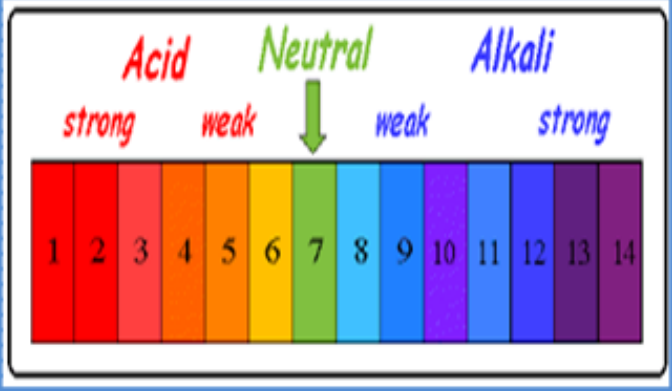
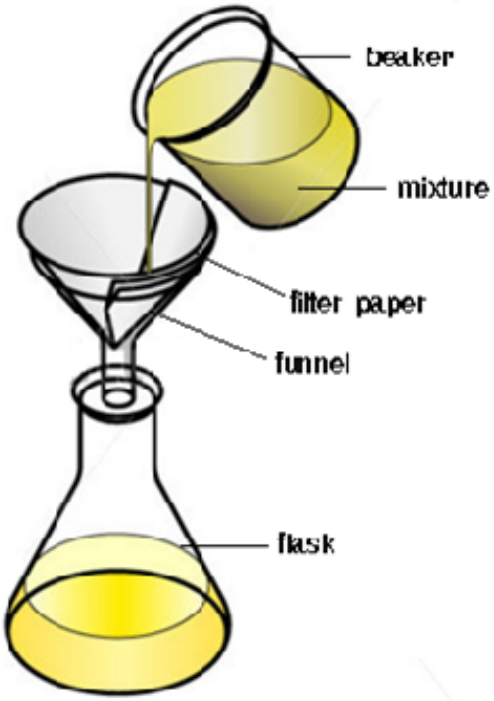
AMHARA REGIONAL STATE EDUCATION BUREAU

CHEMISTRY LABORATORY MANUAL

GRADE 7 AND 8






Dissolution of potassium permanganate in water

2007E.C.

CURRICULUM DEVELOPMENT AND IMPLEMENTATION CORE PROCESS

CHEMISTRY LABORATORY MANUAL FOR GRADES 7&8

CHEMISTRY

LABORATORY MANUAL

GRADE 7 AND 8

Amhara National Regional State Education Bureau

Curriculum Development and Implementation Core Process

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EXPERIMENTS FOR GRADE 8

ACKNOWLEDGMENT

Amhara National Regional State Education Bureau gratefully acknowledges all the following chemistry teachers who participated in identifying areas to be improved during the validation of the draft copy:

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SETTING UP YOUR LABORATORY

In some ways, a laboratory is very much like a library; but instead of looking up information, the laboratory worker finds out about it for himself. In both places the working conditions are similar. Librarians must catalog books in a library and store them in a neat and orderly fashion. Chemists must label their equipment and chemicals in a laboratory and store them in an equally neat and orderly manner. Silence in a library is essential, so the people using it can concentrate on their work. Silence is essential in a laboratory too, so the workers can give their complete attention to their work.

For these reasons, and also for the sake of safety and convenience, you will want to find some special place at home in which to establish your laboratory. It must be reasonably quiet and out of everyone else's way. It must be well lighted and there must be a sink in the laboratory, or very close by, so you can easily get water. To be completely on the safe side, it should be in a place that the younger children can't get to easily. Your fascinating collection of apparatus and chemicals may tempt them to try things that might prove dangerous.

Once you have chosen a good location you will need these things:

1. A large table on which to perform your experiments. You should cover it with a heat- or chemical-proof substance, such as linoleum, glass or tile. If this is not possible, several layers of newspaper, which you must change regularly, will do.
2. Above your work area, there should be one or two shelves on which to keep your chemicals-all, of course, properly labeled and stored, either alphabetically or in groups according to the type of experiment in which you may use them. There is one important exception to this, however. Do not place an *acid*, such as vinegar, near an *alkali*, such as ammonia. Enough molecules of each substance can escape even from closed bottles to cause a chemical reaction in the surrounding air. The reaction could contaminate the outside of the bottles and the chemicals nearby.
3. Your laboratory apparatus will include those items which you can make yourself, a few which you will have to purchase, plus many things you can collect, such as baby-food jars, small plastic bottles and corks of different sizes. Keep all of these in separate places on the shelves or in drawers or boxes which are clearly labeled.

4. Be sure to have at least one ceramic or pottery waste container for discarded, used, or unwanted solid chemicals, for broken glass, and for the remains of successful

experiments. To get rid of liquid wastes, you must pour them into a sink, with the water constantly running, or put them into a separate metal waste container.

Your laboratory, like your desk, is essentially yours. It should meet your needs and convenience and should suit your methods of working. It is also your responsibility. You must see that the work you do there doesn't cause danger, inconvenience, or worry to anyone else.

LABORATORY SAFETY RULES

Chemistry laboratories can be hazardous if the rules are not followed. During a chemistry course a student may handle materials which are carcinogenic, poisonous, flammable, and explosive. Some of these materials and equipment may also cause severe burns, cuts, or bruises if handled improperly or carelessly. Most accidents that occur in the chemistry laboratory are a result of carelessness, impatience, improper or unauthorized experimentation, and disregard for safety rules or proper operating procedures. In order to minimize the chances of an accident in the laboratory certain rules and regulations must be obeyed at all times when one is working or observing in a chemical laboratory. Therefore, it is not advisable for anyone to work in a laboratory without proper knowledge of the dangers involved. Due to the inherent dangers present in a chemical laboratory exercise, it should be understood that the following rules must be obeyed to minimize the chance of an accident. The student is expected to exercise proper judgment and extreme caution at all times when working in the laboratory.

1. DO NOT perform unauthorized experiments or work in a laboratory alone.
2. Approved eye protection must be worn at all times in the laboratory. Tennessee State law requires the use of such devices. Eye protection must be splash proof chemical goggles and be approved by your instructor. If you do get a chemical in your eye rinse immediately with large quantities of water using the eye-wash stations.
3. Long hair and loose clothing must be confined while in a laboratory.
4. Appropriate clothing must be worn at all times while in the laboratory. Your legs must be completely covered below the knee by your choice of clothing. If your clothing does not meet the requirement you may choose to wear an approved laboratory coat or apron which does cover your legs to your knees.
5. Closed shoes with socks must be worn at ALL times – open-toed shoes, backless shoes, sling backs, clogs, and sandals are not permitted.

6. Know the location and proper use of fire extinguishers, fire blankets, safety showers, eye wash devices, and first aid kits.
7. Before obtaining any chemicals carefully read the label on the reagent bottles.
8. Eating, smoking, and drinking are not allowed in a chemistry laboratory.
9. Thoroughly wash your hands after leaving the laboratory.
10. Use the fume hoods when toxic or irritating vapors are involved.
11. Mouth suction is never used to fill a pipette.
12. Never force glass tubing through cork or rubber stoppers without proper lubrication.
13. Never direct the open end of test tube toward yourself or anyone else.
14. Never pour water into concentrated acid.
15. Learn the proper procedure for igniting and operating a laboratory burner. Always extinguish the flame when the burner is not being used. Make sure that all flammable reagents are well removed before lighting the burner.
16. Liquid and solid waste containers must be properly used at all times.
17. Never place chemicals directly on the balance pan. Always use a proper weighing container when using a balance to weigh a chemical. Never pour chemicals directly over the balance.
18. Never return unused chemicals to their original container (unless directed to do so by the instructor).
19. Securely replace lids, caps, and stoppers after removing reagents from containers.
20. Always wipe spatulas clean before and after inserting into reagent bottles.
21. Report any accident and/or injury, however minor, to your instructor immediately.
22. Never place anything that is not directly required for the experiment on laboratory desks; other items may interfere with the experiment.
23. All personal belongings should be placed in the bookcases as you enter the laboratory.
24. Clean up any spill immediately
25. Before leaving the laboratory, make sure your work area is clean and dry. Ensure that all gas, water, vacuum, and air valves are completely turned off.
26. Your instructor is available for any assistance you may need. Never hesitate to ask questions especially if there is any question concerning proper operating procedure. Be sure that you understand every instruction before proceeding.

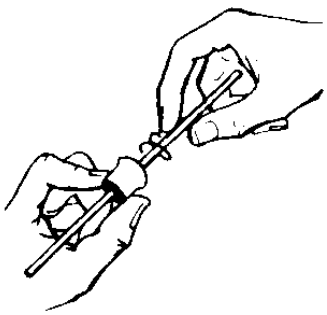
Always keep a good supply of tap water on your laboratory table. Unless you are working near a sink, have a wide-mouthed gallon jar filled with water close at hand, as well as several large sponges for wiping up any chemicals that might be spilled.

If an acid or an alkali (base) is spilled on your clothing, skin or any place in your laboratory, immediately wash the area with lots of clear water.

Be very careful of hot glass. It doesn't look hot and it cools very slowly. Treat burns at once with sodium bicarbonate solution. Never put hot glassware down on an unprotected table.

When heating chemicals or chemical solutions in a test tube do not point the open end toward yourself or anyone else, Keep rotating the test tube constantly with a gentle circular motion so that bubbles forming rapidly in the bottom of the test tube will not force the liquid out of the tube in a dangerous way.

Before using glass tubing, be sure that both ends are fire-polished (page 11). To put the tube through a cork or rubber stopper, wet it first. Hold it with a piece of cloth and insert it gently into the hole by rotating it while you apply pressure. Once you have started the tubing through a stopper, never hold the tube from a point more than 2 inches away from the stopper.



Otherwise, the weight of the stopper will make the tube snap. If the tubing is part of a funnel or thistle tube, do not hold it by the funnel for the same reason. Handle thermometers the same way, too.

Never use a chemical that is not labeled. It might be poisonous or cause a violent and dangerous reaction. Never return unused chemicals to their original bottles. You may cause contamination or make an error that will spoil future experiments. Throw the unused chemical away in the proper waste container. Only waste paper belongs in the wastepaper basket. Put discarded solid chemicals in an earthen or pottery jar. Later you should wrap them in newspaper and throw them in an incinerator or garbage can. Put liquid wastes into a sink partly filled with water, and then wash them away with the tap water running for at least 5

minutes. This will dilute them and lessen the effect they might otherwise have on the plumbing.

Keep glass apparatus spotlessly clean. Contamination often spoils the results of experiments. When you wet clean glass, it takes on an even coating of water, but on dirty glass the water forms small droplets instead. You can use any good detergent for cleaning, but be sure to rinse the apparatus thoroughly afterward.

LABORATORY EQUIPMENT YOU MAY FIND AT HOME OR EASILY BUY

Aluminum foil, aluminum pie pans, apron, rubber or plastic, asbestos pad, large and small candles, cellophane tape, cigarette lighter, coffee can, colorless nail polish, hard paper, copper wire, cord or string corks, dishpan, black and white drawing paper, drinking straws, dry cells, eye dropper, flashlight, large and small funnels, glass chimneys, glass jars, hammer, ink, matches, measuring cup, nails, paper and pencil, paper clips, soft paper, paring knife or penknife, pots and pans, Pyrex bowls, small rubber bands, scissors, steel wool pads, teaspoons and tablespoons, thermometer, waste containers, ceramic and metal wrapping paper-the transparent cellulose kind used to store food.

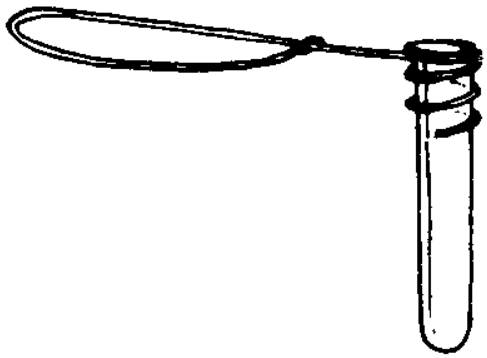
LABORATORY EQUIPMENT YOU CAN MAKE

You won't need a great deal of expensive laboratory apparatus to perform the experiments in this book. You can make much of the equipment yourself from ordinary things you will find at home. Don't be afraid to invent things of your own. Many scientists are constantly devising new pieces of equipment because there is nothing suitable in their laboratories for the new experiments they think up.

1. How to Make a Test Tube Holder

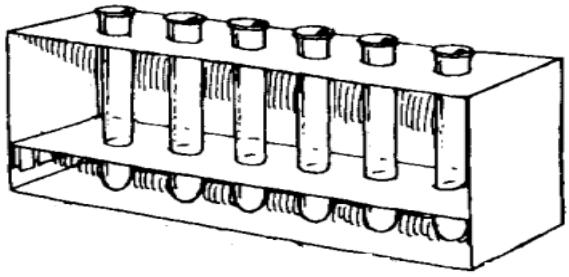
Cut a 12-inch piece of wire from the lower edge of a wire coat hanger. Use a wire cutter or a pair of wire-cutting pliers. Or, with an ordinary pair of blunt-tipped pliers, bend the wire back and forth until it breaks. Starting at one end, wrap the wire around a dowel stick of about the same diameter as your test tubes. Start wrapping the wire from the top of the dowel stick and make at least three turns downward. Remove the dowel and bend the other end of the wire into a loop to use as a handle. Try the wire holder around one test tube for size. The tube should fit within the coils loosely, but shouldn't slide through. The edge of the tube should

rest on the uppermost coil. **If** the tube doesn't fit correctly into the holder, adjust the coils until it does. You might want to make several test tube holders.



2. How to Make a Test Tube Rack

Find an empty but sturdy shoe box that is not quite as wide as your test tubes are long. Remove the cover and stand the box on its side, with the open part facing you. Using the top edge of a test tube as a guide, trace six circles in a straight line on the upper most side. Now cut them out with a pair of scissors or your penknife. Cut the rim off the cover, and fit the cover into the box parallel to the sides. If it's too large to fit into the box, trim it where necessary. Stick a pencil down through the holes in the side of the box to the trimmed-off cover, and make marks on it, directly below the center of each hole. Now cut out holes around these marks and make them the same size as the other six holes. The side of the box will be the rack as you have probably guessed and the trimmed-off cover will be a shelf underneath it. With cellophane tape attach the shelf to the walls of the rack about 1 inch from the bottom. Slip an empty test tube into each hole in the top and through the hole directly below it.

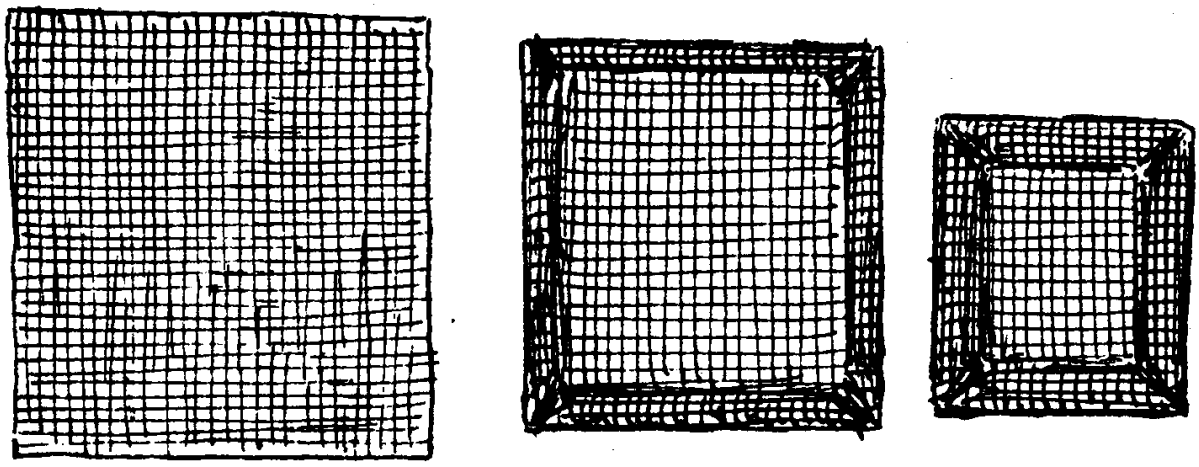


If you traced the holes correctly, the tubes will fit. Cover the surfaces of your test tube rack with aluminum foil to make it last longer. You will need several of these racks, and you will want to replace them as soon as they become wet or contaminated with chemicals. If you have test tubes of more than one size, you will have to find different boxes to fit the various sizes.

3. How to Make a Wire Gauze Pad

From aluminum screening (the kind used in summer window screens) cut a 5-inch square. With a dark pencil or a piece of chalk, measure! of an inch in from each side and draw a square.

Measure 0.5 an inch in from each side of the square you just drew, and draw a second square. Now, using a metal or metal-edged ruler as a guide, fold in the screening in the outside square. Do this on all four sides. After making the first fold, and still using the ruler as a guide, fold in on the second line. You may find it difficult to manage the corners. If so, tap them gently with a hammer.



