WARD'S
FLAME TEST & SPECTRAL ANALYSIS LAB ACTIVITY
Student Investigation

Name: _____ Date: _____

BACKGROUND

When white light passes through a prism, it appears as a continuous band of colors ranging from violet to red. These bands of color are refered to as the **visible spectrum**. Scientists have discovered that each of these colors has a characteristics wavelength that can be measured using a **spectroscope**—an optical device that separates visible light into its component wavelengths. When individual elements are supplied with enough energy (often in the form of heat or electricity), they give off light that appears as a series of colored lines when viewed through a spectroscope. This is called a **bright-line spectra**, and no two elements produce the same pattern. Using this property, we can often determine the element present in an unknown substance by observing its bright-line spectra.

MATERIALS REQUIRED (per student/group)

1 Hand-held spectroscope
4 Nichrome wire loops
1 Sample each of 4 different metallic salts (sodium chloride, calcium chloride, strontium chloride, potassium chloride)
1 Set of student copymasters
Bunsen burner or alcohol burner
Safety goggles
Color pencils (optional)
Water

PROCEDURE

In this activity, you will use a spectroscope to observe the bright-line spectra of four metal salts as they are ignited in an open flame. Make sure you are familiar with using the spectroscope and handling the chemicals and burner before starting. Follow all safety procedures, and check with your teacher if you have any questions.

A. Put on your safety goggles. Light the burner and adjust the flame to give a hot, blue color. Now take the spectroscope and look into the burner flame. Remember, the slit of the spectroscope should be vertical and pointed towards the flame. You should see a sharp spectrum displayed on the side wall of the tube. Rotate the eyepiece, if necessary, to position the spectrum on the side wall. Make sure each student in your lab group has an opportunity to view the flame.

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B. Locate the four vials containing the metal salts and the four nichrome wire loops. Be sure to use only one loop with each vial to avoid contamination. You may wish to label the loops with masking tape to keep from mixing them up during use.

C. Obtain a small cup or container of water you'll use to wet your nichrome loop.

D. Next, have one of your lab partners dip the nichrome loop into the water, and then into the vial containing the sodium chloride. The sample should stick to the loop and coat the wire with a small ball of material about 2mm across. If you are unable to get a sufficient sample to stick to the wire, try bending the loop into a smaller opening and wetting it again.

E. With the rest of your lab group viewing the flame with their spectroscopes, insert the nichrome loop coated with sodium chloride crystals into the burner flame. On the Data Sheet provided, have each person draw the bright-line spectra they see when viewing the glowing sodium chloride. Use colored pencils, or label the color of the bright lines you observe in their appropriate positions. Remember, the bright-line spectra appear as narrow, brighter bands in the full-color scale that you see. Now, trade places with one of your lab partners, and repeat the process so that everyone has a chance to make their observations.

F. Repeat Steps D & E with the samples of potassium chloride, strontium chloride, and calcium chloride. Make sure to use a clean nichrome wire loop with each sample. Draw the bright-line spectra you observe for each salt in the space provided on your Data Sheet.

G. Once you have completed these steps, obtain a sample of an unkown salt from your teacher. Perform Steps D & E once again, and record the bright-line spectrum for this sample on your Data Sheet. Compare the pattern to the other known salts.

QUESTIONS

1. From your observations, how do the bright-line spectra of the samples tested differ?

2. What color appears at the far left end of the visible spectrum? What color do you see at the far right end?

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3. Describe the visible flame color you observed after inserting each of the Seven salts into the burner flame. How did this compare to the bright-line spectra you recorded?

4. How does the spectrum of the unkown salt compare to the spectra of the four known samples? What element does it most likely contain?

5. Why was it necessary to use a separate nichrome wire loop for each sample? How might using a single wire loop for all tests change your results?

6. What do stars and your glowing samples have in common?

7. Stars, like our Sun, emit large amounts of radiant energy. How might astronomers determine the temperature and composition of stars using a spectroscope?

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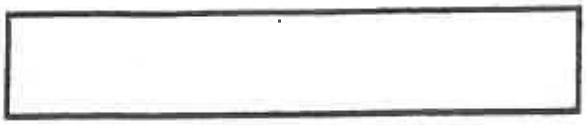
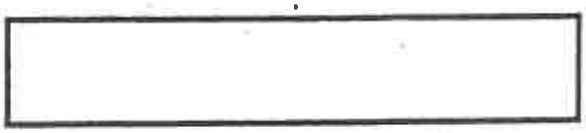
DATA SHEET

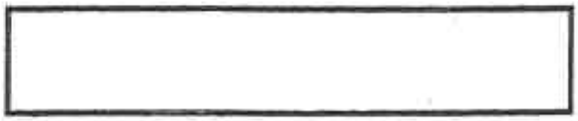


Spectrum of Sodium Chloride

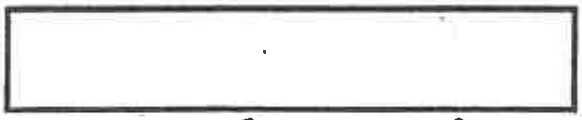
Spectrum of Potassium Chloride



Spectrum of Strontium Chloride

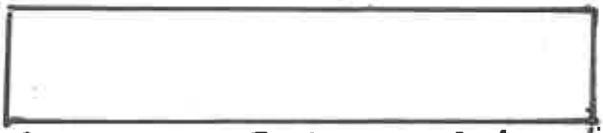


Spectrum of Calcium Chloride



Spectrum of Copper Chloride

Spectrum of Copper Sulfate



Spectrum of Cobalt Chloride