Chemistry 10123, **Exam 4** Name: _____
April 22, 2020 (Please Print)

1. (7 points) Use the ion-electron method to balance the following redox reaction that occurs in ***basic*** solution. Write ***complete, balanced equations*** for the individual half-reactions and for the overall net ionic equation. Also, ***circle the oxidizing agent***.

$$Al_{(s)} + NO_2^-(aq) \longrightarrow AlO_2^-(aq) + N_2H_{4(aq)}$$

Reduction Half Reaction:

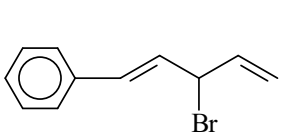
Oxidation Half Reaction:

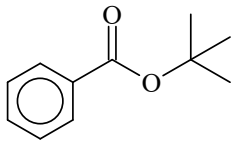
Net Ionic Equation:

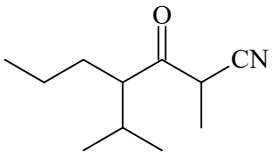
2. (4 points) A compound sometimes called "magnesium cerium sulfate" has the formula $MgCe(SO_4)_3$. Give the oxidation states of all four elements in this compound.

Mg = _____ O = _____ Ce = _____ S = _____

3. (9 points) Write the systematic name of each compound below its structure. Also, circle any carbon atoms which are ***asymmetric (chiral) centers*** in these structures.







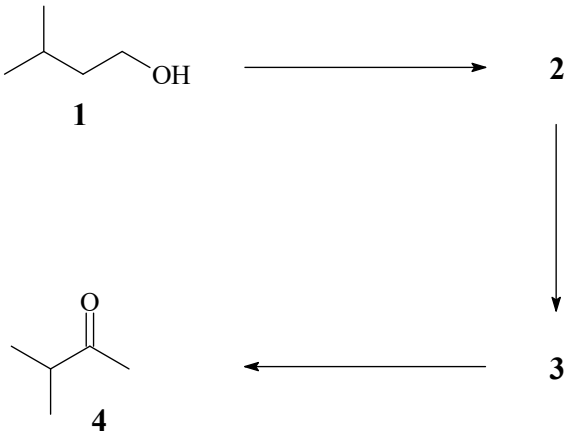
4. (6 points) Write ***balanced ionic equations*** for the half-reactions.

   (a) The ***anode*** reaction in the electrolysis of *aqueous* K_2SO_4.

   (b) The ***anode*** reaction in the electrolysis of *molten* $CaBr_2$.

   (c) The ***cathode*** reaction in the electrolysis of *aqueous* $NiCl_2$.

5. (8 points) Using some of the organic reactions that we have studied, alcohol **1** can be converted into ketone **4** in a 3-step sequence which involves the intermediate formation of compounds **2** and **3**. Draw ***complete structural formulas*** for compounds **2** and **3** (*with all carbons, hydrogens, etc., clearly shown*). On the reaction arrows, indicate the necessary reagents and/or reaction conditions that are required for these transformations.



6. (8 points) Draw ***complete structural formulas*** for each of the following organic compounds.

   (a) 1-bromo-3-*iso*butylbenzene

   (b) *p*-nitroaniline

   (c) phenyl formate

   (d) *cis*-3-hexene

7. A ***battery*** is constructed based on the following electrochemical cell in which the volume of solution in each half-cell is 200 mL.

$$Fe_{(s)} \mid Fe^{2+}\ (1.00\ M) \parallel Au^{3+}\ (1.00\ M) \mid Au_{(s)}$$

(a) (6 points) Write balanced chemical equations for the anode, cathode, and overall cell reactions.

Anode:

Cathode:

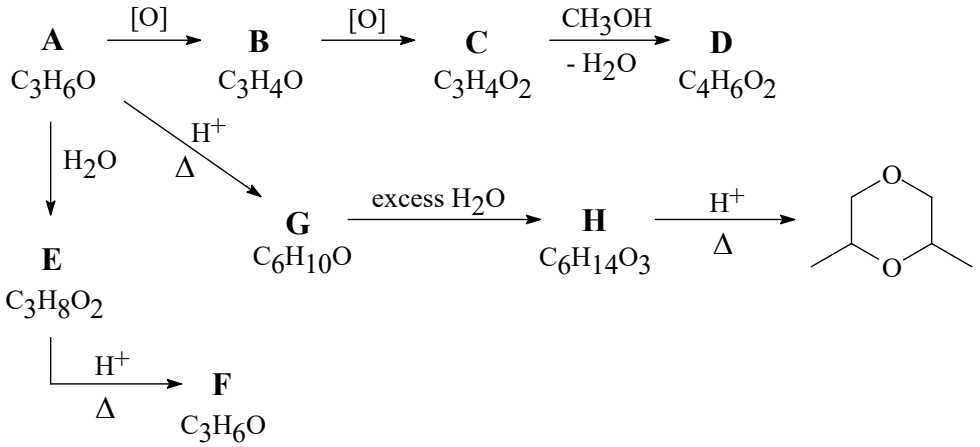
Cell:

(b) (3 points) Determine the ***initial voltage*** of this battery.

(c) (7 points) **SHOW ALL WORK.** Determine the free energy change for the cell reaction of this battery under standard conditions.

(d) (10 points) **SHOW ALL WORK.** Determine the voltage of this battery after it has delivered a current of 0.30 amp for 48 hours.

8. (24 points) An unknown organic compound (**A**) has the simple molecular formula C_3H_6O and contains an alcohol group. Compound **A** is found to undergo the reaction sequences summarized below. (Notice that compounds **A** and **F** have the same molecular formula.)



Draw ***complete structural formulas*** for compounds **A** – **H**. You may write either fully or partially condensed formulas as long as the molecular structure, including the positions of any functional group(s), is clearly shown.

A: **B**: **C**:

D: **E**: **F**:

G: **H**:

9. (8 points) In addition to compounds **A** and **F** in question 8 above, there are several **other *structural isomers*** of molecular formula C_3H_6O. Write clear ***structural formulas*** for C_3H_6O isomers that are good examples of each of the following functional group classes.

ketone ***alcohol*** ***aldehyde*** ***ether***