INSTRUCTOR'S MANUAL

1

Introduction to Chemistry

General Comments

This experiment is designed to help students become familiar with the organization of the laboratory, to stimulate interest, and to acquaint them with safety procedures. Some students feel uncomfortable in not knowing the definitive explanation for their observations. These students can be reassured by pointing out that scientific hypotheses are necessarily tentative and that they will not be severely graded for an incorrect proposal.

A. Instructor Demonstrations

1. This demonstration is enhanced with the lights dimmed and is an opportunity to point out the use and location of the fire extinguisher.
2. This is an example of a substance (sugar) being broken down to another compound (water) and an element (carbon). You may wish to demonstrate the dehydrating effect of concentrated sulfuric acid (using a paper towel) while discussing the precautions in handling this acid.
3. The Instructor should comment on the danger of using concentrated nitric acid. State the principle of pouring concentrated reagents into water. You may also wish to discuss the location and use of distilled water versus tap water.
4. The equations for the formation of the precipitate and complex ion are:

$$Cu^{2+}(aq) + 2\ NH_4OH(aq) \rightarrow Cu(OH)_2(s) + 2\ NH_4^+(aq)$$

$$\text{and,}\quad Cu^{2+}(aq) + 4\ NH_4OH(aq) \rightarrow Cu(NH_3)_4^{2+}(aq) + 4\ H_2O(l)$$

5. A small amount of iodine makes the reaction even more dramatic by producing purple smoke. The powdered zinc must be fresh and should not be allowed to oxidize in air.

B. Student Experiments

1. Methylene blue is reduced by a basic glucose solution and appears colorless. Shaking the flask allows air (oxygen) to temporarily oxidize the indicator which then appears deep blue. Upon standing, the methylene blue is reduced and goes colorless. The solution will last several days.
2. The heat of solution for ammonium chloride is endothermic and the heat of solution for calcium chloride is exothermic.
3. Save the nail for the next step and discard the solution in the sink.
4. Additionally, it is fun to change a new penny into a “dime” by dropping it into mercury(II) nitrate solution.
5. Any two nonidentical mirror image molecular models will suffice to illustrate optical isomerism.

EXPERIMENT 1 NAME _____

DATE _____ SECTION _____

SELECT THE SINGLE BEST ANSWER FOR EACH OF THE FOLLOWING.

1. What is the term for the study of the composition and properties of matter?
   (a) chemistry
   (b) experiment
   (c) philosophy
   (d) science
   (e) none of the above

2. What is the term for collecting data and recording observations under controlled conditions?
   (a) chemistry
   (b) experiment
   (c) hypothesis
   (d) science
   (e) none of the above

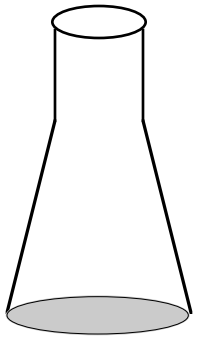
3. What is the term for a tentative proposal of a scientific principle that attempts to explain the meaning of the data gathered in an experiment?
   (a) explanation
   (b) hypothesis
   (c) natural law
   (d) theory
   (e) none of the above

4. What is the term for the methodical exploration of nature and logical explanation of the observations?
   (a) alchemy
   (b) chemistry
   (c) experiment
   (d) science
   (e) none of the above

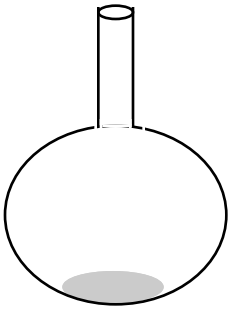
5. What is the term for an investigation that entails performing an experiment, proposing a hypothesis, testing the hypothesis, and stating a theory or law?
   (a) alchemy
   (b) chemistry
   (c) science
   (d) scientific method
   (e) none of the above

6. What is the term for an extensively tested proposal of a scientific principle that offers a model to explain the behavior of nature?
   (a) experiment
   (b) hypothesis
   (c) natural law
   (d) theory
   (e) none of the above

