NAME: **HONORS CHEMISTRY**

SECTION: Lab: Spectra of the Elements

The information we use to understand and interpret the structure of atoms and the arrangement of electrons in atoms comes from many complex experiments. Visible light given off by excited (or energized) elements is one of the most useful sources of information. In this experiment, you will be looking for the relationship between color and electronic states by looking at a number of flame tests and use this information to identify two unknowns. We will then make quantitative observations of light emitted by several elements when they are energized by high voltage electricity, using a simulation. You will then apply what you learn to a practical situation.

Objectives

- Make qualitative observations of atomic emission
- Use the observations to determine the identities of one or more unknown metals
- To relate the chemistry of atomic structures to situations from everyday life

Roles Record the names, and make sure this information is included in your lab report.

Project Manager _____
- Reads directions, keeps track of time, keeps group on task

Quality Control Manager _____
- Monitors data collection, checks calculations, checks data quality

Materials Manager _____
- Gets and returns materials, supervises sharing of materials

Materials

Bunsen burner
wooden splints
0.1 M sodium nitrate solution
0.1 M potassium nitrate solution
0.1 M calcium nitrate solution
0.1 M barium nitrate solution
0.1 M strontium nitrate solution
0.1 M lithium nitrate solution
0.1 M copper (II) nitrate solution
square of cobalt blue glass
unknown solution A
unknown solution B
tongs

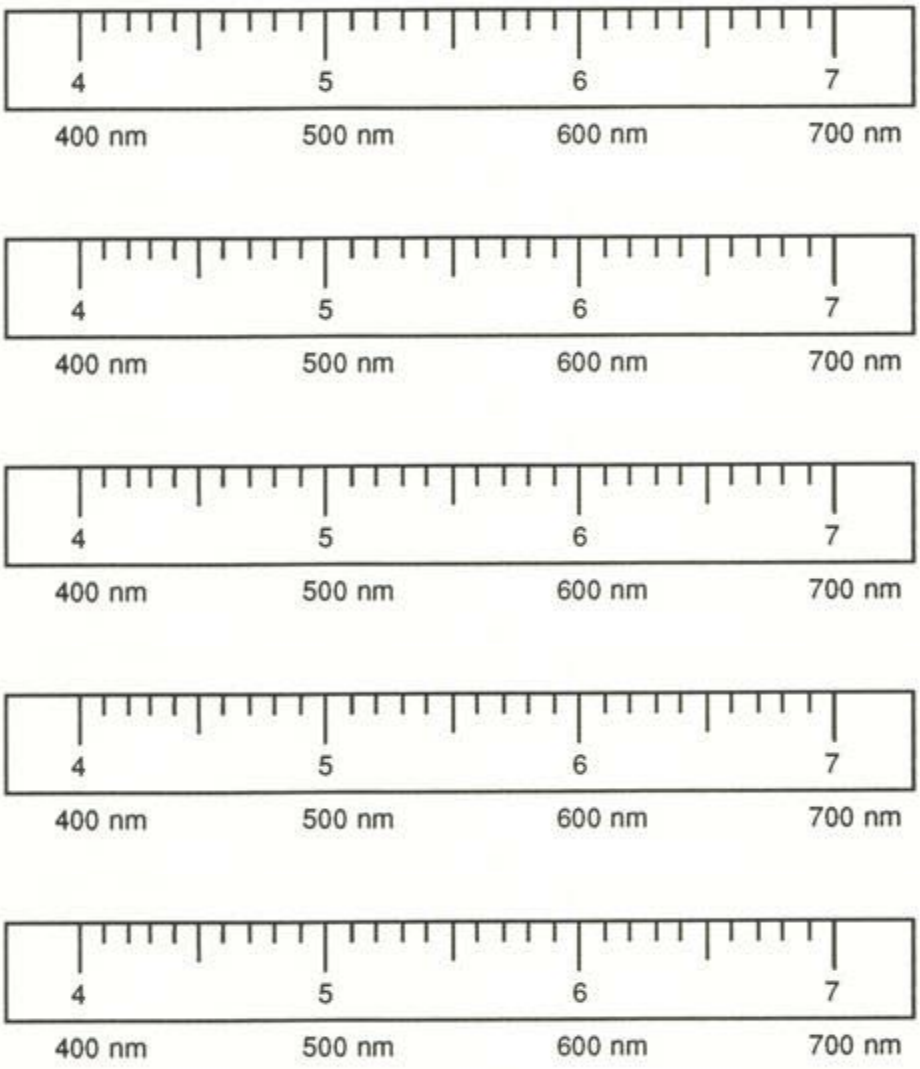
Procedure

Part I (In lab)

1. Read through the entire procedure carefully.
2. Create an appropriate data table in your notebook. Make sure your instructor approves your table.
3. Set up a Bunsen burner. Your instructor will demonstrate how to light the burner and adjust the flame correctly.
4. For each metal ion to be tested, use tongs to take a wooden splint that has been soaked in a solution containing the metal ion.
5. Hold the splint in the hottest part of the burner flame, but do not burn the splint. Record the burst of color observed in your data table. Place the used splint in the designated waste container.
6. Repeat the flame tests for sodium and potassium ions, and observe the colors through a piece of cobalt glass. (Cobalt glass filters out bright yellow light.)
7. The colors observed are characteristic of the various elements and can be used to identify samples of unknown ions. Use steps 4-6 to observe the flame test of unknowns A and B and identify them by their colors.

Part II (at home)

Go to http://people.westminstercollege.edu/faculty/ccline/elements/elements1.html (you may need to update your Java or change your security settings) These are simulations of the data that would be viewed through a spectrometer. Record emission spectra, using crayons or colored pencils, for at least 4 elements that show lines in the visible region. Identify the element for each spectrum. You may attach this page to your lab report.



Observations: Toggle back and forth between the emission spectra and absorption spectra. What is the difference between the (bright line) emission spectra and the (black line) absorption spectra?

What is similar about them?

Analyze and Apply

Remember to answer these questions in complete sentences!

1. Why do the emission spectra (as seen in the simulation) have several spectral lines? Why are the spectra of two elements different?
2. What difference did the cobalt glass make in your data?
3. If an electron in a hydrogen atom changes from energy level 4 to level 2, it will emit a photon of light with energy (E) of 4.086×10^{-19} joules.
    a) Calculate the frequency of the light and its wavelength. Give the relevant equations and show all your work. Report your answers with appropriate sig figs and units.
    b) Estimate where this light would appear in the electromagnetic spectrum.
4. Go to http://www.learner.org/teacherslab/science/light/color/spectra/index.html and complete the activity on stellar spectra for at least 3 different stars. How are these spectra different from the results we gathered in lab? Describe the activity and *your results for at least **3** different stars*.
5. Do you think flame tests would be valuable for detecting metal ions present in a **mixture** of metal ions? Justify your answer.
6. Consider the following situation.
   Ms. Steinway, a worker in the Useful Chemical Company, is suing the company for injuries suffered during a chemical explosion in the factory. She claims that she was hurt when a potassium nitrate tank exploded due to inadequate safety measures undertaken by the company. Eyewitnesses to the explosion report that they saw a bright green flash of light.
   You are the chemical expert witness in court. You have to determine whether Ms. Steinway is telling the truth, using chemical evidence. Explain your claims.

Discuss the following topics in your conclusion:

- The identify of your unknowns from Part I; describe how you arrived at your answers
- Sources of error and ways to improve

For your *introduction*, be sure to include the following terms (underline each the first time it is used in your introduction):

Remember, you need to *explain* the relevant theory and background, so just mentioning the terms won't be sufficient! 10 sentence minimum!