DAY LABORATORY EXERCISE:
SPECTROSCOPY

Name_____ TA's Initials:_____

Class/Section: _____ Date due:_____

Procedure -

1. Your teaching assistant will explain the use of the spectrometers and how to record data on the graphs provided. View the fluorescent lights with your spectroscopes to see the green lines.

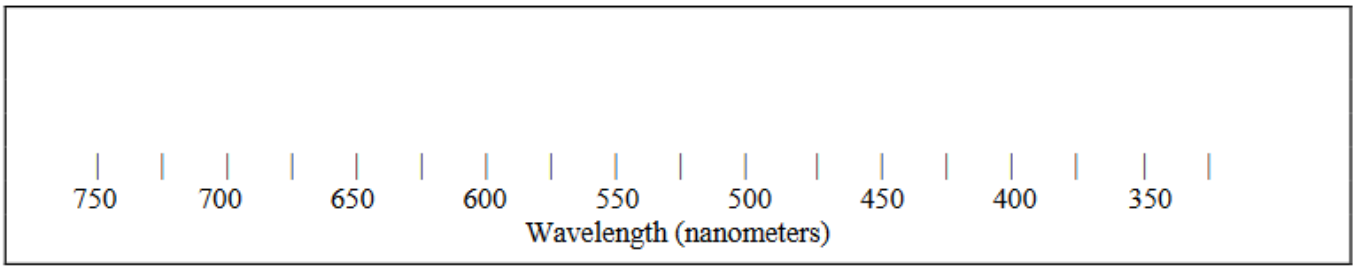
2. Set-Up #1 (Kirchoff's First Law) - use the spectrometers to view an illuminated light bulb. Record the brightness ("A" value) and peak wavelength ("B" value) for a series of variac power levels supplying electricity to the light.

3. Set-Up #2 (Kirchoff's Second Law) - use the spectrometers to view all of the different element discharge tubes. Record the spectral features seen by the spectrometers as to position and color. These will become templates for identifying an unknown mixture of gases. View the unknown gas with your spectrometer, again accurately recording the positions and colors of the spectral features you see.

4. Set-Up #3 (Kirchoff's Third Law) - use the spectrometers to investigate the absorption spectrum of some common solutions and solids. View the daytime sky with the spectrometers to explore the solar spectrum.

1. Spectrometer Orientation and Practice

- Use your spectrometer to view the fluorescent lights in the ceiling. Record what you see in the spectrum window in the space provided below. Please be accurate as to the positions, colors, and relative brightness of the features you see.



2. Set-Up #1 (Kirchoff's First Law)

- Set up an incandescent light bulb and variac inside a dark box. Turn on the spectrometer and position the fiber opening about 6 inches from the bulb. Move the fiber opening direction around to find the best position to record a strong spectrum. Find a way to secure the fiber so that it does not move for the rest of the experiment.

- For a series of variac settings, collect a spectrum, stop data collection, and record the A and B values of the spectrum intensity and peak wavelength. Use the table below as an aid.

Variac Setting (30-100)	Spectrum Brightness ("A" value from fit)	Peak Emission Wavelength ("B" value from fit)

The peak emission wavelength is related to the temperature of the source by: $\lambda_{peak} = \frac{2.897 \cdot 10^{-3}\ m \cdot K}{T}$

- Describe the brightness, color, and temperature of the light bulb at a variac setting of 30

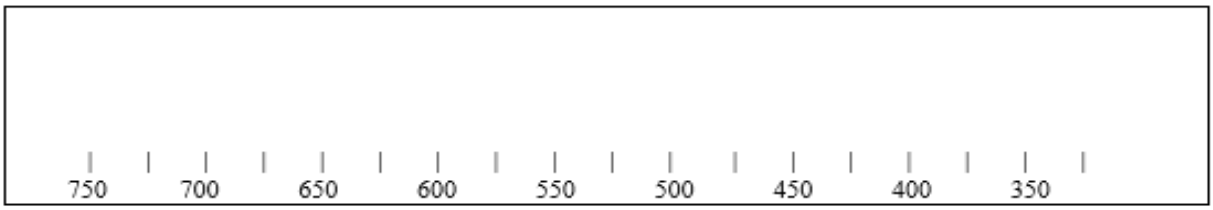
- For a variac setting of 100, describe the brightness and color of the light bulb. Predict the temperature of the light bulb.

