Student Name: _____

Student Name: _____

Team # C-_____School Name_____

Chemistry Lab

2012

Twin Tiers Invitational Tournament

Athens High School

Athens, PA

Do not open this booklet until instructed to do so.

Safety

The following safety equipment is required:

- ◊ Close-toed shoes
- ◊ OSHA approved chemical splash goggles with indirect vents
- ◊ Pants or skirt that covers the legs to the ankles and sleeved shirt
- ◊ Lab coat or apron that reaches below the knees

Do not touch or taste any of the chemicals.
You may remove your safety equipment only after your station is clean and your lab materials are returned to a supervisor.

Strategy

It is fine to take the packet apart, split the test with your partner, and work in any order as long as the packet is stapled in the correct order when it is turned in. There are 2 experiments to perform.

Reactions of Metallic Oxides with Water:

You have been provided with the following:

- Magnesium oxide
- Zinc oxide

- Aluminum oxide
- 3 containers labeled “A”, “B”, and “C”.
- Spatula
- dH_2O
- Graduated cylinders
- Shared balance
- Weighing Boat

Obtain qualitative and or quantitative data to identify “A”, “B”, and “C”.
Justify your choices using principles of periodicity.

Data Table(s): *(10 points)*

	Chemical Formula:	Justification: *(15points – 5 pts. ea.)*
A:	_____ *(5 points)*	_____
B:	_____ *(5 points)*	_____
C:	_____ *(5 points)*	_____

Team # C- _____

Electrochemistry Lab:

You have been provided with the following:

- Cross shaped filter paper
- Glass plate
- 4 metals and beral pipets containing 1 M solutions of those 4 metals labeled **A, B, C, D**
  (Each metal has the same letter as its ion in solution.)
- Sandpaper
- Forceps
- $NaNO_3$ solution
- Voltmeter
- Periodic Table
- Gloves (optional but recommended)

Procedure:

1. Establish 3 half cells by placing drops of each of the four solutions A, B, C, D onto one arm of the filter paper cross.
2. Polish the 4 metals.
3. Use forceps to place the matching metal onto each solution while keeping the top side of the metal dry.
4. Add enough drops of $NaNO_3$ solution to the middle of the filter paper cross to act as a salt bridge between the solutions.
5. Designate copper as the reference metal since it is easiest to identify.
6. Using the voltmeter, measure the potential difference between copper and each of the remaining 3 half cells.
7. Record which metal is the anode and which is the cathode.
8. Record the potential difference of each in the data table below.

Data Table: *(10 pts)*

Metal	Metal	Potential Difference ( )	Anode metal	Cathode metal

Data Analysis:

- Create a table of reduction potentials for all 4 cells including copper as the standard ranked from highest potential on the top to lowest potential on the bottom. (*8 points)*

_____What is the letter of the least active metal? *(1 point)*

Use your data to write the line notation for the galvanic cell produced between the half-reactions of "C" and "D". *(4 points)*

_____

Use your data to write a net ionic equation to represent the spontaneous cell reaction of metals C and D and their solutions. (*4 points*)

_____

_____oxidation half-reaction (*1 point*)

_____reduction half-reaction (*1 point*)

_____Predicted cell potential from data (*2 points*)

What factors other than temperature can cause a difference between experimental and reported values? *(1point)*

_____

_____

_____

Electrolytic Cell:

Consider the electrolysis of molten calcium chloride with inert electrodes. The following experimental observations can be made when current is supplied:

- Bubbles of pale green chlorine gas are produced at one electrode.
- Silvery white molten calcium is produced at the other electrode,

Diagram the cell indicating:

1. The anode
2. The cathode
3. The positive electrode
4. The negative electrode
5. The half-reaction that occurs at the anode
6. The half-reaction that occurs at the cathode
7. The overall cell reaction
8. The direction of electron flow through the wire.

(8 points)

What mass of silver could be plated onto a spoon from electrolysis of silver nitrate with a 3.50 A current for 45.0 minutes?
Faraday's Constant = 96,500 Coulombs/mol e^-

Show work: *(2 points)*

_____ (*2 points*)
Answer

Balance the following redox reactions:

$CH_3OH(aq) + Ce^{4+(}aq) \rightarrow CO_2\ (aq) + Ce^{3+}(aq)$ (in acidic solution)

_____*(3 points)*

$Ag(s) + CN^-(aq) + O_2(g) \rightarrow Ag(CN)_2^-(aq)$ (in basic solution)

_____*(3 points)*

If an element had an atomic number if 119:

Would it be a metal or a nonmetal? _____ *(2 points)*

Explain in terms of electron configuration. *(4 points)*

On the basis of periodic trends, would it have the largest atomic radius in its group or would it have the smallest?
_____ *(2 points)*

Explain in terms of electronic structure. *(4 points)*

What would be the most likely charge of its ion in stable ionic compounds? _____ *(2 points)*

Predict whether or not a carbonate compound of it would be soluble in water. _____ *(2 points)*

Explain your reasoning. *(4 points)*

Team # C- _____

Key

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- dH_2O
- Graduated cylinders
- Shared balance
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Obtain qualitative and or quantitative data to identify "A", "B", and "C".
Justify your choices using principles of periodicity.

