Exploration of IONIC and COVALENT Characteristics

Name_ Key

Objective: ***Compounds*** can be characterized as ***ionic, covalent*** or ***metal*** ... the characteristics of 2 major types of bonds: ***ionic bonds*** and ***covalent bond***.

Procedure: Visit each station and perform the following.

1. Read the "test information" provided for each station below.
2. Perform the procedure as indicated.
3. Make careful observations for the covalent substances and ionic substances.
4. Write a **claim** as well as the **evidence used to support that claim** which explains how **ionic** and **covalent** compounds are similar or different.

Definition of claim and evidence	Example sentence starters
Claim: A statement of what is true or believed to be true	*It was determined that* _____
Evidence: Facts obtained from an experiment that relate to and support the claim	*The evidence that supports this claim is* _____

Station #1: Conductivity

Test Information	Procedure
Conductivity is the ability for a substance to conduct electricity. If compounds produce ***ions*** in water (aqueous), then they will conduct electricity. Determine whether a substance conducts electricity by placing the conductivity tester in solution. RINSE well! Lights up **BRIGHTLY = STRONG** conductor Lights up **DIMLY = WEAK** conductor **DOES NOT** light up = **DOES NOT** conduct electricity	1. Hold each solution under the conductivity tester and observe 2. Make sure to use the rinse beaker in between substances.

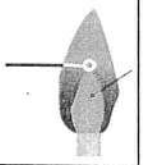
Observations/Record Conductivity #'s.		Claim	Evidence
Ionic	**Covalent**	It was determined that ionic substances have a high conductivity and covalent substances have a low conductivity. Ionic solutions are better conductors because the produced ions in the water.	The evidence that supports this claim is that ionic substances were 2907 MS/CM and covalent substances were 175 MS/CM.
2907 MS/CM High conductivity	175 MS/CM Low conductivity		

Station #2: Crystal Structure

Test information	Procedure
Crystal structures form from the interaction of ***positive ions*** **(cations)** and ***negative ions*** **(anions)**. If it does not have a crystal structure, then it usually just has anions.	Look at each substance under the microscope and observe the structure. **Describe** and **draw** what you see.

Observations		Claim	Evidence
Ionic	**Covalent**	It was determined that the covalent shavings only have anions because it does not have a crystal structure and ionic had both cations and anions.	The evidence that supports this claim is the lack of the covalent shavings' crystal structure. The ionic has anions and cations.
The ionic shavings have a crystal structure. 	The covalent shavings have a powder looking structure. 		

Station #3: Burning* WEAR SAFETY GOGGLES!!!**

Test information	Procedure
When a substance burns, it goes through a chemical change. This can be observed when colors change to **brown** or **black**.	1. Place a micro amount of the first substance onto the nichrome wire and carefully put into the Bunsen burner. Observe. 2. Repeat with each of the other substances. 3. Clean up your station when done. 

Observations		Claim	Evidence
Ionic	**Covalent**		
The ionic substance did not change color to brown or black.	The covalent substance changed color to black.	It was determined that a chemical change occured with the covalent substance, but not the ionic substance.	The evidence that supports this claim is the fact that the covalent substance changed color and the ionic substance, did not.

Station #4: Brittleness/Hardness

Test information	Procedure
Certain bonds tend to form brittle structures. A substance is ***brittle,*** if it is hard and fractures into many pieces when it does break.	1. Touch the substances with your fingers to determine whether they are hard or soft. 2. To test brittleness, place a micro amount of each sample into the mortar. 3. Gently grind with pestle and observe. 4. Repeat with each of the samples 5. CLEAN when finished (place solids into waste bins)

Observations		Claim	Evidence
Ionic	**Covalent**		
Hard to the touch and doesn't break easily when crushed with the pestle.	Is soft to the touch and breaks easily when crushed with the pestle.	It was determined that the ionic substance was hard and the covalent substance was soft. This means that the ionic substance was more brittle.	The evidence that supports this claim is the feeling when you touch each of the substances and the observation that the ionic substance doesn't break easily.

Station #5: Energy of forming bonds. * WEAR SAFETY GOGGLES!!!**

Test information	Procedure
Energy is released when bonds from. The amount of energy released indicates the bond's strength. Observe any differences in energy released when the bonds are formed. You will be forming an ionic compound (MgO) and a covalent compound (CO_2)	1. Place the magnesium in the flame using the tongs. Observe. This was the formation of MgO (ionic compound)- place leftover MgO into water container 2. Place the carbon in the flame. Observe. This was the formation of CO_2 (covalent compound)- place leftover carbon into the waste container (in water)

Observations		Claim (Release energy)	Evidence
Ionic (formation of MgO)	**Covalent (formation of CO_2)**		
Bright fire with white ash	Took a long time to light with no flame at first and then a small one	It was determined that ionic bonds are strong because they produce a flame and release a lot of energy. It was determined that covalent bonds are weaker because the didn't produce a flame with lots of energy. the release of	The evidence that supports this claim is the fact that ionic had a bright and strong flame while covalent was hard to light and when it did, it was a smale flame.

