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Testing Properties on Unknown Substances to categorize them as Ionic or Covalent Compounds

Introduction:

Six different unknown substances are being tested whether they are covalent or ionic through different methods of observation. The experiment is being done to learn the different characteristics between ionic and covalent bonds.

Ionic bonds and covalent bonds are two ways atoms can combine. An Ion is an atom that has gained or lost electrons. An Ionic bond involves the transfer of electrons of a negative ion and a positive ion. This transfer usually happens between metals and nonmetals. This accurance usually only happens between nonmetals and metals because metals are more willing to give up electrons and the nonmetals are more willing to take electrons. The atoms want a complete outer valence shell of electrons, which is when they will be most stable. Ionic bonds form crystalline structures and have a high melting point. Equipment used to determine crystalline structure and melting point could be a dissecting scope and a Bunsen burner. Also ionic bonds conduct electricity when dissolved in water. Used to test this could be a conductivity probe; when the negative and positive wires are placed in the water it completes a circuit activating small lights. Ionic bonds are typically very hard to break, which is why they have such a high melting points.

Covalent bonds form when atoms are sharing electrons. The two atoms are both trying to take electrons but they can't take them away from each other completely. Nonmetals usually form covalent bonds because they have a fuller valence shell, which makes them want to take electrons more. When covalent bonds form they form molecules that are free traveling and have a very low melting point. The molecules are relatively easy to break from each other and form irregular crystal shapes. Covalent compound do not conduct electricity in their solid form nor when they are dissolved in water. An example of a covalent bond is H_2O, where there are two hydrogen bonds sharing electrons with one Oxygen. Ceramics are usually found as covalent bonds and ionic bonds. Ceramics are a mixture of inorganic and non-metallic materials that act as insulators. Also polymers can be found as covalent bonds also, and they are different length strands of bonded molecules.

Results:

Through observing though a Dissecting Scope Unknown A was concluded to have a crystalline structure. Unknown B was speculated to have a crystalline structure but less obvious than some of the other substances. Unknown C did not have an apparent crystalline structure. Unknown D had a crystalline structure, and Unknown E did not. Lastly, Unknown F did not have a crystalline structure. (Table 1)

Conductivity was preformed for each substance to help classify covalent and ionic properties for each unknown. All substances were dissolved in water before operating the conductivity tests. All substances dissolved in water except for unknown E. Unknown A was conductive, Unknown B was conductive, Unknown C was conductive, Unknown D was conductive, Unknown E was not conductive, and Unknown F was conductive. (Table 1)

Melting point was tested to help further classify the unknowns as Ionic or covalent compounds. Unknown B proved to have no melting point at the highest temperature available. It was held in the open flame for three minutes before it was concluded to have a melting point that could not be reached in the lab. Unknown C melted in 40 seconds. Unknown D melted in 9 seconds and Unknown E also melted in 9 seconds. Unknown F did not have a melting point that could be reached in the lab. (Table 1)

Unknowns	**Crystalline Structure**	**Melting Point** (seconds)	**Conductivity**	**Results** (Covalent or Ionic)
Unknown A	Yes	(Incomplete)	Yes	Ionic
Unknown B	Yes	No melting point	Yes	Ionic
Unknown C	No	40 seconds	Yes	Covalent
Unknown D	Yes	9 seconds	Yes	Ionic
Unknown E	No	9 seconds	No	Covalent
Unknown F	No	No melting point	Yes	Ionic

Table 1: Results of the three tests preformed to identify if each substance is an Ionic compound or Covalent compound

Figure 1: photo of the various substances in the process of being classified as covalent or ionic compounds

Discussion:

This experiment was done to classify different unknown substances as covalent or ionic compounds by recognizing key characteristics that describe them. Half of the unknowns was recognized to have a crystalline structure; Unknown A, B, and D. The other half did not have any obvious crystalline structure; Unknown C, E, and F. (Table 1) The significance of these results are good because from conversing with other groups and having a partner confirming each guesstimate our results are reliable. Just from analyzing whether each unknown had a crystalline structure when made an educated guess on which unknown was ionic or covalent compounds. But to further prove our educated guess, we then preformed a conductivity test for each substance. Each Unknown was dissolved in water then, with a conductivity probe measured for conductivity. Every Unknown tested positive for conductivity; Unknown A, B, C, D, and F. Unknown E was the only unknown that didn't test positive for conductivity. (Table 1) One very important observation done in the experiment was that Unknown E, did not dissolve in water and did not conduct electricity. The significance of these results are not great considering the materials

available. The confidence with the hand made conductivity probe was not that good due to the fact that the wires kept slipping from the circuit during the experiment. The last thing tested was the melting point of each unknown. Three unknowns out of six, melted within three minutes under the Bunsen Burner. The unknowns that did not melt within three minutes were considered to have a melting point too high that could be reached in the lab. Unknown C, D, and E proved to have a low melting point. Unknown D and E both melted in nine seconds, while Unknown C melted in 40 seconds. (Table 1)

From the three different tests done, each unknown was classified as covalent or ionic if they passed at least two out of three tests done. Unknown A was concluded to be ionic because it had an obvious crystalline structure and conducted electricity. These results are not as significant compared to the other results because the melting point for Unknown A, was incomplete. In fact the method we used to find the melting point was not the best because the temperature could not be recorded, and the melting time was inaccurate because the solids didn't melt all at once but slowly. A tool that could be used in the future to gather more accurate results could be a temperature probe so the Bunsen Burner's flame temperature could be recorded and the melting point of each unknown. Unknown B was concluded to ionic because it proved to be conductive in water, it had a crystalline structure, and had a high melting point. These results are significant because they all are characteristics of ionic compounds. This unknown tested three out of three for being an ionic compound so it is very assured to be ionic. Unknown C proved to be covalent because it had no crystalline structure and a melting point of 40 seconds. However it did conduct electricity when dissolved in water, which affects the significance of the results because covalent compounds do not conduct electricity. Reasons why it conducted electricity when dissolved in the water are unknown, but considering that it had two out of three characteristics pointing toward covalent compounds it can be said to be covalent. Unknown D can be concluded to be ionic because it has a crystalline structure and conducted electricity when dissolved in water. Though it did melt in 9 seconds, which is a very low melting point and can be argued that it is covalent, Unknown D is ionic because two out three tests done point toward ionic properties. The significance of these results are good but not completely reliable. Another possible solution to gather more accurate results is to conduct a fourth test. Ionic compounds are very good at absorbing infrared light. Shining the light on each substance for a certain amount of time then measuring it with an infrared thermometer could prove some of the insignificant results to be ionic or covalent like unknown D. Unknown E can be concluded to be covalent because it had a very low melting point, it didn't conduct electricity, and didn't have a crystalline structure. The significance of these results are good because it tested three out of three for properties of covalent compounds. Unknown F proved to be ionic although it was concluded to not have a crystalline structure, the other two characteristics tested, pointed more toward ionic properties. The significance of these results are not the best because of reasons said above. A way to further prove that unknown F is ionic would be doing the infrared test.