EXPLORE

HOW CAN COMPOUNDS BE CLASSIFED BY THEIR PHYSICAL PROPERTIES?

**Safety:**

* Do not touch, do not taste any substance provided, even if you think that you know what it is
* Wear aprons and safety glasses at all time. Safety glasses are to protect eyes, not foreheads.
* Use extreme caution around hot materials and equipment.
* Dispose of the solids in the containers marked Waste A, Waste B, etc on the front desk.
* Dispose of the liquids in the containers marked Water Waste and Oil Waste on the front desk.

**Materials:**

Compound A- NaCl

Compound B-MgSO4

Compound C-Vanillin

Compound D-Stearic Acid

Test Station1:

Isobutanol

Distilled Water

Test Tubes

Parafilm

Test Station 2:

Conductivity Tester

24 - well plates

Test Station 3:

Black Paper

Magnifying Glass

Test Station 4:

Mortar and Pestle

Magnifying Glass

Test Station 5:

Meltemps

Capillary Tubes

Thermometers

**PROCEDURE:**

Students may wish to work in groups of four, each group consisting of teams of two. The two teams perform different tests and pool results later.

Team I: Tests 1 and 2

Team II: Tests 3 and 4

Test 5 to be completed by the team which finishes their assigned tests first.

Test 1 – Can you classify the four solids by the liquids in which they dissolve?

1. Prepare four test tubes with water and label A, B, C, and D. Fill to a height of approximately 2 cm.
2. Prepare four test tubes with isobutanol and label A, B, C, and D. Fill to a height of approximately 2 cm.
3. Add a small amount of solid A to each of the two test tubes labeled A. Cover with parafilm and agitate gently.
4. Record your observations in your lab book.
5. Add a small amount of solid B to each of the test tubes labeled B. Cover with parafilm and agitate gently.
6. Record your observations in your lab book.
7. Repeat for solids C and D.

Test Station 2 – Can you classify the solids by their ability to conduct electricity when they are placed in water?

1. Pour a small amount of each water mixture from Test 1 into one well of a 24-well plate.
2. Place the conductivity probe in water mixture A.
3. Record your observations/reading.
4. Clean the probe.
5. Repeat for the remaining three wells.

\*\* NOTE: CAUTION STUDENTS NOT TO ATTEMPT TO MEASURE CONDUCTIVITY IN ISOBUTANOL AS IT IS FLAMMABLE!

Test 3 – How can you classify the four solids by their shapes?

1. Take a sheet of black construction paper and tear it into four squares. Label the squares A, B, C, and D.
2. Add a small amount of solid A to the square labeled A.
3. Look at the solid with the magnifying glass.
4. Record your observations in your lab book.
5. Repeat for the remaining three solids.

Test 4 – How can you classify the four solids by their hardness?

1. Take your four paper squares with the solids to the hardness test station.
2. Place solid A into the mortar marked and grind thoroughly with the pestle marked .
3. Return the ground solid to the paper labeled A.
4. Look at the solid again with the magnifying glass.
5. Record your observations in your lab book.
6. Repeat for the remaining three solids, being careful clean the mortar and pestle after each solid.

Test 5 – How can you classify the four solids by their ability to melt?

1. Obtain a capillary tube for each of the samples A-D.
2. Remove the lid from your practice compound container. Push the open end of the capillary tube into the solid until the solid has moved about ½ cm into the capillary tube. Invert the tube and tap the closed end on the table to pack the solid into the closed end of the tube. As long as some of the compound can be seen in the bottom of the tube, then there is enough sample with which to work. Be sure to put the cap back onto the practice compound container.
3. Place the capillary tube into the Mel-Temp chamber as instructed by your teacher. Three capillary tubes will fit into this chamber, so up to three members of the group can run samples at the same time.
4. Place the thermometer into the appropriate Mel-Temp chamber. If the thermometer is not digital or spirit-filled and/or not a wide-range scale (-10-260˚C), then do NOT use it. Make sure that the Mel-Temp is set on zero. Plug the Mel-Temp in, turn it on, and start with a setting of one to two. Observation of the sample chamber and the thermometer should be made frequently in order not to miss the melting point of the sample. Be sure observations are made through the Mel-Temp eyepiece. Looking directly into the capillary tubes could result in injury should the glass thermometer or capillary tubes explode. Heat slowly, so that accurate results are achieved. Use small incremental increases in the setting when needed. **CAUTION:** Please do **not** turn the power setting **above** **4** because it will destroy the thermometer.
5. Watch the temperature on the thermometer and solid inside the capillary tube. As the melting range of the solid approaches, you will see the solid begin to sweat. This is the low end of the melting range. The temperature at which the solid has completely turned to liquid is the high end of the melting range. Record these values on the data table on the next page.
6. Turn off the Mel-Temp to allow it to cool before trying your unknowns. Remove the capillary tubes and lay them onto the table to cool. Be careful NOT to touch the tubes until they cool. Observe the change(s) that occur(s). It should take about 15 minutes for the temperature to cool down. (Or at least let the temperature cool down to about 75.0˚C). Dispose of the capillary tubes into the broken glass container.

Pool your data using the table below:

DATA TABLE:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Dissolves in  Water? | Dissolves in  Isobutanol? | Conducts  electricity? | Has regular crystalline shapes? | Hard or  soft? | Melts? |
| solid  A |  |  |  |  |  |  |
| solid  B |  |  |  |  |  |  |
| solid  C |  |  |  |  |  |  |
| solid  D |  |  |  |  |  |  |

EXPLAIN

1. Compare and contrast the four solids in terms of their

a) Ability to dissolve in water.

b) Ability to dissolve in alcohol.

c) Ability to conduct electricity while in water.

d) Shape?

e) Hardness?

f) Melting behavior?

2. Describe any patterns you identify among these four solids?

3. Refer to your Periodic Table. How can you classify the elements found in the four solids with respect to the periodic table? The composition of the four solid compounds are as follows:

a) Compound A is composed of Na and Cl.

b) Compound B is composed of Mg, S, and O.

c) Compound C is composed of C, H, and O.

d) Compound D is composed of C, H and O.

4. Why might one compound be harder than another compound?

5. Why might one compound more readily melt than another compound?

6. Using grammatically correct sentences, answer the question posed in the title of this experiment.

ELABORATION

1. Name two other pairs of elements that might form a compound that is both hard and dissolves in water.
2. A compound has the chemical formula C6H12O6. What physical properties would you expect it to have? Why?