**Honors Chemistry Unit 8 – Predicting Products of Reactions**

**Podcast: Balancing Complex Redox Reactions** [**https://goo.gl/k8JKgC**](https://goo.gl/k8JKgC)

Oxidation/Reduction Reactions

Transfer of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ from one element to another

 4Al(s) + 3O2(g)  🡪 2Al2O3

Charge

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_: element loses electrons

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_: element gains electrons

Oxidation/Reduction Reactions

The electrons \_\_\_\_\_\_\_\_\_\_\_\_\_\_ or gained must be balanced in a REDOX reaction

\_\_\_\_\_Al(s) + \_\_\_\_\_O2(g) 🡪 \_\_\_\_\_Al2O3

4 x Al x \_\_\_\_\_e- lost = \_\_\_\_\_ e- lost

6 x O x \_\_\_\_\_e- gained = \_\_\_\_\_ e- gained

Determining Oxidation States

In order to determine which element got oxidized or reduced, one must be able to track the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (oxidation states) of elements throughout the reaction.

Determining Oxidation States
Apply rules in order!

1. Atoms in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ form will have an oxidation number of \_\_\_\_\_\_\_\_\_ (Diatomic elements included.)
2. Monatomic ions will have an oxidation # equal to it’s \_\_\_\_\_\_\_\_\_\_\_\_\_\_.
3. Oxygen has an oxidation # of \_\_\_\_\_\_\_, unless it is a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, then it will be \_\_\_\_\_\_.

rules, cont.

1. Hydrogen has an oxidation # of \_\_\_\_\_\_ when it is bonded to \_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_ when bonded to \_\_\_\_\_\_\_\_\_\_\_\_\_\_.
2. Halogens are usually \_\_\_\_\_\_, unless they are combined with oxygen; then they will be \_\_\_\_\_\_\_\_\_\_\_\_.
3. The sum of the oxidation #’s will equal \_\_\_\_\_\_\_\_\_ for a compound or will equal the value of the \_\_\_\_\_\_\_\_\_\_\_\_\_ for an ion.

Example 1: Determine the oxidation number of each element in Na2SO4.

Balancing Redox Reactions in ACIDIC Conditions

Follow these steps:

1. Divide equation into \_\_\_\_\_\_\_\_- reactions, one for oxidation and one for reduction
2. Balance each half-reaction
	1. Balance elements other than \_\_\_\_\_\_ and \_\_\_\_\_\_ first
	2. Balance O by adding \_\_\_\_\_\_\_\_\_\_
	3. Balance H by adding \_\_\_\_\_\_\_\_ (from the acid).
	4. Balance charge by adding electrons as \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ for reducing an element, or as \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ for oxidizing an element.
3. \_\_\_\_\_\_\_\_\_\_\_\_\_ reactions by a whole number so e-’s in the half-reactions are equal
4. Add the two half-reactions together and \_\_\_\_\_\_\_\_\_\_\_\_\_\_ out like terms.
5. Double check your answer to ensure all \_\_\_\_\_\_\_\_\_\_\_\_ are balanced.

Example 2:
MnO4- + C2O42- → Mn2+ + CO2

Example 3: An acidic solution of potassium dichromate is added to a solution of iron (II) nitrate.

**Assignment #1 Balancing Redox Reactions in Acidic Solution**

Determine the oxidation number of each UNDERLINED element

1. H2SO4  5. HSO4-

2. P4  6. NaH

3. UO3   7. Na2O2

4. U2O5 8. PbSO4

Use oxidation numbers to determine which element is oxidized and which is reduced. Remember that if the oxidation # increases it means oxidation and when it decreases it mean reduction!

**LEO says GER**

9. MnO2 → Mn2O3

10. NH3 →NO2

11. HClO4 → HCl + H2O

12. O2 → O2-

13. P2O5 → P4H10

Balance each redox reaction in acid solution using the half reaction method.

14. H2O2 + Cr2O72-  → O2 + Cr3+

15. TeO32- + N2O4  → Te + NO3-

16. ReO4- + IO- → IO3- + Re

17. PbO2 + I2 → Pb2+ + IO3-

18. As → H2AsO4- + AsH3

Harder Balancing Questions - **DISPROPORTIONATION**

1. CuF2 + NH3 → Cu3N + NH4F + N2

2. Ca3(PO4)2 + SiO2 + C → P4 + CaSiO3 + CO

**Podcast: Building Batteries from Redox Reactions** <https://goo.gl/N6vpoY>

Electrochemical Cells

Electrochemistry: Relationship between electricity and \_\_\_\_\_\_\_\_\_\_\_\_\_\_ reactions

Electricity = movement of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

The energy released in a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ redox reaction used to perform electrical work is harnessed in \_\_\_\_\_\_\_\_\_\_\_\_\_ Cells (also called **Galvanic Cells)**

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ transfer through an external pathway rather than directly between reactants

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**: metals used in the circuit

Electrochemical Cell

Components of Electrochemical Cells

\_\_\_\_\_\_\_\_\_\_\_\_: electrode at which **oxidation** occurs

Cathode: electrode at which **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** occurs

\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_: a connection between two half-cells that allows for the flow of ions

Must be a solution that \_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_ produce a precipitate with any other ion in solution

Salt **\_\_\_\_\_\_\_\_\_\_\_** migrate toward the anode; **\_\_\_\_\_\_\_\_\_\_\_** migrate toward the cathode

\*\***Electrons** flow through a wire from the \_\_\_\_\_\_\_\_\_\_\_\_\_ to the \_\_\_\_\_\_\_\_\_\_\_\_\*\*

Standard Cell Potentials

Used to determine which metal will be the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and which will be the anode for the reaction to be \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Cell EMF, €o : Electromotive Force

Caused by a difference in potential energy between the different electrodes.

A FORCE that allows electrons to be pushed

Denoted Ecell , measured in volts, V

Also called cell \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Cell Potential

Cell potential is

\_\_\_\_\_\_\_\_\_\_\_\_\_ for spontaneous reactions

\_\_\_\_\_\_\_\_\_\_\_\_\_ for nonspontaneous reactions

Eocell based on \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ reduction potentials

Potential associated with each electrode is the ability for \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to occur at the electrode.

Eored = standard reduction potential for metal (compared to the Standard Hydrogen Electrode, SHE

Calculating Cell Potential

Eocell = Eored (cathode) – Eored (anode)

The more \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ the Eored  for a metal, the greater the ability for reduction

Thus the metal with a \_\_\_\_\_\_\_\_\_\_\_\_ Eored  will be the better cathode in a voltaic cell

Example 1:
A voltaic cell is based on the following half cells:
 Cd2+ + 2e- 🡪 Cd
 Sn2+ + 2e- -> Sn

Determine voltage produced in spontaneous reaction.

Example 2: What would be the electrical potential for the reaction:
PbO2 + Na 🡪 Pb2+ + Na+



**Assignment #2**



**Assignment #3**

Answer the following questions that refer to the galvanic cell shown in the diagram below. (A table of standard reduction potentials is printed at the beginning of the free response section of your test.)

a) Identify the anode of the cell and write the half-reaction that occurs there.

b) Write the net ionic equation for the overall reaction that occurs as the cell operates

c) Calculate the value of the standard cell potential, *E*o*cell*.