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| <ol style="list-style-type: none"><li>1. Oxidation Numbers</li><li>2. Electron gain and loss</li><li>3. Agents</li></ol> |
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**Electrochemistry is the study of the interchange of chemical and electrical energy.**

- Reactions with electron transfers are commonly called **oxidation-reduction reactions (redox reactions)**
- Not all reactions involve an electron transfer!

<b>Oxidation Numbers</b>
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**Oxidation number** is the real or apparent **charge** of an atom or ion. Also called “**combining capacity**”.

**Rules for Assigning Oxidation Numbers (simplified):**

1.

2.

3.

4.

5.

6.

7.

**Hint!!**

It might be helpful to break up a compound in a dissociation equation first!

Ex:  $\text{KMnO}_4 \rightarrow$

Ex:  $\text{Na}_2\text{Mo}_2\text{O}_5 \rightarrow$

**Example:** Assign the oxidation number of each atom in the following species

a)  $\text{H}_2\text{O}$

b)  $\text{AsO}_4^{3-}$

c)  $\text{Pb}(\text{NO}_3)_2$

d)  $\text{C}_4\text{H}_{10}$

e)  $\text{Al}_2(\text{SO}_4)_3$

f)  $\text{CO}_3^{2-}$

g)  $\text{NH}_4^+$

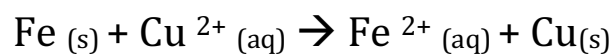
h)  $\text{Na}_2\text{Cr}_2\text{O}_7$

**MORE PRACTICE!**Determine the oxidation number for **each atom** in the following compounds:

$F_2$	$Fe_2O_3$	$CaCO_3$	$BrO_2^-$
$PbI_2$	$H_2$	$S_2O_3^{2-}$	$CN^-$
$ZnO$	$NH_4OH$	$P_4$	$Cs_2O_2$
$S_2O_8^{2-}$	$N_2H_4$	$MnO_4^-$	$PO_3^{3-}$
$N_2O_5$	$WBr_4$	$K_2S$	$SeO_3^{2-}$
$SF_6$	$NO_2$	$MnO_2^-$	$Na_2Mo_2O_5$
$NaNO_3$	$H_2CO$	$OH^-$	$Cl_2O$
$O_3$	$Ba_2XeO_4$	$PCl_3$	$P_2O_5$
$U_3O_8$	$Pb$	$ZnBr_2$	$S_2O_3^{2-}$
$(NH_4)_2SeO_4$	$CH_3OH$	$LiAlH_4$	$CH_3COO^-$
$FeCl_3$	$(NH_4)_2C_2O_4$	$BF_3$	$SiO_4^{4-}$

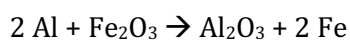
<b>Electron gain and loss</b>
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<b>Loss</b>	<b>Gain</b>
<ul style="list-style-type: none"><li>• Oxidation number increases</li><li>• Called "oxidation"</li></ul>	<ul style="list-style-type: none"><li>• Oxidation number decreases</li><li>• Called "reduction"</li></ul>
<b>L</b>	<b>G</b>
<b>E</b>	<b>E</b>
<b>O</b>	<b>R</b>
<b>O</b>	<b>R</b>
<b>I</b>	<b>I</b>
<b>L</b>	<b>G</b>



**Practice:**

Consider the following reaction:



Determine the oxidation numbers for each atom and write the value on top of the element in the reaction.

1. Are electrons gained or lost by each iron (III) ion? \_\_\_\_\_
  - a. How many? \_\_\_\_\_
2. Are electrons gained or lost by each Al atom? \_\_\_\_\_
  - a. How many? \_\_\_\_\_
3. How many electrons were transferred in total during the reaction? \_\_\_\_\_
4. What happened to the oxide ion,  $\text{O}^{2-}$  during the reaction?

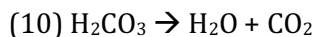
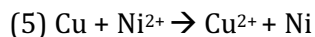
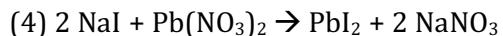
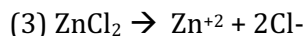
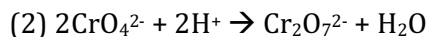
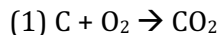
**The number of electrons \_\_\_\_\_ by the species being oxidized must always equal the number of electrons \_\_\_\_\_ by the species being reduced.**

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**Practice:**

1. Consider the following reactions. For each reaction:

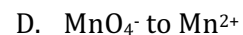
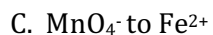
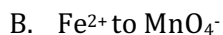
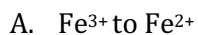
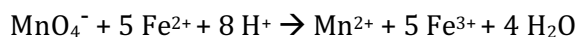
- Determine the **oxidation number** for each of the atoms.
- Identify if the reaction is a **redox** reaction. (**reduction/oxidation**)



2. When  $MnO_4^{2-}$  undergoes **oxidation**, it may form:



3. During the reaction, electrons transfer from:



## Agents

Another way of looking at it is that one species **causes** the electron loss or gain. A species that is being oxidized causes the other species to gain electrons and be reduced.

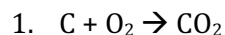


**A substance that is reduced acts as an \_\_\_\_\_ agent.**

**A substance that is oxidized acts as a \_\_\_\_\_ agent.**

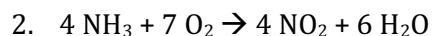
### Practice:

- Assign oxidation numbers to all atoms in the equation.
- Indicate the oxidizing and reducing agents in each of the following reactions.



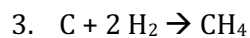
*Oxidizing agent (gets reduced):*

*Reducing Agent (gets oxidized):*



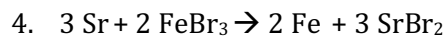
*Oxidizing agent (gets reduced):*

*Reducing Agent (gets oxidized):*



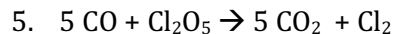
*Oxidizing agent (gets reduced):*

*Reducing Agent (gets oxidized):*



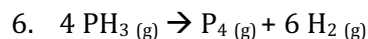
*Oxidizing agent (gets reduced):*

*Reducing Agent (gets oxidized):*



*Oxidizing agent (gets reduced):*

*Reducing Agent (gets oxidized):*



*Oxidizing agent (gets reduced):*

*Reducing Agent (gets oxidized):*

### Worksheet

### Hebden Workbook Pg. 194 #5