Data Table(s): *(10 points)*

	Chemical Formula:	Justification: *(15points – 5 pts. ea.)*
A:	**Al_2O_3** *(5 points)*	Answers will vary.
B:	**ZnO** *(5 points)*	
C:	**MgO** *(5 points)*	

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5. Designate copper as the reference metal since it is easiest to identify.
6. Using the voltmeter, measure the potential difference between copper and each of the remaining 3 half cells.
7. Record which metal is the anode and which is the cathode.
8. Record the potential difference of each in the data table below.

Data Table: *(10 pts)*

Metal	Metal	Potential Difference (**V**)	Anode metal	Cathode metal
A	**B**	0.57	B	A
A	**C**	0.46	A	C
A	**D**	1.10	D	A

Data Analysis:

- Create a table of reduction potentials for all 4 cells including copper as the standard ranked from highest potential on the top to lowest potential on the bottom. (*8 points)*

$C^{+} + e^{-} \rightarrow C$	0.46 V
$A^{2+} + 2e^{-} \rightarrow A$	0 V
$B^{2+} + 2e^{-} \rightarrow B$	-0.57 V
$D^{2+} + 2e^{-} \rightarrow D$	-1.10 V

C What is the letter of the least active metal? *(1 point)*

Use your data to write the line notation for the galvanic cell produced between the half-reactions of "C" and "D". *(4 points)*

D l D^{2+} ll C^{+} l C

Use your data to write a net ionic equation to represent the spontaneous cell reaction of metals C and D and their solutions. (*4 points*)

$2C^{+} + D \rightarrow D^{2+} + 2C$

$D \rightarrow D^{2+} + 2\ e^{-}$ oxidation half-reaction (*1 point*)

$2C^{+} + 2e^{-} \rightarrow 2C$ reduction half-reaction (*1 point*)

See data V Predicted cell potential from data (*2 points*)

What factors other than temperature can cause a difference between experimental and reported values? *(1point)*

Electrical resistance

Electrolytic Cell:

Consider the electrolysis of molten calcium chloride with inert electrodes. The following experimental observations can be made when current is supplied:

- Bubbles of pale green chlorine gas are produced at one electrode.
- Silvery white molten calcium is produced at the other electrode,

Diagram the cell indicating:

1. The anode
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3. The positive electrode
4. The negative electrode
5. The half-reaction that occurs at the anode
6. The half-reaction that occurs at the cathode
7. The overall cell reaction
8. The direction of electron flow through the wire.

(8 points)
See picture

What mass of silver could be plated onto a spoon from electrolysis of silver nitrate with a 3.50 A current for 45.0 minutes?
Faraday's Constant = 96,500 Coulombs/mol e^-

Show work: *(2 points)*

10.6 g Ag (*2 points*)

Balance the following redox reactions (include phase labels):

$CH_3OH(aq) + Ce^{4+(}aq) \rightarrow CO_2\ (aq) + Ce^{3+}(aq)$ (in acidic solution)

$H_2O(l) + CH_3OH(aq) + 6\ Ce^{4+}\ (aq) \rightarrow 6\ Ce^{3+}\ (aq) + CO_2\ (g) + 6\ H^+\ (aq)$

_____*(3 points)*

$Ag(s) + CN^-(aq) + O_2(g) \rightarrow Ag(CN)_2^-(aq)$ (in basic solution)

$8\ CN^-\ (aq) + 4\ Ag(s) + O_2(g) + 4\ H^+ \rightarrow 4\ Ag(CN)_2^-(aq) + 2\ H_2O\ (l)$

_____*(3 points)*

If an element had an atomic number if 119:

Would it be a metal or a nonmetal? **metal** *(2 points)*

Explain in terms of electron configuration. *(4 points)*
Its valence configuration is ns^1 so it easily loses its valence electron.

On the basis of periodic trends, would it have the largest atomic radius in its group or would it have the smallest?
Largest *(2 points)*

Explain in terms of electronic structure. *(4 points)*
Valence configuration is $8s^1$

What would be the most likely charge of its ion in stable ionic compounds? **+1** *(2 points)*

Predict whether or not a carbonate compound of it would be soluble in water. **Yes** *(2 points)*

Explain your reasoning. *(4 points)*
All alkali metals are soluble in water.