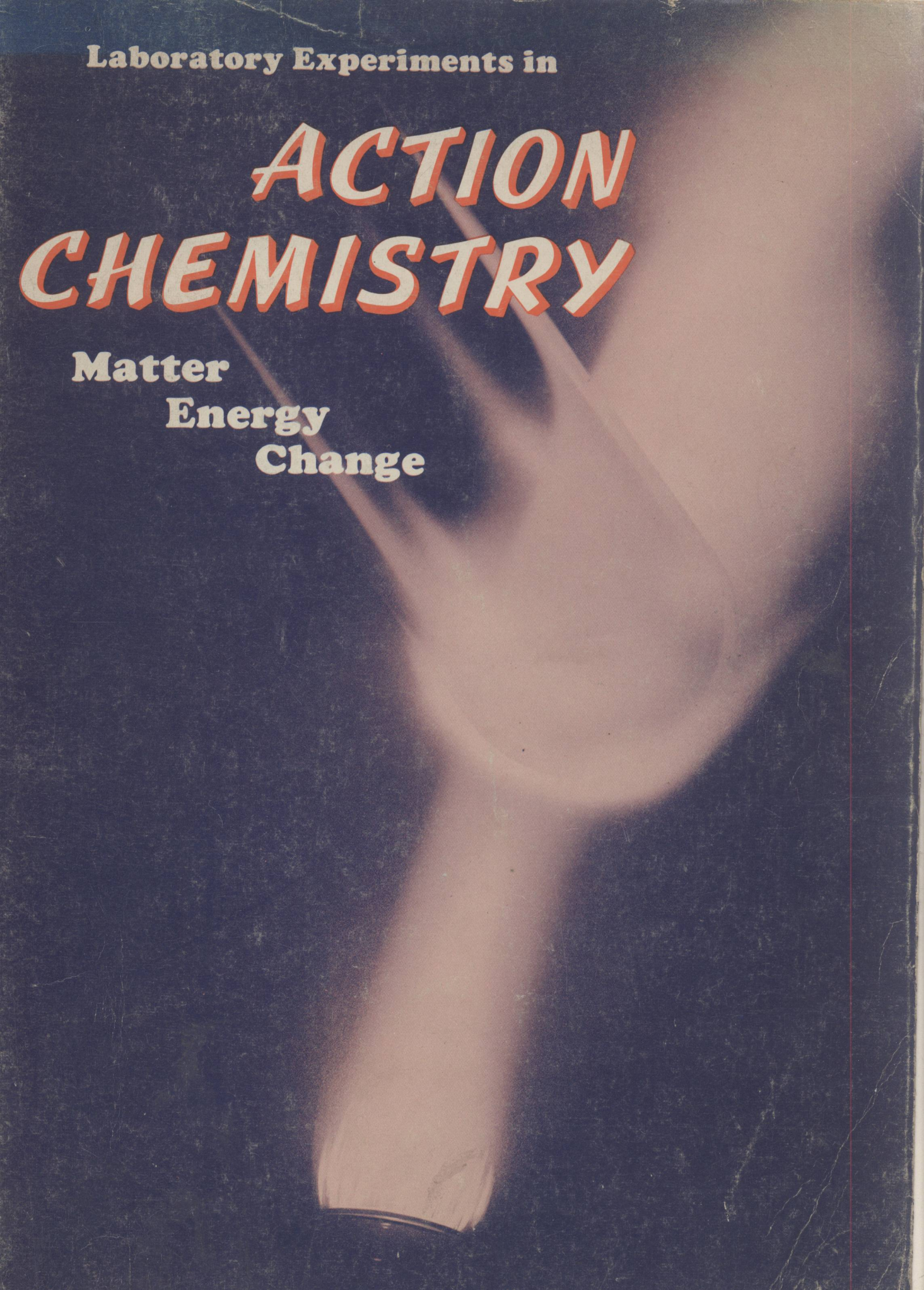
Laboratory Experiments in

ACTION CHEMISTRY

Matter
Energy
Change



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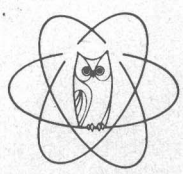
ACTION CHEMISTRY

Ruth P. Bolton
Elizabeth V. Lamphere
Mario Menesini
Paul C. Huang



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Preface

To the alchemist of long ago, chemistry was the stuff of magic. Today the ways of chemistry are less mysterious, but the excitement of magic is still there. In this chemistry course you will have the excitement and fun of finding out for yourself what things are made of and how they change; and that is what chemistry is all about.