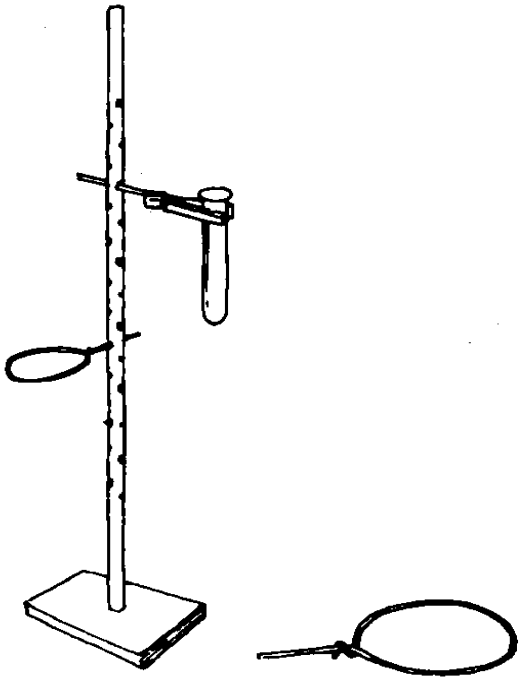
Now you have a wire gauze pad which can withstand the heat of your alcohol burner, and which will not endanger your fingers while you are using it. To use it, you place it over the ring support and rest on it the container you wish to heat. You will probably want several wire gauze pads.

4. How to Make a Ring Support and a Clamp on an Upright Stand

For the stand, obtain a piece of wood 6 inches long, 4 inches wide and 0.5 inch thick. Find the center by drawing diagonal lines from opposite corners. Drill a 0.5 inch hole through the board at the central point. Get a dowel stick 0.5 of an inch in diameter and 2 feet in length. With the help of the shop teacher in your school or your father at home, drill alternate 0.25 inch and 0.125 inch holes in the dowel stick at intervals of 2 inches, beginning 4 inches from one end. You will be able to use these holes to hold either the ring support or the clamp. Insert the dowel stick into the hole in the center of the board.

To make the ring support, cut a l0-inch length of coat hanger wire. Measure 6 inches from one end. With a pair of blunt-end pliers, bend the wire at this point to form one loop, or

circle. This loop will support a funnel, a crucible, an evaporating dish, a wire gauze pad, or other pieces of apparatus. To use the ring support, insert the straight end of it into one of the small holes in the upright dowel stick, at the desired height.



To make the clamp, obtain a 0.5 inch dowel stick, 6 inches long. Glue one end of the "handle" of a pinch-type clothespin to the end of the dowel stick, and for extra strength wrap the two together with fine steel wire, pulled tight and twisted with the blunt-end pliers. When you squeeze it to an "open" position, the clothespin will hold a test tube, glass tubing, or other pieces of equipment. As with the ring support, you can insert this clamp into any suitable hole in the upright dowel that is at the correct height for your needs.

5. How to make a Tripod

Operation of heating something is one of the important methods, when we do the experimental chemistry and a tripod is a useful item for heating. Therefore, we make a tripod in order to expand that we can do chemical experiments.

How to experiment

Materials required: Steel pipe (curtain rail)[12cm] × 3, Iron wire[24cm] ×6, a pair of pliers, saw for metalworking or woodworking or cutter, sand paper, ruler

Procedure:

(1) Cut the steel pipe cm each by using a ruler and saw. (Fig.1)

(2) Cut the iron wire cm each by using a ruler and a pair of pliers. (Fig.1)

(3) Bend the wire like the figure. (Fig.2)

(4) Connect two legs by iron pipe like the figure and connect other legs by another wire like figure. (Fig.3)

(5) Bend the three legs as in order to be stable.

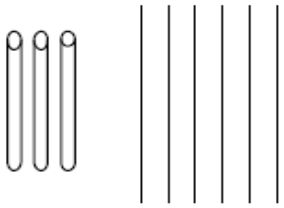


Fig.1.

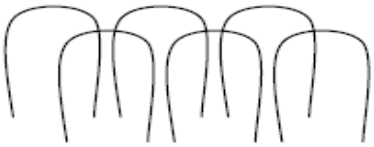


Fig.2.

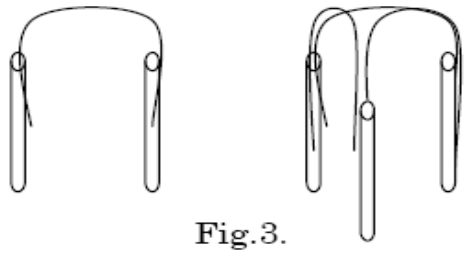
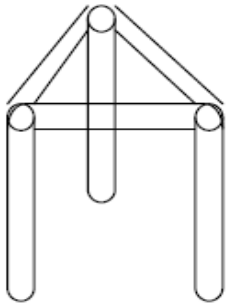


Fig.3.



Finished goods

Conclusion

This tripod is very useful when you heat a beaker or something. It needs to change the length of legs depending on your alcohol burner. It is dangerous if the tripod is NOT stable. Therefore you have to do the legs stable.

6. How to make an Alcohol burner

Operation of heating something is a one of the important method, when we do the experimental chemistry. An alcohol burner is one of the necessary items in the laboratory. Therefore, we make an alcohol burner in order to expand that we can do chemical experiments.

How to experiment

Materials required: Glass bottle with metal cap, nail, hammer, wick (mop), and alcohol.

Procedure:

(1) Make a hole in the center of cap by using a nail and hammer. (Fig.1)

(2) Through the wick into the hole of the metal cap. (Fig.2)

(3) Pour the alcohol into the bottle.

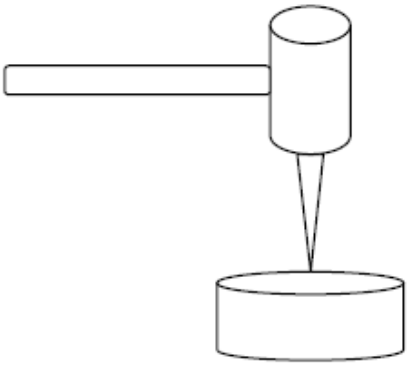


Fig.1.

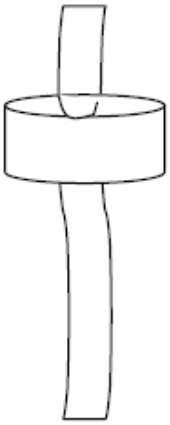
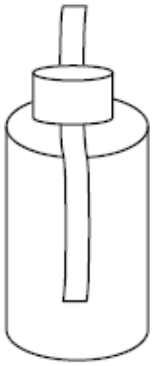


Fig.2.



Finished goods

Conclusion

We can use this alcohol burner when we want to heat something. And we can expand our materials by using this burner. When you use this alcohol burner, put a light to the wick by striking a match. When you put out the fire of the alcohol burner, cover with a small beaker. When you use this alcohol burner, you must NOT put anything unnecessary on the table. If amount of alcohol become half, you should put out the fire once and add the alcohol into the bottle. By using this burner, you can do a lot of experiment that need the heating operation. But using fire is included a danger so you have to be careful always you use.

7. How to take a battery apart

A battery consists of a lot of material for example Zinc, Carbon rod and Manganese dioxide. Therefore we can get these materials by taking the battery apart. These materials are used the experiments of preparation of Hydrogen and Oxygen, electrolysis and so on.

How to experiment

Materials required:

Battery, cutter, a pair of scissors, a pair of pliers, tweezers

Procedure:

(1) Cut a part of top of the battery by using cutter and remove the part by using a pair of pliers. (Fig. 1.)

(2) Cut the part of rubber by using cutter and separate a part of carbon rod and the other part.(Fig.2.)

(3) Remove the part of rubber from the carbon rod.

(4) Take out the all of manganese dioxide from the zinc case. (Fig.3.)

(5) Open the zinc case and separate a rectangle part and circle part. (Fig.4.)

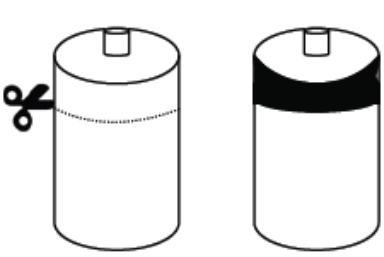


Fig.1.

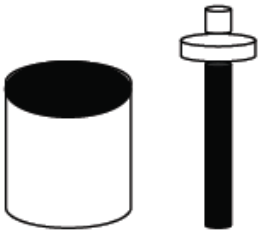


Fig.2.

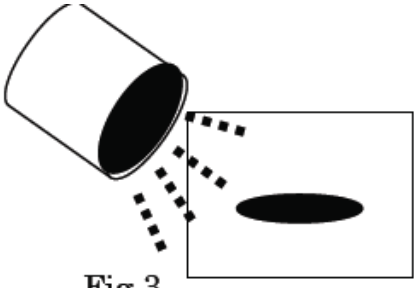


Fig.3.

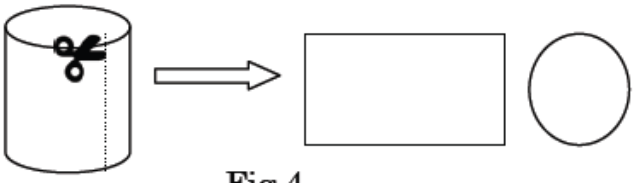


Fig.4.

Conclusion

We can get materials (Zinc, Carbon rod, Manganese dioxide) from the battery. And we can learn about the structure of battery by taking it apart. When you use a used battery for this experiment, you can get Carbon rod and Manganese dioxide but you can't get Zinc. Therefore when you need Zinc, you should use a new battery.

LABORATORY TECHNIQUES

The handling of laboratory apparatus is a skill you will want to develop. As with any other accomplishment, you will find a great deal of satisfaction in mastering it. It will help you to do your experiments more easily and more efficiently.

Neatness and cleanliness are very important in a laboratory. Arrange the shelves above your table to suit your own convenience, but after every experiment, be sure to return each piece of equipment to its proper place. Keep all metal and glassware clean and dry. Keep the outside of your "stock" bottles clean and free of any chemical substance. Replace worn or torn boxes at once. Label everything in your laboratory correctly and legibly.

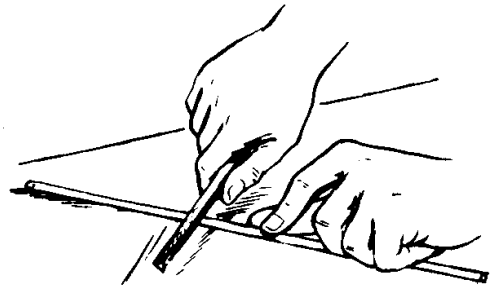
1. How to Use an Alcohol Burner

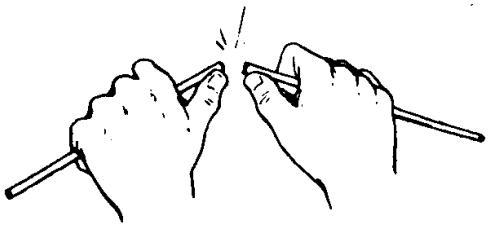
Many experiments require heat, and the alcohol burner is more efficient for this purpose than a candle. Keep the wick clean and trimmed. Whenever the flame is not blue, it is either because the wick is dirty or needs trimming. When you are not using the burner, keep it tightly covered to prevent evaporation of the alcohol. In lighting the burner, strike the match away from you. In putting it out, cover it quickly with the metal cap. After you refill it and

before you strike a match, make sure that no spilled alcohol remains on the outside of the jar, on the table, or on your hands.

2. How to Cut Glass Tubing

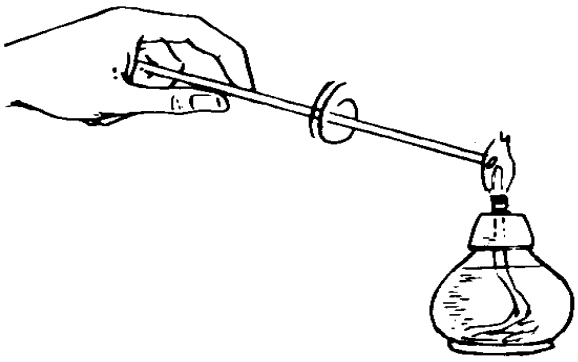
With the sharp edge of a triangular file, scratch one line on the tubing, at the exact point where you wish to cut it. Now place your thumbs on each side of the scratch and break the tubing quickly by forcing it away from you. The diameter of the tubing makes no difference; the method is the same.





3. How to Fire-Polish Glass

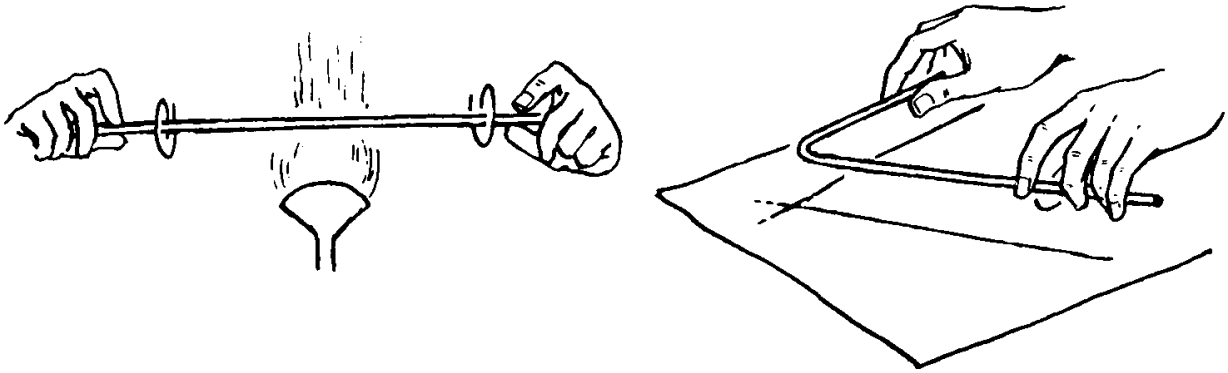
The rough edges of glass tubing make it awkward to use as well as dangerous. **If** the edges are very rough, rub them back and forth on a piece of wire screening to remove the largest "splinters." Do this over a piece of newspaper. When you have finished, fold the newspaper carefully and throw it away. Now light the alcohol burner and place one end of the tubing in the blue flame, holding the other end with your hand. The flame will become bright orange. Rotate the tubing between your thumb and forefinger until the edge in the flame is rounded. Place this end on an asbestos pad until it has cooled and repeat the process on the other end.



CAUTION: If you keep the glass in the flame for too long, it will melt, the hole will close, and you will have a closed tube instead of an open one.

4. How to Bend Glass

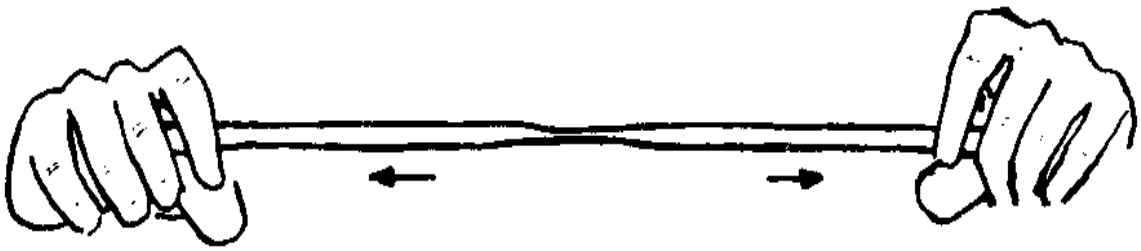
Put the flame spreader, or "fishtail tip" over the wick of your alcohol burner. Holding a piece of glass tubing in both hands, one on either side of the flame, rotate the glass until the bright orange color appears in the flame. Remove the tubing from the flame and bend it quickly to the desired angle. If you want a particular angle or special shape, draw it first on paper. When the glass is ready for bending, hold it an inch above the paper and follow your drawing like a pattern.



CAUTION: Remember the glass is very hot and may cause the paper to smolder if it touches it.

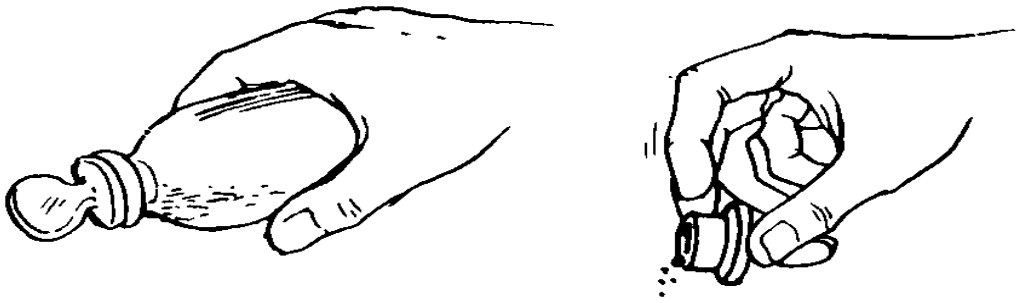
5. How to Stretch Glass

Do not use the fishtail tip on the burner. Hold the glass and roll it in the flame with both hands. When the bright orange color appears, push the ends of the tube together so that the walls of the tube become a little thicker. Remove the glass from the flame and pull the ends of the tube apart. Try to keep your hands and the tube in a straight line. To make a nozzle or a dropper, cut the glass to the length you want and fire-polish each tip.



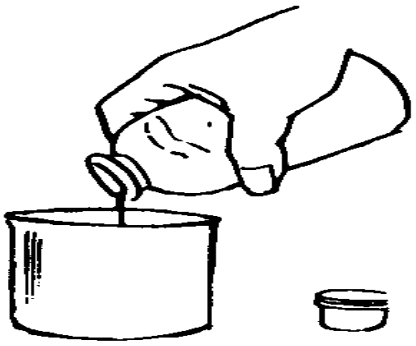
6. How to Handle Powdered Chemicals and Crystals

If the stopper is hollow, turn the bottle on its side and rotate it with one hand until some of the contents are inside the stopper. Remove the stopper in such a manner that the chemical remains in it, but none falls from the mouth of the bottle. Gently tap the stopper with your index finger until the correct amount has fallen out. Replace the stopper.



