George Mason University
Chemistry Department
CHEM 423, Final Exam (75 mins.) Name_____

IN THIS EXAMINATION YOU ARE ALLOWED TO USE YOUR LAB NOTEBOOK, AND A CALCULATOR. EXCEPT FOR MULTIPLE CHOICE QUESTIONS, PROVIDE SHORT ANSWERS/DEFINITIONS; WHERE APPROPRIATE USE A FEW BRIEF SENTENCES, OR PROVIDE AN EXAMPLE, AN EQUATION, CHEMICAL STRUCTURE, OR DRAWING. BEGIN AFTER SIGNING THE HONOR CODE PLEDGE.

Honor code pledge

On my honor, I have neither given nor received aid in this examination.

Signed _____

(Q:1-10, 50 points)
Briefly explain your answer.

1. The total mass of lunar rock sample is determined by weighing each of eight fragments. If the uncertainty in the weight of each fragment is ±0.10 mg, what is the uncertainty in the total weights?

2. The fraction of sample in the stationary phase in reverse phase liquid chromatography will increase when water is added to the mobile phase. Why?

3. Explain why flame atomic absorption is more sensitive than atomic emission spectroscopy.

4. In developing chromatographic separation by HPLC, which parameter should first be adjusted to improve the resolution of a pair of weakly retained overlapping peaks?

5. In gas chromatography of complex samples, weakly retained solutes may be separated poorly or not at all, while strongly retained solutes may exhibit excessively long retention times. Propose a solution to this problem without changing the column

6. Explain quantitatively why there must be a difference in free energy of partitioning to separate two components in chromatography?

7. A solution contains 0.0375 mg/mL of A. Calculate the corresponding concentration in parts-per-billion.

8. Why the most concentrated Ca solution was aspirated first before any other Ca solution in your atomic emission spectroscopy?

9. Is it necessary to use a blank sample in VIS spectroscopy? Explain.

10. In GC, compounds A, B, C produced peak areas 50, 100, and 75, respectively. In the same chromatogram the internal standard peak area was 200 and its concentration was 10.0 ppm. Calculate the concentrations of A, B, and C. Explain your answer.

11. (10 points)

A sample of toothpaste weighing 0.250 g was placed in a 250 mL beaker containing a 50 mL of TISA. The mixture is boiled, cooled, transferred with two washes into a 200.0 mL volumetric flask, and diluted to the mark with distilled water. This solution had a reading of 175 mV with a F^- ion-selective electrode that had a calibration slope of -60 mV/decade. Then, separately, two 0.010 mL spikes of 10.0 mg/mL F^- were added to the sample, mixed and measured. The readings were 73.6 and 55.5 mV, respectively. What was the concentration in ppm of F^- in the original toothpaste?

12. (10 points)
A solution containing 3.47 mM benzene (analyte) and 1.72 mM hexaflurorobenzene (HFB as standard) gave peak areas 3473 and 10222, respectively in a chromatographic analysis. Then 1.00 mL of 8.47 mM HFB was added to 5.0 mL of the solution containing the analyte and diluted to 10.0 mL. This solution gave peak areas of 5428 (for benzene) and 4431 (for HFB).

(a) Find the response factor for benzene relative to HFB

(b) Find the concentration of [HFB] mM in the 10.0 mL mixed solution

(c) Find the mM benzene in the 10.0 mL mixed solution

(d) Find the mM benzene in the original unknown

13. (30 points)
Suggest an appropriate instrumental technique for the analytical measurement for each of the following problem. (Instrument and technique used, brief experimental conditions, and method of calculation or quantitation)

(a) Heterogeneous electron transfer rate constant of a redox couple in solution
(b) Dissolved CO_2 (at 1-5 mM level) in water.
(c) Organic compounds (e.g., pesticide residues) isolated from coffee beans
(d) Polyaromatic hydrocarbons in the atmosphere
(e) Arsenic in drinking water at 10-50 ppb level
(f) Measurement of sodium and chloride (both at ppm level) to monitor changes in the salinity at different locations in the Chesapeake Bay.