The whole world is full of things to wonder about. You will cut chemistry problems down to laboratory size. By building the small ideas you discover into larger ones, you will begin to see patterns in nature. This is important because every part of your life is affected by chemistry.

You will work as scientists have always worked, asking questions, guessing at answers, trying out ideas in experiments, and wondering what the facts you discover mean. You will learn by doing and not by memorizing countless rules and definitions. What about mathematics? Of necessity there are a few number problems, but simple arithmetic will get you by. In a little while you may be surprised by the amount of real knowledge you have acquired. You may be equally amazed by the number of things you have learned to do, such as weighing and measuring and making chemistry apparatus work. Step by step you will see the many uses of chemistry in everyday life.

Ruth P. Bolton
Covina, California
July 24, 1971

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Laboratory Experiments in

ACTION CHEMISTRY

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Laboratory Experiments in

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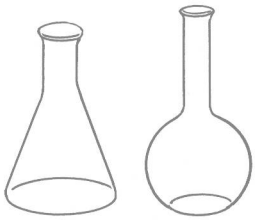
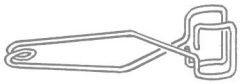
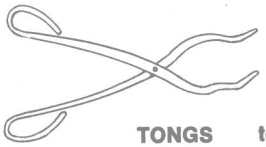
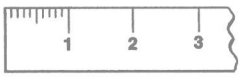
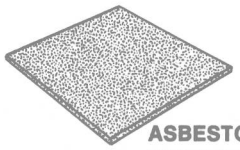
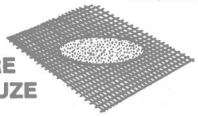
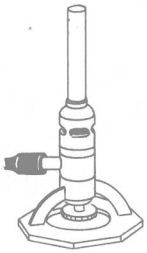
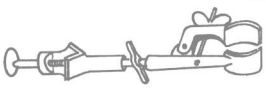
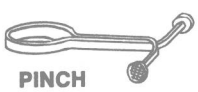
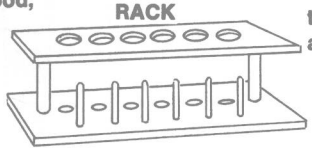
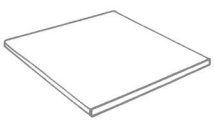
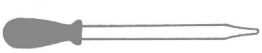
List Of Apparatus For Student Use

DESCRIPTION	APPARATUS	USE
glass common sizes 100 ml 250 ml 400 ml marked on the beaker	 BEAKER	as a container, like a cup may be heated
glass common sizes 125 ml 250 ml 500 ml marked on the flask	 ERLENMEYER FLASK FLORENCE FLASK	may be heated
glass marked with a milliliter (ml) scale size / divisions 50 ml / 1.0 ml 25 ml / 0.2 or 0.5 ml 10 ml / 0.1 ml	 GRADUATED CYLINDER	to measure volume
glass several sizes	 TEST TUBE	many uses can be heated
metal clamp with a spring handle	 TEST TUBE CLAMP	to hold a test tube
metal	 TONGS	to pick up and hold apparatus

DESCRIPTION	APPARATUS	USE
10 centimeter (cm) ruler, plastic divided into centimeter and millimeter (mm) divisions	 10 CM RULER	to measure length
triangular wire frame with clay material coverings	 PIPESTEM TRIANGLE	to support the crucible
small porcelain dish with cover	 CRUCIBLE AND COVER	to heat small amounts of solid material at high temperature
hardened asbestos	 ASBESTOS SQUARE	to place under hot apparatus
wire screen asbestos center	 WIRE GAUZE	to spread the heat of a flame
metal heating device connected to gas outlet with rubber tubing	 LABORATORY BURNER	to heat chemicals in beakers or test tubes
metal rod upright heavy base	 RING STAND	a support with many uses