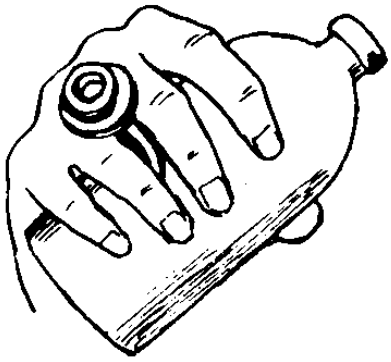
Using a spatula, shovel out a little of the dry material. Tap the blade of the spatula with your index finger as you did the stopper.

To transfer a chemical from a bottle to a small jar or beaker, remove the stopper from the bottle, tip the bottle and rotate it over the desired container until the proper amount is in the new container.



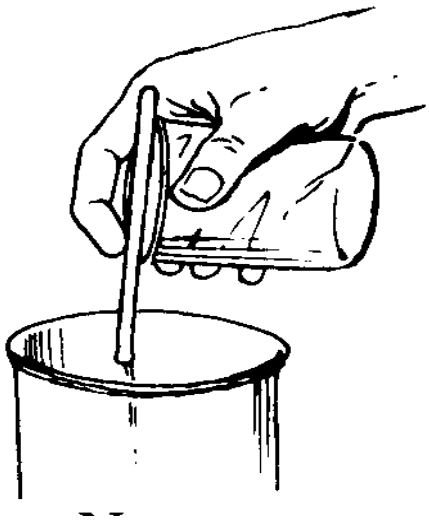
7. How to Remove the Stopper from a Bottle of Liquid Chemical

Holding the stopper in place with one hand, tip the bottle so that the stopper becomes wet with the liquid. Now hold the bottle upright, and, using the stopper, wet the edge of the bottle. Replace the stopper and remove it again between your third and fourth fingers. Keep your palm facing upward, and grasp the bottle in the same hand, between your thumb and first two fingers. By using the same hand to pour the liquid, your other hand remains free to hold additional equipment.



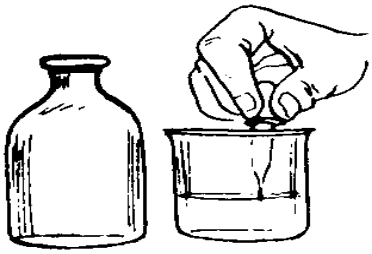
8. How to Pour a Liquid Chemical

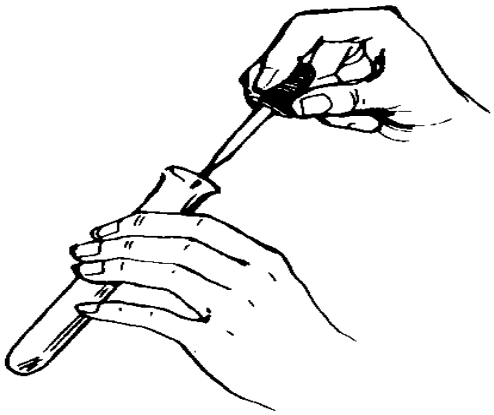
If you have removed the stopper properly, the wet edge of the bottle will prevent the liquid from rushing out too quickly. Now place a glass rod across the mouth of the tilted bottle, and pour the liquid down the rod. The rod acts to direct the flow.



9. How to Use an Eye Dropper

Never use an eye dropper to remove a liquid directly from a bottle. First pour a small quantity of the liquid into a beaker, and then use the eye dropper. To transfer the liquid to a test tube containing another substance, do not plunge the eye dropper into the chemical in the test tube unless instructed to do so. Instead, hold the dropper near the top of the test tube and let the drops run down the inside of the tube.



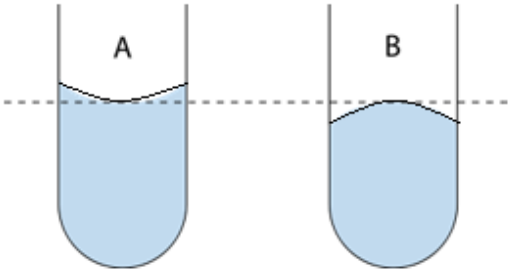


10. Measuring Techniques

Accuracy is of utmost importance when working in a science laboratory and learning how to effectively use common laboratory apparatuses is essential not just to make accurate measurements, but also to conduct successful experiments. The more you know and practice about the apparatuses, the better your chances will become of conducting successful experiments.

a) Measuring the Volume of Liquids with a Graduated Cylinder

The surface of a liquid confined in a cylinder curves to form what is known as a meniscus. The meniscus of most liquids curves up the sides of the container, making the center of the curve appear lower than the edges (Case A as shown below). Mercury is one of the very few exceptions - it curves down at the edges (Case B as shown below).



A: The bottom of a concave meniscus

B: The top of a convex meniscus

Since reading the meniscus at the top or at the bottom of the curve will make a difference in the volume measured, it is agreed to **read the bottom of the curve (in case of concave meniscus)** as shown in the figure below. Volumetric glassware is calibrated such that reading the bottom of the meniscus when it is viewed at eye level, will give accurate results. Viewing the meniscus at any other angle will give inaccurate results.

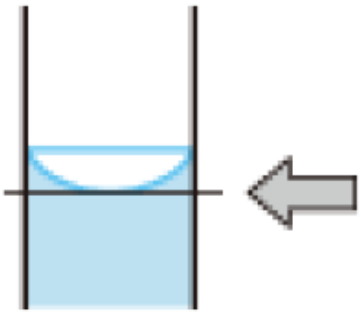


Figure 1: Read the bottom of the curve.

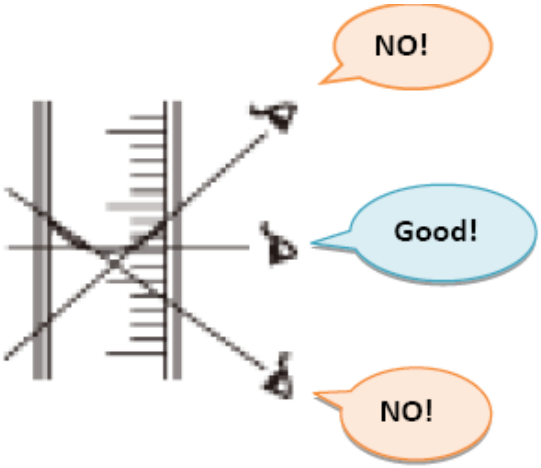
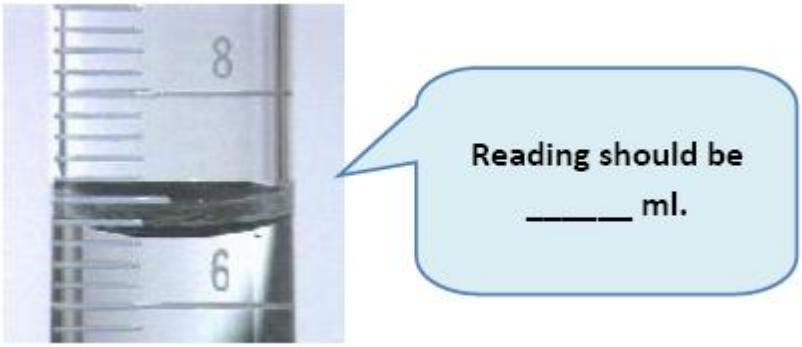


Figure 2: The level of your eyes should be on the same line to

The picture given below shows the meniscus of a liquid in a 10ml graduated cylinder. What is the volume of the liquid?

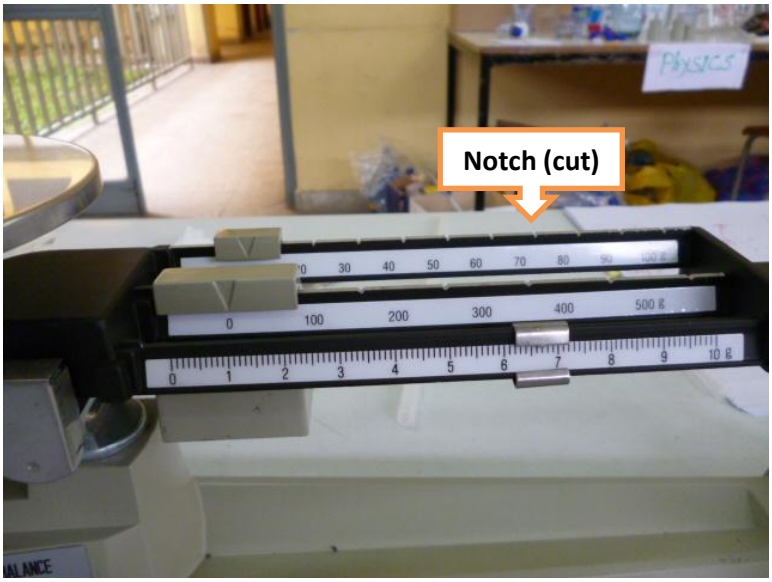


The visibility of the meniscus can be enhanced by using a card with a dark stripe on it, placed behind the cylinder. Adjusting the placement of the card can give you either a white meniscus against a black background or a black meniscus against a white background.

b. Measuring Mass with a Triple Beam Balance

The triple-beam balance was once the "standard" balance in the general science laboratory. While the electronic balance has replaced it in many cases, we should be familiar with the triple-beam balance and how to read one. **The balance is named for its three "beams".**

An object is placed on the pan of the balance and tares on the beams are moved to balance the mass. As you face the balance, the back beam is graduated in **10 gram steps** and the middle beam is graduated in **100 gram steps** as shown in figure below. **It is very important that the tares on these two beams are in the notch (cut) for the whole number of grams and not in between notches.** The front beam is a sliding scale graduated in grams. The tare on this beam can be positioned anywhere on the scale.



Masses on a triple-beam balance **can be read to tenths of a gram, and estimated to hundredths**. Therefore, the adjustment of the tare of the first beam should be as accurate as possible until **the pointer exactly meets the line of balance** as shown in the picture below.

N.B.: Do not put the substance to be measured directly on the pan of the balance as some substances may affect the pan or be affected by the pan. You can use paper or any other appropriate material after taking its mass separately.

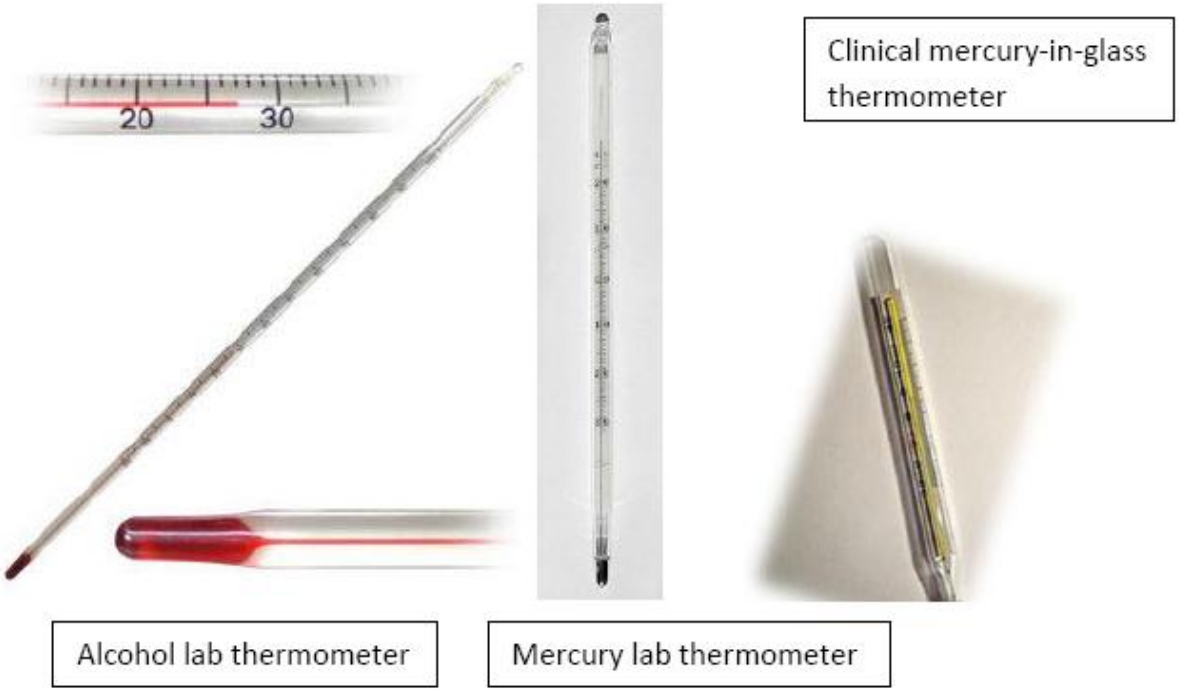
c) Measuring Temperature

Thermometer

A thermometer is a device that measures temperature or temperature gradient using a variety of different principles. A thermometer has two important elements: the temperature sensor (e.g. the bulb on a mercury thermometer) in which some physical changes occur with

temperature, plus some means of converting this physical change into a value (e.g. the scale on a mercury thermometer).

There are different types of thermometer, such as alcohol thermometer, mercury laboratory thermometer and clinical mercury in glass thermometer, as shown below. In Ethiopia, the most common thermometer is mercury laboratory thermometer.



Measuring Temperature in science Laboratory

When measuring the temperature of different samples, basically a mercury laboratory thermometer is used. We also use the thermometer to control the increase or decrease in temperature, if the temperature is a factor affecting the reaction.

Here are tips on how to use and handle the thermometer:

1. Read the thermometer **keeping the level of mercury along the line of sight** as shown in the picture.

2. Handle the thermometer with care. If it hits against some hard object, it can break. If it is broken accidentally,

- Clean up the spill promptly. If spills are not promptly cleaned up, mercury may accumulate on surfaces and then vaporize and be inhaled later which is dangerous.

- Remove animals and other people from the area.
- Do not touch liquid mercury with your hand.
- Because of the properties of liquid mercury, it will tend to form "liquid beads" on a hard surface like a counter or floor.
- Do not flush mercury down the drain.
- Do not use a broom to clean up the mercury.
- Be careful of broken glass fragments. After all the mercury is collected with care, a broom and dust pan can be used to clean up the broken glass. Dispose of the glass in an appropriate trash container.
- Wash the affected area with a detergent soap and allow to air dry before it is safe to reuse the area.
- Remove and dispose of the plastic bags as regular trash.
- Thoroughly wash your hands with a detergent soap.

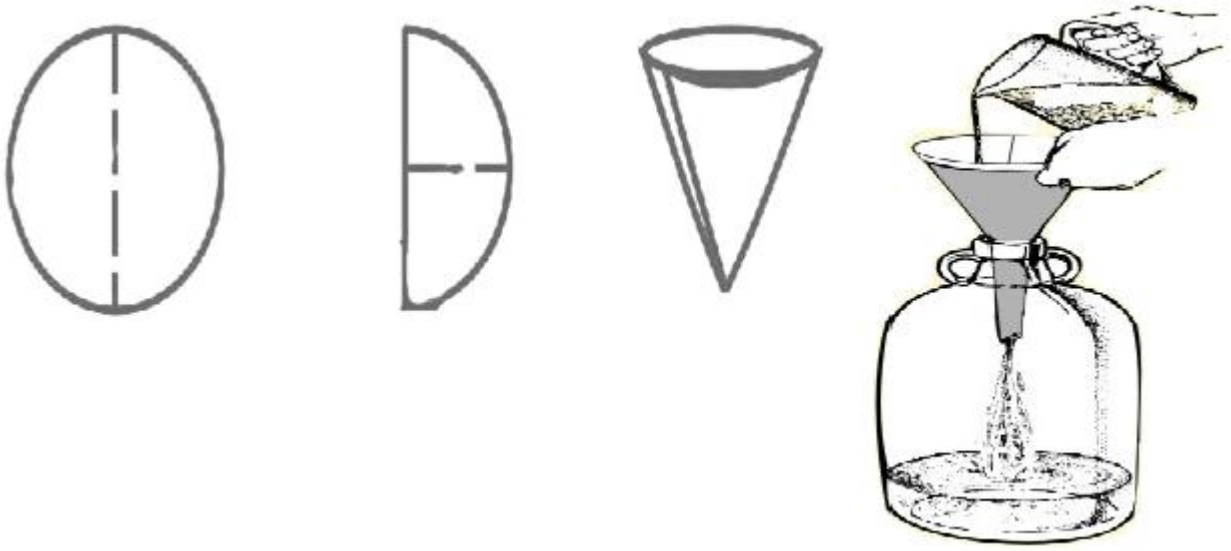
3. **Do not hold the bulb of the thermometer** while reading it.
4. The thermometer should be kept upright not tilted.
5. The bulb of the thermometer should be surrounded from all sides by the substance of which the temperature is to be measured.
6. The bulb should not touch the surface of the container.
7. After checking a temperature with thermometers, the content (mercury or colored alcohol) does not go down quickly, but with time. To reset the thermometer for next measurement, shake it gently until the mercury or alcohol level goes back to room temperature before using it again. Sometimes a bubble develops and the mercury or alcohol inside is stuck in place, or spread over the tube, especially for the alcohol thermometers. This makes it impossible to take temperature readings. Therefore, do not shake it thoughtlessly. Hold the upper side of the thermometer and try to shake it in a way that mercury or alcohol will be pushed down towards the bulb.

N.B

- ✓ Thermometers are expensive and easily broken. Mercury thermometers are a source of overall mercury contamination to the environment and a possible health risk to the user when broken therefore care must be taken.

