**Flame Tests Lab**

*Use this worksheet as a guideline for the lab. Fill in the blanks and complete the chart of colors based on the video. You may also need to use the class notes to answer some of the ten (10) questions. Once completed, go to Study Place and complete the Test.*

**Learning Objective:**

Explain the movement of electrons between orbitals in an atom. Use the flame tests to identify substances.

Use the **Flame Tests Lab Video** to complete the worksheet below.

<http://somup.com/cqe2bonZ5o>

### **How Are the Fireworks Colors Made?**

Have you ever wondered how the beautiful colors of the fireworks are generated? Fireworks come in an array of colors from yellows and reds to blues and greens (**Figure 1**). The colors are produced by heating \_\_\_\_\_ salts. For example, sodium chloride (NaCl) burns \_\_\_\_\_, and calcium chloride (CaCl2) burns \_\_\_\_\_.

### **Electron States and Color**

Many elements and crystalline salts have a distinct color when burned over a flame. This color can be used to \_\_\_\_\_ a chemical compound (\_\_\_\_\_ property). The distinct color produced by each element is the result of the different \_\_\_\_\_ electrons in their specific \_\_\_\_\_.

The \_\_\_\_\_ state of an element is a specific electron arrangement that is the most energetically favorable. When an element is heated, the valence electrons \_\_\_\_\_ the energy from the heat, or become \_\_\_\_\_, and move to a \_\_\_\_\_ -energy orbital. Given that higher-energy orbitals are not \_\_\_\_\_, the excited electron quickly \_\_\_\_\_ to the ground state.

For example, sodium \_\_\_\_\_ has a 1s2 2s22p6 3s1 ground state \_\_\_\_\_ configuration. When sodium bonds ionically, its ground state electron configuration becomes 1s2 2s22p6 creating an overall \_\_\_ charge. When heated, electrons gain energy and can be \_\_\_\_\_ into a \_\_\_\_-energy level such as 4s as shown in **Figure 2**. Because this excited state is \_\_\_\_\_, the excited electron will drop back down to the ground state level and \_\_\_\_\_ energy as \_\_\_\_\_.

A **photon** of energy is given off as color so the sodium ion returns to the **ground state**.

One of the 2p electrons gets excited to 4s.

Sodium Ion Na+



**Figure 2. Sodium Ion Electron Configuration and Flame Color**

Electrons move from the \_\_\_\_\_ state to an \_\_\_\_\_ state when \_\_\_\_\_.

Depending on the amount of energy provided, more than \_\_\_\_\_ electron can be excited, and therefore more than one wavelength of light will be \_\_\_\_\_. It is common for ions to display \_\_\_\_\_ colors in their \_\_\_\_\_ spectra. In addition, the electron may not return all the way to the ground state, but to an \_\_\_\_\_ energy level. So, various wavelengths are possible from the same excited electron. The combination of the \_\_\_\_\_ emitted by an element gives the flame its \_\_\_\_\_.

The energy the valence electron absorbed when it was excited is re-emitted as a \_\_\_\_\_ of light. That photon has the \_\_\_\_\_, specific, \_\_\_\_\_ amount of energy needed to move that valence electron and thus has a particular \_\_\_\_\_. Therefore, the particular \_\_\_\_\_ emitted by an element or compound when it burns is caused by the particular wavelength of light emitted when its \_\_\_\_\_ electron moves from an \_\_\_\_\_ state to \_\_\_\_\_ state.

### **Limitations of the Flame Test**

Although the combinations of wavelengths of light emitted by each element are \_\_\_\_\_, the colors produced may be \_\_\_\_\_ enough that the naked eye may \_\_\_\_\_ be able to \_\_\_\_\_ similar colored ions from each other. Contaminants may also alter the color of the flame. For example, sodium is present in most compounds and will color the flame. A blue glass can filter out the yellow from sodium if necessary. Another limitation of the flame test is that it cannot detect very \_\_\_\_\_ concentrations of \_\_\_\_\_.

Use the **Flame Tests Lab Video** to complete the chart below.

<http://somup.com/cqe2bonZ5o>

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Ion | Li+ | Na+ | K+ | Ca+ | Sr+ |
| Color |  |  |  |  |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Ion | Ba+ | Cu+2 | Cu+1 | Unknown |
| Color |  |  |  |  |