

Complete the following assignments in the order given. Place in 2 pocket folders, <i>in order</i> , 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	Lecture 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 <b>must be taken by Friday, May 5th</b>	
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 <sub>2</sub> O <sub>2</sub> with MnO <sub>4</sub> <sup>-</sup>	Lab to determine % of store brand peroxide. <b>Must be performed May 8<sup>th</sup>-9<sup>th</sup></b> <b>Lab report due May 12<sup>th</sup>.</b>	
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 <b>Must show all work</b>	
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. <b>Must be performed May 11<sup>th</sup>-12<sup>th</sup></b> <b>Lab report due May 15th</b>	
17	Video: The Electrolytic Cell	Lecture notes and video Lecture notes must be completed!	
18	Electrolytic Cell Practice	Homework problems on EMF calculations <b>must show all work</b>	
19	Stoichiometry and electrolysis	Lecture notes and video Lecture notes must be completed!	
20	Stoichiometry practice	Homework problems on stoichiometry <b>must show all work</b>	

**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

# Electrochemistry 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  $\text{Mg} + \text{Zn}(\text{NO}_3)_2 \rightarrow \text{Zn} + \text{Mg}(\text{NO}_3)_2$

What happens to:

Mg

Zn

Is this a REDOX RXN?

Why is it hard to determine if  $\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$  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

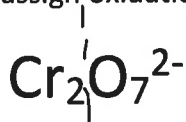
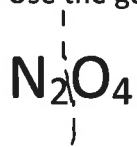
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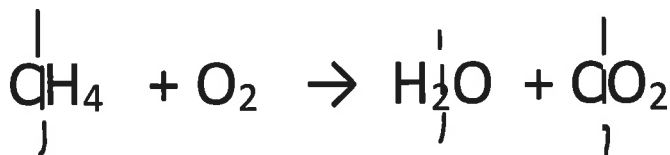
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Use the guidelines to assign oxidation states to the following:



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



Was there a transfer of electrons with:

C

H

O

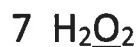
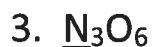
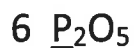
Write a reaction that isn't REDOX. Justify with oxidation states

## Electrochemistry Unit: Assignment 2

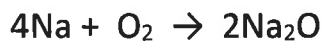
### Oxidation state Practice (practice from lecture in assignment 1)

DIRECTIONS: answer the problems, showing all work.

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



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



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

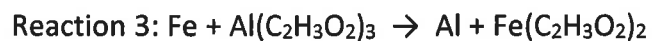
# Electrochemistry Unit: Assignment 3

## 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 oxidation 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



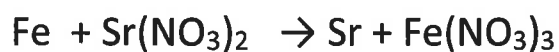
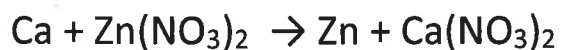
After completing, place in unit folder

## 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)



*worked out sol'n 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  $\text{MnO}_4^- + \text{Fe}^{2+} \rightarrow \text{Mn}^{2+} + \text{Fe}^{3+}$

Guidelines for balancing half reactions in basic solutions:

1-6 from above

NOW:

7

8

9

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

# 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.  $\text{MnO}_4^- + \text{Cl}^- \rightarrow \text{Mn}^{2+} + \text{HClO}$
2.  $\text{NO}_3^- + \text{I}_2 \rightarrow \text{IO}_3^- + \text{NO}_2$
3.  $\text{Cr}_2\text{O}_7^{2-} + \text{C}_2\text{H}_5\text{OH} \rightarrow \text{CO}_2 + \text{Cr}^{3+}$

Basic Solution:

4.  $\text{PbO}_2 + \text{Cl}^- \rightarrow \text{ClO}^- + \text{Pb}(\text{OH})_3^-$
5.  $\text{MnO}_4^- + \text{IO}_3^- \rightarrow \text{MnO}_2 + \text{IO}_4^-$
6.  $\text{CN}^- + \text{MnO}_4^- \rightarrow \text{MnO}_2 + \text{CNO}^-$

Worked out solutions available in your unit packet!!