11. How to Use Filter Paper

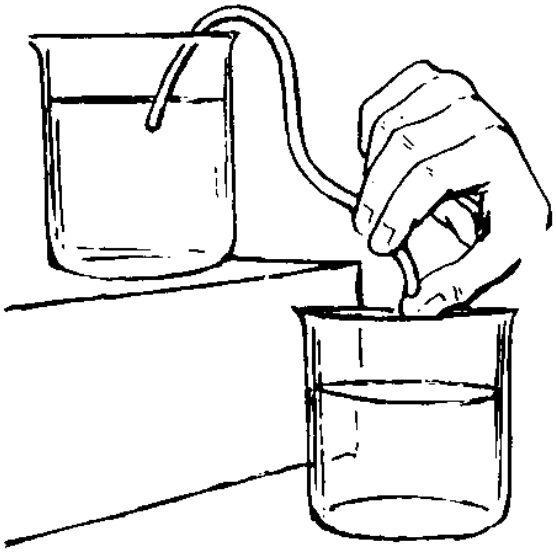
Fold a circle of filter paper in half and then into quarters. Open it so that it becomes cone-shaped. Roughly tear off one corner. Place the filter paper in a funnel and fill it with water. Let the water run through until there is no air in the stem, then stop the flow with your finger. Now add the liquid mixture to be filtered. The presence of liquid rather than air in the stem makes the other liquid, that is, the mixture, pour through more quickly.



12. Siphoning

When you have to transfer a liquid from one jar or beaker to another without disturbing the liquid by tilting the jar to pour from it, you use the technique of siphoning. You need two containers, of course, and a long tube. Use a rubber tube which will bend easily, not a glass tube. Place the containers on two different surfaces. The container to be filled should be on a surface lower than the bottom of the container to be emptied.

Submerge the tube in the upper container so that it is completely filled with liquid. Keep one end of the tube submerged and, holding the other end closed, lower it into the empty container. When you open the tube, the liquid will flow.



13. Heating technique

Heat is energy transferred from one system to another by thermal interaction. Heating substances is always exciting but it is essential to keep the amounts used to a minimum and to use the correct apparatus in the recommended manner.

a) Adjusting a flame

The principle upon which a Bunsen burner works is the combustion/burning of a gas composed of lower hydrocarbons. That may be natural gas, which consists, mainly of methane or butane. When hydrocarbons burn they produce **a flame**. Flame is the hot visible part of combustion of burning gases.

The complete combustion of butane gas produces a blue non luminous flame. The combustion reaction can be represented by the following chemical equation:

$$2C_4H_{10} + 13O_2 \longrightarrow 8CO_2 + 10H_2O + \text{Heat}$$

If the supply of oxygen is limited, the hydrocarbon would not be completely combusted and one of the products would be carbon, as shown the reaction equation:

$$2C_4H_{10} + 8O_2 \longrightarrow 3CO_2 + 10H_2O + 5C + \text{Heat}$$

In this case, the gas burns with a yellow luminous flame.

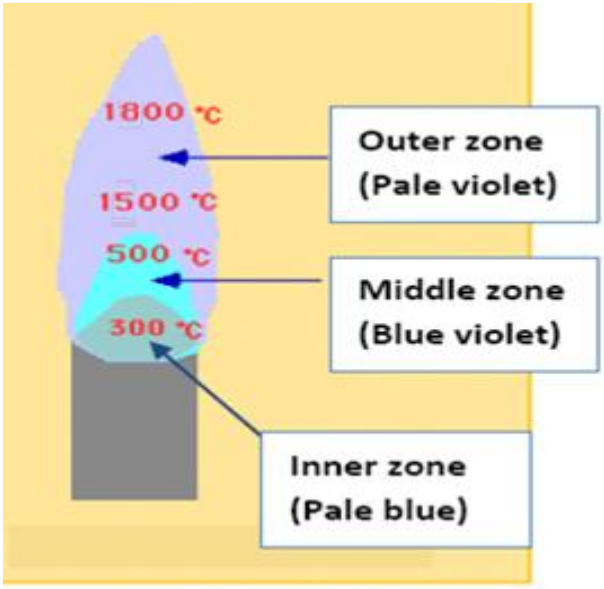
Table: Comparison between complete and incomplete combustion.

Complete Combustion (Non-luminous)	Incomplete Combustion (Luminous)
• Blue non-luminous flame • Unsteady and small size flame • No soot • More heat but less light	• Yellow luminous flame • Steady and large size flame • Soot • More light but less heat

If needed for its heat the flame should be non-luminous.

A non-luminous flame is steady and usually has three distinct zones:

1. Inner zone (un-burnt gas zone)
2. Middle zone (incomplete combustion zone)
3. Outer zone (complete combustion zone)



Zones of flame

Remember, when using a Bunsen burner:

(1) To light, have the air hole closed and the gas half on;

(2) To heat, use the blue flame, with the air hole half open and the gas half on;

(3) To heat strongly, use the roaring flame, with air hole wide open the gas fully on;

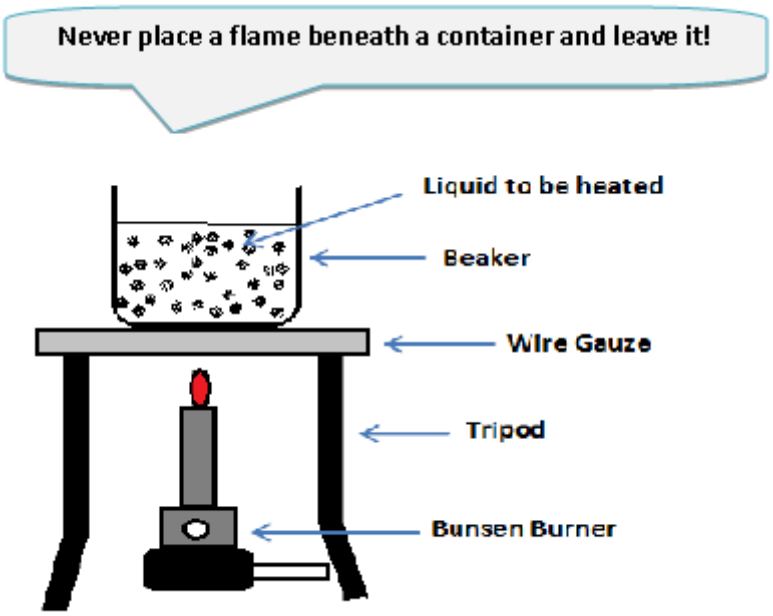
(4) To leave unattended, use the yellow flame, with the air hole closed.

b) Heating Liquids and solids

i. For heating liquids in a beaker or flask

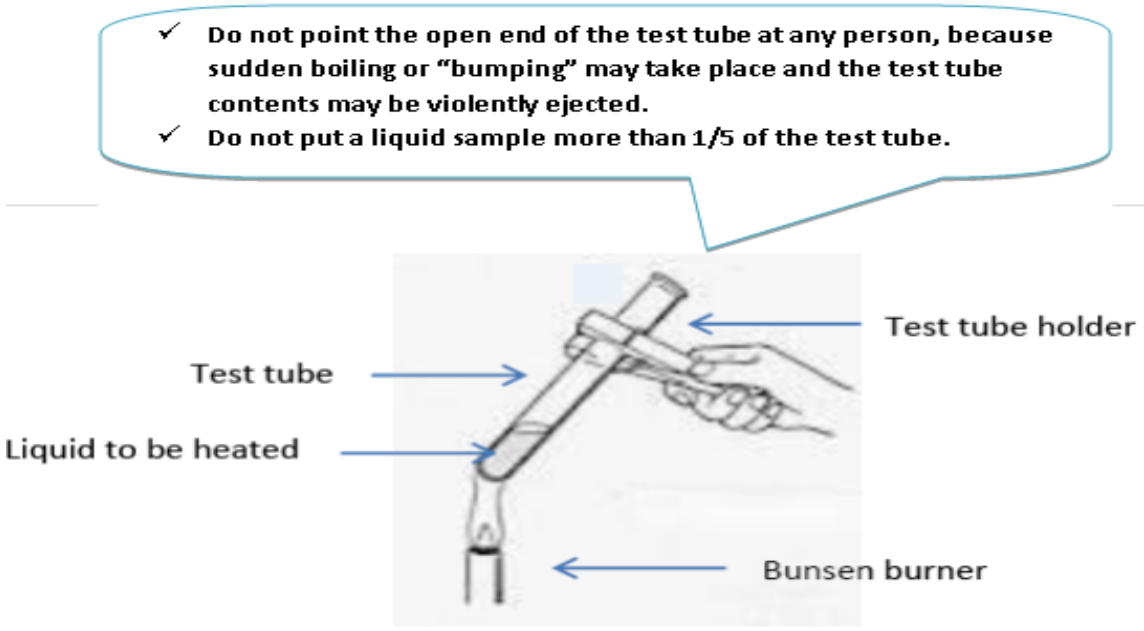
Place a square wire gauze on a ring clamped to a ring stand, or on a tripod stand. Put the container on the wire gauze. Adjust the amount of heat to be applied by altering the height of the flame.

In case of high pressure causes due to the long heating by Bunsen burner, round-bottomed flask with stand and clamps should be used. It is also recommended to use boiling stones or chips to avoid the sudden production of large gas bubbles which can lead to "bumping".



ii. For heating liquids in a test tube

Clamp the test tube at the top with a test-tube holder. Hold the tube at about a 30^{o}angle to the vertical. Pass the test tube **back and forth** through the flame until heating complete.



iii. For heating solids in a test tubes

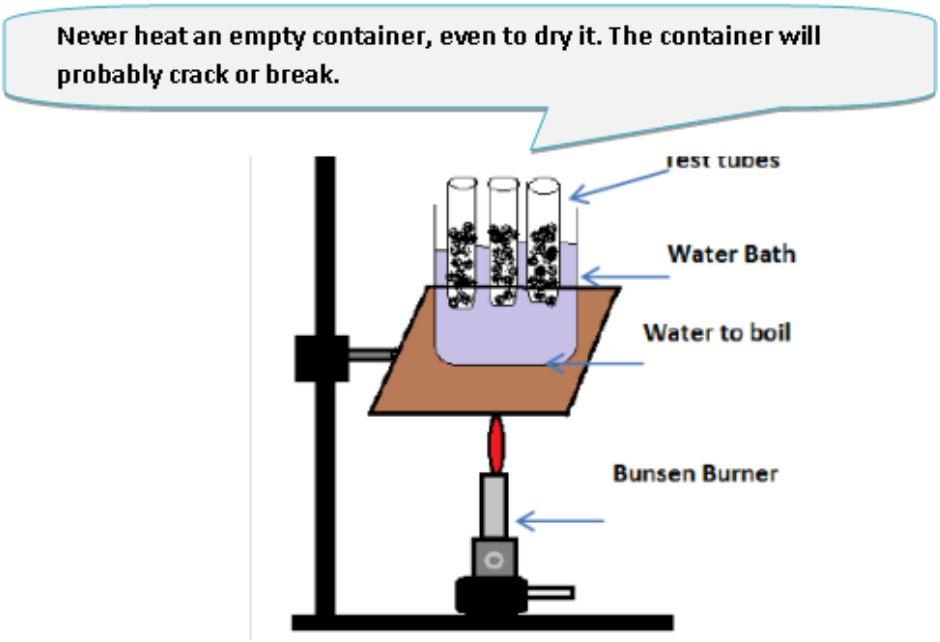
- ✓ Wear eye protection.
- ✓ Only fill to a maximum of 1/5 full.
- ✓ Use a suitable test tube holder.
- ✓ Hold the test-tube at a slight angle.
- ✓ Ensure that the open end of the test tube isn't pointing directly at anybody.
- ✓ Hold the test tube so that the bottom is just in the tip of the flame.
- ✓ Always start heating with a small, gentle flame.

The open end of test tube should be away from anybody.

iv. For heating liquids contained within test tubes in water bath

If many test tubes or small containers are required to be heated, it is a good practice to heat them in water bath. (Note: The temperature of heating is limited to that of boiling point of water.) This bath may be set up by filling half-full of tap water. You can boil the water and keep it there with proper adjustment. Test tubes or small containers may then be heated by simply placing them in the water bath.

This technique can be also used for heating inflammable liquids such as ethanol.



Heating in a water bath

14. The Statistical Method

All this really means is that the more times you repeat a particular experiment, the better basis you will have for predicting the result of that experiment in the future. The first time you do an experiment, you cannot really tell whether you would get the same result if you were to repeat it. But, if you did the same experiment 10 times and got the same result every time, you would then be fairly safe in predicting that that experiment will continue to produce the same result whenever it is done. In other words, the *margin of error* of your prediction would go down the more times you repeated the experiment and got the same result. If, on the other hand, you got 10 different results, your margin of error would go up, and any prediction you might make would be meaningless.

Professional scientists always use the statistical method. They know that they cannot leap to conclusions on the basis of a single experiment. The only way to be sure that particular conditions produce a particular result is to repeat an experiment over and over again. In science, to be "sure" means being able to predict with only a small margin of error that particular conditions will produce particular results. Accurate predictions can be made on one basis only-repeated experiments.

EXPERIMENTS FOR GRADE 7

1. DETERMINTION OF THE PHYSICAL PROPERTIES OF SUBSTANCES

Objectives: To determine the density and conductivity of substances

Materials required: Three fifty cent coins with equal masses, nails, beam balance, water, measuring cylinder, dry cell, light bulb, two pieces of **connecting wires**, wood and plastic.

PART A: *Determination of the density of a substance*

Procedures:

1. Using a beam balance, measure the mass of the three fifty cent coins. Record the mass.
2. Take a measuring cylinder which is large enough for the coin to enter in to it and
    a. Fill the measuring cylinder with water up to the 50 mL mark
    b. Add the three coins into the measuring cylinder turn by turn and see the change in the volume of the water after dropping all the coins as shown in Figure_1 and record the reading.

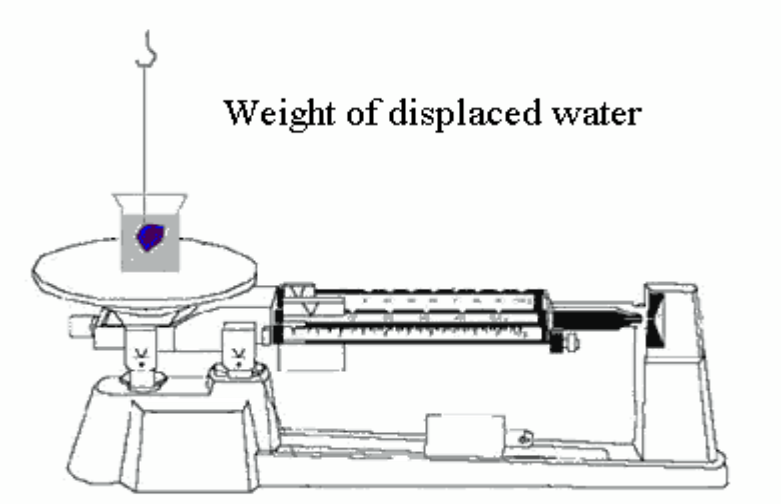


Figure 1: Determination of density

Observation and analysis:

i. What is the total mass of the three coins?

ii. What is the total volume of the three coins? (volume of coins= volume reading after putting the coins in to the beaker -50mL)

iii. What is the density of a single fifty cent coin?

PART B: *Conductivity of a substance*

Procedures:

1. Take a nail and connect its end to two different wires.
2. Attach one wire to one end of a dry cell (+ve) and the other wire to a bulb and then to the other end of a dry cell (-ve) as shown in the figure –2
3. *Observe whether the bulb gives light or not.*

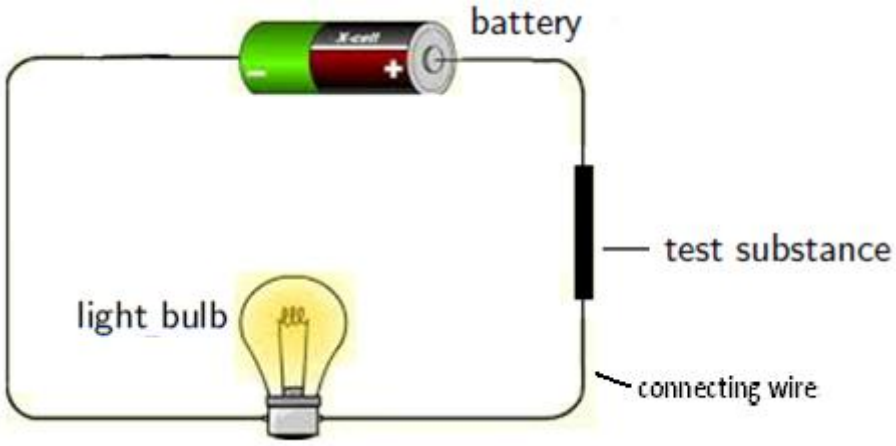


Figure 2: Conductivity of a substances

Observation and analysis:

i. Does the bulb give light? What does this indicate?

ii. What will happen if the nail in this experiment is replaced by a wood or a plastic material?

2. IDENTIFICATION OF SUBSTANCES BASED ON THEIR PHYSICAL PROPERTIES

Objective: To investigate the physical state and solubility of substances.

Materials required: Five different substances, water, five small beakers, spatula and glass rod.

Use the following procedure to identify the substances.

Procedures:

1. Examine each of the five substances and record your observation on their physical state.
2. Take the five small beakers and add 50mL water to each beaker. Then, add a spatula full of each of the substances to each beaker. Stir the mixture in each of the five beakers with a glass rod and observe the solubility of each substance.

Observation and analysis:

Copy the following table in your exercise book and record your observations.

Substance	State	Colour	Solubility in water
A			
B			
C			
D			
E			

3. IDENTIFICATION OF METALS ON THE BASIS OF THEIR PHYSICAL PROPERTIES

Objective: To identify metals by observing their physical properties.

Materials required: Copper, iron, aluminium, lead, sodium metal, and a magnet.

