6. OXIDATION NUMBERS

UNIT 1 REACTIONS IN AQUEOUS SOLUTIONS
CH40S
MR. WIEBE

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OXIDATION NUMBERS

When polyatomic ions and covalent compounds are involved in a redox reaction, it can be difficult to tell if electrons are being lost or gained.

CrO_4^{2-} → $Cr_2O_7^{2-}$

☐ Are any electrons being lost or gained here?
☐ Which element(s) is being oxidized/reduced?

Oxidation numbers are assigned numbers that are used to determine if oxidation or reduction has occurred.

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RULES FOR ASSIGNING NUMBERS

1. All elements are zero

OXIDATION #

N_2

Pb

Na

O_2

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RULES FOR ASSIGNING NUMBERS

2. Monatomic Ions are their charge

OXIDATION #

Na^+

Br^-

$\underline{Mg}SO_4$

$Al_2\underline{S}_3$

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RULES FOR ASSIGNING NUMBERS

3. **O** in a compound is **-2**

OXIDATION #

$Na_2\underline{O}$

$C\underline{O}_2$

$\underline{O}_2$

$CH_3C\underline{O}OH$

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RULES FOR ASSIGNING NUMBERS

4. **H** in a compound is **+1**

OXIDATION #

$\underline{H}_2O$

$C_{12}\underline{H}_{22}O_{11}$

$\underline{H}_2$

$\underline{H}NO_3$

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RULES FOR ASSIGNING NUMBERS

5. The **sum** of the **oxidation numbers** must **equal** the **charge**

oxidation #s ⟶

$\underline{S}O_4^{2-}$

Total charge ⟶

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EXAMPLE

oxidation #s ⟶

$\underline{P}O_4^{3-}$

Total charge ⟶

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EXAMPLE

oxidation #s →

$\underline{Si}_2O_3^{2-}$

Total charge →

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TRY A FEW…

$\underline{C}_6H_{12}O_6$ $H_3\underline{P}O_3$ $Al(\underline{N}O_3)_3$

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USING OXIDATION NUMBERS

If the oxidation number of the central atom increases going from left to right, oxidation has occurred.

$ClO_2^- \rightarrow ClO_4^-$

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USING OXIDATION NUMBERS

If the oxidation number of the central atom decreases going from left to right, reduction has occurred.

$NO_3^- \rightarrow HNO_2$

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BACK TO THE START…

CrO_4^{2-} → $Cr_2O_7^{2-}$

Is the chromium in the above equation undergoing oxidation **or** reduction?

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NOT ALL REACTIONS ARE REDOX

Reactions in which there has been no change in oxidation number are **not** redox rxns.

Examples:

$$\overset{+1}{Ag}\overset{+5}{N}\overset{-2}{O_3}(aq) + \overset{+1}{Na}\overset{-1}{Cl}(aq) \rightarrow \overset{+1}{Ag}\overset{-1}{Cl}(s) + \overset{+1}{Na}\overset{+5}{N}\overset{-2}{O_3}(aq)$$

Precipitation reactions are NOT redox!

$$2\overset{+1}{Na}\overset{-2}{O}\overset{+1}{H}(aq) + \overset{+1}{H_2}\overset{+6}{S}\overset{-2}{O_4}(aq) \rightarrow + \overset{+1}{Na_2}\overset{+6}{S}\overset{-2}{O_4}(aq) + \overset{+1}{H_2}\overset{-2}{O}(l)$$

Neutralization reactions are NOT redox!

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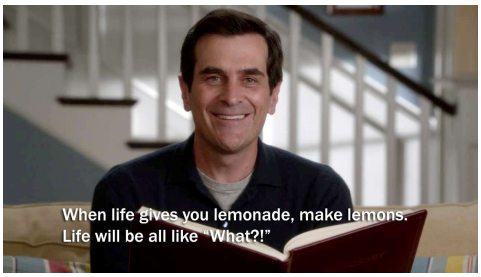
OXIDIZING & REDUCING AGENTS

Agents always HELP ANOTHER PARTY.



Eg) Real Estate Agents HELP OTHERS find real estate.

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Oxidizing Agents cause oxidation…

…by undergoing reduction.

They gain electrons, causing the other reactant to lose electrons.

Reducing Agents cause reduction…

…by undergoing oxidation.

They lose electrons, causing the other reactant to gain electrons.

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THE CHEMICAL BATTLEFIELD

$MnO_4^-(aq) + H^+(aq) + CH_3OH(l) \rightarrow Mn^{2+}(aq) + H_2O(l) + CH_2O(aq)$

1. Is this reaction a redox reaction or not? Prove it using oxidation numbers.
2. Identify the reactant being oxidized and the reactant being reduced.
3. Identify the oxidizing agent and the reducing agent.

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