DESCRIPTION	APPARATUS	USE
iron ring with screw fastener several sizes	 IRON RING	to fasten to the ring stand as a support for apparatus
metal clamp with 1. screw fastener 2. swivel and lock nut 3. adjusting screw 4. curved clamp	 BURET CLAMP	to hold apparatus may be fastened to the ring stand
heavy porcelain dish with grinder	 MORTAR AND PESTLE	to grind chemicals to a powder
may be of metal or porcelain	 SPATULA	to transfer solid chemicals in weighing
metal file with three cutting edges	 TRIANGULAR FILE	to scratch glass to file
short length of rubber tubing	 RUBBER CONNECTOR	to connect parts of apparatus
metal clamp with finger grips	 PINCH CLAMP	to clamp a rubber connector
rack; may be wood, metal or plastic	 TEST TUBE RACK	to hold test tubes in an upright position

DESCRIPTION	APPARATUS	USE
brush with wire handle	 TEST TUBE BRUSH	to scrub glass apparatus
glass rod	 STIRRING ROD	to stir combinations of materials to use in pouring liquids
porcelain dish	 EVAPORATING DISH	as a container for small amounts of liquid being evaporated
thick glass	 GLASS PLATE	many uses (should not be heated)
curved glass	 WATCH GLASS	may be used as a beaker cover may be used in evaporating very small amounts of liquid
glass or plastic	 FUNNEL	to hold a filter paper may be used in pouring
glass tip with rubber bulb	 MEDICINE DROPPER	to transfer small amounts of liquid
metal	 FORCEPS	to pick up or hold small objects

Chapter 1

CHANGES

CHEMISTRY is the study of materials and how they change.
The laboratory is the place where we will do this study.

Experiment 1.1

Equipment and Supplies per Lab Station
beaker—250 ml or 400 ml
sandpaper; (2) test tubes; clock
(2) iron nails; marking pen or 2 labels
paper towel; (2) pieces of string; water
Solution of copper (II) sulfate

What to do

1. Take two clean iron nails. Sandpaper the nails until they are bright. Examine them. Write your observations on the chart.
2. Tie a string longer than a test tube to each of the nails.
3. You will be given two test tubes standing in a beaker. Each test tube will be one-third full of a liquid.
   Mark or label the tube with water: 1.
   Mark or label the tube with the blue copper sulfate solution: 2.
4. Lower one nail into the water. Let the string hang over the top of the test tube. Leave the nail in the water for 2 to 5 minutes. Watch carefully for any change in the nail. Using the string, remove the nail. Blot the nail gently on a piece of paper towel. Describe the results in the Data Chart. Replace the nail in the water and set the test tube in the beaker.
5. Repeat the experiment by placing the other nail in the blue copper sulfate solution in Test Tube No. 2. Let the string hang over the test tube. Leave the nail in the blue copper sulfate solution for 2 to 5 minutes. Watch carefully for any change in the nail. Using the string, remove the nail. Blot it gently on a paper towel. Describe the results in the Data Chart.