Procedures:

1. Take a magnet and check if the above metals are attracted by the magnet. Which metals are attached by the magnet and which are not?
2. Examine each metal carefully. Your record should include physical state and whether the metal is light or heavy, magnetic or nonmagnetic.

Metals	**Observed physical properties**		
	Colour	**State**	**Magnetic or non magnetic**
Copper			
Iron			
Aluminium			
Lead			

Observation and analysis:

i. Which metal can be identified by its reddish-brown?

ii. Which metal is light, silvery-white and attracted by a magnet?

iii. Which metal is greyish and has a high density?

4. DISTINGUISHING COMPOUNDS AND MIXTURES

Objective: To investigate the difference between a compound and a mixture.

Materials required: Magnet, iron filings, powdered sulphur, test tube, Bunsen burner, magnifying glass, tong and beam balance.

PART I

Procedure:

1. Mix 10g of iron filings with 6 g of powdered sulphur. Examine the mixture using a magnifying glass as shown in the figure 3
2. Place half of this mixture on a sheet of paper. Bring one end of a magnet close to the mixture as shown in Figure 3
3. Observe the components of the mixture with a magnifying glass.

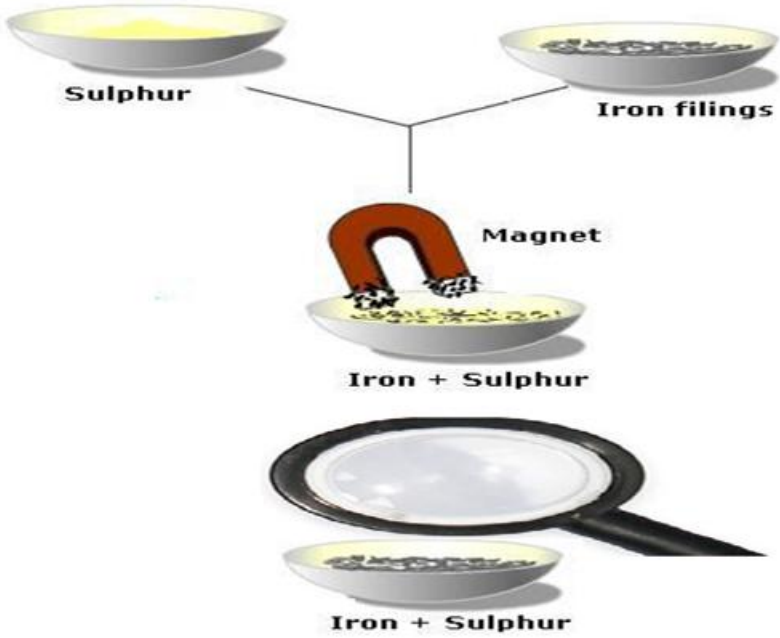


Figure 3: separating iron from a mixture of iron and sulphur

Questions:

i. What did you observe as you bring the magnet close to the mixture?

ii. What did you observe under the magnifying glass?

PART II

Procedure:

1. Place the remaining half of the mixture in a test tube. Heat the test tube strongly for a few minutes as shown below in Figure 4
2. Put off the flame and remove the test tube. After the reaction stops, break the test tube by plunging the hot end into a beaker of cold water.
3. Take the product formed and powder it. Examine the product under a magnifying glass. In addition, observe what happens when a magnet is brought over it.

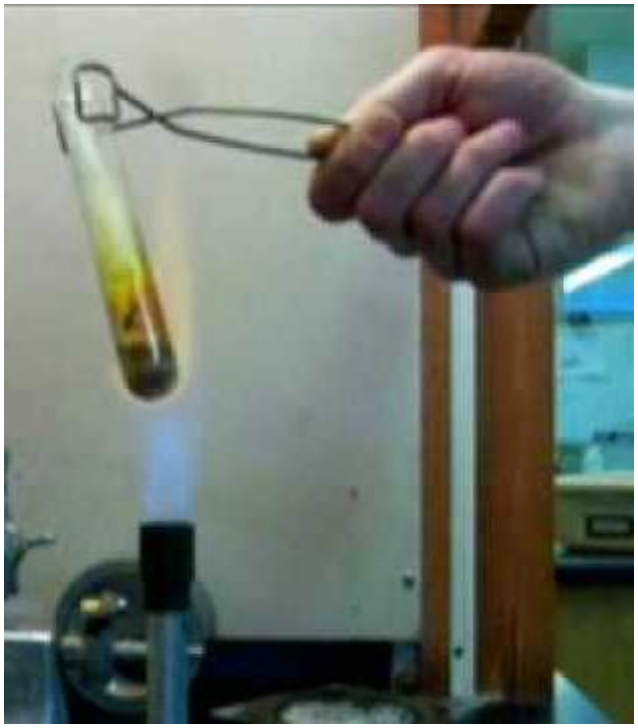


Figure 4: The reaction between iron and sulphur

Questions:

- What difference did you see under the magnifying glass?
- What about when a magnet is moved over it?
- Can you justify the cause for the difference you observed?

5. MELTING SULPHUR

Objectives: *to determine whether the melting of sulphur is a physical or a chemical change.*

Materials required: evaporating dish, watch glass, tripod Bunsen burner, tong, powdered sulphur, match and spatula.

Procedures:

1. Put 50g powdered sulphur on an evaporating dish,
2. Heat the test tube gently until all the sulphur melts as shown in figure 5
3. Observe the colour of the molten sulphur
4. Pour the molten sulphur on a watch glass and allow it to cool.
5. Let the watch glass stay for some days, and observe the change again.

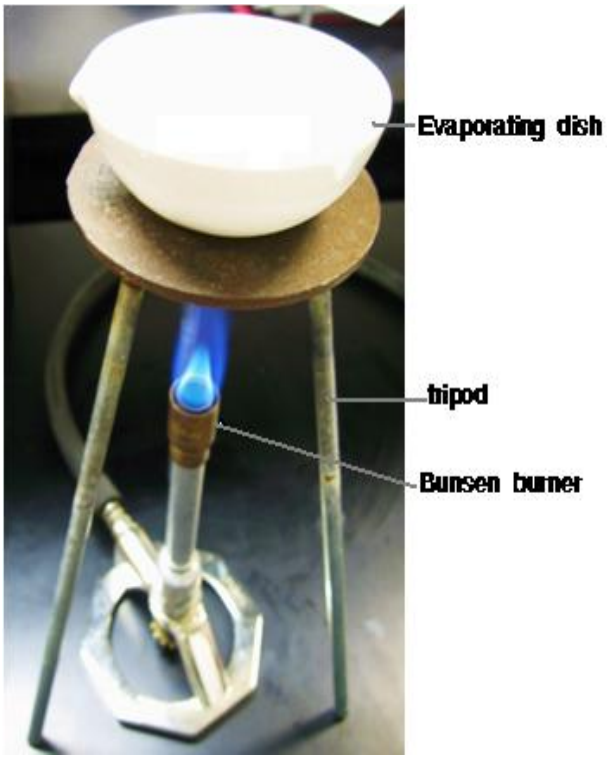


Figure 5: Melting sulphur

Observation and analysis

i. Name all the colour of sulphur you observed before and after the experiment.

ii. Is the change physical or chemical? Why?

6. RUSTING OF IRON

Objective: To investigate the type of change that occurs during rusting of iron.

Materials required: iron nails, test tube, water

Procedures:

1. Pour some amount of tape water into a test tube.
2. Put 3 or 4 clean and shiny iron nails into the test tube as shown in the Figure 6.
3. Let the test tube stay for a few days in an open air.
4. Observe the change that takes place.

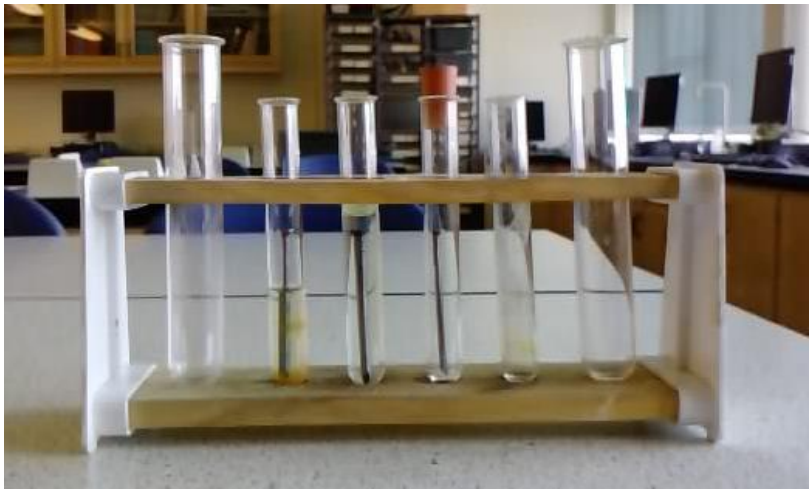


Figure 6: Rusting of iron

Observation and analysis

i. What happened to the surface of the iron nail?

ii. What colour do you observe on the iron nail?

iii. Is the change physical or chemical? Why?

7. BURNING MAGNESIUM RIBBON

OBJECTIVES: To investigate the change that occurs during burning of magnesium.

Materials required: Crucible, tong, magnesium ribbon, match, Bunsen burner (splint lamp).

Procedures:

1. Take about 7cm of magnesium ribbon.
2. Notice the properties of magnesium.
3. Polish the ribbon with a cloth
4. Hold the magnesium ribbon with tongs and burn it in the crucible as shown in Figure 7
5. Collect the substance formed in the crucible, and observe the colour. Will it burn if heated again?
6. Compare the properties of magnesium and the product formed.

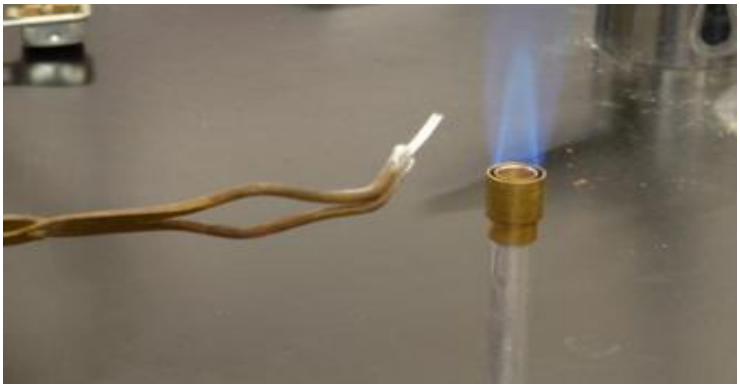


Figure 7: Burning of magnesium

Fill the following table based on your experimental result

Properties	Before burning	After burning
Colour		
State(form)		
Appearance		
Ductility		

Observation and analysis:

i. Is there a change in the composition of the after magnesium ribbon burning?

ii. Will the product burn if it is heated again? Explain.

iii. What type of change does the experiment indicate?

Note: If not available a magnesium ribbon in your laboratory substitute paper or sugar instead of it.

8. SEPARATION OF MIXTURE USING A MAGNET

Objective: To separate a mixture of iron and sulphur using a magnet

Materials required: magnet, iron filings, powdered sulphur, beaker, sheet of paper/ watch glass, spatula.

Procedures:

1. Take two spatulas of each of iron filings and powdered sulphur in to a beaker, and mix them thoroughly.
2. Place portion of the mixture on a sheet of paper/ watch glass.
3. Bring a magnet close to the surface of the mixture as shown in Figure 8.

Figure 8: Magnetic separation

Observation and analysis:

i. Which component of the mixture is attracted to the magnet?

ii. What can you conclude from the experiment?

9. DECANTATION

Objective: To separate a mixture of liquid and insoluble solid denser than the liquid component.

Materials required: Two beakers, glass rod, sand and water.

Procedures:

1. Put water and sand in to a beaker, and stir them thoroughly.
2. Allow the mixture in a beaker for one minute to settles down the insoluble solid.
3. Poured the liquid above solid into another beaker as shown in Figure 9.

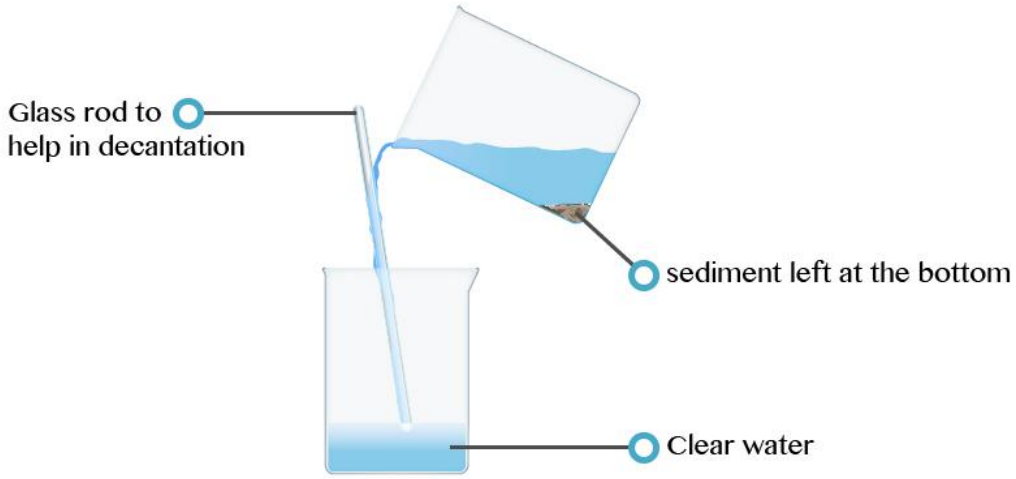


Figure 9: Decantation of muddy water

Observation and analysis:

i. Which component of the mixture is a sediment?

ii. What can you conclude from the experiment?

10.FILTRRATION

Objective: To separate a mixture of chalk (insoluble) and water by filtration.

Materials required: beakers, filter paper, funnel, flask, powdered chalk and water.

Procedures:

1. Put powdered chalk in to a beaker containing water, and stir the mixture to dissolve it.
2. Pour the mixture into the funnel fitted with a filter paper and collect the filtrate in the flask as shown in Figure 10.
3. Observe the result.

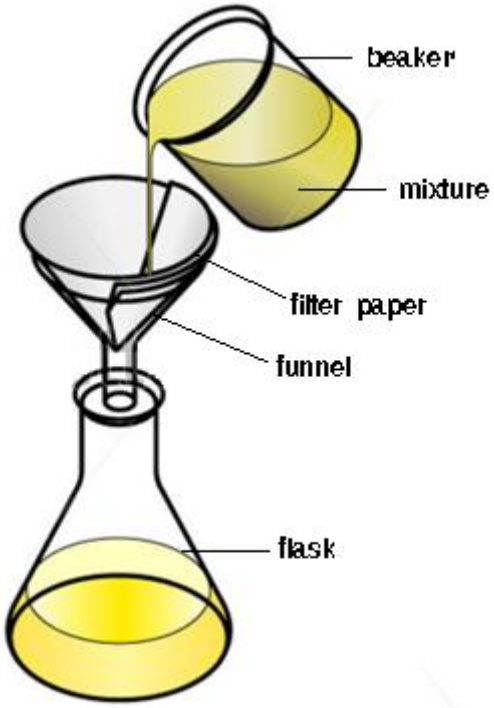


Figure 10: Filtration

Observation and analysis:

i. Does the powdered chalk dissolve in water?

ii. Which substance is collected in the flask?

iii. Which substance remains on the filter paper?

11.EVAPORATION

Objective: To separate salt from a salt solution.

Materials required: Burner, evaporating dish, tripod, wire gauze, salt, beaker, watch glass, beam balance, measuring cylinder.

Procedures:

1. Dissolve about 10g of common salt (NaCl) in 30mL of tape water in a beaker.
2. Pour the salt solution in an evaporating dish as shown in Figure 11
3. Boil the solution until all the liquid evaporates and observe the result.

Fig 11: The separation of salt from a salt solution by evaporation.

Observation and analysis

1. What did you observe in the evaporating dish?
2. What would happen to the level of the liquid if the evaporating dish is covered with a watch glass? Is evaporation possible?
3. What do you think to the rate of evaporation with increasing the size of the evaporating dish?
4. What about with the temperature?

12.SIMPLE DISTILLATION

Objective: To separate the mixture of water and alcohol.

Materials required: Distillation flask, condenser, wire gauze, ring, stand with base, clamp, Bunsen burner, conical flask, and beaker.

Procedures:

1. Mix 100 mL of ethyl alcohol with 150 mL of pure water in a 250 mL beaker.
2. Set up the distillation apparatus as shown in Figure 12.
3. Add the mixture into the distillation flask.
4. Put a porous material or sand (*boiling chips if there are any*) in the flask.
5. Heat the distillation flask gently and observe the results.

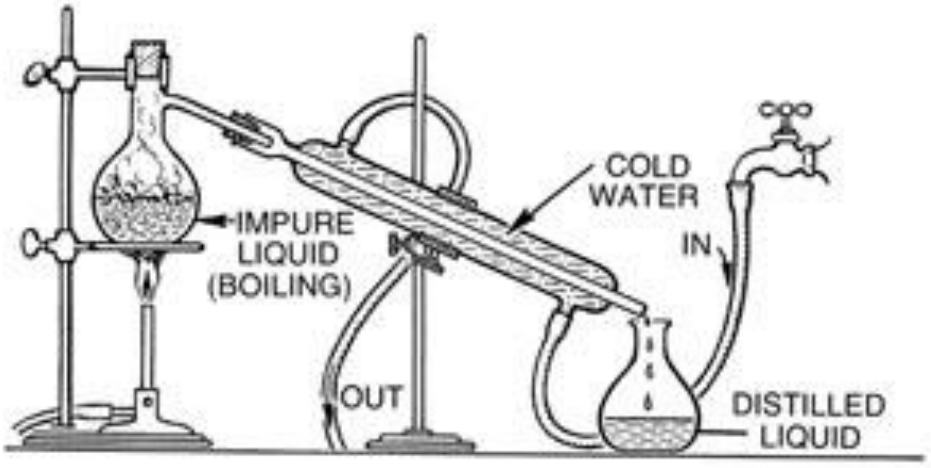


Figure 12: Simple distillation

Observation and analysis

i. What is collected in the receiver (conical flask) and what remains in the distillation flask?

ii. Give the names of the apparatus used for the evaporation and condensation processes in the experiment?

iii. Why is the condenser connected to tap water in a simple distillation set up?

iv. Why the cold water applied from bottom to top?

v. What is the need to use the boiling chips?

