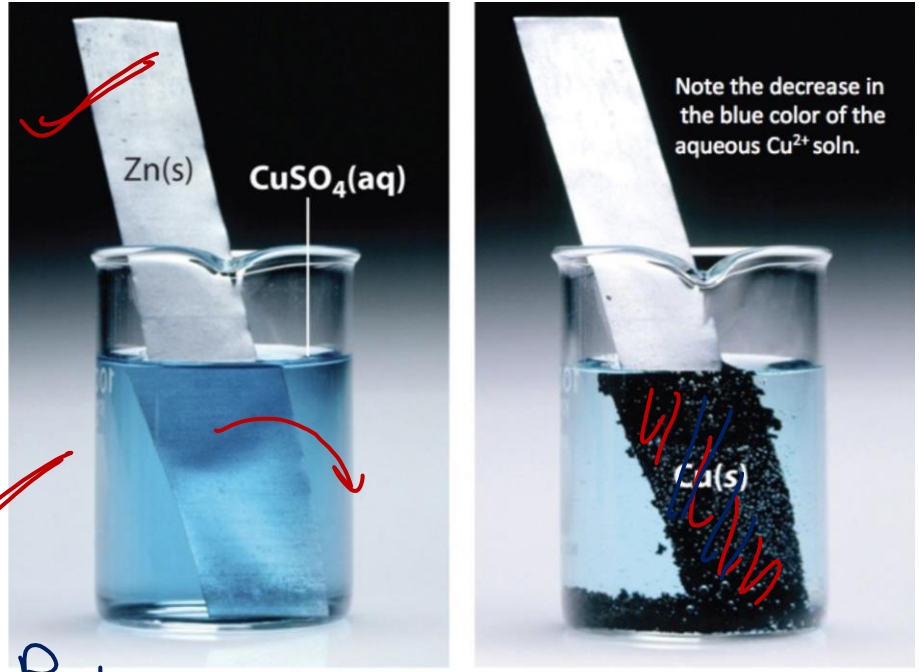
Placing a Zinc Rod in water



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

Red: $Cu^{2+} + 2e^- \rightarrow Cu(s)$

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

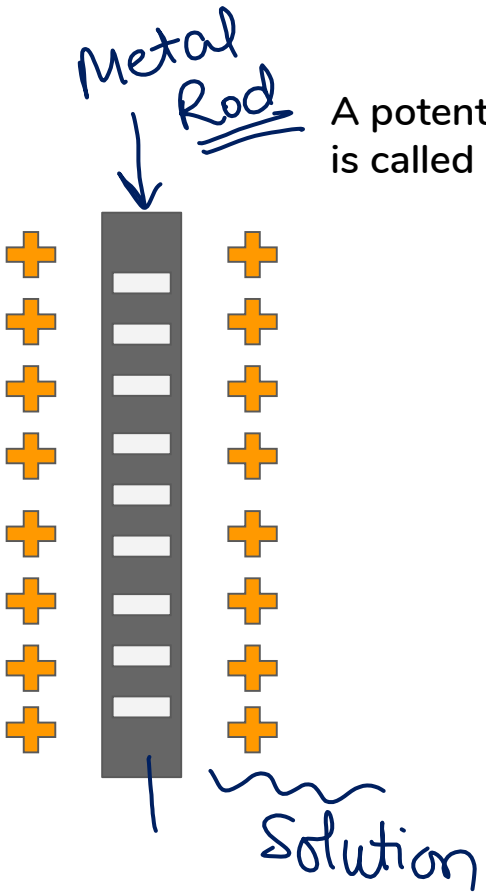


$Zn(s) + Cu^{2+}(aq) \rightarrow Zn^{2+}(aq) + Cu(s)$

Spontaneous Rxn

$\Downarrow$

$\Delta G = -ve$ $\quad \Delta G = W_{useful}$



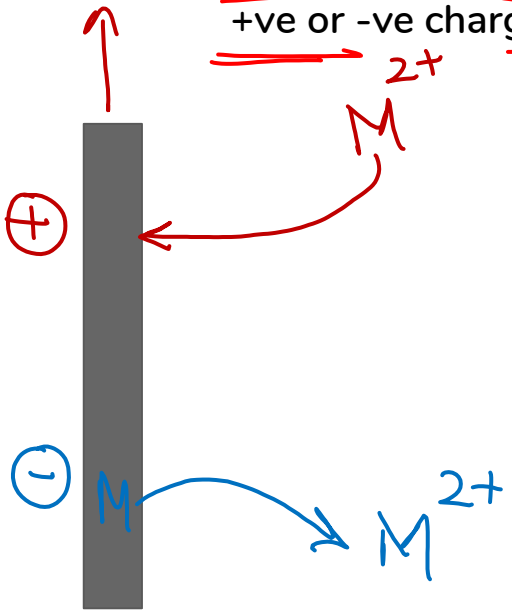
A potential difference developed at the metal - solution interface is called ad electrode potential.

