

Multiple choice questions are worth 4 pts each
Short answer questions are worth 8 pts each

- In UV absorption spectroscopy, which of the following statements are true?
 - $\sigma \rightarrow \sigma^*$ transitions are lower in energy than $\pi \rightarrow \pi^*$ transitions
 - A conjugated systems of double bonds in a molecular shifts the a absorption maxima to higher wavelengths
 - $\sigma \rightarrow \sigma^*$ transitions are higher in energy than $\pi \rightarrow \pi^*$ transitions
 - B and C
- Fourier transform is
 - a mathematical function
 - used to convert from the time domain to the frequency domain
 - used in many modern analytical techniques, such as IR and NMR
 - all of the above
- The function of the Michaelson interferometer in an FT-IR instrument is to
 - perform the FT
 - increase the sensitivity
 - speed up the acquisition time
 - modulate the interference patterns of the light beam from the source
- FT-IR is used mostly for
 - quantification of organic molecules
 - functional group analysis of organic molecules
 - heavy metal analysis
 - molecular weight determination
- Which of the following techniques is *least* useful for structural determination of small organics
 - UV spectroscopy
 - NMR
 - GC-MS
 - FT-IR

6. In NMR sensitivity is determined by the
- A) Magnetogyric ratio of the nuclei being measured
 - B) magnetic field strength
 - C) natural isotopic abundance of the nuclei being measured
 - D) All of the above
7. As compared to ^1H NMR experiments, ^{13}C NMR experiments generally take longer to acquire useful spectra because
- A) the ^1H decoupler is used
 - B) the ^{13}C precessing frequencies cover a broader range of energies
 - C) more signal averaging is needed on the account of lower ^{13}C sensitivity
 - D) B and C
8. How many equivalent "NMR" protons are in butanoic acid?
- A) 8
 - B) 2
 - C) 6
 - D) 4
9. The main advantage of fluorescence over UV-vis spectroscopy is
- A) its sensitivity
 - B) its compatibility with separation techniques
 - C) that emission spectra give fairly sharp peaks
 - D) its compatibility with most analytes
10. Select the true statement about fluorescence spectroscopy of molecules in the UV-visible region
- A) Emission usually occurs at a broad range of energies that are greater than the energies of excitation
 - B) Emission usually occurs at a broad range of energies that are less than the energies of excitation
 - C) Generally, most of the emission comes from resonance fluorescence at the exact wavelength of excitation
 - D) None of the above are accurate

11. Fluorescence probes
- A) are highly fluorescent reagents that are designed to bind strongly and specifically to certain targets
 - B) are the basis of many very sensitive assays developed biological molecules of interest
 - C) enable the use of fluorescence for the detection of molecules that are not fluorescent
 - D) all of the above

Short Answer Problems

1. Why is it necessary to use quartz cuvetts in the UV region, but less expensive glass or plastic cuvetts are acceptable in the visible region? Why are salt (NaCl or KBr) plates used to hold the sample in FT-IR applications?

5. Why can't GC be used to separate involatile mixtures (such as protein digests)?
12. In GC, retention depends upon the
- A) vapor pressure and polarity of the solute
 - B) size and charge of the solute
 - C) the method of sample introduction
 - D) the type of detector used
13. If the optimal flow rate for a 2.0 mm ID RP-HPLC column is 250 $\mu\text{L}/\text{min}$, which of the following flow rates would be appropriate for use with a 1.0 mm ID version of the same column?
- A) 5 $\mu\text{L}/\text{min}$
 - B) 250 $\mu\text{L}/\text{min}$
 - C) 60 $\mu\text{L}/\text{min}$
 - D) 1 ml/min
14. Which of the following is not an advantage of HPLC over GC?
- A) more versatile in adjusting separation parameters
 - B) a greater number of theoretical plates
 - C) applicable to wider range of analytes
 - D) none of the above
15. The main advantage of the mass spectrometer over the flame ionization detector as a GC detector is
- A) dynamic range
 - B) rate at which data is acquired
 - C) compound identification through library matching
 - D) sensitivity

