Electrochemistry Unit Check List **Unit test: Friday, May 19th** **Name:** _____

Complete the following assignments in the order given. Place in 2 pocket folders, *in order*, when completed			
Assign #	**Name**	**Description**	**√ when done!**
1	Video: Electrochem assigning oxidation states	Lecture notes and video Lecture notes must be completed!	
2	Assigning oxidation states practice	Homework problems on assigning oxidation states. All work must be shown	
3	Video: Electrochem and half reactions	Lector notes and video Lecture notes must be completed	
4	Half reactions practice	Homework problems on balancing half reactions. All work must be shown	
5	Video: half rxns in acidic and basic solutions	Lecture notes and video Lecture notes must be completed	
6	Balancing half reactions in acidic and basic solutions practice	Homework problems on balancing half rxns in acidic and basic solns. Must show all work	
7	Quiz over balancing in acidic/basic sol'n	short quiz over this concept ***must be taken by Friday, May 5th***	
8	Video: Advanced REDOX	Lecture notes and video Lecture notes must be completed	
9	Advanced REDOX practice	Homework problems on advanced REDOX Must show all work	
10	Lab: REDOX titration of H_2O_2 with MnO_4^-	Lab to determine % of store brand peroxide. ***Must be performed May 8th-9th*** ***Lab report due May 12th.***	
11	Video: Galvanic Cell part I	Lecture notes and video Lecture notes must be completed!	
12	Video: Galvanic Cell part II	Lecture notes and video Lecture notes must be completed!	
13	Galvanic Cell Practice	Homework problems on galvanic cell parts I and II *Must show all work*	
14	Video: EMF	Lecture notes and video Lecture notes must be completed!	
15	EMF calculation practice	Homework problems on EMF calculations must show all work	
16A	Pre-Lab: The Galvanic Cell	Answer 1-4 of assignment 16 as a pre-lab	
16	Lab: The Galvanic Cell (continue pre-lab on same sheet)	Lab to make a galvanic cell and measure the voltage. **Must be performed May 11th-12th** **Lab report due May 15th**	
17	Video: The Electrolytic Cell	Lecture notes and video Lecture notes must be completed!	
18	Electrolytic Cell Practice	Homework problems on EMF calculations *must show all work*	
19	Stoichiometry and electrolysis	Lecture notes and video Lecture notes must be completed!	
20	Stoichiometry practice	Homework problems on stoichiometry *must show all work*	

Grade:

(1) Assignments in order and in two pocket folder 10pt (2) quiz 7 10 pt (3) each lab 15 pt (4) all assignments completed 25 pt (5) exam 150 pt

Electrochemisty Unit: Assignment 1

Lecture notes on Assigning oxidation states

DIRECTIONS: view "Electrochem assigning oxidation states" video and answer the following questions. Place in project folder when finished.

Define REDOX RXN:

Define oxidation and write an equation showing oxidation

Define reduction and write an equation showing reduction

What is the acronym to help you distinguish between oxidation and reduction?

Determining if a reaction is REDOX:
Write the Net ionic equation (NIE) for $Mg + Zn(NO_3)_2 \rightarrow Zn + Mg(NO_3)_2$

What happens to:
Mg

Zn

Is this a REDOX RXN?

Why is it hard to determine if $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$ is a REDOX RXN?

What is the solution to this problem?

What is an oxidation state and how does it differ from a "charge"?

Guidelines for assigning oxidation states:

1

2

3

4

5

6

7

Continued on next page

Use the guidelines to assign oxidation states to the following:

N_2O_4 $Cr_2O_7^{2-}$ S_8 Mg_3P_2

Back to the combustion of methane. Determine if this is REDOX by assigning oxidation states to each species

$$CH_4 + O_2 \rightarrow H_2O + CO_2$$

Was there a transfer of electrons with:

C

H

O

Write a reaction that isn't REDOX. Justify with oxidation states

After completing, place in unit folder

Electrochemistry Unit: Assignment 2

Oxidation state Practice (practice from lecture in assignment 1)

DIRECTIONS: answer the problems, showing all work.

Use guidelines learned in lecture 1 to assign oxidation states to the underlined atom

1. $\underline{Cr}O_4^{2-}$
2. $\underline{C}_{60}$
3. $\underline{N}_3O_6$
4. $NaClO_3$
5. $\underline{Al}_2O_3$
6. $\underline{P}_2O_5$
7. $H_2\underline{O}_2$
8. $\underline{Mn}O_4^-$

Which of the following reactions are REDOX? Justify with oxidation states

$4Na + O_2 \rightarrow 2Na_2O$

$F_2 + 2CsI \rightarrow I_2 + 2CsF$

$KBr + LiCl \rightarrow LiBr + KCl$

Ans: (1) +6 (2) 0 (3) +4 (4) +5 (5) +3 (6) +5 (7) -1 (8) +7 equations yes, yes, no

After completing, place in your unit folder

Electrochemistry Unit: Assignment 3

Lecture notes on balancing half reactions

DIRECTIONS: view "Electrochem half reactions" video and answer the following questions. Place in project folder when finished.

