Name: _____ Period: _____ Date: _____

1-4 Atomic Structure Lab – Activity Answers

Flame Tests – Identifying Metal Ions

Background and Theory

Chemists are often required to test samples to find out if they contain specific ions or compounds. This lab allows students to practice these techniques and identify the different metal ions.

When atoms are heated they become excited causing the electrons to jump into higher energy levels. These higher energy levels are less stable. As the electrons return back to their original positions, the energy is released as light energy. Group 1 elements in the periodic table are known as the alkali metals. They include lithium, sodium and potassium, which all react vigorously with air and water.

https://www.youtube.com/watch?v=MGUPKA_pOEE

Group 2 metals are known as the alkaline earth metals and include beryllium, barium, magnesium, calcium and strontium. Both groups one and two metals have a distinct flame color which allows us to identify the presence of a metal ion in a solid sample.

Curriculum Links:

- ***HS-PS1-1:*** Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.
- ***HS-PS1-2:*** Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.

Specific Learning Objectives:

1. Identify the positive ion in a substance.
2. Carry out an analytical test to identify metal ions.
3. Describe how electrons can move between energy levels.

Lab Part 1: Flame Tests for Metals

Pre-lab Questions:

1. Name the group one alkali metals
   Lithium, Sodium, Potassium, rubidium, cesium, and francium

2. Give the chemical formula for each of the IONS of the group one metals.
   Li^{+1}, Na^{+1}, K^{+1}, Rb^{+1}, Cs^{+1}, and Fr^{+1}

3. What do the group one metals have in common?
   Each metal has a lone electron in its outer (valence) shell which it gives away/donates during a chemical reaction.

Name: _____ Period: _____ Date: _____

1-4 Atomic Structure Lab – Activity Answers

4. Name the group two alkaline earth metals.
   Beryllium (Be), magnesium (Mg), calcium (Ca), strontium (Sr), barium (Ba), and radium (Ra)

5. Give the chemical formula for each of the IONS of the group two metals.
   Be^{+2}, Mg^{+2}, Ca^{+2}, Sr^{+2}, Ba^{+2}, and Ra^{+2}

6. What do the group two metals have in common?
   Each metal has two electrons in its outer (valence) shell which it gives away/donates during a chemical reaction.

Name: _____ Period: _____ Date: _____

1-4 Atomic Structure Lab – Activity Answers

Practical Activity:

You will need:

- Bunsen burners
- Flame test wires (one per two students)
- Hydrochloric acid
- Labelled solid samples of the metals you plan to test:
    - Copper chloride
    - Potassium iodide
    - Calcium chloride
    - Strontium chloride
    - Lithium chloride
    - Barium chloride
    - Sodium chloride
- Three mystery samples from the above list labelled 'W', 'X' and 'Y'

Method:

1. Dip a flame test wire into hydrochloric acid and then hold it in a blue Bunsen flame.
2. Dip the wire into a sample of the compound and place it into the edge of a blue Bunsen flame. The flame color produced indicates which metal ion is present in the compound.
3. Clean the wire loop and continue testing with other samples.

Name of Substance	Ion present	Flame color
Copper chloride	*Copper, Cu^{2+}*	*Blue-green with white flashes*
Potassium iodide	*Potassium, K^{+}*	*Violet*
Calcium chloride	*Calcium, Ca^{2+}*	*Orange-red*
Strontium chloride	*Strontium, Sr^{2+}*	*Crimson red*
Lithium chloride	*Lithium, Li^{+}*	*Red*
Barium chloride	*Barium, Ba^{2+}*	*Pale yellow-green*
Sodium chloride	*Sodium, Na^{+}*	*Yellow-Orange*

Lab Part 2: Identifying Unknown Samples

Students test each mystery sample and then identify them using their information they found in part one.