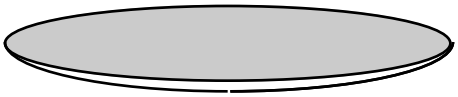
7. What is the name of the laboratory equipment shown in the diagram?
   (a) beaker
   (b) Erlenmeyer flask
   (c) Florence flask
   (d) volumetric flask
   (e) wash bottle



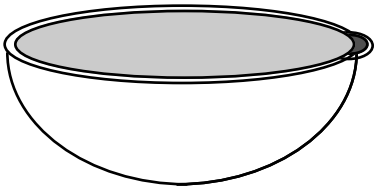
8. What is the name of the laboratory equipment shown in the diagram?
   (a) beaker
   (b) Erlenmeyer flask
   (c) Florence flask
   (d) volumetric flask
   (e) wash bottle



9. What is the name of the laboratory equipment shown in the diagram?
   (a) casserole
   (b) crucible
   (c) evaporating dish
   (d) glass disk
   (e) watchglass



10. What is the name of the laboratory equipment shown in the diagram?
   (a) casserole
   (b) crucible
   (c) evaporating dish
   (d) mortar
   (e) watchglass



11. Which of the following chemicals is potentially dangerous?
    (a) ammonium nitrate
    (b) ethyl alcohol
    (c) nitric acid
    (d) sodium hydroxide
    (e) all chemicals are potentially dangerous

12. What should you do if a chemical is spilled on your skin?
    (a) wash immediately with water
    (b) ask another student for help
    (c) ask the Instructor for help
    (d) read the safety rules
    (e) clean up the spill

13. What is the proper technique for detecting the odor of a vapor in a test tube?
    (a) breathe deeply from the test tube
    (b) use a match to detect a vapor
    (c) waft the vapor toward your nose
    (d) all of the above
    (e) none of the above

14. Why must a burner never be ignited in the laboratory in the presence of an organic liquid such as acetone or alcohol?
    (a) organic solids are toxic
    (b) organic vapors are flammable
    (c) organic liquids decompose
    (d) all of the above
    (e) none of the above

EXPERIMENT 1 NAME *SAMPLE DATA*

DATE _____ SECTION _____

DATA TABLE

A. Instructor Demonstrations

1. *Cold Heat*

Observation	Hypothesis
• *Light blue flame* • *Handkerchief does not ignite*	• *Alcohol is flammable* • *Alcohol is more combustible than wet cloth*

2. *Black Foam*

Observation	Hypothesis
• *Black foam* • *White smoke* • *Gas with sharp odor*	• *Carbon* • *Water vapor and sugar dust* • *Sulfur oxides*

3. *Copper Smog*

Observation	Hypothesis
• *Brown gas* • *Green solution* • *Blue solution*	• *Nitrogen oxides* • *Copper is green in conc acid* • *Copper is blue in dilute acid*

4. *Here and Gone*

Observation	Hypothesis
• *Blue-white solid particles form in solution* • *Particles disappear and solution changes color*	• *Blue-white solid is insoluble* • *Excess ammonia dissolves the solid particles*

5. *Water Hazard*

Observation	Hypothesis
• *Sparks and flashes* • *White smoke* • *Yellow/white residue*	• *Energy released* • *Sulfur oxide gas* • *Zinc compound formed*

B. Student Experiments

1. *Disappearing Blue*

Observation	Hypothesis
• *Clear solution turns blue (upon shaking)* • *Blue solution turns clear (after several seconds)*	• *Reacts with oxygen in flask* • *Oxygen in solution is used up*

2. *Hot and Cold*

Observation	Hypothesis
• *Ammonium Chloride – cold*	• *Dissolves, taking heat from surroundings*
• *Calcium Chloride – hot*	• *Dissolves, evolving heat to environment*

3. *Active and Unreactive*

Observation	Hypothesis
• *Iron – no reaction*	• *Iron is unreactive*
• *Calcium – bubbles, white residue*	• *Calcium reacts to produce a gas and a white insoluble compound*

4. *Copper Nails*

Observation	Hypothesis
• *Nail turns to bronze*	• *Copper is plated onto the iron nail*

5. *Mirror Images*

Observation	Hypothesis
• *Models are not superimposable*	• *Four different objects with a common center have a special symmetry*

EXPERIMENT 1 NAME *ANSWER KEY*

DATE _____ SECTION _____

POSTLABORATORY ASSIGNMENT

1. State whether each of the following laboratory safety precautions is *true* or *false*.

   (a) ***true*** Wear safety goggles in the laboratory.

