**Introduction to Oxidation & Reduction**

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Original Understanding of Redox

* The substance \_\_\_\_\_\_\_\_\_\_\_\_ oxygen is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_,
* while the substance \_\_\_\_\_\_\_\_\_\_\_ oxygen is reduced.

Reduction-Oxidation Reactions (Redox)

* Reactions that involve the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_; \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ must happen \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* Reduction- \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ by an atom or ion; \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Oxidation- \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ by an atom or ion; \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ goes \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

How to Remember Redox (mnemonics)



* LEO the lion says GER
	+ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	+ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* OIL RIG
	+ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
	+ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Conservation of charge

* If one atom \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ electrons, there must be another atom that will \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

to conserve charge.

Redox Reactions that Form Ions

* The substance that \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is called the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

(Substance that is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_)

* The substance that \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is called the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (Substance that is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_)

Example:

Identifying Oxidation Numbers

* One way that we can begin to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is to identify the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ from reactant to product side for every element involved in the reaction.
* Oxidation numbers are used to track the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (electron transfer) from reactants to products side of reaction.

Oxidation Number (State)

* \_\_\_\_\_\_\_\_\_\_\_\_\_, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, or \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ values that can be assigned to atoms.
* Used to identify how many electrons are being lost or gained by an atom/ion when they \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* Top listed number on the upper right is the most common oxidation number for that element

Tricks to Identifying Redox Reactions

* Trick 1: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ are always REDOX!

Example: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

* Trick 2: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ are NOT REDOX

Example: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

A Reaction is Redox if….

* Oxidation numbers change for 2 elements within a reaction
* Reduction (GER) = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ by an atom or ion; \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ goes \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Oxidation (LEO)= \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ by an atom or ion; \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ number goes

\_\_\_\_\_\_\_\_\_\_\_\_\_ or \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

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

**Assigning Oxidation Number Practice**

**Part 1:** **Single Elements**

1. Al: \_\_\_\_\_\_\_\_\_
2. Cu: \_\_\_\_\_\_\_\_
3. H2: \_\_\_\_\_\_\_\_\_
4. Ar: \_\_\_\_\_\_\_\_
5. O2: \_\_\_\_\_\_\_\_
6. Zn: \_\_\_\_\_\_\_\_
7. Zn+2: \_\_\_\_\_\_\_
8. Cl-1: \_\_\_\_\_\_\_\_
9. Ca+2: \_\_\_\_\_\_\_
10. Li+1: \_\_\_\_\_\_\_
11. Te-2: \_\_\_\_\_\_\_
12. Ag+1: \_\_\_\_\_\_\_

**Part 2: Elements in Compounds**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|

|  |  |  |  |
| --- | --- | --- | --- |
| CO2 | C | O |  |
| Sub | 1 | 1 |
| Ox # | +4 | -2 |
| Total | +4 | -4 |  |

1. Carbon dioxide (CO2)
 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Ca(OH)2 | Ca | O | H |  |
| Sub |  |  |  |
| Ox # |  |  |  |
| Total |  |  |  |  |

1. Calcium hydroxide (Ca(OH)2)
 |
|

|  |  |  |  |
| --- | --- | --- | --- |
| H2O | H | O |  |
| Sub |  |  |
| Ox # |  |  |
| Total |  |  |  |

1. Water (H2O)
 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Mg3(PO4)2 | Mg | P | O |  |
| Sub |  |  |  |
| Ox # |  |  |  |
| Total |  |  |  |  |

1. Magnesium phosphate (Mg3(PO4)2)
 |
|

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| NH4Cl | N | H | Cl |  |
| Sub |  |  |  |
| Ox # |  |  |  |
| Total |  |  |  |  |

1. Ammonium chloride (NH4Cl)
 |

|  |  |  |  |
| --- | --- | --- | --- |
| CO32- | C | O |  |
| Sub |  |  |
| Ox # |  |  |
| Total |  |  |  |

1. Carbonate ion (CO32-)
 |

**Part 3: Regents Questions**

1. What are the two oxidation states of nitrogen in NH4NO2?
	1. +3 and +5
	2. +3 and -5
	3. -3 and +3
	4. -3 and -3
2. What is the oxidation number of manganese in KMnO4?
	1. +7
	2. +2
	3. +3
	4. +4
3. What is the oxidation state of nitrogen in the compound NH4Br?
	1. -1
	2. +2
	3. -3
	4. +4
4. What is the oxidation number of sulfur in Na2S2O3?
	1. -1
	2. +2
	3. +6
	4. +4
5. Given the balanced equation representing a reaction: 2 KClO3*(s)* 🡪 2KCl*(s)* + 3O2*(g)*. The oxidation state of chlorine in this reaction changes from
	1. -1 to +1
	2. -1 to +5
	3. +1 to -1
	4. +5 to -1
6. What is the oxidation number of chromium in the chromate ion, CrO42-?
	1. +6
	2. +2
	3. +3
	4. +8