

Analytical Cumulative Exam

6 October 2005

Please answer all of the following questions completely and concisely. **Explanations or descriptions should be in the form of complete sentences.** In some cases, a limited number of diagrams are also appropriate as supporting information. All questions worth 10 pts.

1. The sample in analytical chemistry is almost never a solution of pure analyte. Assuming that you have: 1. a chemically complex mixture that is not entirely defined and 2. an instrumental method for measuring your analyte, what general method would you use to quantitate an analyte from this mixture. You must describe the method for full credit.
2. The textbook used for undergraduate analytical chemistry here at UIC gives an approximate definition for pH as $\text{pH} \approx -\log([\text{H}^+])$. Why is this approximate (' \approx ')?
3. Explain why you would use the following statistical tests:
 - a) t test
 - b) Q test
 - c) F test
4. What is the theoretical pH of pure water at 298 K? Why is it typically not that pH even after reverse osmosis, ultrafiltration and further dionization to 18 M Ω conductance?
5. What is an evanescent wave and how could you use it for a spectroscopic measurement? Please include a diagram to answer each part of this question.
6. Describe how a glass pH electrode operates. At least a diagram of a standard combined electrode assembly is needed to help with your discussion.
7. If you are given a chromatogram with a single peak, how do you find the number of theoretical plates?
8. What is an aptamer and what is an application in analytical chemistry?
9. Why are two photomultiplier tubes (PMTs) commonly used for scintillation counting? How are the PMTs placed relative to the sample vial.
10. Describe, in general, how an ELISA is performed.