#### 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: CO<sub>2</sub>, CO, SO<sub>3</sub>, SO<sub>2</sub>, CO<sub>3</sub><sup>2-</sup>, SO<sub>4</sub><sup>2-</sup> and H<sub>2</sub>O all have an oxidation number of -2 for oxygen.

    <u>An exception occurs in peroxides</u> (compound containing O<sub>2</sub><sup>2-</sup>) where the oxygen has an oxidation number of -1.
- 4. Hydrogen in Binary Compounds and Polyatomic Ions has an Oxidation Number of +1.

Examples: H<sub>2</sub>O, HCl, HBr, CH<sub>4</sub>, NH<sub>4</sub> and H<sub>2</sub>S 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. NH<sub>3</sub>: N is more electronegative. Thus, N has an oxidation number of -3. H<sub>2</sub>S: 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] SO<sub>2</sub>: 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.

# **Oxidation Reduction Study Guide Answers**

**James Thompson** 

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