- In the box below, sketch two lines – one line representing the brightness of the spectrum as a function of variac power to the light bulb, and one line representing the peak wavelength as a function of variac power. (Label or color the lines to distinguish them.)

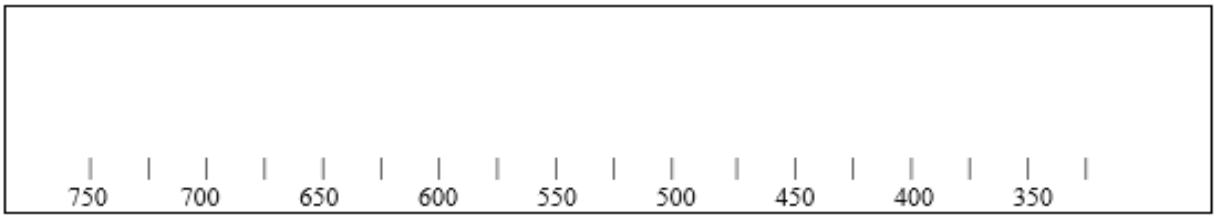
3. Set-Up #2 (Kirchoff's Second Law):

- Examine the spectrum emerging from the "unknown" box to gain a sense of the complexity of emission lines in the unknown.
- Use your spectrometer to view five different element discharge tubes. Accurately render the spectral features of each element using the colored pencils. Pay highest attention to the wavelengths, numbers, colors, and relative brightness of the spectral features.

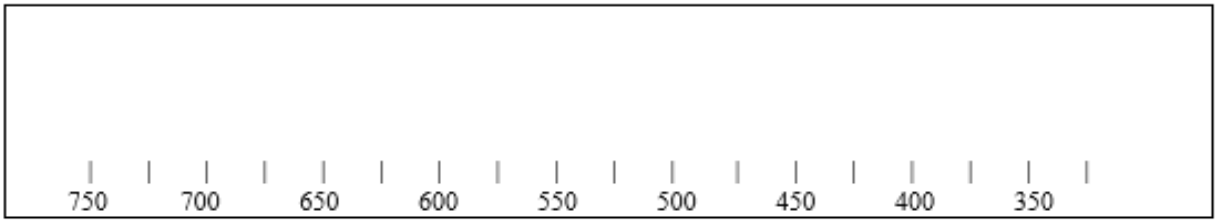
1. Element Hydrogen Overall color of discharge tube _____



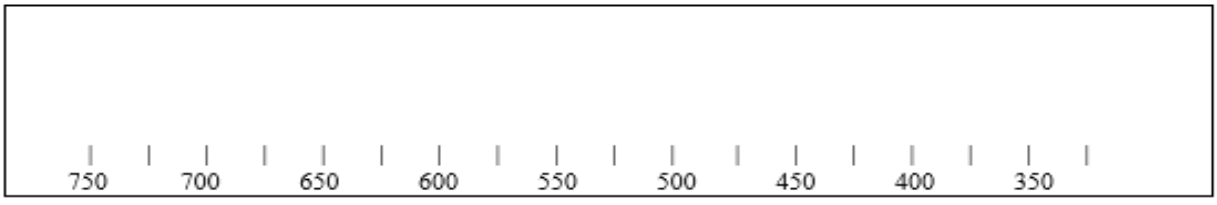
2. Element Helium Overall color of discharge tube _____



