Objectives for our Discussion of Sample Preparation

1. Describe primary goals of sample preparation
2. Recognize circumstances when sample preparation is needed
3. Given circumstances, suggest an appropriate sample preparation method
4. Outline the specific steps of a SPE method, given target analyte/sample matrix combination
5. Predict behavior of a target analyte given a sample preparation method and conditions

Overall Objectives for our Discussion of Quantitation

1. Given analytical circumstances, give detailed description of what constitutes a blank, control, dummy analysis
2. Given analytical circumstances, describe how each quantitation concept (e.g., blank sample) contributes to the validity of the analytical method
3. Describe quantitation methods, plot data as appropriate, and determine mean and standard deviation for estimate of unknown concentration
    a. External calibration
    b. Internal standard
    c. Standard addition
4. Choose and justify method given analytical circumstances
5. Design a calibration scheme for an analysis where the target concentration of the analytes is known. Be able to defend your choices of variables such as the range of concentrations and numbers of standards

Objectives for our Discussion of Separations

Basics

1. Define, understand, and use key terms such as retention time, retention factor, selectivity, and resolution.
2. Predict changes in separation metrics (e.g., resolution) upon a change in conditions (e.g., column length, particle size, flow rate, etc.).

Retention

1. (GC/LC) Predict the effect of a change in conditions on relative retention (e.g., change in stationary phase, mobile phase, flow rate, etc.).
2. (GC/LC) Use chemical and physical reasoning to explain the basis of retention, given a specific scenario (e.g., why is benzyl alcohol less retained than benzene in RPLC?).

Peak Broadening

1. (GC/LC) Predict the effect of a change in conditions (e.g., mobile phase type, temperature, particle size, etc.) on peak properties (e.g., height, width, retention time).
2. (GC/LC) Use chemical and physical reasoning to explain the basis of peak broadening, given a specific scenario (e.g., why is the peak for anthracene broader than the peak for benzene under RPLC conditions?).

Objectives for our Discussion of Mass Spectrometry

1. Be able to discuss the physical principles that underlie the operation of different types of mass spectrometers.
2. Identify and justify an appropriate mass spectrometric technique for a given application. As part of this, one must identify and discuss differences between different:
    a. Ionization methods
    b. Mass Analyzers
3. Become conversant with important terms such as: monoisotopic mass, accurate mass, resolution, and resolving power

Some objectives for our adventure in spectroscopy

1. Appreciate and be able to describe the unique utility of different spectroscopic methods. For example, what does IR tell us about an analyte, qualitatively, that UV/Vis does not? How do these techniques differ from a quantitative perspective?
2. Appreciate and be able to describe the physical working principles of different instrument components. For example, as a light source, how is a laser fundamentally different from a deuterium lamp, and what theoretical and practical consequences do these differences have?
3. Be able to explain why we do what we do the way we do it, with respect to spectroscopic measurements. For example, why do we like to work with absorbance values less than 1 when working with absorbance techniques? Under what circumstances would we use a slit width of 10 nm? How about 0.5 nm?

Some objectives for our study of electronics and signal processing…

1. Be able to define 'the four laws' and apply them to explain the behavior of an electrical circuit (Power Law, Ohm's Law, and Kirchoff's Current and Voltage Laws)
2. Be able to explain, in quantitative terms, the problems that arise in measuring small currents and voltages in instrumentation
3. Be able to explain the valuable characteristics of operational amplifiers for use in instrumentation, and describe the specific circuits used for current and voltage measurements
4. Be able to describe circuits used for signal processing in the analog domain, and predict their behavior in quantitative terms
5. Be able to describe approaches used for signal processing in the digital domain, and prescribe a particular approach when presented with a real instrument signal
6. Be able to describe the characteristics of an analog-to-digital converter, in quantitative terms
7. Be able to describe the concept of Fourier analysis, by showing the relationships between a raw analog signal, a power spectrum, and a reconstructed signal produced using an inverse Fourier transform

Some objectives for our study of electrochemistry…

1. Be able to draw a simple electrochemical cell (e.g., Cu and Ag) and predict which species will be reduced/oxidized using thermodynamics to support your argument
2. Be able to discuss the significance of the Nernst equation in instrumental methods
3. Be able to discuss the differences and similarities between the four main electroanalytical methods
4. Be able to explain the utility of amperometry as a tool for both qualitative and quantitative analysis
5. Be able to discuss the origin of the membrane potential in the case of potentiometry (ion-selective electrodes)