Chemistry ~ Ms. Hart   <u>**Class:**</u>   Anions   or   Cations

THE URBAN
ASSEMBLY
SCHOOL
FOR CRIMINAL
JUSTICE

<u>**11.4 Classwork – Half Reactions**</u>

SPARK:

4 Al + 3 O₂ → 2 Al₂O₃
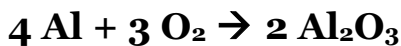
1. Is this a REDOX reaction? _____

2. What is being reduced? _____

3. What is being oxidized? _____

4. What is the reducing agent? _____

5. What is the oxidizing agent? _____

Half-Reactions:
•   Half reactions is shows just one portion of a chemical equation.

    o   There is a separate half reaction for oxidation and a separate half reaction for reduction
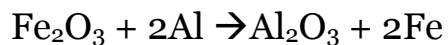
<u>**Practicing Balancing:**</u>

1. Sn^{2+} $\Rightarrow$ Sn^{4+}

2. Pb^{2+} $\Rightarrow$ Pb

3. Br_2 $\Rightarrow$ $2Br^-$

4. I_2 $\Rightarrow$ $2I^-$

5. Fe^{2+} $\Rightarrow$ Fe^{3+}

Example 1:

$$2Al(s) + 3Cu^{2+}(aq) \rightarrow 2Al^{3+}(aq) + 3Cu(s)$$

1. Write the oxidation numbers of all atoms

2. What is being oxidized? _____

3. What is being reduced? _____

4. What is the oxidizing agent? _____

5. What is the reducing agent? _____

6. What is the half reaction for oxidation? _____

7. What is the half reaction for reduction? _____

Example 2:

$$Fe_2O_3 + 2Al \rightarrow Al_2O_3 + 2Fe$$

1. Write the oxidation numbers of all atoms

2. What is being oxidized? _____   3. What is being reduced? _____

4. What is the oxidizing agent? _____   5. What is the reducing agent? _____
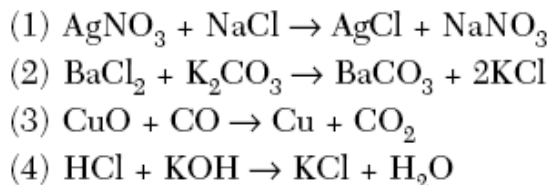
6. What is the half reaction for oxidation? _____

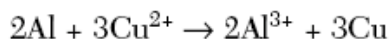7. What is the half reaction for reduction? _____

PRACTICE:

1. $H_2 + Cl_2 \rightarrow 2HCl$ Redox? yes or no	3. $H_2 + CuO \rightarrow Cu + H_2O$ Redox? yes or no
oxidation:	oxidation:
reduction:	reduction:
oxidizing agent:	oxidizing agent:
reducing agent:	reducing agent:
half reaction for oxidation: 	half reaction for oxidation:
half reaction for reduction: 	half reaction for reduction:
2. $2KNO_3 \rightarrow 2KNO_2 + O_2$ (hint: use loose leaf to find the oxidation state of N) Redox? yes or no	4. $NaOH + HCl \rightarrow NaCl + H_2O$ Redox? yes or no
oxidation:	oxidation:
reduction:	reduction:
oxidizing agent:	oxidizing agent:
reducing agent:	reducing agent:
half reaction for oxidation: 	half reaction for oxidation:
half reaction for reduction: 	half reaction for reduction:

Regents Practice:
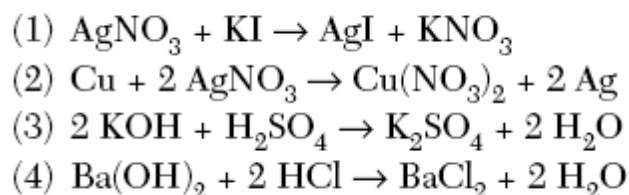
1. Which balanced equation represents a redox reaction?
   (1) $AgNO_3 + NaCl \rightarrow AgCl + NaNO_3$
   (2) $BaCl_2 + K_2CO_3 \rightarrow BaCO_3 + 2KCl$
   (3) $CuO + CO \rightarrow Cu + CO_2$
   (4) $HCl + KOH \rightarrow KCl + H_2O$

2. Given the balanced equation representing a redox reaction:
   $$2Al + 3Cu^{2+} \rightarrow 2Al^{3+} + 3Cu$$
   Which statement is true about this reaction?
   (1) Each Al loses $2e^-$ and each Cu^{2+} gains $3e^-$.
   (2) Each Al loses $3e^-$ and each Cu^{2+} gains $2e^-$.
   (3) Each Al^{3+} gains $2e^-$ and each Cu loses $3e^-$.
   (4) Each Al^{3+} gains $3e^-$ and each Cu loses $2e^-$.

