LAD B5 (pg 1 of 3) **Electrolysis of Aqueous KI** Name______________________________

Electricity can be run through an aqueous solution and force a thermodynamically unfavorable reaction to proceed. Use the reduction reactions in the table below to consider the electrolysis of an aqueous solution of KI.

1. What particles are present in an aqueous KI solution?

Reduction Potential Table	
Half Reaction	E^o_{red} **(V)**
$O_{2(g)}$ $4\ H^+ + 4\ e^- \rightarrow 2\ H_2O_{(L)}$	1.23
$I_2 + 2e^- \rightarrow 2\ I^-$	0.53
$2\ H_2O_{(L)} + 2\ e^- \rightarrow H_{2(g)} + 2\ OH^-$	−0.83
$K^+ + e^- \rightarrow K$	−2.92

2. Choose two possible ***reduction*** reactions that could occur in this aqueous KI solution?

3. Choose two possible ***oxidation*** reactions that could occur in this aqueous KI solution?

4. For the reactions you wrote above, put a box around the reduction reaction that will occur first (more easily, "cheaper")? In the space above, ***justify*** why you make the selection that you did?

5. For the reactions you wrote above, put a box around the oxidation reaction that will occur first (more easily, "cheaper")? In the space above, ***justify*** why you make the selection that you did?

6. Write out the balanced equation below, and calculate the minimum voltage required to cause the electrolysis.

7. What are the number of electrons that are transferred during this electrolysis?

8. You may recall phenolphthalein is an acid base indicator. What color in acid? What color in base?

Procedure

A. Collect: 1 plastic dish, 2 tiny metal electrodes, 1white square of paper, 2 connecting alligator clip wires, 1 battery
B. Put just enough aqueous KI solution to cover the bottom of the petri dish
C. Add two drops of phenolphthalein to the KI solution.
  - KI is a white salt, and produces a colorless solution. When I^- is oxidized to produce I_2 (which is a solid purple-black element) some of the I_2 will combine with I^- in the solution to produce the ***yellow*** I_3^- ion.

D. Alert: Please do not allow the metal alligator clip tips to dunk in the solution. This will cause them to rust, and become less effective. Please hold onto your clips and only allow the wires, and paper clips to dunk into the solution.
E. Connect up the cell using the metal electrodes (not the paperclip). Then look for evidence of electrolysis.
F. Note that the battery has + / − on the sides. The negative end of a battery is the end from which electrons spew out of the battery. **Make your observations in the context of those markings and the half reactions that are occurring.**

LAD B5 (pg 2 of 3) **Electrolysis of Aqueous KI**

9. Color changes occur at each electrode. (Reread #8 and the bullet under Procedure “C” before proceeding.)
   (a) Which half reaction is occuring at the electrode where the solution turns pink. What is causing the pink color to form?

   (b) Which half reaction is occuring at the electrode where yellow appears. What is causing the yellow color to form?

   (c) Take out the electrode where the “yellow” occurs and wipe the electrode on paper…observe. Any suggestions of what is causing this observation?

10. Do you detect any formation of gases, at which electrode, and what substance do that gas give evidence of?

 Electrolysis of Aqueous KI

11. Rinse out the petri dish again, replace the KI solution, but do NOT put phenolphthalein in this time, and swap the nichrome wires for paper clips. Gently swish the electrodes near one another (as demonstrated in class) so the products each half reaction can mix with each other.

    (a) Does yellow color show up at the anode?

    (b) What half reaction might be happening at the anode

Reduction Potential Table	
Half Reaction	**E^o_{red} (V)**
$O_{2(g)}$ $4 H^+ + 4 e^- \rightarrow 2 H_2O_{(L)}$	1.23
$I_2 + 2e^- \rightarrow 2 I^-$	0.53
$Fe^{2+} + 2 e^- \rightarrow Fe$	−0.44
$2 H_2O_{(L)} + 2 e^- \rightarrow H_{2(g)} + 2 OH^-$	−0.83
$K^+ + e^- \rightarrow K$	−2.92

    (c) Iron(II) hydroxide is not particularly soluble and can be green in color. Does this help explain what might be happening at the anode?

    (d) Write the net ionic equation that is happening in the solution when the iron paperclips are used instead of the nichrome wire.

12. Put 1 drop of phenolphthalein in the solution from #14. If pink forms, put the electrodes back in the solution far away from each other, and see if you can "mop up" the pink with the anode, while more pink will be forming at the cathode.