# 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.



Sometimes there is not a sharp delineation between each  $\frac{1}{2}$  reaction and balancing becomes more nuanced



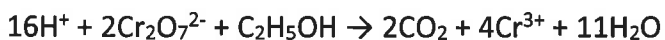
REDOX Titrations in acidic and basic solutions:

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

Why do titrations involving transition metals not require an indicator?

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

REDOX titration problem:

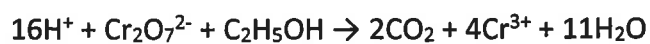


At equivalence point  $M_{\text{dichromate}} V_{\text{dichromate}} = M_{\text{ethanol}} V_{\text{ethanol}}$

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

Bill titrates 25.0 mL of 0.50 M  $\text{Cr}_2\text{O}_7^{2-}$  with 20.0 mL of  $\text{C}_2\text{H}_5\text{OH}$  to the visible EP. Determine the concentration of the ethanol

General stoichiometry problem



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

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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  $\text{H}_2\text{O}_2$  important in this lab?

After completing, place in unit folder

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# 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:

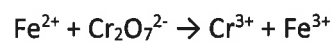
1.  $\text{Pb} + \text{PbO}_2 + \text{H}_2\text{SO}_4 \rightarrow \text{PbSO}_4$
2.  $\text{H}_2\text{O}_2 + \text{FeSO}_4 + \text{H}_2\text{SO}_4 \rightarrow \text{Fe}_2(\text{SO}_4)_3 + \text{H}_2\text{O}$
3.  $\text{Br}_2 \rightarrow 2\text{Br}^- + \text{OBr}^-$

Basic Solution:

4.  $\text{MnO}_4^{2-} \rightarrow \text{MnO}_2 + \text{MnO}_4^-$
5.  $\text{Cl}_2 \rightarrow \text{Cl}^- + \text{OCl}^-$
6.  $\text{MnO}_4^- + \text{S}^{2-} \rightarrow \text{MnS} + \text{S}$

REDOX titration problem:

46.0 mL of an acidified solution of 0.035M  $\text{K}_2\text{Cr}_2\text{O}_7^{2-}$  was titrated to the endpoint with 10.5 mL of  $\text{Fe}(\text{NO}_3)_2$



1. Balance the reaction that occurred between potassium dichromate and iron (II)nitrate. [spectator ions  $\text{K}^+$  and  $\text{NO}_3^-$  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!!

# 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

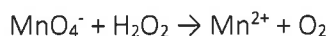
## Background:

Bottled peroxide states it is 3% H<sub>2</sub>O<sub>2</sub>. 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



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

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

Third: Approximate the amount of MnO<sub>4</sub><sup>-</sup> needed to titrate

3. based on the stoichiometry of permanganate and peroxide (from part 1.) approximate the volume of 0.02M MnO<sub>4</sub><sup>-</sup> required to completely titrate a 1.0 mL sample of 3% H<sub>2</sub>O<sub>2</sub>

## Procedure

- transfer 10.0 mL distilled water to Erlenmeyer flask
- Add 10.0 mL of 3.0M H<sub>2</sub>SO<sub>4</sub> to the flask (do what you gotta....)
- Add 1.0 mL of 3% H<sub>2</sub>O<sub>2</sub> to the flask
- Swirl to mix thoroughly
- Fill buret with adequate amount of MnO<sub>4</sub><sup>-</sup> record initial amount in 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<sub>4</sub><sup>-</sup> 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 <sub>4</sub> <sup>-</sup>		
Final volume of MnO <sub>4</sub> <sup>-</sup>		
Volume of MnO <sub>4</sub> <sup>-</sup>		
Analysis of Hydrogen Peroxide		
	Trial 1	Trial 2
Moles of H <sub>2</sub> O <sub>2</sub>		
Mass of H <sub>2</sub> O <sub>2</sub>		
Percentage of H <sub>2</sub> O <sub>2</sub>		
Avg percentage H <sub>2</sub> O <sub>2</sub>		

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  $\text{H}_2\text{O}_2$  reacted in each trial (show all work)
4. Calculate mass of  $\text{H}_2\text{O}_2$  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  $\text{H}_2\text{O}_2$  in 1.0 mL sample (show all work)
6. Calculate the average percentage of  $\text{H}_2\text{O}_2$  (show all work)

*Turn in for separate grade by May 12th*