3. Which reaction is an example of an oxidation-reduction reaction?

   (1) $AgNO_3 + KI \rightarrow AgI + KNO_3$
   (2) $Cu + 2\,AgNO_3 \rightarrow Cu(NO_3)_2 + 2\,Ag$
   (3) $2\,KOH + H_2SO_4 \rightarrow K_2SO_4 + 2\,H_2O$
   (4) $Ba(OH)_2 + 2\,HCl \rightarrow BaCl_2 + 2\,H_2O$

4. In a redox reaction, how does the total number of electrons lost by the oxidized substance compare to the total number of electrons gained by the reduced substance?

   (1) The number lost is always greater than the number gained.
   (2) The number lost is always equal to the number gained
   (3) The number lost is sometimes equal to the number gained.
   (4) The number lost is sometimes less than the number gained.

5. Given the balanced equation representing a reaction:

   $$2Fe + 3Cu^{2+} \rightarrow 2Fe^{3+} + 3Cu$$
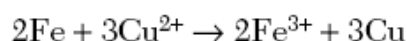
   When the iron atoms lose six moles of electrons, how many moles of electrons are gained by the copper ions?
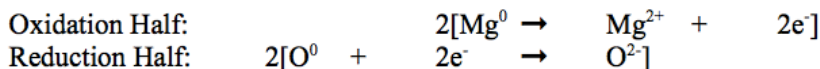
   (1) 12 moles   (3) 3 moles
   (2) 2 moles   (4) 6 moles
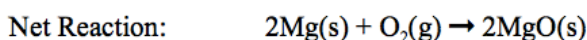
Writing Half Reactions

During a redox reaction electrons are both lost and gained. The metal loses and the non metal gains. An equation showing either the gain or the loss of electrons but not both is called a half reaction. Consider the reaction below:

$$2Mg(s) + O_2(g) \rightarrow 2MgO(s)$$
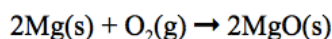
Magnesium loses electrons while oxygen gains. The reaction can be split into two half reactions showing each. The oxidation half reaction shows the loss of electrons. Electrons are shown on the product side of the equation. The reduction half reaction shows the electron gain. Electrons are shown on the reactant side of the equation.

| Oxidation Half: | | $2[Mg^0 \rightarrow$ | $Mg^{2+} +$ | $2e^-]$ |
| Reduction Half: | $2[O^0 +$ | $2e^- \rightarrow$ | $O^{2-}]$ | |

Which half reaction are you, oxidation or reduction?

Both! We're always together!

The net equation, the redox reaction, is a combination of the half reactions such that the number of electrons lost equals the number of electrons gained. The electrons are not shown in the net equation because the electrons that were lost are the same ones that were gained.

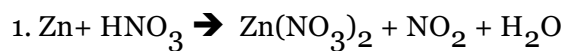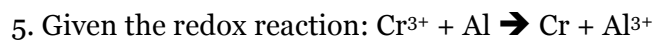Net Reaction: $2Mg(s) + O_2(g) \rightarrow 2MgO(s)$

To write the half reactions, it is first necessary to determine the oxidation states of the elements on both sides of the equation so you know what was oxidized and what was reduced. Then write the oxidation and reduction halves as shown above, making sure the equation is balanced so the number of electrons lost equals the number gained.

MORE PRACTICE:

1. $Zn + HNO_3 \rightarrow Zn(NO_3)_2 + NO_2 + H_2O$

HINT: you need to find the oxidation state of Nitrogen... Use a table!

Element	H	N	O	
Subscript (how many are there?)				Total
Oxidation State				
Product of oxidation states				

2. $NaClO + H_2S \rightarrow NaCl + H_2SO_4$

3. $Fe(OH)_2 + H_2O_2 \rightarrow Fe(OH)_3$

4. $Na + H_2O \rightarrow NaOH + H_2$
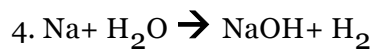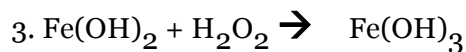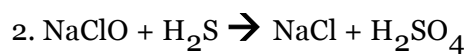
5. Given the redox reaction: $Cr^{3+} + Al \rightarrow Cr + Al^{3+}$
As the reaction takes place, there is a transfer of
a.   electrons from Al to Cr3+
b.   electrons from Cr3+ to Al
c.   protons from Al to Cr3+
d.   protons from Cr3+ to Al
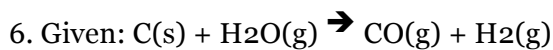
6. Given: $C(s) + H2O(g) \rightarrow CO(g) + H2(g)$
Which species undergoes reduction?
a. C(s)
b. H+
c. C2+
d. H2(g)