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ELECTROLYSIS OF WATER

Few things to remember:

- ✓ Oxygen atom has a valency of 2. That means, it **takes** 2 electrons to complete its octet. When it gets these two electrons, the Oxygen atom becomes O^{2-} ion.
- ✓ At the time of formation of Water – H_2O, the Oxygen atom gets these two electrons from the two Hydrogen atoms.
- ✓ When this water is electrolyzed, while splitting into ions, this **Oxygen does not return the electrons to Hydrogen**, it keeps it with itself.
- ✓ One of the Hydrogen atom separates from the Water molecule to form H^+ ion, while the other Hydrogen atom remains attached to the Oxygen atom, to give us OH^- ion.
- ✓ Now, for the OH^- to turn into O, it needs to separate the H^+ (hydrogen with one less electron) from it and also give away the two electrons that it has extra. Something like this –

  $OH^- - H^+ \rightarrow O^{2-}$ ..... (1)

  $O^{2-} - 2e^- \rightarrow O$ ..... (2)

  But we never use '–' sign in chemical reactions, hence those terms will be taken to the right. And the new equations will be –

  $OH^- \rightarrow O^{2-} + H^+$ ..... (3)

  $O^{2-} \rightarrow O + 2e^-$ ..... (4)

During the Electrolysis of water, the following things take place:

At the Cathode:

- The Cathode is the negative electrode; hence it is also the electrode that **gives away electrons**.
- Now, water splits into its constituent ions, when electricity is passed through it

  $2H_2O \rightarrow 2H^+ + 2OH^-$ ..... (5)
- Now, the positive Hydrogen ions travel to the Cathode, get electrons from it and release themselves as Hydrogen gas

  $2H^+ + 2e^- \rightarrow H_{2\,(g)}$ ..... (6)
- If we combine the two reactions 5 and 6 given above, then the final Cathode Reaction becomes:

  $2H_2O + 2e^- \rightarrow 2OH^- + H_{2\,(g)}$

At the Anode:

- The Anode is the negative electrode; hence it is also the electrode that **takes electrons from ions**.
- Like mentioned above, the water splits into its constituent ions, when electricity is passed through it

  $2H_2O \rightarrow 2H^+ + 2OH^-$ ..... (5)

  The negative OH^- ions travel to the Anode, where, the reactions given at the beginning (reactions 3 and 4) occur. But we never have only one Oxygen in the molecule. It is always O_2. Hence the reactions will be multiplied by 2.

  $2OH^- \rightarrow 2O^{2-} + 2H^+$ ..... (7)

  $2O^{2-} \rightarrow O_2 + 4e^-$ ..... (8)

  Now for the final step, we combine equations 5, 7 and 8 together, to get the final Anode reaction.

  $2H_2O \rightarrow O_2 + 2H^+ + 4e^-$