Unit 7: Reduction, Oxidation and Electrochemistry

Chapter 17: Electrochemistry

4.9: Oxidation-Reduction Reactions

- Reduction-Oxidation Reactions (Redox Rxn): chemical reactions where there is a transfer of electron(s).
- Oxidation States (Oxidation Number): a number that is arbitrary assigned to an atom in an element, molecule, and polyatomic ions to account for the number of electrons in *redox* reaction.

Rules for Assigning Oxidation Numbers:

Natural Elements (include diatomic and polyatomics) have an Oxidation Number of 0.

Examples: Na io, O2 (g), O3 (g), H2 (g), F2 (g), P4 (o), and Hg (o) all have an oxidation number of 0.

2. Single Atomic Ions have an Oxidation Number Equals to its Charge.

Example: K' has an oxidation number of +1.

- Oxygen in Binary Compound and Polyatomic Ions has an Oxidation Number of -2.
 - Examples: CO₂, CO, SO₃, SO₂, CO₃²⁻, SO₄²⁻ and H₂O all have an oxidation number of -2 for oxygen.

 <u>An exception occurs in peroxides</u> (compound containing O₂²⁻) where the oxygen has an oxidation number of -1.
- 4. Hydrogen in Binary Compounds and Polyatomic Ions has an Oxidation Number of +1.

Examples: H₂O, HCl, HBr, CH₄, NH₄ and H₂S all has an oxidation number of + 1 for hydrogen.

- In Binary Compounds, the Atom that has the most attraction to electrons (HIGHER Electronegativity) is assigned the NEGATIVE Oxidation Number. This Negative Oxidation Number is the SAME as its Ionic Charge.
 - Examples: HF: F is more electronegative. Thus, F has an oxidation number of -1. NH₃: N is more electronegative. Thus, N has an oxidation number of -3. H₂S: S is more electronegative. Thus, S has an oxidation number of -2.
- 6. The Sum of all Oxidation Numbers is 0 for all Electrically Neutral Compounds.

Examples: CO: Oxidation numbers: O = -2; C = +2 [(+2) + (-2) = 0] SO₂: Oxidation numbers: O = -2; S = +4 [(+4) + 2(-2) = 0]

7. The Sum of all Oxidation Numbers is Equal to the Overall Charge for all Polyatomic Ions.

Examples: CO_3^{2-} : Oxidation numbers: O = -2; C = +4 [(+4) + 3(-2) = -2] SO_4^{2-} : Oxidation numbers: O = -2; S = +6 [(+6) + 4(-2) = -2]

Note: Same Atom from different chemical species might NOT have the Same Oxidation Number. We write the charges of ionic species as n+ or n-. Oxidation numbers are written as +n or -n.

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