Spectroscopy Worksheet
CHEM 212

1. Define spectroscopy

Properties of electromagnetic radiation

2. State the relationship and value of any constants relating the wavelength and frequency of electromagnetic radiation.

3. State the relationship and value of any constants relating the wavelength and energy of electromagnetic radiation.

4. Fill in the table below for the general properties of light of different wavelengths

EM radiation	Wavelength range	Frequency range	Energy range	Atomic or molecular transitions	Instruments
Radio					
Microwave					
Infra-red					
Visible					
Ultra violet					
X-rays					
Gamma Rays					

Beer's Law

5. Draw a basic diagram of spectroscopic measurements

6. State the relationship between transmission and absorbance

7. State Beer's Law and define each variable (include units)

8. State the optimal range of Absorbance for Beer's Law measurements.

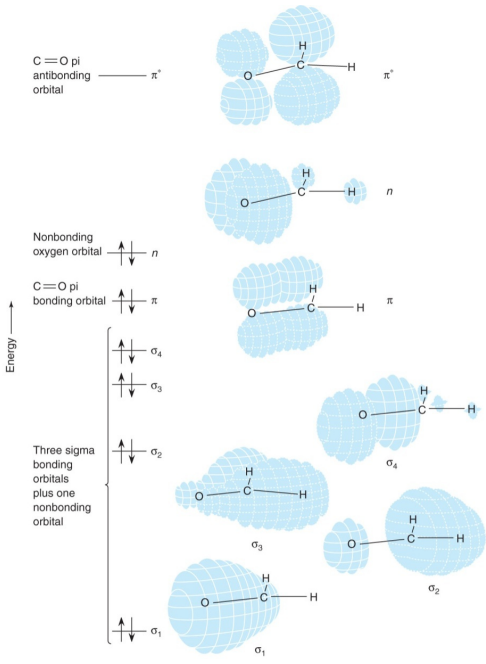
9. Limitations of Beer's Law. State, explain, and describe how the six sources of potential error in Beer's Law measurements are minimized or avoided

Source of error	Explanation and how to avoid improper measurements

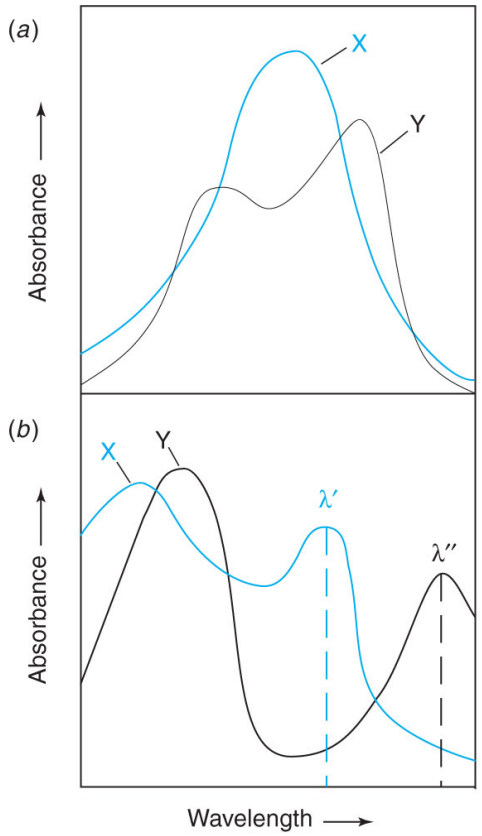
10. Draw, label, and explain a Jablonski diagram (figure 17-15). Label S0, S1, T1 states, absorption, fluorescence, and phosphorescence processes, and internal conversion and intersystem crossing.

Molecular Spectroscopy

11. Label the orbitals populated in the S0 and S1 states. What is the difference between the S1 and T1 states? (Figure 17-12)



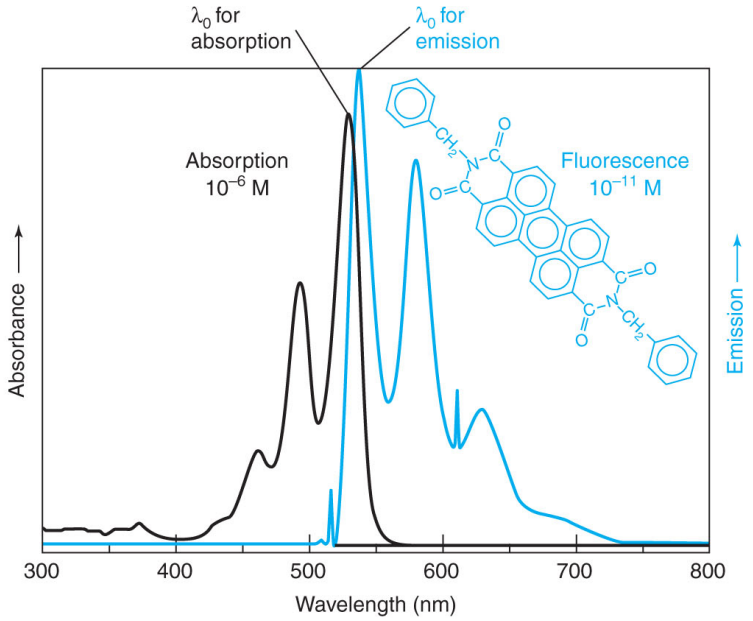
12. Describe how you would quantify X and Y in these spectra (Figure 18-1).



Fluoresence Spectroscopy

13. What transitions (from Q 10) are probed using a florimeter?

14. Describe why the absorption and emission spectra appear as mirror images of each other.



15. Why is luminescence always more sensitive than absorption measurements?

Instrumentation

16. Diagram a monochromator. How does a monochromator produce monochromatic light?

17. Diagram a photomultiplier tube. How does it work?

18. What transitions are probed using a UV-Vis spectrometer?

19. Diagram, label and describe a single beam UV-Vis spectrometer

20. Diagram, label and describe a double beam UV-Vis spectrometer

21. Diagram, label and describe a photo-diode array UV-Vis spectrometer

22. Diagram, label and describe a florimeter

FT-IR

23. Diagram, label and explain an FT-IR

24. What is an interferogram?

25. Describe how a fourier transform works

Noise

26. State the equation relating signal and noise

27. If you want a 4x reduction in noise, how many scans do you need? If the S/N is 2.3 after 6 scans?

Atomic Spectroscopy

28. What phenomena gives rise to atomic spectroscopy?

29. Diagram, label, and describe an Atomic Emission instrument

30. Diagram, label, and describe an Atomic Absorption instrument

31. Diagram, label, and describe an Atomic Fluoresence instrument

32. Why is the monochromator in the UV-Vis before the sample and in the atomic absorption after the flame?

33. Compare Molecular and Atomic Spectroscopy

	Molecular	Atomic
Transmission instrument		
Fluoresence instrument		
Normal peak width		