In this video you will walk through four single replacement reactions. For each reaction do the following:

- Assign oxidations states
- Pull out half reactions and balance charge and mass
- Add half reactions together (after number of electrons transferred are equal)
- Identify spectator ion and explain why it is ignored

Reaction 1: $Mg + Zn(NO_3)_2 \rightarrow Zn + Mg(NO_3)_2$

Reaction 2: $Na + CsClO_3 \rightarrow Cs + NaClO_3$

Reaction 3: $Fe + Al(C_2H_3O_2)_3 \rightarrow Al + Fe(C_2H_3O_2)_2$

Reaction 4: $Ag + CuSO_4 \rightarrow Cu + Ag_2SO_4$

After completing, place in unit folder

Electrochemistry Unit: Assignment 4

Balancing half reactions Practice (practice from lecture in assignment 3)

Directions: for the following reactions:

- Assign oxidation states
- Pull out each half reaction and identify as oxidized or reduced
- Balance mass and charge of each half reaction
- Add together (after the electrons transferred are equal)

$Ca + Zn(NO_3)_2 \rightarrow Zn + Ca(NO_3)_2$

$F_2 + NaCl \rightarrow Cl_2 + NaF$

$Fe + Sr(NO_3)_2 \rightarrow Sr + Fe(NO_3)_3$

$Cr^{2+} + Mn^{7+} \rightarrow Mn^{5+} + Cr^{3+}$

worked out soln on-line

After completing, place in your unit folder

Electrochemistry Unit: Assignment 5

Lecture notes on balancing half reactions in acidic and basic solutions

DIRECTIONS: view "half rxns in acidic and basic soln" video and answer the following questions. Place in project folder when finished.

Guidelines for balancing half reactions in acidic solutions:

1

2

3

4

5

6

Use those rules to balance $MnO_4^- + Fe^{2+} \rightarrow Mn^{2+} + Fe^{3+}$

Guidelines for balancing half reactions in basic solutions:

1-6 from above

NOW:

7

8

9

Use those rules to balance: $Ag + CN^- + O_2 \rightarrow Ag(CN)_2^-$ (this is not an ionic compound but a complex ion)

After completing, place in unit folder

Electrochemistry Unit: Assignment 6

Balancing half reactions In acidic and basic soln (practice from lecture in assignment 5)

Directions: on a separate piece of paper show all your work to balance the following reactions in either acidic or basic solutions:

Acidic solution:

1. $MnO_4^- + Cl^- \rightarrow Mn^{2+} + HClO$
2. $NO_3^- + I_2 \rightarrow IO_3^- + NO_2$
3. $Cr_2O_7^{2-} + C_2H_5OH \rightarrow CO_2 + Cr^{3+}$

Basic Solution:

4. $PbO_2 + Cl^- \rightarrow ClO^- + Pb(OH)_3^-$
5. $MnO_4^- + IO_3^- \rightarrow MnO_2 + IO_4^-$
6. $CN^- + MnO_4^- \rightarrow MnO_2 + CNO^-$

Worked out solutions available in your unit packet!!

After completing, place in your unit folder

Electrochemistry Unit: Assignment 8

Lecture notes on advanced REDOX reactions

DIRECTIONS: view "advanced REDOX reactions" video and answer the following questions. Place in project folder when finished.

What is meant by the word "disproportionation"?

Balance the following disproportionation reaction.

$NO_2^- \rightarrow NO + NO_3^-$

Sometimes there is not a sharp delineation between each ½ reaction and balancing becomes more nuanced

$CuS + HNO_3 \rightarrow Cu(NO_3)_2 + NO + S$

REDOX Titrations in acidic and basic solutions:

Why are transition metals unique with respect to ions and colors formed?

Why do titrations involving transition metals not require and indicator?

How does the color change as you progress to the equivalence point, and then beyond the equivalence point?

REDOX titration problem:

$16H^+ + 2Cr_2O_7^{2-} + C_2H_5OH \rightarrow 2CO_2 + 4Cr^{3+} + 11H_2O$

At equivalence point $M_{dichromate}V_{dichromate} = M_{ethanol}V_{ethanol}$

Since mole ratio is 2:1 $M_{dichromate}V_{dichromate} = (M_{ethanol}V_{ethanol})\ 2$

Bill titrates 25.0 mL of 0.50 M $Cr_2O_7^{2-}$ with 20.0 mL of C_2H_5OH to the visible EP. Determine the concentration of the ethanol

Continued on next page

General stoichiometry problem

$16H^+ + Cr_2O_7^{2-} + C_2H_5OH \rightarrow 2CO_2 + 4Cr^{3+} + 11H_2O$

If 5.0 grams of ethanol fully reacts with dichromate, how many grams of Cr^{3+} will form?

