Identification of Unknown Substances I

Name _____

Introduction

Is the white powder on the floor next to the body aspirin, flour, cocaine, sugar, or some other deadly powder? How do authorities distinguish between substances that might look alike? To the criminalist the answers may be critical to solving a case or getting a conviction.

Concepts

- Standards/controls
- Chemical reactions
- Precipitation
- Solubility
- Conductivity

Background

Substance identification is very important in many real-life situations. An unconscious victim has ingested some drug- it is critical to identify the substance as quickly as possible. A child has swallowed some pills from a medicine cabinet- identification could be a matter of life or death. Someone is seen selling bags of white powder- it must be identified for a criminal conviction to occur. A person has died from someone tampering with drug bottles at a local pharmacy-what was added to the antacid tablets?

The basis for identification of unknown substances always hinges upon using known standards for comparison. Without knowing exactly how a known substance reacts to all tests, it would be impossible to make a positive identification of an unknown substance. As new drugs and substances are created, standards for testing for these substances must also be developed. The FBI Crime Laboratory, for example, works very closely with pharmaceutical companies to produce tests for all new drugs as they are developed. The "standards," which are kept on file, are critical for proper identification of "unknowns."

In the first part of this lab, a set of standards will be established for the simulated drugs Scogaine, Davlate, Bradlin, Irenin, and Markopan. Once the standards have been established, tests will be run to identify an unknown chemical. Though this simulation is clearly an oversimplification and cannot actually be used to test unknowns, the principles are the same as those utilized by a crime laboratory. In the criminal laboratory, the simple chemical reactions would be replaced by complex chemical analyses utilizing very expensive and sophisticated equipment.

Materials

Hand lens	Plastic graduated test tubes with screw tops, 5
Scogaine	Distilled water
Davlate	Sodium carbonate 1.0 *M* solution, Na_2CO_3
Bradlin	Iodine solution
Irenin	Silver nitrate 0.3 *M* solution, $AgNO_3$
Markopan	Small cups
Unknown drug	Scoopula (student provides)
0.1 *M* Hydrochloric acid (aq)	Aluminum foil
	Tongs or forceps

Safety Precautions

Hydrochloric acid, silver nitrate, and iodine solutions are toxic by ingestion or inhalation and severely corrosive to skin and eyes. Sodium carbonate is also a skin irritant. Iodine and silver nitrate solutions will stain the skin and clothing. Wear eye protection at all times. Wash hands thoroughly upon completion of laboratory work.

Procedure

1. Using a scoop and a separate graduated test tube for each drug, fill each tube to the 0.5 mL line with one of the drugs. Clean the scoop in between each drug to avoid contamination. Label each tube carefully.
2. Examine each drug with a hand lens. Describe the appearance of each substance on the data table.
3. Make a small, flat cup from a piece of aluminum foil (1.5" x 1.5 "). Label the cup and pour the contents of one of the test tubes into the aluminum cup. Repeat this procedure using a separate aluminum foil cup for each drug. Use tongs to place the cups on a hot plate set to 4. Observe the substances for 3-4 minutes after the hot plate is hot. Which ones melt? Remove the cups from the hot plate. Record your results. Write NR for no reaction.
4. Refill each test tube to the 0.5 mL mark again with a new supply of drug.
5. Use a pipet to add 5 drops of 0.1 *M* HCl to each tube. As the acid is added, note any reaction that occurs and record the results in your data table for each drug.
6. Thoroughly wash and dry the test tubes.
7. Relabel the test tubes, if necessary, and add fresh samples of each substance to the 0.5 mL line in the appropriate test tubes.
8. Using a clean pipet, add about 5 mL of distilled water to each tube. Place a screw cap on each tube and shake each tube for about a minute. Note which substances dissolve in water and which do not. Record the results in your data table. **Save the solutions for the next two tests!**
9. Go to one of the computers. Collect conductivity data for each sample.
    a. Place the tip of the probe into the liquid containing the first sample. The hole near the tip of the probe should be completely covered by the liquid.
    b. When the conductivity reading on the main screen has stabilized, record it on your data table.
    c. Rinse the Conductivity Probe thoroughly with distilled water before collecting data for the next sample.
    d. Repeat steps 9a-9c for each of the remaining samples.
    e. Save the samples for the next test!
10. Use a clean pipet to add 2-3 mL of 1.0 *M* sodium carbonate solution to each test tube from step 9. Observe each carefully as the test solution is added and note any reactions on your data table.

11. Thoroughly wash and dry the test tubes. Relabel if necessary.
12. Add a fresh 0.5 mL sample of each substance to the test tubes.
13. Use a clean pipet to add 5 drops of iodine solution to each sample. Iodine solution is an orange/brown color and will stain the skin and clothing. Record any color changes when iodine reacts with each of the five samples on your data table.
14. Thoroughly wash and dry the test tubes. Relabel if necessary.
15. Add a fresh 0.5 mL sample of each substance to the test tubes.
16. Use a clean pipet to add 5 mL of water to each sample. Place a screw cap on each test tube and invert the tube several times. Allow each tube to sit for 30 seconds. Use a clean pipet to add 5 drops of silver nitrate to each solution. If a precipitate forms as a result of the addition of silver nitrate, record this result on your data table.
17. Thoroughly wash and dry all of the test tubes.
18. Secure a sample of an unknown substance from your teacher. Run all of the tests from steps 2-16 on the unknown substance. Record the results from all of the tests on your data table.
19. Compare the test results for the unknown substance against the "Standards" for each known drug and then determine which drug the unknown most closely resembles.

Disposal

- Place foil cups into the trash can.
- All substances can be washed down the drain with excess water.

Resources

Adapted from Flinn Scientific ChemFax! Publication No. 10521
Adapted from TI-84 CSI Explorations Case File 7: Drug Tests; Copyright 2005

Name _____

Unknown Substances Worksheet

	Scogaine	**Davlate**	**Bradlin**	**Irenin**	**Markopan**	**Unknown**
General Appearance						
HCl Test						
Heat Test						
Solubility in Water						
Conductivity Test						
Sodium Carbonate Test						
Iodine Test						
Silver Nitrate Test						

Unknown most closely resembles: _____