13.DISSOLVING POTASSIUM PERMANGANATE IN WATER

Objective: To investigate the discrete nature of matter.

Materials and chemicals required: Beaker or jar, stirring rod, potassium permanganate and spatula.

Procedures:

1. Dissolve a small crystal of potassium permanganate in 10 mL of water.
2. Pour 5 mL of the solution into a jar or a large beaker.
3. Add 20 mL water to it. What do you observe?
4. Add more water to the solution step wise until the purple colour disappears.

Figure 13: Dissolution of potassium permanganate in water

Observation and analysis

i. What happens to the crystal of potassium permanganate in 10 mL water?
ii. Do the particles disappear as the colour fades out?
iii. Do you think that the chemical nature of potassium permanganate is changed during the dissolution process?

EXPERIMENTS FOR GRADE 8

1. PREPARATION OF SULPHUR DIOXIDE

Objective: To prepare sulphur dioxide and test whether it is an acidic or a basic oxide.

Materials required: Sulphur, litmus paper (blue and red), gas jar, Bunsen burner, deflagrating spoon, water.

Procedures:

1. Put some powdered sulphur in a deflagrating spoon and ignite it as shown in Figure 1
2. When it starts burning, put it into a gas jar.
3. When the burning stops, add 5mLof water to the gas jar and shake.
4. Put red and blue litmus paper, one after the other, in the jar and follow the change in.
5. Record your observation.

Figure 1: Preparation of sulphur dioxide

Observation and analysis

i. What is the colour of the flame when sulphur burns in air?

ii. Write the chemical equation for this combustion reaction.

iii. What happens to the blue and red litmus papers?

iv. Classify the oxide formed by the combustion of sulphur as acidic or basic.

2. PREPARATION OF MAGNESIUM OXIDE

Objective: To prepare Magnesium Oxide and test whether it is an acidic oxide or a basic oxide.

Materials required: Magnesium ribbon, red and blue litmus papers, Bunsen burner, tongs, crucible, water.

Procedures:

1. Cut about 2 cm of magnesium ribbon.
2. Hold a polished ribbon with a tong and burn it over a flame from the Bunsen burner as shown in figure2. The moment it starts burning, put the burning metal into a crucible and collect the product.
3. Add a small amount of water to the resulting powder in the crucible and shake it.
4. Rub the resulting substance between your fingers.
5. Test the solution with red and blue litmus paper.
6. Record your observations.

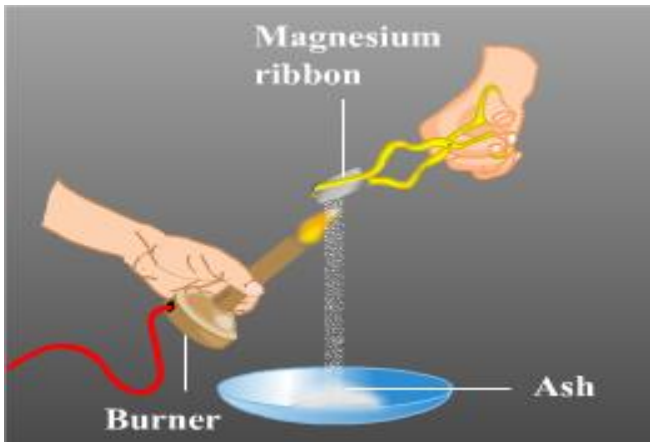


Figure 2: Burning of magnesium in air

Observation and analysis:

a. What is the colour of the flame produced when magnesium burns in air?
b. Write the chemical equation for the reaction.
c. What do you feel when you rub the magnesium oxide solution between your fingers.
d. What happens to the red and blue litmus papers when in contact with the solution?
e. Is the resulting solution basic or acidic?

3. EFFECT OF ACIDS ON ACID-BASE INDICATORS

Objective: To investigate the effect of dilute hydrochloric acid and sulphuric acid on the colours of litmus paper, phenolphthalein and methyl orange.

Materials required: Red and blue litmus papers, phenolphthalein and methyl orange, test tubes, test tube rack, dilute solutions of hydrochloric acid and sulphuric acid.

Procedure:

1. Pour about 5 mL of dilute HCl into three test tubes.
2. Hold the first test tube in inclined position and put red and blue litmus papers turn by turn into it and see if there is any colour change.
3. Add few drops of phenolphthalein in the second and few drops of methyl orange in the third and observe if there is colour change.
4. Repeat the above procedure using dilute H_2SO_4 solution.

Observation

1. Did you see any change on the litmus papers?
2. What happened to the phenolphthalein?
3. What about the methyl orange?

4. REACTION OF AN ACID WITH A METAL

Objective: To investigate the reaction of zinc metal with dilute hydrochloric acid.

Materials required: Test tube, rubber stopper, zinc metal, dilute sulphuric acid, wooden splint or candle, delivery tube, match, steel wool, soap solution and through.

Procedures:

1. Polish a piece of zinc metal with a steel wool until is shiny.
2. Prepare a soap solution in through (water jar).
3. Pour about 5mL of dilute HCl in to a test tube.
4. Add the polished zinc metal to the test tube containing dilute HCl and close the test tube with a one hole rubber stopper.
5. Inset one end of a delivery tube in to the hole of the rubber stopper and the other end in to the soap solution as shown in the figure below.
6. Ignite a wooden splint or candle using a match, introduce the lighted splint/ candle at the top of the soap solution as shown in figure 3.

Caution! Note that you should hold the lighted splint/ candle away from yourself and others!

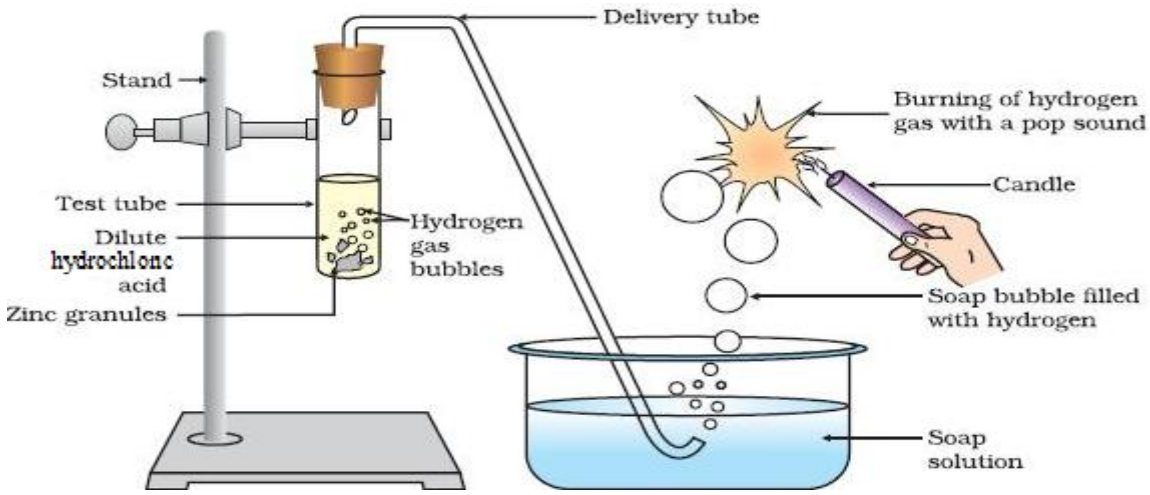


Figure 3: Reaction of zinc with HCl

observation and analysis;

a. Why was the piece of zinc cleaned with steel wool?
b. What happens when zinc metal was added into the test tube containing dilute HCl?
c. How do you know that a gas is produced in the reaction?
d. What is the colour of the gas?
e. Write the chemical equation for the reaction between zinc and HCl.

5. REACTION OF ACIDS WITH CARBONATES AND HYDROGEN CARBONATES

Objectives: To investigate the reaction of calcium carbonate with sulphuric acid.

Materials required: dilute sulphuric acid, calcium carbonate, test tubes, lime water (calcium hydroxide solution), delivery tube, spatula, and rubber stopper.

***Procedures**:*

1. Set up the apparatus as shown in the diagram.
2. Using a spatula, add a calcium carbonate powder or a lump of calcium carbonate into the first test tube and 5mL of lime water into the second test tube.
3. Add 5mL of dilute sulphuric acid into the test tube containing calcium carbonate. Quickly replace the rubber stopper and the delivery tube. Ensure that the delivery tube reaches almost to the bottom of the second test tube.
4. Allow the gas to pass into the second test tube for about 1 minute. Record what happens in both tubes.

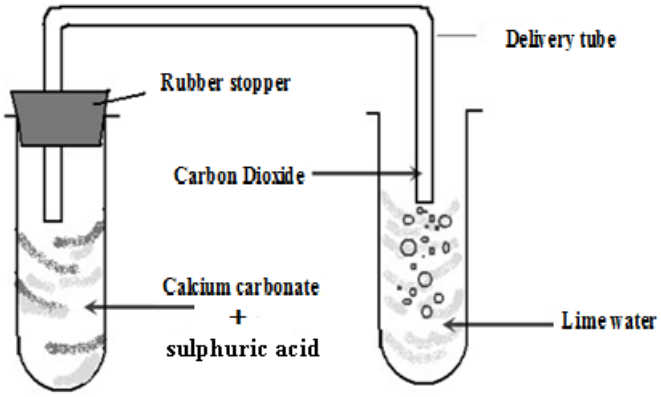


Figure 4: Reaction calcium carbonate and sulphuric acid

Observation and analysis:

a. Is there formation of bubbles in step 2?
b. If yes, what does the formation of bubbles indicated?
c. What happens to the lime water after the reaction of calcium carbonate and sulphuric acid?
d. Write the equation for the reaction:
    1. Between calcium carbonate and sulphuric acid.
    2. Between sodium hydrogen carbonate and sulphuric acid.

6. NEUTRALIZING EFFECT OF AN ACID ON A BASE

Objectives: to investigate the neutralizing effect of sulphuric acid on sodium hydroxide.

Materials required: Dilute sulphuric acid, sodium hydroxide solution conical flask, phenolphthalein, burette, stand, clamp, measuring cylinder, red and blue litmus papers.

Procedures:

1. Set up the the apparatus as shown in Figure 5
2. Fill the burette with dilute sulphuric acid and record the volume.
3. Pour 20 mL of sodium hydroxide solution into a conical flask and add about 3-5 drops of phenolphthalein in to it.
4. Add sulphuric acid in to the flask containing sodium hydroxide by opening the stop cock of the burette with your one hand, while shaking the conical flask with your other hand.
5. When the colour begins to disappear, add the acid drop by drop followed by shaking the flask continuously.
6. When the colour disappears compeletly, close the stop cock of the burette immediately and check the effect of the solution in the conical flask on blue and red litmus papers.

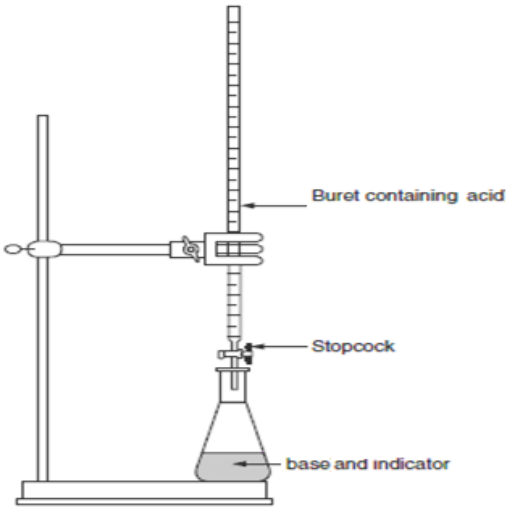


Figure 5: Neutralization reaction of sulphuric acid and sodium hydroxide

Observation and analysis:

a. What colour appeared when drops of phenolphthalein are added to the solution in the conical flask? What does it indicate?
b. Why does the colour disappear in step 6?
c. Does the solution obtained in step 6 affect the colour of either blue or red litmus paper?
d. Write the balanced equation for the reaction that takes place in this experiment.

7. PREPARATION OF CALCIUM HYDROXIDE

Objective: to prepare calcium hydroxide from calcium

Materials required: Evaporating dish, tripod, wire gauze, Bunsen burner, tong, calcium metal, water, and red litmus paper.

Procedures:

1. Take small amount of calcium in an evaporating dish.
2. Heat it on a Bunsen burner as shown in figure 6.
3. After it is burned, remove the evaporating dish from the tripod holding it with a tong and add some drops of water to dissolve.
4. Now, put a piece of red litmus paper to the solution in the evaporating dish.

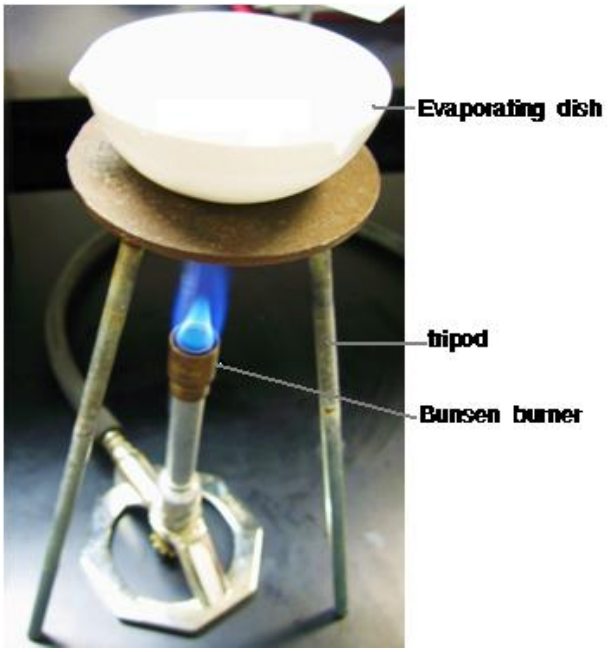


Figure6: Heating calcium metal in an evaporating dish

Observation and analysis:

a. What did you observe when calcium is heated in air using the Bunsen burner flame? Can you write the chemical equation for the change resulted as a result of heating calcium in air?
b. When the resulting product in the evaporating dish is dissolved in water, what happens to it? Write the chemical equation for the reaction that takes place.
c. When red litmus paper is placed in the evaporating dish containing calcium hydroxide solution, what did you observe? What do you conclude from your observation?

8. THE EFFECT OF A BASE ON INDICATORS

Objective: to study the effect of a base on indicators

Materials required: Red and blue litmus papers, phenolphthalein solution, methyl orange, ammonia solution (NH_4OH),test tubes, test tube holders and test tube rack.

Procedures:

1. Take four clean test tubes.
2. Add about 5mL ammonia solution in each of the test tubes and level the test tubes as 1,2,3, and 4 as shown in figure 7.
3. Observe the of ammonia solution, red litmus, blue litmus, methyl orange and phenolphthalein, then follow the change when a red litmus paper, blue litmus paper, 2 drops of phenolphthalein solution, and 2 drops of methyl orange solution are added in to test tubes 1, 2, 3, and 4, respectively.

Figure 7: Testing the effect of a base on indicators

Observation and analysis:

a. What colour changes did you see when red litmus paper, blue litmus paper, phenolphthalein and methyl orange solutions are added in to the ammonia solution?

b.Can you draw a conclusion on the effect of base solution on the indicators?

c. Using a table, show the effects of acidic and basic solutions on the indicators?

9. NEUTRALISING EFFECT OF A BASE ON AN ACID.

Materials required: Sodium hydroxide solution, hydrochloric acid, conical flask, phenolphthalein, burette, stand, clamp, measuring cylinder, red and blue litmus papers.

Procedures:

1. Set up the apparatus as shown in Figure 8.
2. Fill the burette with sodium hydroxide and record the volume.
3. Add 20mL of hydrochloric acid solution into a conical flask followed by 5 drops of phenolphthalein.
4. Open the stop cock of the burette to add Sodium hydroxide solution to the acid solution with your one hand, while shaking the conical flask with your other hand.
5. When the colour begins to appear, add the base drop by drop shaking the flask continuously.
6. When a persistant color change is appeared, close the stop cock of the burette immediately and record the final volume reading of the burette.
7. Check the acidity and basicity of the solution in the conical flask using blue and red litmus papers as indicators.

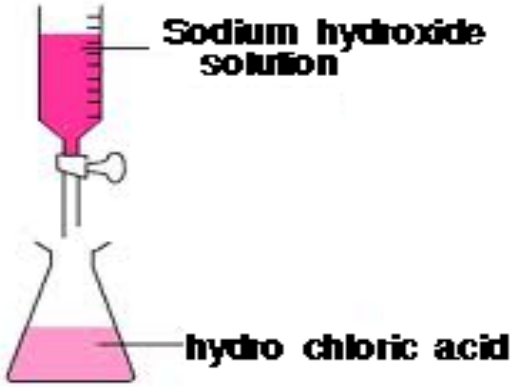


Figure8: Neutralization reaction of hydrochloric acid and sodium hydroxide

Observation and analysis:

a. What colour was observed appeared when phenolphthalein is added to the solution in the conical flask in step 3?
b. Why does a new colour appear with the addition of sodium hydroxide in step 6?
c. Does the solution obtained in step 6 affect the colour of either blue or red litmus paper?
d. Write the balanced equation for the reaction that takes place in this experiment.