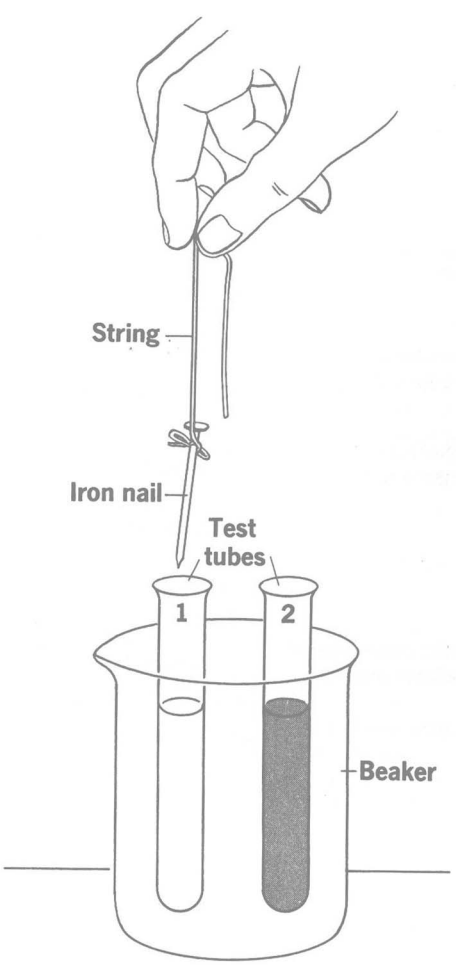
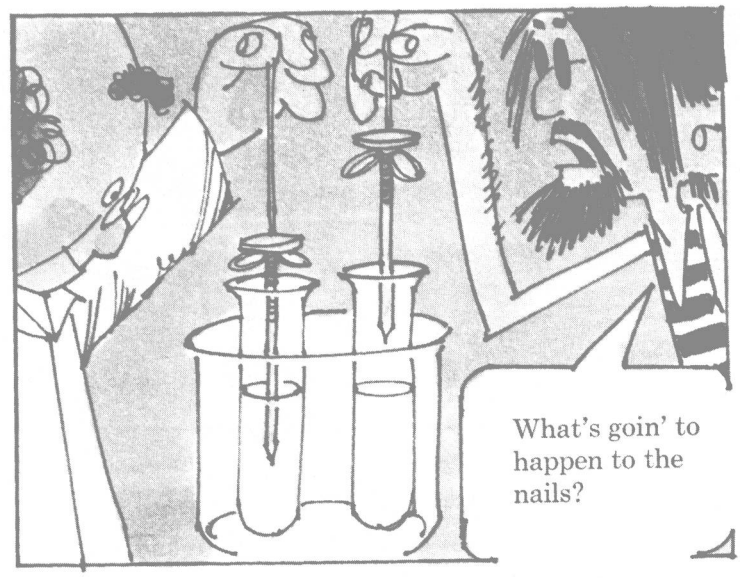


Fig. 1. Two test tubes in a beaker.

6. Return the nail to the copper sulfate solution. Let the nail slide slowly to the bottom. Place the test tube back in the beaker.
7. Write your name on a piece of paper. Place the paper in the beaker with the two test tubes. Set the beaker aside where your teacher directs since you will use the materials in Experiment 1.2.
8. Your teacher will save a sample of unused copper(II) sulfate for your use in the next experiment.



DATA CHART

	WHAT YOU HAVE SEEN		
	Color	Dull or shiny	Other observations
Iron nail as received			
Iron nail after being suspended in water			
Iron nail as received			
Iron nail after being suspended in the blue copper(II) sulfate solution			

Questions about the experiment

1. Copper sulfate solution is made by dissolving solid copper(II) sulfate in water. Why do you think that you were told to suspend a nail in it and in the water?

