**Name**

**Pre-Lab Interactive Notes**

In this lab you will be using chemical reactions between the different forms of halogens in order to determine a group trend in an atomic property. Remember that atomic properties can only be measured for individual atoms in the gas phase. In this lab we will use a chemical reaction in solution (macroscopic view) to model what would happen if we could use the gas phase (molecular view).

***New Terms:***

Electron Affinity: The energy released when a neutral gaseous atom attracts an extra electron. Higher electron affinity = more attraction for the electron. In this lab we will be modeling electron affinity using bulk samples, rather than individual atoms.

Partitioning: The distribution of a solute between two *immiscible* solvents. A solute that can dissolve in both solvents will mostly go into the solvent it is best attracted to.

“Like dissolves like”: Ions are more attracted to polar solvents like water. Element molecules are more attracted to nonpolar solvents like oils or organic solvents.

**Procedural Concepts**

You will be studying three of the halogens: chlorine, bromine, and iodine. You will mix the molecular element forms with the ion forms to see which element will be the one to best attract the electron. By testing each halogen against the others, you will be able to rank them in terms of increasing or decreasing electron affinity. All of the halogen molecular elements and ions will be dissolved in water solutions so that they can move around and react with each other when you mix them. You will add an organic solvent (oil) that will stay separate from the water (oil floats on water). The halogen molecular element that is neutral will migrate out of the water and into the oil because it is more attracted to that than it is to water. The halogen in its ion form will stay dissolved in the water because it is more attracted to the water. Since each halogen turns a distinct color in the oil, we can use the color to identify whether or not the element pairs reacted.

The six chemicals to be used are:

**Halogen Molecules Halogen Ions**

Cl2 (dissolved in water) Cl- (found in KCl dissolved in water)

Br2 (dissolved in water) Br- (found in KBr dissolved in water)

I2 (dissolved in water) I- (found in KI dissolved in water)

**Some Concept Questions**

1. Circle the ions and put a square around the element molecules.

F F2 F- Cl Cl2 Cl- Br Br2 Br- I I2 I - At At2 At –

1. Explain what would have to happen in the atom for the following change to occur:

Br2 🡪 2Br –

1. Is the process above something that can happen if bromine does not interact with anything? Explain.
2. Explain what is happening (follow the electrons) in the following reaction:

X2 + 2Y- 🡪 2X- + Y2

1. Use the following data to determine whether element X or element Y has a higher “electron affinity”.

X2 + 2Y- 🡪 2X- + Y2

2X- + Y2 🡪 no change

Element has a higher electron affinity. I know this because…

**The Goal:**

Using elements from the halogen group, you will determine the group trend for electron affinity by reacting the elements against each other.

**Pre-Lab:** Define the terms and take notes from pre-lab discussion in your lab notebook.

***Terms***

Copy the three terms from the pre-lab activity and explain each in your own words.

***Safety* – Wear goggles, apron, and gloves throughout the procedure!**

* All neutral halogens will irritate the mucous membranes (do not breathe vapors and be sure to wear goggles). They will also bleach your clothing (wear aprons). Keep test tubes covered when not in the fume hood!
* The oil and the halogens can be skin irritants. Wash with soap and water if it gets on your skin.
* Final products may NOT be disposed of in the sink! Use the waste container in the fume hood.

The six chemicals to be used are:

Cl2 (dissolved in water) Cl- (found in KCl dissolved in water)

Br2 (dissolved in water) Br- (found in KBr dissolved in water)

I2 (dissolved in water) I- (found in KI dissolved in water)

**Getting Ready:** *Your teacher will show you how the chemical dispensing stations are set up.*

You will try combinations of each ion with each molecular element. Prove to yourself that there are six combinations. Set up 6 test tubes **with labels** for each combination. See the “Data” section to set up your data table **before you begin**.

**Procedure**

1. Using 5-10 drops of each solution (ion and molecule), prepare your reaction tubes as labeled.
2. Once your combinations are prepared, gently swirl each of the reaction tubes to allow the reaction to occur. Be sure to keep the tubes capped whenever away from the fume hood.
3. Return to the fume hood and add 5-10 drops of the oil to each tube, then re-cap.
4. Return to your lab table and swirl each tube more vigorously to allow the solution and the oil to interact.
5. Once settled, the oil will sit on top of the water solution. Whichever neutral element remains after the reaction will dissolve into the oil layer during swirling. Record the color of the oil. If it is difficult to see the color, add a few more drops of the oil and swirl again.
6. When all observations are complete, rinse the contents of all tubes into the beaker labeled “waste” under the fume hood. Return to your table and remove all labels, then wash all tubes and droppers with soap and water.

**Data**

Your data table should have the following headings:

|  |  |  |  |
| --- | --- | --- | --- |
| **Ion** | **Molecule** | **Color of oil** | **Analysis/Meaning** |
|  |  |  | *Be sure to leave room for several lines of writing here!* |

**Name**

**Post-Lab Questions**

1. List the halogens you observed from lowest to highest electron affinity as determined by your data.
   1. Explain how you came to your conclusions to answer the above question.
   2. According to your data, what is the pattern in electron affinity from top to bottom of a group on the periodic table?
2. Use electron configurations to draw Bohr diagrams for each of the halogens studied in the lab. Place them in the boxes according to their placement on the periodic table.

|  |
| --- |
|  |
|  |
|  |

* 1. What is the main difference in the diagrams for each element?

1. Use Coulomb’s Law and atomic structure to justify WHY the electron affinity changed in the way you described in question 1b.
2. Fluorine is not used in this lab because it is very hazardous. If we could have used fluorine, what would have happened when the neutral fluorine molecule was mixed with the chloride ion (Cl -)? Explain how you know, using your data.