10.PREPARATION OF SALTS BY NEUTRALIZATION

PART I: ***preparation of salt by the reaction of metal oxide with acid***

Objective: To prepare copper (II) sulphate from copper (II) oxide and dilute sulphuric acid.

Materials required: copper (II) oxide, dilute sulphuric acid, glass rod, beaker, funnel, filter paper, Bunsen burner, tripod, wire gauze, evaporating dish, measuring cylinder and conical flask.

Procedures:

1. Measure 10 mL of dilute sulphuric acid and pour it into a beaker.
2. Warm the solution in the beaker on a Bunsen burner flame and then add copper (II) oxide little by little followed by stirring the mixture using a glass rod.
3. Continue adding copper (II) oxide stirring until the reaction is complete.
4. Place a funnel fitted with a filter paper on to a conical flask.
5. Filter the solution by pouring it on the funnel fitted with a filter paper and collect the filtrate in the conical flask.
6. Pour the filtrate into an evaporating dish, and heat the solution on a Bunsen burner until a solid begins to form.
7. Put off the flame and leave the evaporating dish to cool.

Observation and analysis:

a. What is the colour of copper (II) oxide?
b. What colour change is observed when you add copper (II) oxide to the acid solution? What does this show?
c. What is the colour of the solid formed? Name the solid.
d. Write a balanced chemical equation for the reaction.

PART II: ***preparation of a salt by the reaction of metal hydroxide with acid***

Objective: To prepare sodium chloride by the reaction of sodium hydroxide with hydrochloric acid.

Materials required: sodium hydroxide solution, dilute hydrochloric acid, glass rod, beaker, evaporating dish, wire gauze, tripod, Bunsen burner, measuring cylinder, blue and red litmus papers.

Procedures:

1. Measure 15 mL of sodium hydroxide and pour it into a beaker.

2. Measure 20 mL of dilute hydrochloric acid solution. Pour about 13 mL of it into the beaker containing sodium hydroxide solution. Stir the mixed solution using a glass rod and test its acidity using red and blue litmus papers.
3. Continue adding the acid solution little by little while testing its acidity using red and blue litmus papers until a point where red and blue litmus papers show no colour change.
4. When the colours of the red and blue litmus papers remain the same, pour the solution into an evaporating dish, and heat the evaporating dish on a Bunsen burner till the liquid evaporates.

Observation and analysis:

a. Which of the two indicators show colour change at step 2?
b. At what added volume of hydrochloric acid where the colour of the red and blue litmus papers the same?
c. What is left in the evaporating dish after evaporation?
d. Write a balanced chemical equation for the reaction.

11.PHYSICAL PROPERTIES OF METALS

Objective: To investigate some of the physical properties of metals.

Materials required: iron, copper, Aluminium, zinc, lead, bulb, Dry Cell, Hammer and Bunsen burner.

Procedures:

1. Connect the various substances given into the circuit below (Figure 9a) one at a time, and find out if they are conductors or non-conductors of electricity.
2. Take 10 cm long wire or foil of each metal, heat at one end on a Bunsen burner flame holding the other end turn by turn. Follow the heat conductivity of each metal.
3. Observe each metal and identify whether or not it is lustrous.
4. Hit the foil or rod of each metal with a ruler or stick and record whether or not it is sonorous.

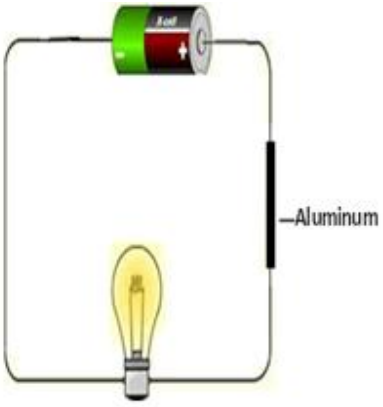


Figure 9a: An electric circuit

Figure 9b: Hammering a wire

Figure 9c: Testing heat conductivity

Observation and analysis:

A) Complete the following table by putting a tick (√) mark where appropriate. .

Metal	**Properties**			
	Electric conductor	**Thermal (heat) conductor**	**Lustrous**	**Sonorous**
Iron				
Copper				
Aluminium				
Lead				
Zinc				

B) Which of these metals are electrical and thermal conductors?

C) Are all the metals Sonorous?

D) Which of this metals are Lustrous?

12. THE EFFECT OF SOIL ON A PIECE OF MAGNESIUM OR CALCIUM METAL

Objective: To investigate the changes on magnesium or calcium metal placed in soil.

Materials required: Magnesium or Calcium metal

Procedure: Place a piece of magnesium or calcium metal in a soil for two weeks.

Observation and analysis: observe the effects of the soil on the metals.

13.THE BELL JAR EXPERIMENT

Objective: To investigate the nitrogen content of air by removing oxygen and carbon dioxide.

Materials required: White phosphorus, scissors or knife, tongs, glass rod, one holed rubber stopper, bell jar, two rubber bands, match, Bunsen burner, water, trough, graduated cylinder, crucible, calcium oxide or calcium hydroxide.

Procedures:

CAUTION! *White phosphorus is dangerous because it catches fire very easily. Always store and cut it under water.*

1. Fill a trough with water to three fourth of its total volume and add a spatula full of calcium oxide or calcium hydroxide.
2. Float a crucible on the water in a trough.
3. Cut apiece of white phosphorus (about a size of a pea) with scissors, hold the piece of phosphorus with tong, take it out of the container, dry it on a tissue paper and put it in the floated crucible.
4. Place a bell jar over the crucible, with its stopper removed as shown in figure 10.
5. Mark the level of the water in the jar with a rubber band.
6. Insert a glass rod through the hole of the rubber stopper and heat one of its ends with a Bunsen burner flame.
7. Push the rubber stopper into the neck of the bell jar, making it air tight, push the glass rod down until the hot end touches the phosphorus in the crucible and pick it immediately. Observe what is happening.
8. Leave the apparatus until the fumes dissolve in water and mark the final water level with the other rubber band.
9. Remove the bell jar, fill it with water to the first rubber band, and measure the volume of water with a graduated cylinder to get the initial volume of air and record volume of air before the experiment.

10. Again, fill the bell jar with water to the second rubber band and measure the volume of water to get the final volume of air (volume of air after experiment).

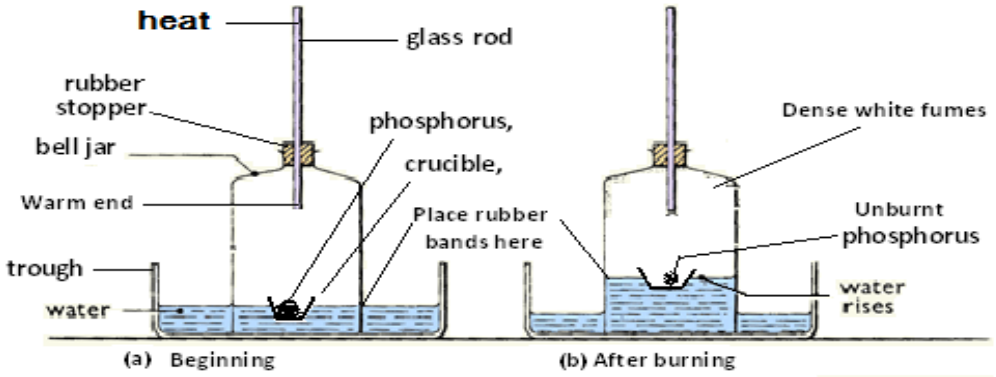


Figure 10: Bell-jar Experiment

Observation and analysis:

a. How do you remove oxygen and carbon dioxide from air?
b. How can dry nitrogen be collected?
c. What is the volume of air before the experiment?
d. What is the volume of air after the experiment?
e. Calculate the fraction of nitrogen in air from the data you collected in the experiment using the reaction:

Fractional part of N_2= $\frac{Final\ volume\ of\ air}{Initial\ volume\ of\ air}$

f. Taking air as a mixture of nitrogen and oxygen, what fraction of air is oxygen?

Fractional part of O_2= $\frac{Initial\ volume\ of\ air - Final\ volume\ of\ air}{Initial\ volume\ of\ air}$

14.THE EFFECT OF HARDNESS OF WATER

Objective: To investigate the effect of hardness of water on the formation of lather with soap.

Materials required: Rain water, distilled water, ground water, soap, scissors, three test tubes and measuring cylinder.

Procedures:

1. Pour about 20mL of rain water, distilled water, and ground water in the first, second and third test tubes, respectively. Cut pieces of soap with scissors and add equal sizes of slices of soap into each test tube.
2. Shake each of the test tubes by closing their mouth with your thumb turn by turn as shown in Figure 11.

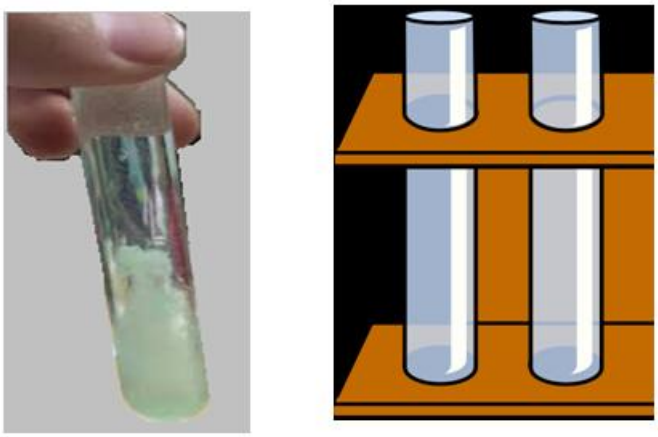


Figure 11: Dissolving soap in water

Observation and analysis:

a. In which test tube does the water form lather more rapidly?
b. In which test tube does the water form lather slowly?
c. Which water sample is relatively (i) soft water (ii) hard water?

15.FORMATION OF CALCIUM HYDROGENCARBONATE

Objective: To prepare temporary hard water by the formation of calcium hydrogen carbonate.

Materials required: conical flask, rubber stopper with one hole, beaker, straw (delivery tube), distilled water or rain water, graduated cylinder, test tube, calcium oxide or calcium hydroxide, and a beam balance.

Procedures:

1. Measures 100mL of distilled or rain water and pour it in to a beaker.
2. Dissolve about 6-8 g of calcium oxide or calcium hydroxide to produce limewater.
3. Pour 100mL of limewater into the conical flask fitted with a rubber stopper to which a delivery tube is inserted.
4. Blow carbon dioxide through the delivery tube (straw) into the lime–water until the clear solution turns milky. See Figure 12.

Figure 12: blowing CO_2 through lime water

5. Continue blowing carbon dioxide gas until the milky solution becomes clear again.
6. Pour about 20 mL of the solution obtained in step 5 in a test tube, add apiece of soap and shake well. (keep the remaining solution for the next experiment)

Observation and analysis:

a. Why did the solution in step 4 turn milky? Explain using chemical equation that represents the reaction.
b. Why did the solution turn clear in step 5? Explain using chemical equation that represents the reaction
c. Is the formation of lather in step 6 as rapid as it was in distilled or rain water? If not, what is the reason?

16. SOFTENING TEMPORARY HARD WATER

Objective: To investigate that boiling removes temporary hardness.

Materials required: Temporary hard water, beaker, test tube, wire gauze, tripod, Bunsen burner, and soap.

Procedures:

1. Put 40 mL of the temporary hard water you reserved in step 6 of experiment 28 into one test tube and 20 mL into the other test tube.
2. Heat the test tube containing 40 mL of water using a Bunsen burner flame until it boils.
3. Transfer about 20 mL of the boiled water into an empty test tube.
4. Add a slice of soap into each of the test tubes containing boiled and cold water samples and shake well.

Observation and analysis:

a. Which water sample forms lather with soap (i) slowly (ii) rapidly?
b. What makes them differ in the duration of time they form lather?

17.BOILING HARD WATER

Objective: To prove whether or not boiling removes permanent hardness of water.

Materials required: Permanent hard water, soap, two beakers, graduated cylinder, wire gauze, tripod, Bunsen burner, glass rod and match.

Procedures:

1. Measure and pour about 30mL of permanent hard water into each of the two beakers.
2. Place on of the two beakers on wire gauze and heat it using Bunsen burner until the water boils.
3. Stop heating the beaker and place it on one side of the beaker containing cold water.
4. Add a piece of soap in to the two beakers followed by stirring using a glass rod.

Observation and analysis:

a. What did you observe when you dissolve pieces of soap in the water sample?
b. Is there formation of an insoluble solid in step 4?
c. In which beaker does the soap form lather easily? What do you conclude from your observation?

18. REMOVING PERMANENT HARDNESS OF WATER

Objective: To prove the addition of sodium carbonate or washing soda removes permanent hardness of water.

Materials required: Permanent hard water, graduated cylinder, two beakers, washing soda, soap, glass rod and spatula.

Procedures:

1. Take about 30mL of permanent hard water into each of the two beakers.
2. Add a spatula full sodium carbonate only in one of the beakers and stir until all the sodium carbonate dissolves.
3. Add a piece of soap into both beakers and stir.

Observation and analysis:

a. What did you observe as sodium carbonate dissolve in the water in step 2?
b. Did the two water samples form lather with soap at the same speed? If not, explain why this happened?

19.ANALYSING POLLUTED WATER SAMPLE

Objective: To carry out a simple analysis of polluted water sample by comparing its properties with that of pure water such as pH, clarity, smell and amount of dissolved solids.

Materials required: A bottle of polluted water, a bottle of pure water, pH indicator paper, two evaporating dishes, graduated cylinder and beam balance.

Procedures:

1. Compare the clearness and smell of the pure and polluted water samples and record your observation.
2. Insert the pH indicator paper into the sample of pure water and record the pH. Repeat the same procedure for the polluted water.
3. Weigh the evaporating dishes separately, record their masses and level them as 1 and 2.
4. Pour 100 mL of pure water into the first evaporating dish (dish 1) and the same volume of polluted water into the second evaporating dish (dish 2).
5. Place the two evaporating dishes in sunlight until all the water evaporates.
6. Weigh the two evaporating dishes after dryness and compare their masses with those you recorded in step 3. Two get the mass of dissolved solids in each sample, use the relation:

$$\textit{Mass of dissolved solid} = \textit{mass measured in step 6} - \textit{mass measured in step 3}$$

Observation and analysis:

a. Do the two water samples have the same clearness, smell and pH?

b. Which water sample contains a large amount of dissolved solids?

20. THE COMPOSITION OF SOIL

Objective: To investigate the composition of soil sample and see the gradation (level) of particles.

Materials required: 400 mL beaker, water and soil sample.

Procedures:

1. Half-fill the beaker with water.
2. Add some soil in the water and shake well.
3. Leave the soil and water mixture to stand for sometimes and observe.

Observation and analysis:

a. Did you observe particles that settle to the bottom of the beaker?

b. Did the largest or the finest particles sink to the bottom of the beaker? In what order did they settle?

c. Did you observe any component of the soil floating on the surface of the water? What is that?

21.CHARACTERSTICS OF SOIL

Objective: To investigate soil characteristics such as moisture content, air content, humus content and particle size distribution.

Materials required: soil sample, oven, tin lid, Bunsen burner, two graduated cylinders, water, two sieves of different hole size, test tube, beam balance, evaporating dish, wire gauze and tripod.

Procedures:

1. Weigh the mass of clean and dried evaporating dish and record its mass.
2. Add some soil to the evaporating dish until the mass of the soil is 100 g and record the total mass (total mass=100 g+ mass of the dish).
3. Place the evaporating dish containing the soil in an oven at 100 ^{o}c and wait for about 25 minutes.

4. Take the evaporating dish out of the oven, cool it, measure the total mass and record it. Did you see any mass loss?
5. Measure the mass of a tin lid using a balance and record its mass.
6. Place the dry soil from step 4 on the tin lid until the mass of the soil is 20 g, place the tin lid on wire gauze and heat it on a Bunsen burner flame for about 20 minutes. (Total mass= 20 g + mass of tin lid).
7. Put off the Bunsen burner flame, leave the tin lid for some time to cool, weigh the total mass of the tin lid and soil and record the mass.
8. Measure 50 ml of soil in one graduated cylinder and 50 mL of water with the other. Pour the water into the graduated cylinder containing the soil, wait for few minutes, and record the total volume. (The soil you use in this procedure should not be heated).
9. Measure 100 mL of dry powdered soil (The soil should not be heated) and place it onto the sieve with larger holes, try to pass as much soil as you can through it. After that, place the soil that passes through this sieve onto the other with holes of smaller size. Try to pass soil again through this sieve. Compare the size of the particles left on the first and second sieves and those passes through the sieve of smaller holes.
10. Take a test tube; add soil onto it to one half of its total volume. Pour water into test tube and measure the time it takes for the water to reach the bottom of the test tube. That is from the start of pouring up to the time you see water reaching the bottom.

Observation and analysis:

a. What is the water content of the soil? (Total mass in step 2- Total mass in step 4)
b. What is the humus content of the soil? Calculate its percentage.

$$\frac{(\text{Total mass in step 6- Total mass in step 7})}{20\ \text{g}} \times 100$$

c. What is the air content of the soil? (Volume of air = Total volume of soil and water before mixing - Total volume of soil and water after mixing)
d. How do you describe the particles of the soil obtained in step 9?
e. What is the time retention of the soil? (The time recorded in step 10)

22.DETERMINING pH OF SOIL SAMPLES

Objective: To determine whether or not a soil sample is acidic, alkaline or neutral by measuring its pH.

Materials required: Different soil samples, pure water, funnels, two conical flasks, filter paper, two beakers, pH indicator and glass rod.

