Name:_____

1. Draw box diagrams of the following instruments and suggest appropriate components for the source, wavelength dispersion, and detectors, as requested.
    a. (10 pts) Flame Atomic Absorption

source	Wavelength selection	detector

(5 pts) Draw an example output voltage as a function of time under a variety of conditions: sample, no sample, only flame.

    b. (10 pts) Double beam in time UV-Vis

source	Wavelength selection	detector

2. (15 pts) Diagram. label, and describe EITHER: the mass Spectrometer of your choice or a Fourier Transform Infrared Spectrometer.

   a. (5 pts) What are the four main components of an MS instrument?

   b. (5 pts) What is the output signal of an FT-IR before the fourier transform is applied? Draw an example and label the axis.

3. (20 pts, 10 pts each) Diagram **two** of the following and describe what they are used for and how each works: a chaneltron, a PMT, an HCL, a monochromator, or an HPLC column.

4. (5 pts) Why is the difference between molecular and atomic spectroscopies? What gives rise to this difference?

(20 pts) Draw, label and explain a Jablonski diagram. Include nonradiative decay, fluorescence, phosphorescence, internal conversion, and intersystem crossing. Also be sure to label the electronic and vibrational energy levels.

5. (20 pts, 5 pts each) Describe each of the following possible interactions between light and matter in terms of the laws governing the phenomena

Phenomena	Description	Law
Transmission		---
Refraction		
Diffraction		
Polarization		---

6. (20 pts) Consider experimental error
(3 pts) Define Random error

(3 pts) Define Systematic error

(4 pts) List at least four ways you can assess your method for systematic error

(3 pts) Describe the random and systematic sources or error in the procedures described below. Four consecutive 20 μl injections of a standard into a Capillary Electrophoresis yielded peak values of 50.4, 52.7, 49.8, 52.3.

(3 pts) Calibration checks of your 750 μS cm^{-1} standard for a field electrical conductivity meter yields consecutive readings, taken at 2 hr intervals during the day, of 753, 749, 735, 727, 711 μS cm^{-1}.

(4 pts) Make up an example similar to the two above and describe if the error is systematic or random or both.

7. (40 pts, 8 each) Select an object from the front of the room. Create 5 specific questions relating to the analysis of specific components of your object. Then describe your strategy for answering each question. Be specific about which instruments you might use for what purposes.

OBJECT:

8. (25 pts) A 5.00 mL aliquot is taken from a 25 mL sample of blood was treated with trichloroacetic acid to precipitate proteins. After centrifugation, the resulting solution was brought to pH 3 and extracted with two 5 mL portions of methyl isobutyl ketone containing the organic lead- complexing agend APCD. The extract was aspirated directly into an air/acetylene flame and yielded an absorbance of 0.502 at 283.3 nm. Next, 5 ml aliquots of standard solutions containing 0.400 and 0.600 ppm lead were treated in the same way and yielded absorbances of 0.396 and 0.599, respectively. Calculate the lead in parts per million in the original sample assuming Beer's law is followed.