Name _____ Block: _____ Date: _____

Chemistry 12

STANDARD REDUCTION POTENTIALS

1. A cell is constructed using Nickel metal and 1 M nickel (II) nitrate along with Fe metal and 1 M Iron (II) nitrate.

   a) Write the equation for the half-rxn at the **cathode** (with the E^o)

   _____

   b) Write the equation for the half-rxn at the **anode** (with the E^o)

   _____

   c) Write the balanced equation for the **overall reaction** (with the E^o)

   _____

   d) What is the **initial cell voltage**? _____V

2. A cell is constructed using aluminum metal, 1 M $Al(NO_3)_3$ and lead metal with 1 M $Pb(NO_3)_2$. Write the overall redox reaction and find the initial cell voltage.

   Cathode: _____

   Anode: _____

   Overall redox reaction: _____

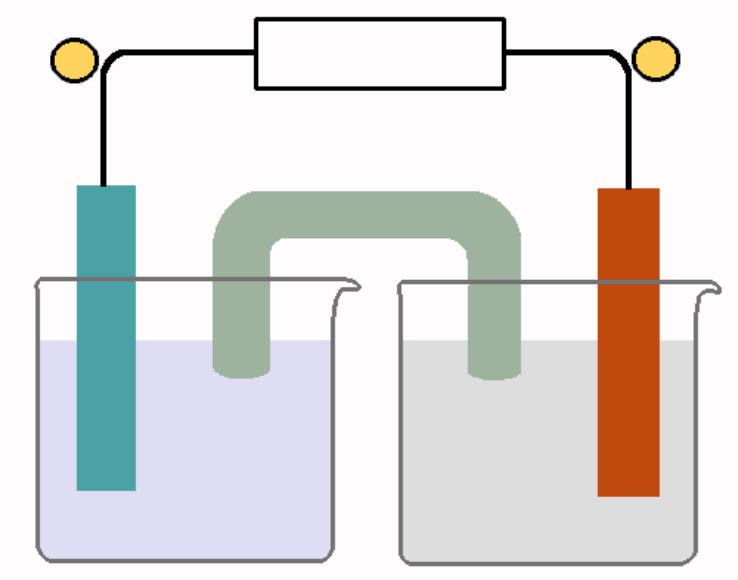
   Initial cell voltage: _____Volts.

3. A student has 3 metals: Ag, Zn and Cu; three solutions: $AgNO_3$, $Zn(NO_3)_2$, and $Cu(NO_3)_2$, all 1 M. She also has a salt bridge containing KNO_3(aq) wires and a voltmeter.
   a) Which combination of 2 metals and 2 solutions should she choose to get the **highest** possible voltage?

      Metal: _____Solution: _____

      Metal: _____Solution: _____

b) Draw a diagram of the cell labeling metals, solutions, salt bridge, wires, and voltmeter.



c) Write an equation for the half-rxn at the **cathode**. (with E°)

_____

d) Write an equation for the half-rxn at the **anode** (with E°)

_____

e) Write a balanced equation for the **overall redox reaction** in the cell (with E°)

_____

f) The initial voltage of this cell is _____Volts.

g) In this cell, electrons are flowing toward which metal?_____ In the _____.

h) Positive ions are moving toward the _____ solution in the _____ _____.

i) Nitrate ions migrate toward the _____ solution in the _____.

j) _____ metal is gaining mass
_____ metal is losing mass } As the cell operates.

The student now wants to find the combination of metals and solutions that will give the **lowest** voltage.

k) Which metals and solution should she use?

Metal _____ Solution _____

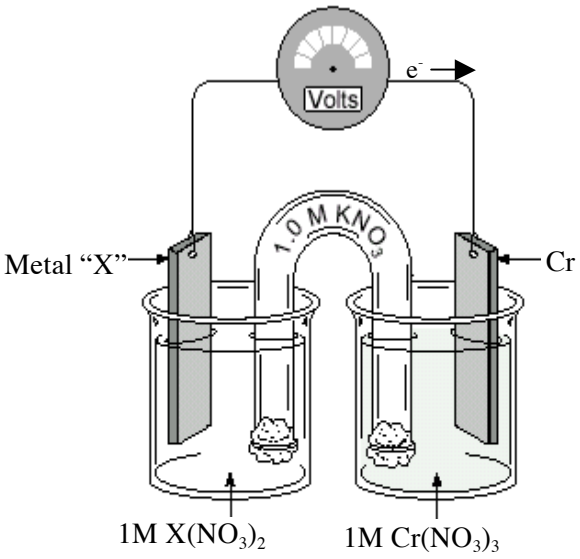
Metal _____ Solution _____

l) Find the **overall redox equation** for this cell.

m) Find the **initial cell voltage** of this cell _____Volts.

4. Consider the following cell:

<u>The voltage on the voltmeter is 0.45 Volts.</u>



a) Write the equation for the half-reaction taking place at the anode. Include the E^o.

