Family Name: _____     First Name: _____

I. D #: _____     Major: _____

Section (day): _____

**Score:**

I. _____ /26

II. _____ /10

III. _____ /64

**Grade:** _____ /100

*Good Luck*

**I. A (18%)   Fill in the blanks:**

- The study of reaction rates and reaction mechanisms is known as
  _____.

- _____ represents a dynamic state in which two or
  more opposing processes are taking place at the same time and at the
  same rate.

- If a stress is applied to a system in equilibrium, the system will
  respond in such a way to relieve that stress. This is known as

  _____.

- Use "increase", " decrease", "or has no effect on":
  Increasing the $[H^+]$ of a solution will _____ pH,

  _____ pOH, _____ $[OH^-]$, _____ Kw.

- A cell that produces electric current from a _____ a Chemical
  reaction is called a voltaic cell or a _____ cell.

- Consider an element X that can have oxidation numbers of 0, +2 and
  +4. $X^{2+}$ can be _____ to X, or it can be _____ to $X^{4+}$.

- The Nernst equation is given by _____.

**B. (8%)**    Give the title of one experiment of Chemistry 205 in which each of the following was used:

- Chronometer _____

- Voltmeter _____

- Spectrophotometer _____

- Chromatography _____

- O-phenanthroline _____

- Sodium oxalate _____

- Phenolphthalein _____

- Mettler Balance _____


**II. (10%)**    In each of the following cases, give one reagent that can be used to separate a mixture containing

1.    $Ag^-$ and $Na^+$ _____

2.    $Fe^{3-}$ and $Al^{3-}$ _____

3.    $Pb^{2-}$ and $Hg_2^{2-}$ _____

4.    $Pb^{2+}$ and $Cu^{2+}$ _____

5.    $Hg^{2+}$ and $Cu^{2-}$ _____

6.    $Ca^{2-}$ and $K^-$ _____

7.    $Al^{3+}$ and $Cu^{2+}$ _____

8.    $Hg_2^{2+}$ and $Fe^{3-}$ _____

9.    $K^+$ and $Fe^{3+}$ _____

10.    $Hg_2^{2+}$ and $Hg^+$ _____

**III. (64%)**    Circle the letter of the best answer:

**A cation that is common between group I and group II is:**

a.    $Ag^-$
b.    $Pb^{2+}$
c.    $Bi^{3+}$
d.    $Mg^{2-}$
e.    $Hg^{2+}$

**What is common between $Al^{3+}$ and $Fe^{3-}$**

a.    Both are amphoteric
b.    They belong to group III
c.    They form complexes with ammonia
d.    They form sulfides with $S^{2-}$
e.    (a) and (b)

**The cations that have no common group reagent are:**

a.    $Al^{3-}$, $Na^-$, $Ca^{2-}$

b.    $Na^+$, $Ca^{2+}$, $NH_4^+$

c.    $K^+$, $Na^-$, $Fe^{2+}$

d.    $NH_4^-$, $K^+$, $Na^+$

e.    $Ca^{2+}$, $Mg^{2+}$, $K^-$

**$H_2SO_4$ can be used to precipitate:**

a.    $Pb^{2+}$    ·
b.    $Zn^{2+}$
c.    $Ca^{2+}$
d.    $Cu^{2+}$
e.    (a) and (c)

**What is <u>incorrect</u> about a concentration cell:**

a.  It is constructed from two half-cells composed of the same material but differing in ion concentrations.

b.  The two half-cells can be composed of different materials but of the same charge like $Pb(NO_3)_2$ and $Cu(NO_3)_2$

c.  An example of such a cell is $Zn_{(s)}/ Zn^{2+}(0.10M)// Zn^{2-}(1.0M)/Zn_{(s)}$

d.  $E°$ of a concentration cell is zero

**What is <u>incorrect</u> about Beer's Law:**

a.  It tells that at constant wavelength, the absorbance of a given substance is constant if the concentration varies

b.  It can provide a plot of absorbance versus molar concentration of a given species

c.  Using the slope of the Beer's Law plot, one can determine the molar extinction coefficient of the analyzed solution

d.  It is given by $A=abC$

**Given that**

$$Sn^{2+}+2e^- \longrightarrow Sn(s) \qquad E° = -0.14V$$
$$Zn^{2+}+2e^- \longrightarrow Zn(s) \qquad E° = -0.76V$$
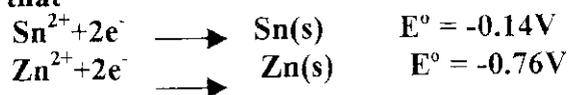
**Circle the letter of the <u>CORRECT</u> statement under standard -state conditions:**

a.  Sn reduces $Zn^{2-}$

b.  Zn reduces $Sn^{2+}$

c.  Zn oxidizes $Sn^{2+}$

d.  No reduction occurs because of negative $E°$ values

**Consider the reaction $2X+Y \rightarrow Z$. If this reaction is first order in X and second order in Y, then what would be a <u>False</u> statement:**

a.  The reaction is a third order reaction

b.  Doubling the concentration of Y will double the rate of the reaction

c.  Reducing the concentration of X by half will reduce the rate to its half.

d.  The use of a catalyst will speed up this reaction by lowering its activation energy.

Consider the following reaction:

$$H^+ + MnO_4^- + S^{2-} \rightarrow Mn^{2+} + S + H_2O$$

After balancing, the stoichiometric coefficients with respect to the reaction as written, will be:

a.    8, 1, 5, 1, 5, 4
b.    8, 2, 7, 2, 7, 4
c.    16, 2, 7, 2, 7, 8
d.    16, 2, 5, 2, 5, 8


A certain volume V of water was added to 100.0 ml of 12.0 M HCl to prepare 0.500M HCl. Determine V

a.    0.600 L
b.    2.40 L
c.    2.30 L
d.    0.500 L


A 1.0- g sample of a monoprotic acid HA required 17.0 ml of 0.65 M NaOH to reach the end point of a titration. Determine the molecular weight of A in g/mol

a.    90.5
b.    11.1
c.    38.2
d.    26.2


Determine the pH of 0.30 M $HNO_3$ solution

a.    13.48
b.    0.52
c.    13.70
d.    0.30

What is the percent transmittance of a $Cr(NO_3)_3$ solution that shows an absorbance of 0.347 at 575nm

a.   22.2%
b.   55.0%
c.   45.0%
d.   77.8%

What is the solubility of $PbSO_4$ (Ksp= $1.3 \times 10^{-8}$) in grams per liter (M.Wt. of $PbSO_4$ = 303.3 g/mol)

a.   $3.3 \times 10^{-2}$
b.   $1.1 \times 10^{-4}$
c.   $1.3 \times 10^{-8}$
d.   $2.6 \times 10^{-6}$

$CaF_2$ is a sparingly soluble salt (Ksp = $3.9 \times 10^{-11}$). Calculate the molar concentration $[Ca^{2+}]$ in a saturated solution.

a.   $3.4 \times 10^{-4}$ M
b.   $1.1 \times 10^{-4}$ M
c.   $9.75 \times 10^{-12}$ M
d.   $2.1 \times 10^{-4}$ M

What would be the concentration $[F^-]$ in the above question

a.   $[F^-] = 2 [Ca^{2+}]$
b.   $[F^-] = \frac{1}{2} [Ca^{2+}]$
c.   $[F^-] = [Ca^{2+}]^2$
d.   $[F^-] = \frac{1}{2}$ Ksp