   _____

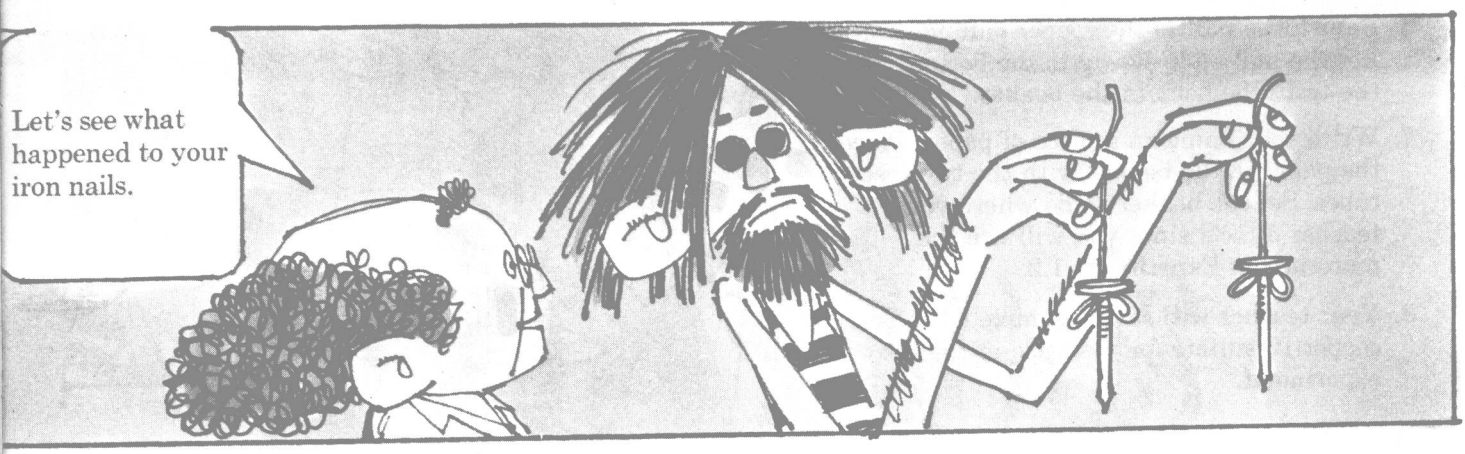
   _____

2. Do you think that anything new has been formed in either test tube? _____

   Explain your answer. _____

   _____

   _____



A Little Detective Work

One of the major jobs of the chemist is to find out what is happening to substances. Let's find out what happened to your iron nail.

Experiment 1.2

Equipment and Supplies per Lab Station

beaker, test tubes, nails, and solution from Experiment 1.1
beaker—100 ml or 150 ml
test tube labeled No. 3; paper towel; sandpaper
small piece of copper foil (1 in × 1 in)
Solution of silver nitrate

What to do

1. Examine the contents of your two test tubes from Experiment 1.1.
   (a) Has there been a change in the blue liquid in Test Tube No. 2? _____
   (b) Describe the contents of the test tubes.

   _____

   _____

2. Using its string, pull the nail out of each tube. Lay the nails on a paper towel. Describe any changes in the nails different from those you saw in Experiment 1.1.

   _____

   _____

   _____

3. Do you find any particles on the bottom of either test tube? _____. If so, what do they look like?

   _____

   _____

   _____

4. Obtain a small piece of bright copper metal. How does the colored material on either nail compare with the copper metal?

   _____

   _____

   _____

5. Pour the water from Test Tube No. 1 into the sink. Now put the known copper metal into this test tube.

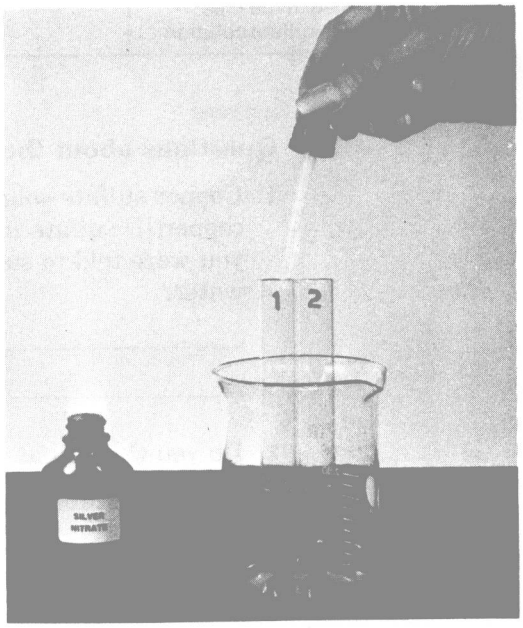


Fig. 2. Add silver nitrate.

6. See How to Decant. Pour the liquid from Test Tube No. 2 into a second beaker. Be careful to leave any particles present in the bottom of the test tube. Compare the liquid in the beaker with the sample of unused copper sulfate.

_____

_____

7. If there is any colored material on the nail use sandpaper to scrape it into Test Tube No. 2 with possible particles already there. Place half of your particles in Test Tube No. 3. Set these particles aside for Experiment 1.2-A.

8. Add a dropperful of silver nitrate solution to Test Tubes No. 1 and 2.
BE SURE NOT TO GET ANY SILVER NITRATE SOLUTION ON YOUR SKIN!

(a) What happens in Test Tube No. 1? _____

_____

(b) What happens in Test Tube No. 2? _____

_____

(c) Do you still agree with your answer to the second part of step #3? _____
If not, what answer would you give now?

_____

_____

Questions about the experiment.

