

- 10) (3 pts) Using smaller diameter HPLC columns can
- a) provide improvements in sensitivity
 - b) cause overloading problems
 - c) decrease separation efficiency
 - d) a) and b)
- 11) When size-exclusion chromatography is used to separate complex mixtures of proteins the smaller proteins tend to elute from the column before the larger proteins. (True or False) (3 pts)
- 12) Why is electroosmotic flow in capillary electrophoresis pH dependent? (3 pts)
- 13) Why do GC columns typically contain more theoretical plates than HPLC columns even though H values for GC are generally much larger. (3 pts)

14) The ideal flow rate for a C18 reverse column having an internal diameter of 4.6 mm is 1.2 ml/min. Calculate the ideal flow for a 100 μm ID column packed with the same stationary phase. (3 pts)

15) Which type of radiation is appropriate for probing the following chemical phenomena?

Types of radiation: radio waves, X-rays, IR, UV, visible, microwave

- a) Outer electrons energy levels
- b) Rotational motion of molecules
- c) Nuclear spin states
- d) Vibrational motion of molecules
- e) Inner shell electron energy levels
- f) d-orbital splitting in transition metals

16) Match the technique(s) to the type of information that obtained. (8 pts)

UV/vis	functional group analysis
FT-IR/microwave	elemental composition
NMR	general quantification
X-ray spectroscopy	structural analysis of molecules

- 17) GC-MS is often described as a 2-D technique. Explain! What are the two dimensions?(3)
- 18) For what type of samples must an experimenter use HPLC instead of GC? (3).
- 19) What is the advantage of using a Z-shaped UV detector in conjunction with HPLC?(3)
- 20) On a bare fused silica column toward which electrode is the electroosmotic flow flowing? Does the electrophoretic velocity of a negatively charged ion flow with or against the electroosmotic flow if an uncoated silica capillary is used?(3)
- 21) At what velocity do neutral species flow in a standard capillary electrophoresis separation?(3)

- 22) Describe the terms that make up the Van Deemter Equation?
Which term is dominant in GC?
Which is/are dominant in HPLC?
Which is dominant in CE? And why? (5)
- 23) For what reason might one try to use an HPLC column packed with smaller ID particles and how does this relate to the Van Deemter Eq.(3)
- 24) Is UV spectroscopy useful for identifying unknown organic compounds?
Why or why not? (3)
- 25) In an FT-IR experiment what is the purpose (function) of the Michelson interferometer? (3)

- 26) (In FT-NMR) In response to an RF pulse the nuclei bunch together and begin to nuclei to precess in the plane of the RF coil in phase. The nuclei quickly begin to spread out (become unbunched)!!! Why? (3)
- 27) In fluorescence spectroscopy, why are the energies of the emitting photons less than the energies of the absorbing photons? You may draw an energy level diagram! On the same axis draw typical excitation and emission spectra for a fluorescent molecule. (5)
- 28) Why is fluorescence generally a more sensitive technique than UV absorption? (3)
- 29) How does a monochromater work? What is its function? Why do we need to use a monochromatic light source? (5)