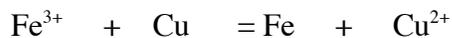PRACTICE PROBLEMS FOR CHEM. 103 FINAL

First: Look over the earlier review sets! The final is cumulative. Questions below are mainly on the most recent material. Answers are not given -deliberately.

1. What element undergoes alpha decay to form Pb-208?

2. Carbon 11 has a half-life of 20.4 min. What percentage of the original number of C-11 nuclei in a sample will remain after 75.0 minutes?

3. Explain the principles upon which the Shroud of Turin was assigned a probable age of about 700 years.

4. Calculate the binding energy in J/nucleon of Zn-64, of nuclear mass 63.92914 amu.

5. What type of structural information is obtained from proton magnetic resonance (pmr) spectroscopy? Illustrate your answer with an example for which you must sketch a pmr spectrum. (You are NOT expected to recall chemical shift data.)

6. Explain why, in principle, both fission and fusion processes can be used in power generation.

7. What differences would you expect in the pmr spectra of the following pairs of isomers? Make a sketch of the spectra.

7.1 $CH_3CH_2CH_2CH_3$ and $(CH_3)_3CH$

7.2 CH_3CH_2OH and $CH_3O\ CH_3$

$CH_3CH_2CHCl_2$ and $CH_3CHClCH_2Cl$

8. A voltaic cell uses the following reaction (not balanced):

Fe^{3+} + Cu = Fe + Cu^{2+}

Calculate the standard cell potential; what is the spontaneous reaction?

What is the cell potential at 298K when the concentration of Fe^{3+} is 0.100 M and that of Cu^{2+} is 0.010 M ?

9. Lightweight energy sources are an attractive goal. Consider a battery which uses the oxidation of a metal by oxygen in basic solution:

$$? \text{ M} + ?? \text{ O}_2 + ??? \text{ OH}^- + \ldots \rightarrow ? \text{ M(OH)}_n + ????\ldots \quad (1)$$
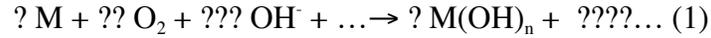
Half reaction	E°/V	reaction	K
$Al^{3+} + 3e^- \rightarrow Al$	-1.66	$Al^{3+} + 4\ OH^- \rightarrow Al(OH)_4^-$	7.7×10^{33}
$Mg^{2+} + 2e^- \rightarrow Mg$	-2.37	$Mg(OH)_2 <-> Mg^{2+} + 2\ OH^-$	1.8×10^{-11}
$O_2 + 4e^- + 2\ H_2O \rightarrow 4\ OH^-$	0.40		

a. Choose either metal, balance the equation of reaction and calculate E° for the balanced equation of reaction (like equation (1)).

b. Calculate the actual voltage under operating conditions of 10 **M** NaOH, 0.20 atm O$_2$pressure and when 0.2 moles of metal ion per L have undergone reaction. Pay attention to column 3!