1. What do you believe the colored material formed on the clean iron nail to be? _____

_____

_____

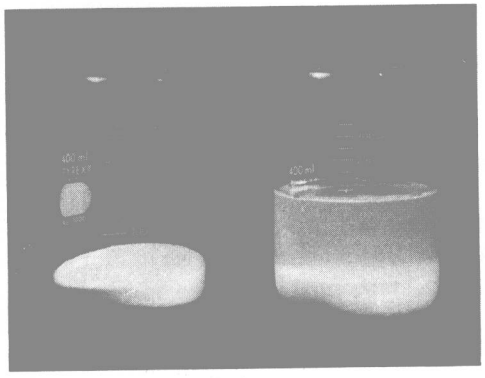
_____

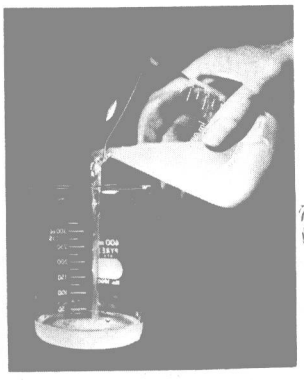
2. What two reasons do you have for thinking this?
(a) _____

_____

(b) _____

_____

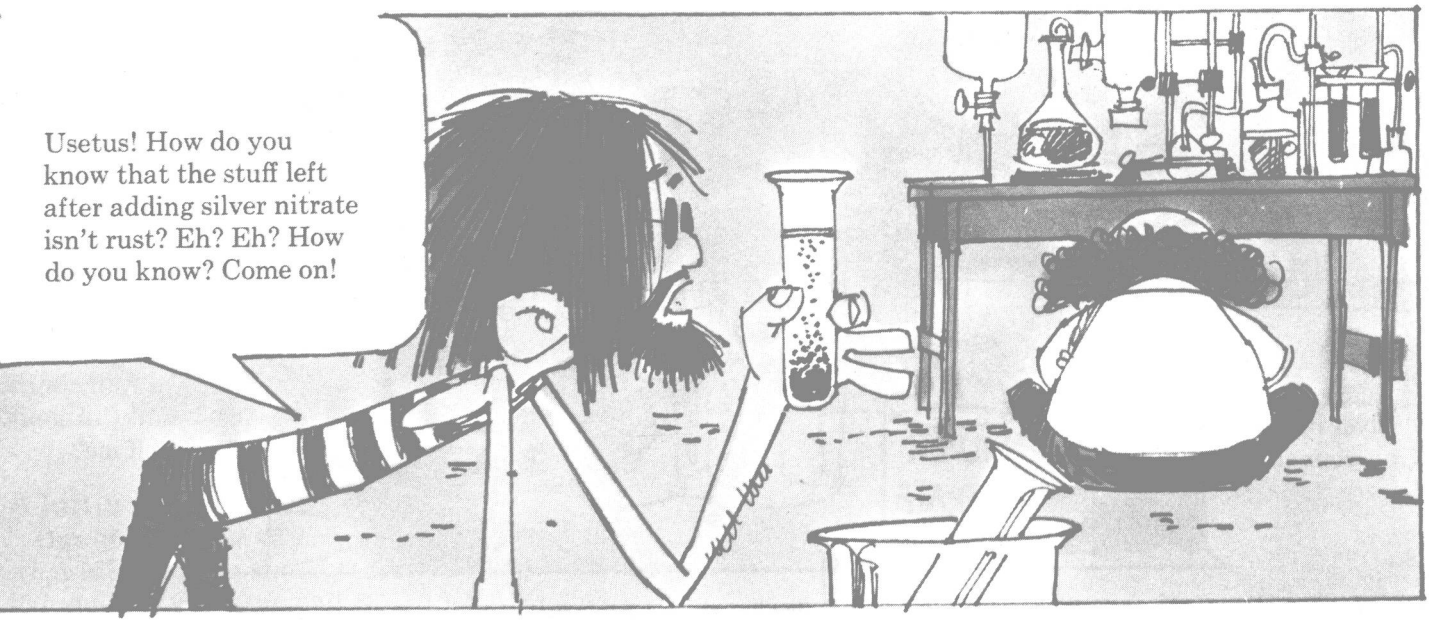




HOW TO

Decant a Liquid

Carefully pour off the liquid. Make sure the solid is *not* poured off.



Identity Can Be Mistaken

Mistaking a material new to you for something familiar may be easy to do.