_____ E^o: _____V

b) Write the equation for the half-reaction taking place at the cathode.

_____ E^o: _____V

c) Write the balanced equation for the redox reaction taking place as this cell operates. Include the E^o. _____E^o: _____V

d) Determine the reduction potential of the ion X^{2+}. E^o: _____V

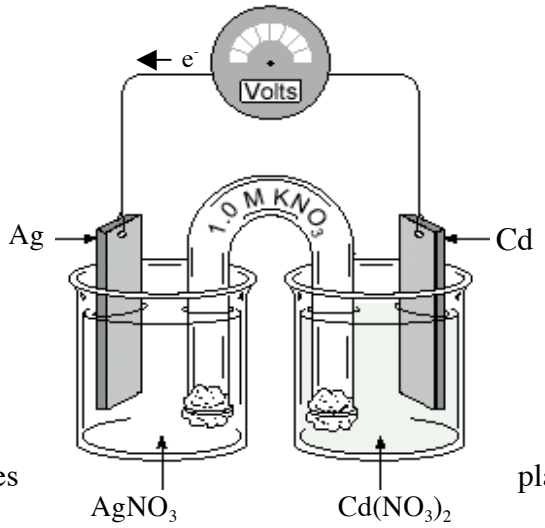
e) Toward which beaker ($X(NO_3)_2$) or ($Cr(NO_3)_3$) do NO_3^- ions migrate?

_____

f) Name the actual metal "X" _____

5. Consider the following cell:

The initial cell voltage is <u>1.20 Volts</u>



a) Write the equation for the half-reaction which takes place at the cathode. Include the E^o

_____ E^o= _____V

b) Write the equation for the half-reaction taking place at the anode:

_____ E^o= _____V

c) Write the balanced equation for the overall redox reaction taking place. Include the E^o.

_____ E^o= _____V

d) Find the oxidation potential for Cd: E^o= _____V

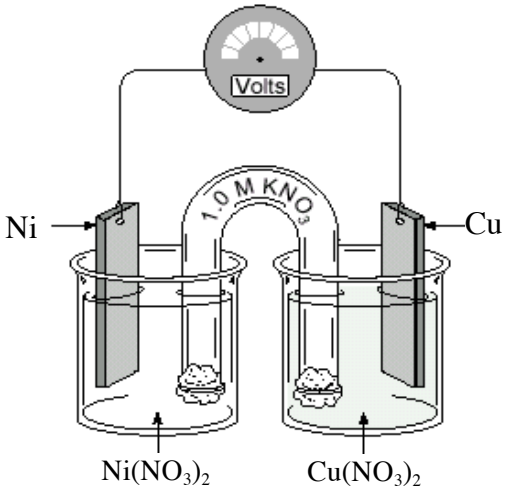
e) Find the reduction potential for Cd^{2+}: E^o= _____V

f) Which electrode gains mass as the cell operates? _____

g) Toward which beaker ($AgNO_3$ or $Cd(NO_3)_2$) do K^+ ions move? _____

h) The silver electrode and $AgNO_3$ solution is replaced by Zn metal and $Zn(NO_3)_2$ solution. What is the cell voltage now? _____Which metal now is the cathode? _____

6. Consider the following electrochemical cell:



a) Write the equation for the half-reaction taking place at the nickel electrode. Include the E^o

_____ E^o= _____V

b) Write the equation for the half-reaction taking place at the Cu electrode. Include the E^o.

_____ E^o= _____V

c) Write the balanced equation for the redox reaction taking place.

_____ E^o= _____V

d) What is the initial cell voltage? _____V

e) Show the direction of electron flow on the diagram above with an arrow with an "e^-" written above it.

f) Show the direction of flow of cations in the salt bridge using an arrow with "Cations" written above it.

7. A cell is constructed using $Cr/Cr(NO_3)_3$ and $Fe/Fe(NO_3)_2$ with both solutions at 1.0 M and the temperature at 25 ºC.

   a) Determine the **initial cell voltage**.

   Answer: _____V

   b) What is the **equilibrium cell voltage**?

   Answer: _____V

   c) Write the balanced equation for the overall reaction taking place. Write the word "energy" on the right side and make the arrow double.

   _____

   d) Using the equation in (c), predict what will happen to the cell voltage when the following changes are made:

   i) More $Cr(NO_3)_3$ is added to the beaker to **increase** the $[Cr^{3+}]$

   Cell voltage ____creases

   ii) The $[Fe^{2+}]$ ions is **increased**.

   Cell voltage ____creases

   iii) A solution is added to precipitate the Fe^{2+} ions

   The $[Fe^{2+}]$ will ____crease & cell voltage will ____crease

   iv) Cr^{3+} ions are removed by precipitation. Voltage ____creases

   v) The surface area of the Fe electrode is increased

   Voltage _____

   vi) The salt bridge is removed. Voltage _____