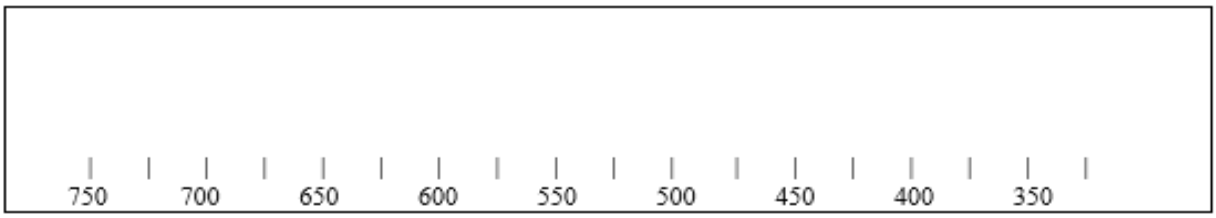
3. Element Neon Overall color of discharge tube _____



4. Element CO_2 Overall color of discharge tube _____



5. Next, use the spectroscope provided to view the gas in the box labeled "Unknown #1". Record the spectrum:



What elements (up to two) do you think are present in this unknown gas sample? What do you base your conclusions on?

Element #1 _____ Basis of Assignment = _____

Element #2 _____ Basis of Assignment = _____

- Use your spectroscope to view another two discharge tubes. Do not draw the spectra, instead describe the features that distinguish each spectrum.

1. Element _____ Overall color of discharge tube _____

Distinguishing Features:

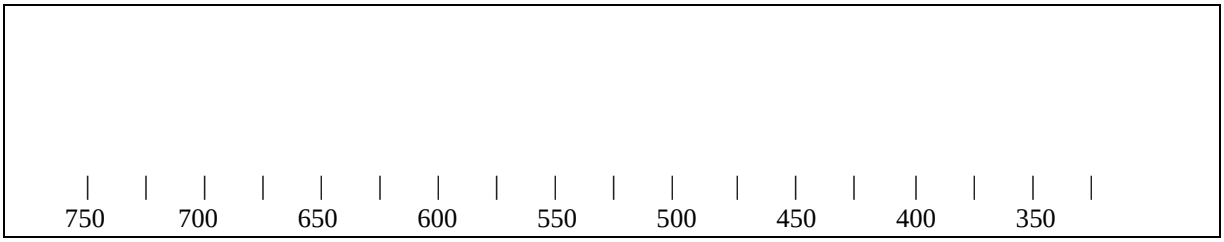
2. Element _____ Overall color of discharge tube _____

Distinguishing Features:

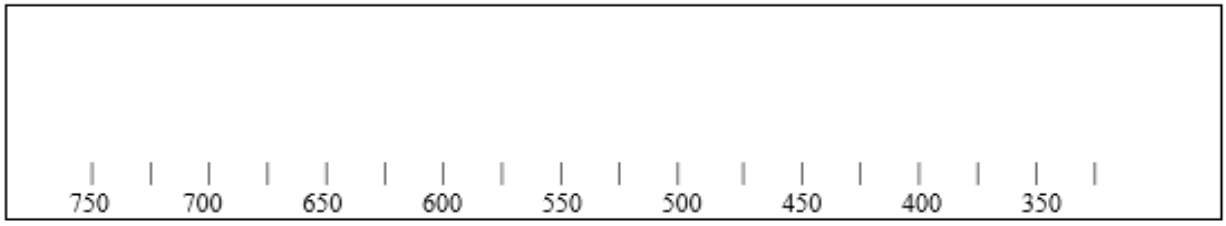
4. Station 3 (Kirchoff's Third Law)

- Set up your spectrometer to view the spectra of the light bulb from about 6 inches away.
- While collecting spectra data, put each liquid solutions and transparent solid in the light beam and notice the changes to the spectra.