How can you be sure that the particles found in the bottom of Test Tube No. 2 in Experiment 1.2 are not ordinary iron rust? Let's see!

Experiment 1.2-A Extension

Equipment and Supplies per Lab Station

(3) watch glasses or test tubes in a rack
white sheet of paper
sandpaper or a file, rusty nail
Solution of nitric acid, HNO_3
particles left from Experiment 1.2

What to do

1. Shake the particles you saved from Experiment 1.2 onto a watch glass.
2. Obtain a very rusty nail.
3. Scrape the rust from the nail onto a second watch glass.
4. Place a piece of copper metal on a third watch glass. Which of the three samples look most alike?

_____

Explain. _____

_____

_____

_____

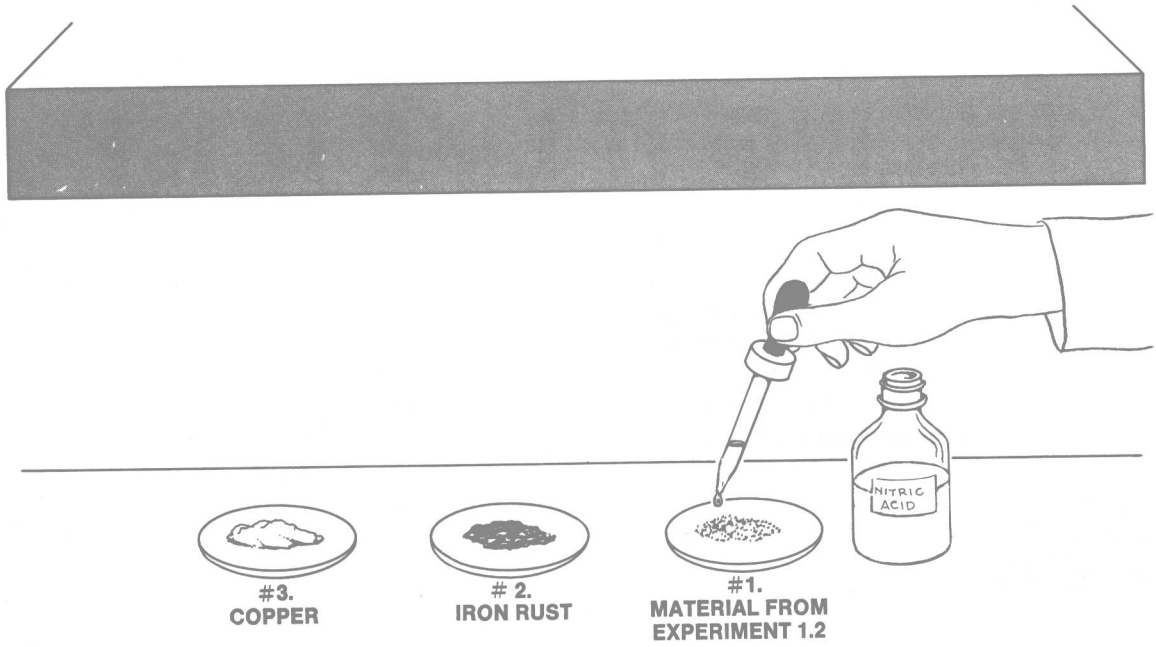


Fig. 3. Is #1 like either #2 or #3?

5. Add a dropperful of water to each sample. Place the three watch glasses on a white sheet of paper under the laboratory hood. Drop nitric acid onto each sample until each is well covered. Record your observations in the following Data Chart.

DATA CHART

NITRIC ACID TEST			
Test	Color of Solution	Material Disappears	Anything Else You Observed
1. Particles in Test Tube No. 3 from Expt. 1.2			
2. Iron Rust			
3. Copper Metal			

6. Which of the samples act in the same way with the nitric acid?

_____

Questions about the experiment

1. Look carefully at your observations in this experiment.
Were the particles formed when an iron nail is left over night in copper(II) sulfate solution, copper or ordinary iron rust?

Explain. _____

_____

2. Experiment 1.2 and 1.2A show a method used to identify an unknown substance. First you "guess" what the substance is most likely to be, then what do you do?

_____

_____