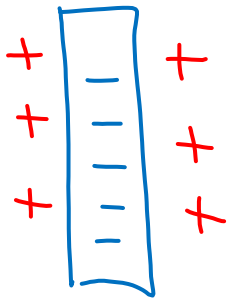
$Zn - ZnSO_4$

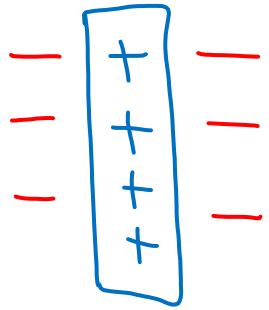
$Cu - CuSO_4$

$Ag - AgNO_3$

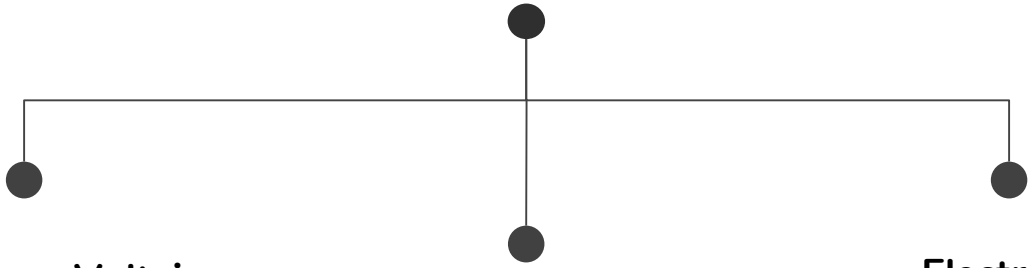
- Metal Surface may acquire +ve or -ve charge based on different cases.
- At equilibrium, there is a separation of charges and depending on the tendencies of the two opposing reactions, the electrode may become +ve or -ve charges w.r.t. electrolyte.







Electrochemical cell



Galvanic or Voltaic cell

- Chemical → electrical
- Spontaneous reaction
- Power is produced.

Reversible

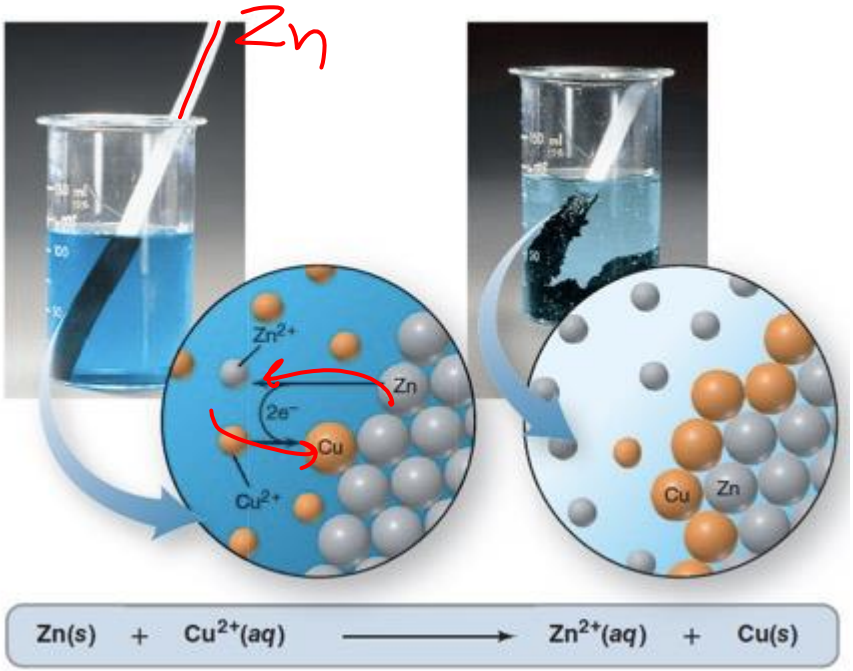
- No net reaction
- A equilibrium
  P=E.I