For the titration, you will be doing:

What are you titrating?

What color change will you be looking for?

What is the goal of the lab?

Why is the density of H_2O_2 important in this lab?

After completing, place in unit folder

Electrochemistry Unit: Assignment 9

Advanced REDOX practice
(practice from lecture in assignment 8)

Directions: on a separate piece of paper show all your work to balance the following reactions in either acidic or basic solutions:

Acidic solution:

1. $Pb + PbO_2 + H_2SO_4 \rightarrow PbSO_4$
2. $H_2O_2 + FeSO_4 + H_2SO_4 \rightarrow Fe_2(SO_4)_3 + H_2O$
3. $Br_2 \rightarrow 2Br^- + OBr^-$

Basic Solution:

4. $MnO_4^{2-} \rightarrow MnO_2 + MnO_4^-$
5. $Cl_2 \rightarrow Cl^- + OCl^-$
6. $MnO_4^- + S^{2-} \rightarrow MnS + S$

REDOX titration problem:

46.0 mL of an acidified solution of 0.035M $K_2Cr_2O_7^{2-}$ was titrated to the endpoint with 10.5 mL of $Fe(NO_3)_2$

$Fe^{2+} + Cr_2O_7^{2-} \rightarrow Cr^{3+} + Fe^{3+}$

1. Balance the reaction that occurred between potassium dichromate and iron (II)nitrate. [spectator ions K^+ and NO_3^- have been removed]
2. What species is reduced in this reaction? Justify
3. Determine the concentration of the iron(II) nitrate
4. How many grams of chromium (III) and iron (III) ions will be produced in this reaction?

Worked out solutions available in your unit packet!!

After completing, staple your work to this page and place in your unit folder

Assignment 10: Titration of hydrogen peroxide with potassium permanganate in Acidic solution

Directions: show work and answer questions on second page of this report sheet

Background:

Bottled peroxide states it is 3% H_2O_2. We will determine the actual percentage of the peroxide by titrating to the equivalence point with permanganate.

Preliminary Stuff (show work on second page of this lab sheet)

First: we must determine the stoichiometric relationship between permanganate and peroxide

1. Balance the oxidation-reduction half reactions for hydrogen peroxide and permanganate ion, respectively. Write the NIE for the reaction

   $MnO_4^- + H_2O_2 \rightarrow Mn^{2+} + O_2$

Second: we must determine the amount of peroxide in a given volume of 3% peroxide

2. If the density of the 3% H_2O_2 solution is 1.00g/mL, what mass of H_2O_2 is in a 1.00 mL sample? How many moles is this? (hint: if you had 100 mL, how many mL would be H_2O_2?)

Third: Approximate the amount of MnO_4^- needed to titrate

3. based on the stoichiometry of permanganate and peroxide (from part 1.) approximate the volume of 0.02M MnO_4^- required to completely titrate a 1.0 mL sample of 3% H_2O_2

Procedure

- transfer 10.0 mL distilled water to Erlenmeyer flask
- Add 10.0 mL of 3.0M H_2SO_4 to the flask (do what you otta....)
- Add 1.0 mL of 3% H_2O_2 to the flask
- Swirl to mix thoroughly
- Fill buret with adequate amount of MnO_4^- record initial amount n the buret
- Titrate to a pale pink endpoint (use calculations above to estimate when endpoint should occur)
- When close to endpoint, use distilled water to make sure all MnO_4^- is off the sides of flask and has combined with peroxide solution.
- Make sure to swirl throughout titration to ensure proper mixing.
- Record final volume, in the buret, and record volume required to titrate the peroxide.
- Repeat procedure one more time.

Summary of procedure and calculations (make write answers in this table)

Titration of hydrogen peroxide		
	Trial 1	Trial 2
Volume of peroxide solution titrated		
Initial volume of MnO_4^-		
Final volume of MnO_4^-		
Volume of MnO_4^-		
Analysis of Hydrogen Peroxide		
	Trial 1	Trial 2
Moles of H_2O_2		
Mass of H_2O_2		
Percentage of H_2O_2		
Avg percentage H_2O_2		

con't

Preliminary Stuff work space:

1.

2.

3.

Calculations and Questions

1. What species is oxidized in this reaction? Justify with oxidation states

2. What species is reduced in this reaction? Justify with oxidation states

3. Calculate number of moles H_2O_2 reacted in each trial (show all work)

4. Calculate mass of H_2O_2 reacted in each trial (show all work)

5. Assuming the density of the hydrogen peroxide solution was 1.00 g/mL, calculate the percent by mass of H_2O_2 in 1.0 mL sample (show all work)

6. Calculate the average percentage of H_2O_2 (show all work)

Turn in for separate grade by May 12th