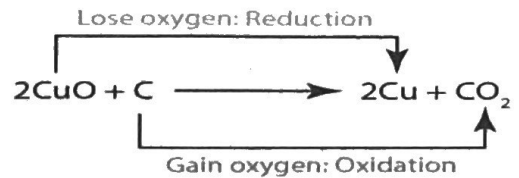


Introduction to Oxidation & Reduction

Original Understanding of Redox

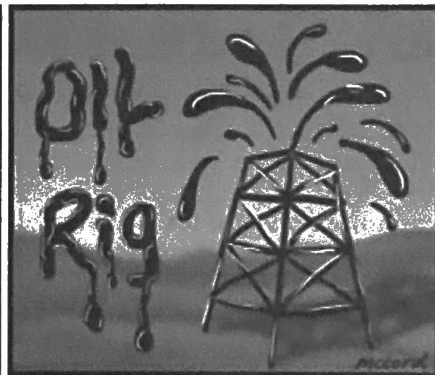
- The substance gaining oxygen is oxidized.
- while the substance losing oxygen is reduced.



Reduction-Oxidation Reactions (Redox)

- Reactions that involve the transfer of electrons; both reduction and oxidation must happen simultaneously.
- Reduction- gain of electrons by an atom or ion; ox. # goes down / reduces
- Oxidation- loss of electrons by an atom or ion; oxidation number goes up / increases

How to Remember Redox (mnemonics)



- **LEO** the lion says GER
 - Lose Electrons Oxidation
 - Gain Electrons Reduction
- **OIL RIG**
 - Oxidation is Loss
 - Reduction is Gain

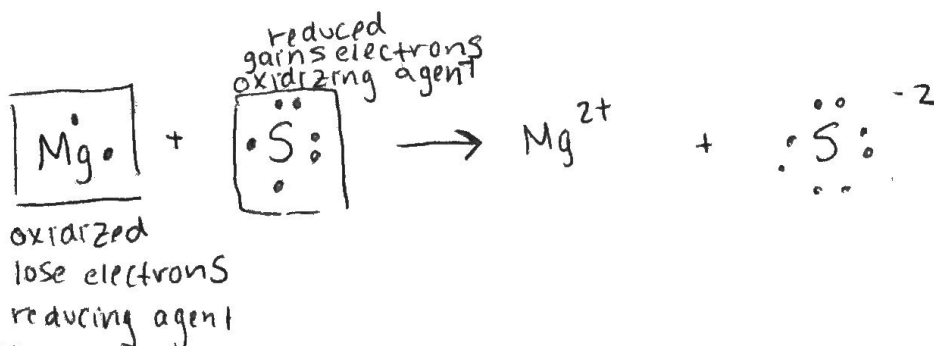
Conservation of charge

- If one atom loses electrons, there must be another atom that will gain electrons to conserve charge.

Redox Reactions that Form Ions

- The substance that loses electrons is called the reducing agent (Substance that is oxidized)
- The substance that gain electrons is called the oxidizing agent (Substance that is reduced)

Example:



Name: KEY Official Class: _____ Date: _____

Teacher: _____ Period: _____ Class: _____

Identifying Oxidation Numbers

- One way that we can begin to identify a redox reaction is to identify the oxidation # from reactant to product side for every element involved in the reaction.
- Oxidation numbers are used to track the movement of electrons (electron transfer) from reactants to products side of reaction.

Oxidation Number (State)

- Positive, negative, or neutral (zero) values that can be assigned to atoms.
- Used to identify how many electrons are being lost or gained by an atom/ion when they form bonds.
- Top listed number on the upper right is the most common oxidation number for that element

12.0111	-4
C	+2
	+4
6	
2-4	

Tricks to Identifying Redox Reactions

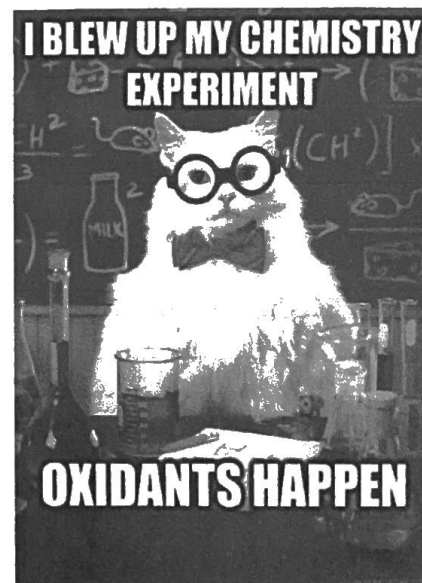
- Trick 1: Single replacement reactions are always REDOX!
Example: $Zn + HCl \rightarrow ZnCl_2 + H_2$
- Trick 2: double replacement reactions are NOT REDOX
Example: $NaOH + HCl \rightarrow NaCl + H_2O$

A Reaction is Redox if....