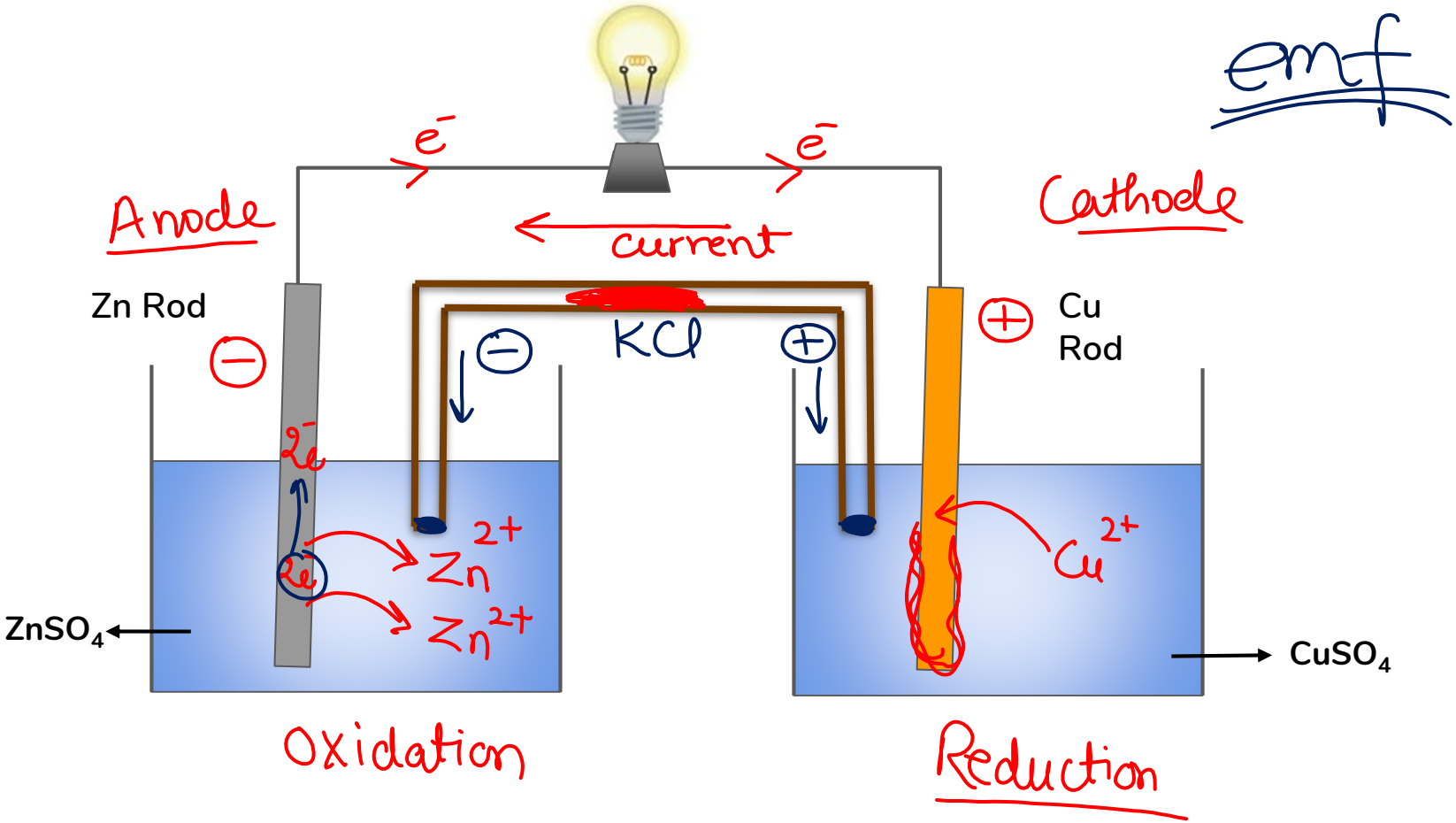
Electrolytic cell

- Electrical → chemical
- Non spontaneous reaction.
- Power is consumed

Galvanic Cell

Being a spontaneous reaction, it's Gibbs energy decreases during the reaction, which is converted to electrical energy by constructing a cell arrangement




emf
e⁻
e⁻
Anode
current
Cathode
Zn Rod
KCl
Cu
Rod
2e⁻
2e⁻
Zn²⁺
Zn²⁺
Cu²⁺
ZnSO₄
CuSO₄
Oxidation
Reduction