

**January 2017**

**Analytical Cumulative Exam**

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This exam covers fundamental aspects of molecular spectroscopy. There are seven questions, many have several parts. Answer them in a clear and concise manner.

1. Many spectroscopic methods used Fourier Transform (FT). (a) How does FT works? (b) What are the advantages of using an FT instrument?
2. (a) Describe three types of noise that can be encountered in an instrumental system. (b) What is the gain in signal as a result of number of measurements?
3. Draw a Jablonski Diagram and label all the appropriate processes.
4. The Beer-Lambert Law (commonly referred to as Beer's Law) describes the absorbance of light by a molecule. (a) Write the expression for absorbance as a relationship of light transmission. (b) Draw a diagram to explain how the measurement is obtained.
5. (a) A diffraction grating is used for what in spectroscopy experiments? (b) Draw a diffraction grating and label all parts. (c) Bragg's law is used to describe the phenomena of diffraction gratings. Write out Bragg's law.
6. Draw and describe how a chopper works.
7. Consider the molecule carbon dioxide. (a) How many possible modes of vibration are there? (b) Draw the two modes that result in being IR active.