Electrochemistry **Name**_____

Redox Reactions

Read from **Lesson 1: Redox Reactions** in the **Chemistry Tutorial** Section**, Chapter 18** of **The Physics Classroom**:
Part a: Oxidation and Reduction Part b: Oxidation States

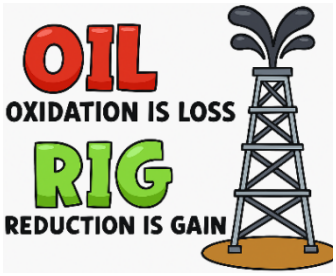
Part 1. Oxidation, Reduction, and Oxidation States

- **Redox reactions** involve the transfer of electrons between substances.
- **Oxidation** = loss of electrons; **Reduction** = gain of electrons.
- These processes always occur together: one species is oxidized while another is reduced.
- **Oxidizing agent**: the species that gains electrons (is reduced).
- **Reducing agent**: the species that loses electrons (is oxidized).
- **Oxidation states** are a bookkeeping tool to track electron movement in complex reactions.

Part 2. Oxidation and Reduction

Example: $\mathbf{Mg + 2HCl \rightarrow MgCl_2 + H_2}$ *(Cl^- does not lose or gain electrons in this reaction.)*

- $Mg(s) \rightarrow Mg^{2+} + 2e^- \rightarrow$ **oxidation**
- $2H^+ + 2e^- \rightarrow H_2\ (g) \rightarrow$ **reduction**



Mnemonics:

- **OIL RIG** → Oxidation Is Loss, Reduction Is Gain
- **LEO the lion says GER** → Loss of Electrons = Oxidation, Gain of Electrons = Reduction

Part 3. Oxidation States

- **Definition:** Assigned numbers that represent the "electron ownership" of atoms in compounds.
- **Rules:**
  - Free elements = 0 (e.g., O_2, N_2).
  - Monatomic ions = charge ($Na^+ = +1$).
  - Group 1 metals = +1; Group 2 metals = +2.
  - Oxygen = -2 (except peroxides = -1).
  - Hydrogen = +1 (except hydrides = -1).
  - Sum of oxidation numbers = 0 for neutral compounds; equals ion charge for polyatomic ions.

Example: In $\mathbf{N_2 + 3H_2 \rightarrow 2NH_3}$, N goes from 0 → -3 (reduction), H goes from 0 → +1 (oxidation).
N_2 is the oxidizing agent and H_2 is the reducing agent

Part 1 Questions

1. For each of the following ions, write the correct chemical formula and determine the oxidation number of each element present.

a. Iron (III) b. Bromide c. Chromium (II)

d. Hydroxide e. Sulfate f. Dichromate

2. For each of the following compounds, write the correct chemical formula and determine the oxidation number of phosphorus in each compound.
   a. Potassium phosphide b. Phosphorus disulfide c. Magnesium phosphate

   d. Phosphorous acid e. Phosphorus trichloride f. Diphosphorus pentoxide

Part 2 Questions

Consider the following reactions. For each reaction:

- Determine the oxidation state of every element in each reactant and product.
- Identify the following:
  a. The substance being oxidized. b. The substance being reduced.
  c. The oxidizing agent. d. The reducing agent.

3. $Ca + S \rightarrow CaS$

   a.

   b.

   c.

   d.

4. $K + O_2 \rightarrow K_2O$

   a.

   b.

   c.

   d.

Electrochemistry

5. $Na + H_2O \rightarrow NaOH + H_2$

   a.

   b.

   c.

   d.

6. $Fe + H_2SO_4 \rightarrow Fe(SO_4)_3 + H_2$

   a.

   b.

   c.

   d.

7. $C + H_2SO_4 \rightarrow CO_2 + SO_2 + H_2O$

   a.

   b.

   c.

   d.

8. $KMnO_4 + HCl \rightarrow MnCl_2 + Cl_2 + H_2O + KCl$

   a.

   b.

   c.

   d.