

Lab #2: Flame Tests and Emission Spectrums

Objectives:

1. To examine the light emitted by various elements when heated.
2. To study the spectral lines of various elements in emission spectroscopy.

Pre-lab:

Using scientific principles you have learned in this course, explain why when materials are heated, their elements emit specific colours of light.

Materials:

Lighter or Matches	Spectrum Tube Power Supply	Calcium Nitrate ($\text{Ca}(\text{NO}_3)_2$)
Metal Spatulas	Gas Discharge Tubes (H_2 , Hg, He, O_2)	Strontium Nitrate ($\text{Sr}(\text{NO}_3)_2$)
Handheld Spectroscopes	Lithium Nitrate (LiNO_3)	Barium Nitrate ($\text{Ba}(\text{NO}_3)_2$)
Coloured Pencils or Crayons	Sodium Nitrate (NaNO_3)	Copper (II) Nitrate ($\text{Cu}(\text{NO}_3)_2$)
8 Pyrex Petri-Dishes	Potassium Nitrate (KNO_3)	Methanol (CH_3OH)

Procedure:

A. Flame Tests:

1. Using a spatula, place a small amount of various ionic compounds into separate Pyrex petri-dish except one.
2. Add the methanol into the dishes. Try to dissolve the some of compounds.
3. Light a match and ignite the methanol.
4. Wait a few minutes and record the colour of the flame.

B. Emission Spectroscopy:

1. Make sure the spectrum tube power supply switch is at the OFF position and unplugged.
2. Place one of the gas discharge tube into the power supply. Plug in socket and turn switch ON.
3. In a dark room, observe the light emitted from the gas discharge tube using the handheld spectroscopes.
4. Record the colour and the positions (wavelengths between 350 to 750 nm) of the lines.
5. Repeat step 1 to 4 using other gas discharge tubes.

Observations:

Part A: Flame Tests

Compound	Colour
CH_3OH Methanol (Reference)	
LiNO_3 Lithium Nitrate	
NaNO_3 Sodium Nitrate	
KNO_3 Potassium Nitrate	
$\text{Ca}(\text{NO}_3)_2$ Calcium Nitrate	
$\text{Sr}(\text{NO}_3)_2$ Strontium Nitrate	
$\text{Ba}(\text{NO}_3)_2$ Barium Nitrate	
$\text{Cu}(\text{NO}_3)_2$ Copper (II) Nitrate	

Part B: Emission Spectroscopy

Sketches of Line Spectrum								
Elements	750 nm	700 nm	650 nm	600 nm	550 nm	500 nm	450 nm	400 nm
H ₂ Hydrogen								
He Helium								
O ₂ Oxygen								
Hg Mercury								

Analysis:

1. In Part A, using the methanol flame colour as a reference, which of the metal elements in the ionic compounds produced the most easily identified colour? Which metal element is the hardest to identify? Explain your reasoning.
2. The energy of coloured light increased in the order of red, yellow, green, blue, indigo, and violet. List the metallic element in the flame tests in increasing order of the energy of light emitted.
3. Explain why in Part A of the experiment, we see one colour, and in Part B, we see a series of different coloured lines.

Evaluation:

Research on the Internet and answer the following questions.

1. Astronomers often use spectrosopes to determine the chemical makeup of a star millions of light years away. Explain how this may be accomplished.
2. Explain how the use of spectral analysis can determine whether a star is moving away or towards the Earth. What is this phenomenon called?
3. In this lab, we dealt with emission spectroscopy. Another type of spectroscopy is called adsorption spectroscopy. What is it and how does the absorption spectrum look like?
4. Besides astronomy, list two other uses for emission or absorption spectroscopy.

Conclusion:

Summarize what you have learned from this lab.