Ms. Randall
Regents Chemistry
Lab Activity: Flame Test

Background: When metals are heated, their valence electrons become excited and jump up to higher energy levels. These energized electrons are not stable at higher energy levels so they fall back down to their ground state energy level, giving off their extra energy as specific wavelength of light. As a result, metals impart characteristic colors to a flame. The flame test is used to visually determine the identity of an unknown metal or metalloid ion based on the characteristic color the salt turns the flame of a Bunsen burner. The heat of the flame excites the metals ions, causing them to emit visible light. The characteristic emission spectra can be used to differentiate between some elements.

Pre-Lab: Copy into your lab notebook and fill in the blanks.

When the atoms of metals in solution are excited by heating, their _____ are able to move from their _____state to an _____state. This high energy state is _____so the electrons return to ground state releasing _____. This energy corresponds to particular wavelengths of _____, and so produces particular _____ of light. Each element has its "fingerprint" in terms of its_____line emission spectrum.

Objective: To perform flame tests with a variety of metal compounds and identify unknowns based on these flame test results. You will be identifying the metals that exist as cations in solution.

Materials (*per group*):
Bunsen burner; beaker; metal solutions (barium, calcium, lithium, potassium, sodium, strontium); nichrome wire loop; hydrochloric acid; safety goggles; unknown solutions

Safety: In this lab, the solutions you will be using contain harmful materials. Avoid skin contact with these chemicals. Observe all precautions, especially the ones listed below.

Caution:

- Wear your safety goggles at all times.
- Hydrochloric acid is corrosive and can cause severe burns.
- Do not taste any of the substances or touch them with your hands.
- Do not touch the end of the wire loop used in the flame tests. This wire gets extremely hot and can cause severe burns. Do not hold the wire loop over the flame for an extended period of time.
- Return or dispose of all materials according to your teacher's instructions.

Procedure:
1. Read the labels on all of your beakers. Fill in Table 1 accordingly. Light your Bunsen burner.
2. Clean a nichrome wire loop by dipping it into the beaker of hydrochloric acid. Then hold the loop in the hottest part of the flame (at the tip of the cone) as shown below until it imparts very little color to the flame. If necessary repeat the procedure.
3. Dip the clean nichrome wire loop into one of the metal solutions. Place the tip of the loop in the hottest part of the flame as shown above.
4. Observe the color imparted to the flame by the metal solution. Record your observation in the data table 1 on the next page.
5. Repeat steps 2 through 4 of the procedure with each of the remaining metal solutions.
6. After you have completed your observations with each of the metal solutions, repeat steps 2 through 4 of the procedure with each of the unknown solutions.
7. Each of the unknown solutions contains one or more of the metal ions you examined above. Based on the color imparted to the flame, identify the metals present in each of the unknown solutions. Record the identity of the unknowns in the data table 2 below.

Table 1

Solution	***Metal cation***	***Flame Color***
Ex: Calcium chloride	Ca^{+2}	

Table 2

Sample	***Flame Color***	***Identity of cation***
Unknown 1		
Unknown 2		
Unknown 3		

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<u>Lab Conclusion:</u> Flame Test

1. Write a paragraph summarizing what you have learned about the scientific concept of the lab from doing the lab. Back up your statement with details from your lab experience.

2. Compared to an electron in the first electron shell of an atom, an electron in the third shell of the same atom has

A) less mass B) less energy
C) more mass D) more energy

3. **Base your answer to the following question on the information below.**
A fluorescent light tube contains a noble gas and a drop of mercury. When the fluorescent light operates, the Hg is a vapor and there are free-flowing Hg ions and electrons in the tube. The electrons collide with Hg atoms that then emit ultraviolet (UV) radiation. The inside of the tube is coated with a mixture of several compounds that absorbs UV radiation. Ions in the coating emit a blend of red, green, and blue light that together appears as white light. The compound that produces red light is Y_2O_3. The compound that produces green light is $CeMgAl_{11}O_{19}$. The compound that produces blue light is $BaMgAl_{10}O_{17}$. **Explain, in terms of *both* electrons and energy, how ions in the coating emit light.**

Base your answers to questions 4 and 5 on the information below

An atom in an excited state has an electron configuration of 2-7-2.

4. Explain, in terms of subatomic particles, why this excited atom is electrically neutral.

5. Write the electron configuration of this atom in the ground state.