- Oxidation numbers change for 2 elements within a reaction
- Reduction (GER) = gain of electrons by an atom or ion; ox. number goes down/reduces
- Oxidation (LEO) = loss of electrons by an atom or ion; ox. number goes up or increases.

Rules for Assigning Oxidation Numbers

1. Elements that are free or uncombined will be assigned an oxidation charge of 0, this includes diatomic atoms
 - Ex. Cu: Oxidation number of Cu is 0
 - Ex. H₂: Oxidation number of H is the 0
2. The oxidation number of a monoatomic ion = the charge of the monoatomic ion
 - Ex. S²⁻: Oxidation number is -2
 - Ex. Al³⁺: Oxidation number is +3
3. Group 1 metals *in compounds* are always assigned an oxidation state of +1
4. Group 2 metals *in compounds* are always assigned an oxidation state of +2
5. Hydrogen (H) has two possible oxidation numbers
 - +1 when bonded to a nonmetal
 - -1 when bonded to a metal
6. Oxygen in compounds are assigned an oxidation state of -2 except when it is a peroxide formula X₂O₂ (then its -1 which is rare)
7. Fluorine in a compounds always has an oxidation state of -1
8. The sum of the oxidation numbers of all atoms in a polyatomic ion = the charge on the polyatomic ion
9. The sum of the oxidation numbers if all atoms (or ions) in a neutral compound is 0



Name: KEY Official Class: _____ Date: _____
 Teacher: _____ Period: _____ Class: _____

Assigning Oxidation Number Practice

Part 1: Single Elements

- | | | | |
|------------------------------|------------------------------|---------------------------------|----------------------------------|
| 1. Al: <u>0</u> | 4. Ar: <u>0</u> | 7. Zn ⁺² : <u>+2</u> | 10. Li ⁺¹ : <u>+1</u> |
| 2. Cu: <u>0</u> | 5. O ₂ : <u>0</u> | 8. Cl ⁻¹ : <u>-1</u> | 11. Te ⁻² : <u>-2</u> |
| 3. H ₂ : <u>0</u> | 6. Zn: <u>0</u> | 9. Ca ⁺² : <u>+2</u> | 12. Ag ⁺¹ : <u>+1</u> |

Part 2: Elements in Compounds

1. Carbon dioxide (CO₂)

CO ₂	C	O	
Sub	1	1	
Ox #	+4	-2	
Total	+4	-4	0

2. Calcium hydroxide (Ca(OH)₂)

Ca(OH) ₂	Ca	O	H	
Sub	1	2	2	
Ox #	+2	-2	+1	
Total	+2	-4	+2	0

3. Water (H₂O)

H ₂ O	H	O	
Sub	2	1	
Ox #	+1	-2	
Total	+2	-2	0

4. Magnesium phosphate (Mg₃(PO₄)₂)

Mg ₃ (PO ₄) ₂	Mg	P	O	
Sub	3	2	8	
Ox #	+2	+5	-2	
Total	+6	+10	-16	0

5. Ammonium chloride (NH₄Cl)

NH ₄ Cl	N	H	Cl	
Sub	1	4	1	
Ox #	-3	+1	-1	
Total	-3	+4	-1	0

6. Carbonate ion (CO₃²⁻)

CO ₃ ²⁻	C	O	
Sub	1	3	
Ox #	+4	-2	
Total	+4	-6	-2

do this one last

Part 3: Regents Questions

- What are the two oxidation states of nitrogen in NH₄NO₂?
 a. +3 and +5 b. +3 and -5 c. -3 and +3 d. -3 and -3
- What is the oxidation number of manganese in KMnO₄?
 a. +7 b. +2 c. +3 d. +4
- What is the oxidation state of nitrogen in the compound NH₄Br?
 a. -1 b. +2 c. -3 d. +4
- What is the oxidation number of sulfur in Na₂S₂O₃?
 a. -1 b. +2 c. +6 d. +4
- Given the balanced equation representing a reaction: 2 KClO_{3(s)} → 2 KCl_(s) + 3 O_{2(g)}. The oxidation state of chlorine in this reaction changes from
 a. -1 to +1 b. -1 to +5 c. +1 to -1 d. +5 to -1
- What is the oxidation number of ~~chromate ion~~ ^{chromium in} CrO₄²⁻?
 a. +6 b. +2 c. +3 d. +8

CrO ₄ ²⁻	Cr	O	
Sub	1	4	
Ox #	+6	-2	
Total	+6	-8	-2