AP CHEMISTRY LAB
CLASSIFICATION OF SOLIDS

Purpose:

- Identify the kinds of properties common to a particular class of solid.
- To be able to classify a solid substance by its properties.
- Develop lab techniques to check the melting point, to check the conductivity, to check the solubility, and observe the gross properties of a solid substance.

Logic behind the lab:

From our study of chemical bonding, we know that many types of forces are at work within a solid. How these forces interact upon the molecules in a substance fall into general categories, and if considered closely, will allow us to group the solid substances into several general classes. Once we have completed the classifications, we should be able to predict the properties of a new solid if we know its classification. Conversely, by looking at some of its properties, we should be able to know its classification and other properties that we did not check. Once we get a handle on the significant properties, hopefully we will be able to extend our knowledge to consider melting to the liquid state and the dissolving process to form solutions. Another way of saying the same thing is that we are expanding our base of knowledge about matter so that we can better explain the world around us.

Well, Thiel is getting carried away, so lets get started!

Procedure:

(Part I)

1) Obtain a 12 well porcelain plate. Place in it 1.5 to 2 scoops of the following substances: MgO, $CoCl_2 \cdot 6H_2O$, naphthalene, benzoic acid, KBr, charcoal, sand, powdered iron, and powdered zinc. Mark the chemical symbols of each above the well in which that substance is in so that you do not get the solids mixed up. These samples will be your stock supply for the remainder of the lab.

2) Construct a data table listing the properties to be checked as columns and the substances as the rows.

3) Crystalline or amorphous solid

   A) Take a hand lens and observe a few grains of each solid. If you put the solids on a dark background they will be easier to observe.

   B) Record if they appear to have a regular geometric pattern and if so what does the pattern look like? A sketch may be worthwhile. If you want to make more detailed observations, use a dissecting scope.

4) Melting temperature and Conductivity of the Melt

   A) Place a pea-sized sample of each of the substances in a small test tube. Gently warm each. If the substance does not melt, gradually increase the temperature looking for any changes. If the texture of the sample changes, but it does not melt, continue to increase the intensity of the flame. A guide to the temperature of the flame may help. (Look on the next page at Gentle heating, Moderate heating, etc.)

B) *If* the substance melts, check its conductivity as a liquid. Insert the electrodes for a little screamer into the test tube so that they come in contact with the melted substance. You may have to continue to warm the test tube so that the substance stays in the liquid state.

Gentle heat: Warm the test tube by passing it back and forth over the top of the flame. Substance melts quickly: up to 100 ^{o}C.

Moderate heat: Continue to move the test tube back and forth over the flame but keep the tube in the flame longer. The flame will remain colorless: 100 – 300 ^{o}C.

Hot: Hold the test tube in the flame continuously. The flame will turn yellow-orange from the hot glass: 300 – 500 ^{o}C.

Toasty: Hold the test tube in the flame continuously and adjust the flame to a rushing two-cone flame. The flame will be very yellow and the glass will start to soften and change shapes: 550 ^{o}C and up.

5) Solubility

A) Again, use a pea-sized sample.

B) Adding a solvent:

i) The volume of the solvent should be uniform. Throughout these trials, use about 2 ml.

ii) Determine how much 2 ml is in one of your droppers so that you can measure that volume quickly and accurately.

iii) Use 3 solvents for each solid. The solvents will be water, ethanol, and charcoal lighter fluid. Record if none, some, or all of the sample dissolves.

C) If the sample dissolves in water, transfer that solution to a well in your 24 well dropper plate and save that sample for a test to be run in the next part of this exercise. Make sure you label that sample some way.

6) Conductivity

A) Solids:

i) Place the electrode of a little screamer in each of the solids remaining in the wells of the porcelain dropper plate. Make sure you wipe the electrodes off between trials.

ii) Record if the screamer screams or not.

iii) If the screamer does not scream, try filling the well in the penny arrangement with the solid, and squeezing that arrangement with a pliers.

iv) While squeezing the pennies touch *both* pennies with the electrodes of the screamer. Make sure that the pennies are not touching directly.

v) Record the results.

7) Solutions:

A) Check each of the solutions that you saved in the 24 well plate from Part C. Make sure you rinse the electrodes between each trial. A little contamination goes a long way here!

B) Record your results.

(Part II)

Interpreting your results:

8) Read the information given you that was taken from the Slowinski lab book. Now write a one sentence definition for the terms:
A) Molecular solid B) Ionic solid C) Metal D) Network solid (Macromolecular).

9) Now set up a new table with the columns:
Molecular solid Ionic solid Metal Network solid.

10) Place each of the substances tested in Part I in the appropriate column. Under each column, summarize the tests you would run to identify that type of solid.

(Part III)

Unknowns:

11) Get 2 unknowns from RT and conduct enough tests on them to identify each of the unknowns. Make sure that you run at least 2 confirming tests for each sample. Have fun!

QUESTIONS:

1) We classified solids into 4 groups. Which group would:
A) Be soluble in water?
B) Conduct electricity in the melt?
C) Be soluble in organic solvents?
D) Conduct electricity when it is under pressure?
E) Be slightly soluble in water and slightly conductive in that solution?

2) A solid is a white at room temperature. It melts at 80 ^{o}C and the melt has a slight electrical conductivity. What would be its classification and why?

3) A white solid melts at 1000 ^{o}C and is insoluble in all solvents. The melt does not conduct electricity. What would be its classification and why?

4) Classify each of the following species in one of the types of solids:
A) K B) $CaCO_3$ C) C_8H_{18} D) $HCl_{(g)}$.

5) Of the 4 types of solids, which one(s) are generally:
A) Insoluble in water B) Ductile and malleable C) Generally nonvolatile?

6) List one test that did not seem to work well in this lab and propose a way to improve that test.

Source:
Chemical Principles in the Laboratory, fifth edition; By Slowinski, Wolsey, Matherton; © Saunders.