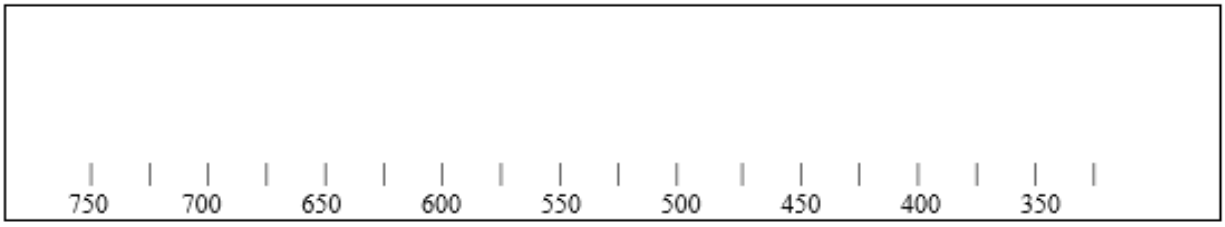
1. Liquid/Solid Type _____ Overall color _____



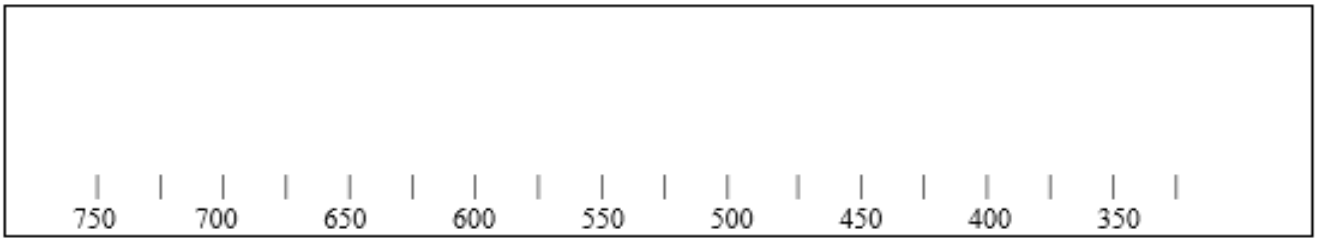
2. Liquid/Solid Type _____ Overall color _____



3. Liquid/Solid Type _____ Overall color _____

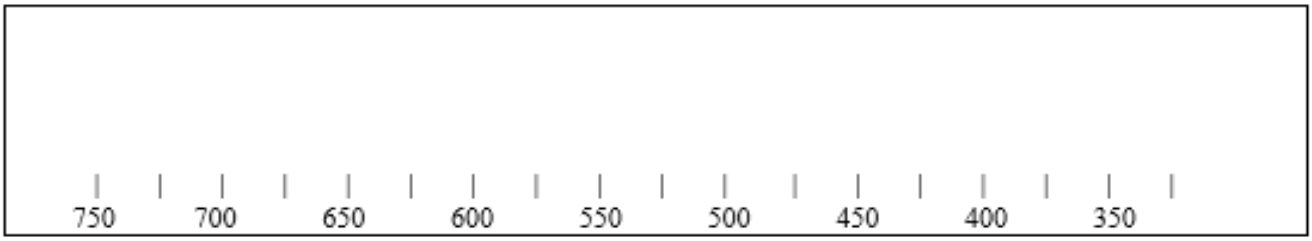


5. Next, view the absorption spectrum for "Unknown #2" sketch it below:



What are the constituents (up to two) of Unknown #2 and what is your reasoning?

6. Use your spectrometer to view the daytime blue sky. Record what you see below, using a black pencil to mark absorption line locations.



Next, using one of the wavelength tables or charts provided, match up the strongest spectral features seen in the solar spectrum with known elements.

Wavelength of Absorption Line = _____ Element _____

Wavelength of Absorption Line = _____ Element _____

Wavelength of Absorption Line = _____ Element _____

Wavelength of Absorption Line = _____ Element _____

Wavelength of Absorption Line = _____ Element _____

Wavelength of Absorption Line = _____ Element _____

Summary Questions:

Use the data you have collected and your understanding of the concepts to answer the following questions:

1. What can you infer about the relationship between the temperature of the emitting material and the color of the light emitted? (In Station 1, temperature increases with the variac power setting.)

2. In the Orion constellation, the star Betelgeuse appears to be red, while another star in the constellation, Rigel, appears noticeably bluer. What can you say about the temperatures of these two stars?

3. What kind of spectrum would you expect to see from the atmosphere of a star by looking in optical wavelengths?

4. Why does the hot Sun show absorption lines?

5. The Sun's corona shows emission lines. Why?