CHEM 212 Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Exam 3

Fall 2012

**Do 5 of the following 7 questions. It is essential YOU indicate the problems you want graded. Otherwise, I will grade the first five with writing.**

**1 2 3 4 5 6 7**

**Write CLEARLY and show your work (points will be reduced for the correct answer with inadequate work shown).**

1. Consider a pH meter.

1. (14) Diagram and label a pH meter. Describe how it measures protons in solution.
2. (3 each) List and briefly describe 2 largest, least controllable factors that can affect the accuracy of pH measurements.

2. Given a voltaic cell made from the following components:

Fe3+ + e- 🡪 Fe2+ E0= 0.771 V

Ce3+ + 3e- 🡪 Ce0 E0= -2.336 V

1. (5) Draw a picture of the cell. Label the anode, cathode, and the direction of electron flow on the picture.
2. (5) Write each of the balanced half reactions in the appropriate direction with E**°.**
3. (5) Write the balanced equation and calculate E**°.**
4. (5) Calculate the cell potential for the following conditions:

[Fe2+]= 0.31M [Fe3+]= 0.02M [Ce3+]= 0.45M

3. Consider a UV-Vis spectrometer

1. (12) Diagram and label a photodiode array beam instrument. Briefly state the function of each component in the diagram.



1. (2) Estimate the concentration at A=0.3, given the data to the right.
2. (2) What is the apparent linear range of Beer’s Law from this data? Is this consistent with your expectation?
3. (2 each) List two **INSTRUMENT RELATED** reasons for nonlinearity of Beer’s Law.

4. Consider the following instrument components.

1. (10) Diagram and label a monochromator. Briefly state the function of each component in the diagram.
2. (10) Diagram and label a PMT. Briefly state the function of each component in the diagram.

5. Consider a UV-Vis fluorimeter.

* 1. (10) Diagram and label a fluorimeter
  2. (4) Why are fluorescence measurements always more sensitive than absorption measurements?
  3. (2) State what is stationary and what is scanned in emission and excitation scans
  4. (4) Why is the emission energy less than the excitation energy for the same transition? Draw a Jablonski diagram and another diagram to illustrate your point.

6. Consider an FT-IR spectrometer.

1. (12) Draw a diagram, label all the parts, of an FT-IR. Briefly state the function of each component in the diagram.
2. (2) Why does an FT-IR not have a monochromator? Which part functions instead of a monochromator in an FT-IR?
3. (2) What is the output of an FT-IR?
4. (2) What signal processing occurs to make an interpretable FT-IR spectrum?
5. (2) Draw an FT-IR spectrum including labeling the axis.

7. Consider the suite of atomic spectrometers

1. (4) Diagram a flame sample delivery system.
2. (2) What does the flame do to the sample?
3. (14) Diagram, and label atomic emission, atomic absorption, and atomic fluorescence spectrometers.