Station #6: Component of compounds: Metals or Non-metals (Paper Lab)

Test information	**Procedure**
To determine the type of bond in a substance, analyze whether a **nonmetal is bonded to a nonmetal** OR **a metal is bonded to a nonmetal.**	1. Study the chart of ionic and covalent compounds. 2. Record similarities of the ionic and covalent in terms of whether they contain only **metals**, **only non-metals**, or **both metals and non-metals**.

Observations:		**Claim**	**Evidence**
Ionic	**Covalent**	It was determined that some of the compounds were ionic and could conduct electricity because it was an ionic, but some compounds were covalent and did not conduct electricity well.	The evidence that supports this claim is the fact that ionic bonds are determined by containing a metal and non-metal and covalent bonds are determined by containing only non-metals.
Contain metals and nonmetals	Contain only non-metals		

Station #7: Melting points (Paper Lab)

Test information	**Procedure**
Melting point is the temperature at which a ***solid*** becomes ***liquid.*** Certain types of compounds tend to have higher melting points than others.	1. Look at the chart of ionic and covalent compounds. 2. Compare the melting points of ionic and covalent compounds in terms of which tend to be higher and which are lower.

Observations				**Claim**	**Evidence**
Ionic		**Covalent**		It was determined that ionic compounds have heigher melting points than Covalent compounds.	The evidence that supports this claim is that it took more heat to change a solid into a liquid than it takes a Covalent compound to become a liquid, (aka melting point).
Compound	**Melting Points**	**Compound**	**Melting Points**		
CaI_2	784°C	HNO_3	42°C		
$CaCl_2$	782°C	O_3	192°C		
MgO	2,852°C	P_4O_6	23.8°C		
KBr	239°C	SO_2	-72°C		
NaCl	801°C	H_2O	0°C		

Station #8: Differences in Electronegativity Values (Paper Lab)

Test information	**Procedure**
Compounds may be characterized by analyzing the electronegativity differences between the elements making up the compound. **Subtract** the two electronegativity values from each other. (Ignore subscripts when you subtract) For example: $CaCl_2$ **Ca:** 1.00 **Cl:** 3.16 **The difference is** 2.16	1. Study the chart of electronegativity values at station #8 page (or in your Glencoe textbook page 169) 2. Determine the differences in electronegativity for the ionic compounds (by subtracting) and write the differences under ***ionic.*** 3. Then, determine the differences in electronegativity for the covalent compounds (by subtracting) and write the differences under ***covalent.***

Observations				**Claim**	**Evidence**
Ionic		**Covalent**		It was determined that ionic compounds have higher electronegativity than covalent compounds. Difference in	The evidence that supports this claim is that the compounds were analyzed by taking the electronegativity differences between the elements. The result was that ionic compounds had greater differences, thus greater electronegativity.
Compound	Difference	Compound	Difference		
NaCl	2.26	NO_2	.5		
$MgBr_2$	1.5	BrCl	.36		
NaF	3.1	SO_2	1		
CaF_2	2.7	PO_4	.3		
Cs_2O	2.7	CO_2	0		

Conclusion:

In a full paragraph explain what you have learned. What is one source of error? How would this error affect your results? What would you change to improve the accuracy of your results?

In this experiment, it was discovered that Ionic and Covalent compounds differ in mostly every way from one another.

Three examples of data and evidence from the experiment that support this claim are

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- When looking at ionic compounds under a microscope, the form a crystalized structure because they are made up of cations and anions. The covalent structures appeared to be more of a powder because they are made only of anions.
- Upon touching ionic and covalent substances, it was determined that ionic compounds are brittle while covalent compounds were soft and maliable under pressure.
- When the ionic was placed in a flame, it became white and large where as the covalent was a small flame. This proves that ionic compounds release more energy when subject to extreme temperatures.

One source of error in this experiment could have been during the burning lab it is possible that the group before us could have switched up the salt and sugar and could have thrown off our experiment.

This could have affected the results by throwing off our conclusions in the experiment because the labs would have been placed over the opposite information.

I would reduce the error and improve the lab by making sure with the teacher that each substance was the correct one so that my labeling would be true.