   (b) ***true*** Wear closed-toe shoes in the laboratory.

   (c) ***true*** Do not bring food or drink into the laboratory.

   (d) ***true*** Note the location of the fire extinguisher(s) in the laboratory.

   (e) ***true*** Note the location of the first-aid equipment in the laboratory.

   (f) ***true*** Do not perform unauthorized experiments.

   (g) ***true*** Waft a gas toward your nose when detecting an odor.

   (h) ***true*** Perform experiments that produce a gas under a fume hood.

   (i) ***true*** When heating a test tube, point the open end in a safe direction.

   (j) ***true*** Always pour an acid into water—not water into acid.

   (k) ***true*** Clean up broken glass immediately.

   (l) ***true*** Do not use an organic liquid near an open flame in the laboratory.

   (m) ***true*** If you contact a chemical, wash with water and notify the Instructor.

   (n) ***true*** Notify the Instructor immediately in the event of an accident.

2. Which of the following chemicals should be handled carefully in the laboratory?

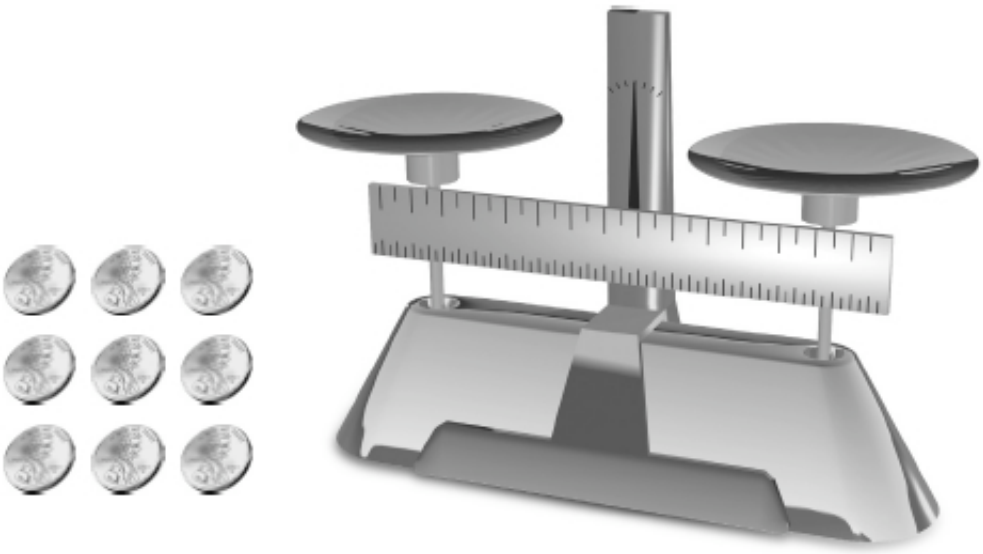
   (a) acids – ***handle all chemicals carefully***

   (b) bases – ***handle all chemicals carefully***

   (c) alcohol – ***handle all chemicals carefully***

   (d) distilled water – ***handle all chemicals carefully***

3. (optional) You are given nine pennies. One penny was minted in 1980 and the other eight pennies were minted after 1982. The 1980 penny weighs 3.0 grams; the other pennies have less copper and weigh only 2.5 grams. Assuming the mint dates are illegible, devise a method using the balance shown to determine the heavier 1980 penny in only two trials.



Weighing 1: ***Place three coins on each balance pan. If a pan drops, it indicates the heavier penny. This observation allows us to identify the set-of-three coins that contains the heavy penny.***

Weighing 2: ***Place one penny on each pan from the set-of-three coins found to contain the heavy penny. The balance will indicate the heavy penny unless it is the penny that is not on a pan.***