# **What are Reduction-Oxidation Reactions?**

# These are special reactions that occur when there is a transfer of electrons

# Oxidation involves a loss of electrons

# Reduction involves a gain of electrons

# **So why care?**

# The rusting of metal

# The process involved in photography

# The way living systems produce and utilize energy

# The operation of a car battery

# **So, to start I want you to learn this statement!**

# Image result for leo the lion**LEO** the lion goes **GER** when he picks up the **CRA**y**O**n off the student’s **LAP** with **EFFORT** and throws it in the **VAN**

# **LEO** –Lose Electrons Oxidation

# **GER** – Gain Electrons Reduction

# **CR** – Cathode, reduction occurs

# **A**y**O**n– Anode, oxidation occurs

# **LAP –** Electrolytic cell Anode Positive

# **VAN** – Voltaic cell Anode Negative

# **EFFORT-** Electrons flow from oxidation to reduction

## **Oxidation Numbers**

## Before discussing redox reaction, we must first look at oxidation numbers

## **Oxidation numbers** or **Oxidation States** are used to indicate the general distribution of electrons in a molecule or ion

## *NOTE:* Charges and oxidation states are different.

## A charge is a physically real characteristic

## Oxidation numbers are “bookkeeping” devices to keep track of the overall electron distribution and **ARE NOT** actual physical characteristics of atoms

## **Assigning Oxidation Numbers**

## **Rule #1 -** The oxidation number for a free element is **ALWAYS** zero

## Example:

## Oxidation number of Na(s) is zero

## Oxidation number of H2(g) is zero

## **Rule #2 -** The oxidation number of a monatomic ion equals the charge of the ion.

## Image result for rules memeExample:

## Oxidation number of Cl- is -1

## Oxidation number of Mg2+ is +2

## **Rule #3 -** The oxidation number of hydrogen in a compound is usually +1 except in hydrides where it is -1

## Example:

## Oxidation number of hydrogen in **H**Cl is +1

## Oxidation number of hydrogen in Na**H** is -1

## **Rule #4 -** The oxidation number of oxide and sulfide in compounds is usually -2.

## Example:

## Oxidation number of oxide in H2**O** is -2

## Oxidation number of sulfide in Na2**S** is -2

## **Rule #5 -** The oxidation number of elements in group I in a compound is +1

## Example:

## Oxidation number of potassium in **K**I is +1

## Oxidation number of lithium in **Li**Cl is +1

## **Rule #6 -** The oxidation number of elements in group II in a compound is +2

## Example:

## Oxidation number of calcium in **Ca**(OH)2 is +2

## Oxidation number of barium in **Ba**Cl2 is +2

## Image result for rules meme**Rule #7 -** The oxidation number of aluminum in a compound is usually +3

## Example:

## Oxidation number of aluminum in **Al**Cl3 is +3

## **Rule #8 -** The oxidation number of fluoride in a compound is **ALWAYS** -1

## Example:

## Oxidation number of fluoride in H**F** is -1

## Oxidation number of fluoride in Li**F** is -1

## **Rule #9 -** The oxidation number of the halogens (group 17/VIIA) in a compound is -1 except…

## Fluorine is **ALWAYS** a -1When bonded to oxygen, nitrogen or another halogen

## Example:

## Oxidation number of chloride in Al**Cl**3 is -1

## Oxidation number of bromide in Na**Br** is -1

## **Rule #10 -** The sum of the oxidation numbers of all the atoms in a neutral compound is 0.

## Example:

## AlCl3

## Aluminum is +3

## Chloride is -1 **X** 3 so total -3

## So, +3 and -3 make the compound neutral

## **Rule #11 -** The sum of the oxidation numbers in a polyatomic ion is equal to the charge of the ion.

## Example:

## OH-

## Oxygen is -2

## Hydrogen is +1

## So, -2 and +1 make the ion have a charge of 1-

## Image result for oxidation numbers

## **Problem solving method**

## Assign oxidation state to atoms that have a known number

## Fluoride

## Halogens

## Oxide and sulfide

## Hydrogen

## Group 1

## Group 2

## Aluminum

## Assign other oxidation numbers to the other atoms remembering….

## If it is a compound, it must be neutral

## If it is an ion, then there is an overall charge

## **Oxidation**- is the process in which an atom or ion loses electrons

## Image result for oxidation vs reduction**Example:**

## Na → Na+ + e-

## Cu  Cu2+ + 2e-

## Note: Electrons are products

## GER- Gaining electrons

## **Reduction**- is the process in which atoms or ions gain electrons

## **Examples:**

## Cl2 + 2e- → 2Cl-

## Br2 + 2e-  2Br-

## Note: Electrons are reactants

## Examples

## Identify the following half reaction as either an oxidation or reduction half reaction.

## 2 I- → I2 + 2e-

## Cl2 + 2e-→2 Cl-

## Fe  Fe2+ + 2e-

## Fe3+ + e-  Fe2+

## For the following reaction, indicate which element is oxidized and which is reduced

## Start with the oxidation numbers

## H2(g) + CuO(s) → Cu(s) + H2O(l)

## H2(g) + Cl2(g) → 2HCl

## **Electrochemistry** is the branch of chemistry that deals with electricity-related applications of oxidation-reduction reactions

## These reactions usually take place in an electrochemical cell.

## There are two types of electrochemical cells: Voltaic (also known as galvanic) and Electrolytic

## A voltaic cell is an electrochemical cell where a redox reaction occurs naturally and produces electrical energy

## An electrolytic cell is an electrochemical cell where a redox reaction requires electric energy to occur

## **So, what is the same about these cells?**

## Both cells have electrodes

## An electrode is a conductor in a circuit that carries electrons

## The electrode where reduction occurs is the CATHODE

## The electrode where oxidation occurs is the ANODE

## Just remember **CRA**y**O**n

## **Let’s look at each cell more specifically**

## Voltaic cells

## These cells occur naturally or spontaneously

## We will look at potentials to determine when a reaction is spontaneous but let’s look at a cell first

## Let’s look at the reaction between zinc and copper.

## Zinc and copper are electrodes

## The zinc is in a solution of ZnSO4

## The copper is in a solution of CuSO4

## Zn(s) → Zn2+(aq) + 2e-

## Cu2+(aq) + 2e- → Cu(s)

## Let’s identify

## Which reaction is oxidation?

## Which reaction is reduction?

## the anode?

## the cathode?

## the positive metal?

## the negative metal?

## **Electrolytic cell**

## Let’s look at the reaction between iron and silver.

## Iron and silver are electrodes

## The electrodes are in a solution of Fe(NO3)3

## Fe3+(aq) + 3e- → Fe(s)

## 3Ag(s) → 3Ag+(aq) + 3e-

## Let’s identify

## Which reaction is oxidation?

## Which reaction is reduction?

## the anode?

## the cathode?

## the positive metal?

## the negative metal?