Procedures:

1. Bring two soil samples from different localities.
2. Add some amount of one of the soil samples in the first beaker and the other in the second beaker.
3. Add some amount of water to each beaker containing the soil sample and stir the mixture with glass rod.
4. Leave the mixtures to stand until the solid settles.
5. After soaking a filter paper into each funnel, filter the mixture and collect the filtrate using different beakers.
6. Compare the acidity of the two soils using the pH indicators.

Observation and analysis:

Mention the type of indicator used, the colour change when the indicator is immersed in to the filtrate and the acidity of each soil sample?

23.PREPARATION OF AMMONIUM NITRATE

Objective: To prepare ammonium nitrate fertilizer by mixing equivalent amounts of ammonia and nitric acid.

Materials required: Ammonia solution, dilute nitric acid, beaker, conical flask, graduated cylinder, phenolphthalein indicator, dropper, evaporating dish, a burette, wire gauze, tripod, Bunsen burner, stand and clamp.

Procedures:

1. Add 10 mL of ammonia solution into a conical flask and add 3-4drops of phenolphthalein indicator using a dropper.
2. Fix a buret to the stand with a clamp as shown in figure 13.
3. Using a beaker, fill the burette with nitric acid and record the volume.
4. Place the conical flask containing ammonia solution below the burette; open the stop cock of the burette so that nitric acid can flow into the flask. Pour the acid slowly

followed by shaking the conical flask until the colour of the solution in the flask disappears.

5. When the colour disappears, close the stop cock and transfer the solution in the flask into an evaporating dish.
6. Put the evaporating dish on the wire gauze placed on the tripod and heat it gently on Bunsen burner flame to dryness (Do not heat it strongly) and observe.

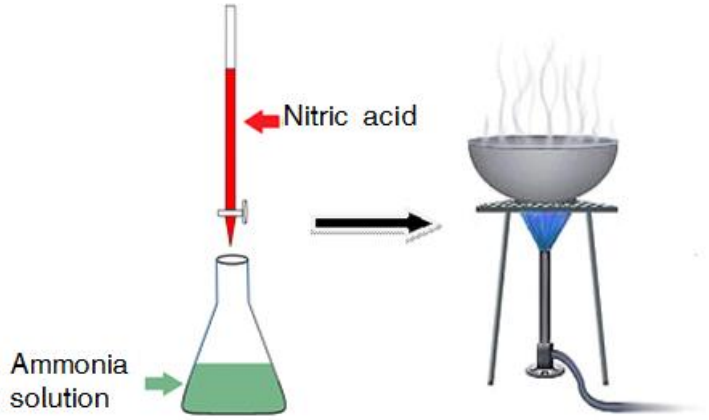


Figure13: preparation of ammonia nitrate

Caution! 1. Wear gloves and goggles while performing this experiment.

2. Avoid contact of ammonia and nitric acid with any of your body parts.

Observation and analysis:

a. What colour did you observe when you add phenolphthalein step 1?
b. What colour change did you observe in step 4?
c. Is there any substance left in the evaporating dish when the solution was heated to dryness? What is that?
d. Write the balanced equation for the reaction that takes place in this experiment.

24.PREPARATION OF SLAKED LIME

Objective: To prepare slaked lime from quick lime obtained by the heating of limestone.

Materials required: limestone, crucible, beam balance, water, wire gauze, tripod, litmus paper, beaker, Bunsen burner, and tong.

Procedures:

1. Put 10 g of lime stone on a crucible.
2. Put the crucible on the wire gauze placed on the tripod and heat it for about 20 minutes with Bunsen burner flame.
3. Put off the flame and leave the crucible to cool on the gauze.
4. After few minutes, using a tong transfer the heated substance from the crucible into a beaker.
5. Add water into the beaker, shake well and test the solution using blue and red litmus papers and observe if there is any colour change.

Observation and analysis:

a. To what substances does the limestone change up on heating? Write a chemical equation representing the change.
b. What substance was formed when the compound obtained after heating limestone is dissolved in water? Show what has happened by writing an equation.
c. Does the red and blue litmus paper show colour change in procedure 5? What does this change show?

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Annexes

Annex I: Necessary laboratory Equipments and apparatuses for grade 7 and 8 chemistry experiments

Annex II: Necessary laboratory chemicals and apparatuses for grade 7 and 8 chemistry experiments

Annex III: Common laboratory Equipments

Annex IV: Common Laboratory apparatuses and their use

Annex V: Common laboratory chemicals, major properties and how to treat

Annex VI: Common indicators

Annex 1: Necessary laboratory Equipments and apparatuses for grade 7 and 8 chemistry experiments

Beakers,
Beam balance,
Bunsen burner (splint lamp)
Burette
Candle
Clamp
Condenser
Conical flask
Crucible
Deflagrating spoon,
Delivery tube
Distillation flask,
Dropper

Dry Cells
Evaporating dish
Filter paper
Funnel
Gas jar
Glass rod
Hammer
Light bulbs
Litmus paper (blue and red)
Magnet
Magnifying glass
Match
Measuring cylinder
Nails
Ring
Rubber stoppers
Scissors
Sieves of different hole size
Spatula
Stand with base,
Test tube rack
Test tubes
Through
Tong
Tripod
Watch glass
Wire gauze
Wooden splint

Annex 2: Necessary laboratory chemicals for grade 7 and 8 chemistry experiments

Aluminium

Ammonia solution

Calcium carbonate

Calcium hydroxide

Calcium metal

Calcium oxide

Copper

Copper (II) oxide,

hydrochloric acid

Iron

Iron filings

Lead

Lime water (calcium hydroxide solution)

Limestone

Magnesium

Magnesium ribbon

methyl orange

phenolphthalein

Potassium permanganate

Powdered sulphur

Salt

Soap

Sodium hydroxide

Sodium metal

Steel wool

sulphuric acid.

Tin lid

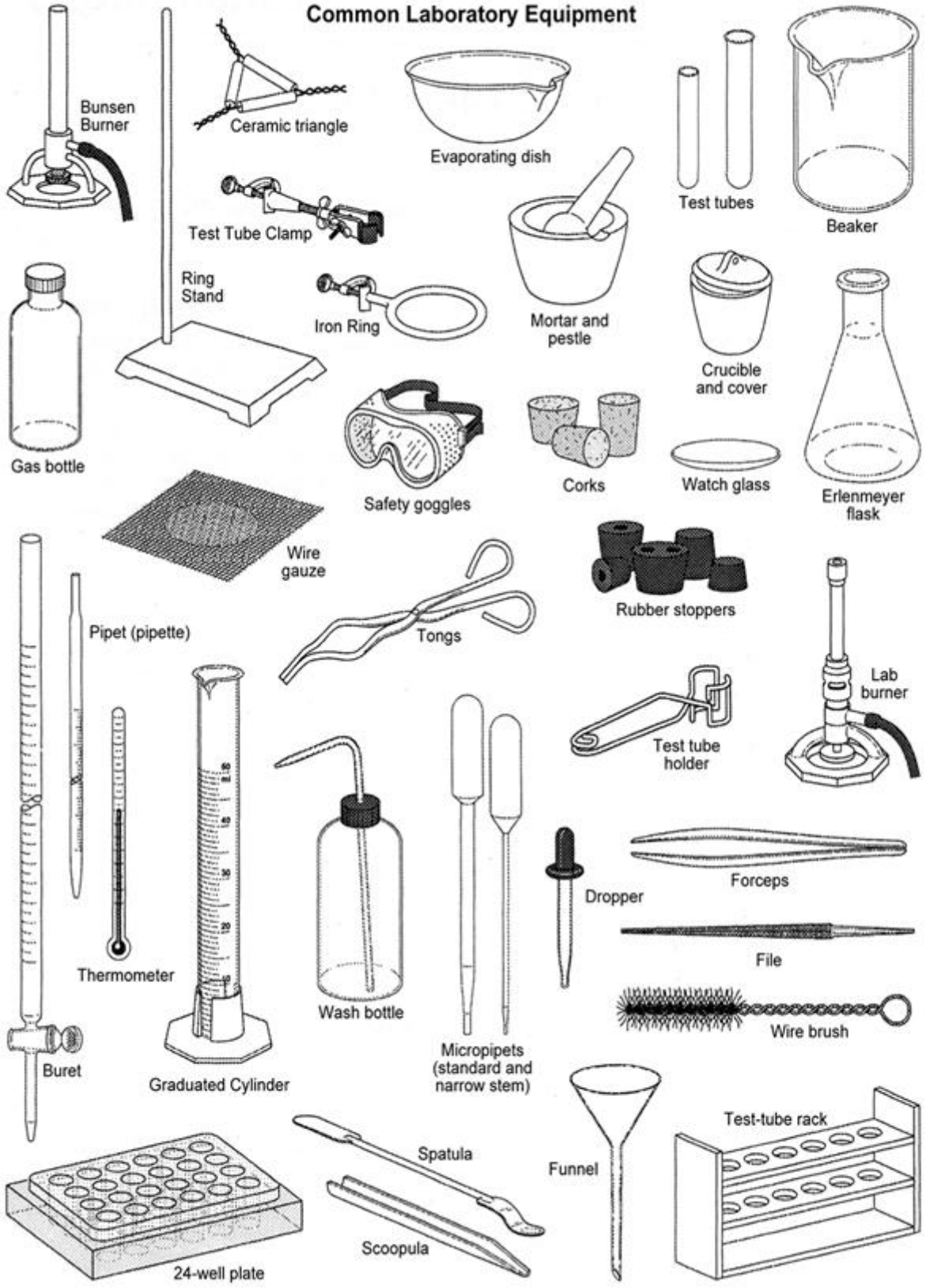
Universal indicator

Washing soda

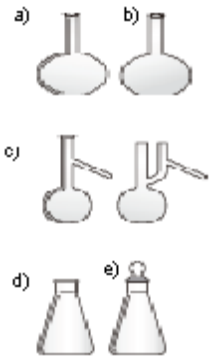
Zinc metal

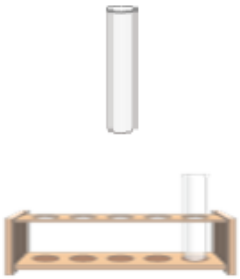
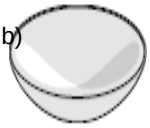
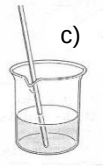
Annex 3

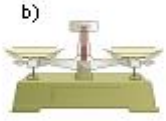
Common Laboratory Equipment

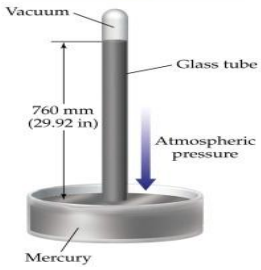
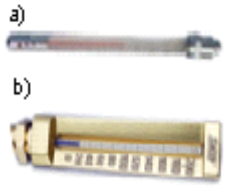


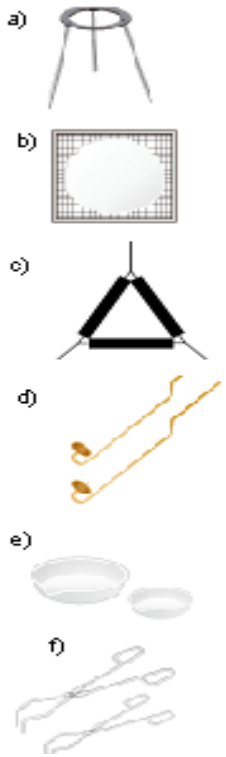
Annex 4. Common laboratory apparatuses and their use

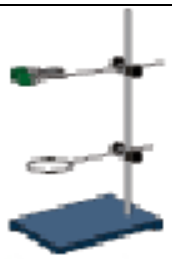
Category	Type	Picture	Use	Materials available in Science Kit
Glass wares	**Beakers** • Different size: 10ml, 50ml, 100ml, 250ml, 300ml, 400ml, 500ml, 1000ml		• **Beakers** are useful as a reaction container or to hold liquid or solid samples. They are also used to catch liquids from titrations and filtrates from filtering operations. They are excellent containers for observing chemical reactions.	• Beakers (50ml (2), 500ml (1))
	Flasks a) Round-bottom flask b) Flat-bottom flask c) Flasks with side arm d) Erlenmeyer flask e) Reagent bottles		a) **Round-bottom flasks** are used for experiments that cause high pressure inside the flasks, or that bring reduction of the pressure, or when strong heat is applied. b) **Flat-bottom flasks** are used for experiments that do not cause high pressure and temperature. They are easy to handle, as it can be put on anywhere. c) **Flasks with side arm** are used for distillation. The glass tube stretched from the neck of the flask conduct produced gas. d) **Erlenmeyer flasks** are used to carry out reactions or to hold liquid samples. They are also used to collect filtrates. e) **Reagent bottles** have very small openings and are primarily used to store chemical substances used during the experiments.	

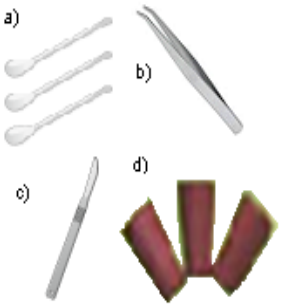
Category	Type	Picture	Use	Materials available in Science Kit
	Test tubes • Different size • With stand		• **Test tubes** are useful for running small-scale experiments that require multiple solutions. • **Test tube holders** are for holding test tubes when tubes should not be touched, and/or to observe reaction inside the tubes, or to dry the washed tubes.	• Test tubes small (6) • Test tubes large (1) • Test tube brush (1) • Test tube stand (1)
	Others a) Funnels b) Watch glasses c) Stir (glass rods) d) Petri dishes	a)  b)  c)  d) 	a) **Funnels** are for funneling liquids from one container to another or for filtering when equipped with filter paper. b) **Watch glasses** are for holding small samples or for covering beakers or evaporating dishes. c) **Stir rods** have the shape of drinking straws and are made of solid glass and used to stir mixtures. d) **Petri dishes** are a shallow glass or plastic cylindrical lidded dish, used to culture fungi or to keep samples.	• Delivery glass tube (245mm (1), 80mm (2)) • Petri dish plastic (2) • Funnel (small grass (1), small plastic (1))

Category	Type	Picture	Use	Materials available in Science Kit
Measuring tools (glass)	a) Burettes b) Pipets c) Droppers d) Measuring cylinders : 10ml, 100ml, 250ml, 500ml, 1000ml	a)  b)  c)  d) 	a) **Burettes** are for addition of a precise volume of liquid. The volume of liquid added can be determined to the nearest 0.01 ml with practice. b) **Pipettes** are long tube use for measuring and transferring small quantities of liquids from one flask to the other. c) **Measuring cylinder or graduated Cylinders** are for measurement of an amount of liquid. The volume of liquid can be estimated to the nearest0.1 mL with practice. d) **Droppers** are for addition of liquids drop by drop. (Note: When you read the level of a liquid, the eye should be at the same level as the bottom of the meniscus or curve at the surface of the liquid.)	• Measuring cylinder plastic (50ml) • Dropper (1)
Measuring tools	**[Mass & weight]** Balance and scale a) Spring balances / newton meter b) Beam balances c) Triple beam balance	a)  b)  c) 	a) **A spring balance** is an apparatus to measure weight, a spring fixed at one end with a hook to attach an object at the other, worked by Hooke's law. b) **A beam balance** is used to measure masses by putting a sample on one pan and weight on the other pan. c) **A triple beam balance** is used to measure masses very precisely; the reading error is 0.05 gram. With the pan empty, move the three sliders on the	• Weight (10g (1), 20g (2), 50g (3), 100g (2))

Category	Type	Picture	Use	Materials available in Science Kit
			three beams to their leftmost positions, so that the balance reads zero. If the indicator on the far right is not aligned with the fixed mark, then calibrate the balance by turning the set screw on the left under the pan. (Note 1: Knowing the exact amount of a substance is incredibly important in science because it drastically can impact the results of an experiment.) (Note 2: We **must not** put samples to be measured directly on the pan of beam balances.)	
	[Pressure] • Barometer	 	• **A barometer** is a scientific instrument used in meteorology to measure atmospheric pressure.	
	[Temperature] • Thermometer: a) alcohol type and		• **Thermometer** is for measuring temperature.	• Thermometer (1)

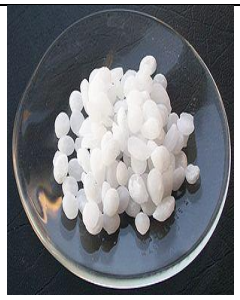
Category	Type	Picture	Use	Materials available in Science Kit
Heating tools	a) Tripods b) Wire gauzes c) Clay triangles d) Deflagrating spoons e) Melting pots f) Tongs		a) **Tripods** are three-legged racks used to support beakers, flasks, etc. above them for heating. b) **Wire Gauze** on a ring supports beakers to be heated by Bunsen burners c) **Clay Triangles** are placed on a ring attached to a ring stand as a support for a funnel, crucible, or evaporating dish. d) **Deflagrating spoons** are used to burn a sample. e) **Melting pots** are vessels made of material that does not melt easily; used for high temperature chemical reactions. f) **Tongs** are similar in function to forceps but are useful for larger items. They are used to hold a hot melting pot or to hold a sample and heat it directly.	• Deflagrating spoon (1)
Heating sources	a) Bunsen burners b) Spirit lamps		a) **Bunsen burner** is a heating device made of a metallic base and a fitted gas tube and is used for heating and sterilizing. It has a stronger flame and can heat for a long time. The Bunsen burner produces the flame with evenly distributed heat (817^{o}C). b) **Spirit lamp** is a lamp that burns methylated or other spirits instead of oil. The temperature is higher in the outer flame at	

Category	Type	Picture	Use	Materials available in Science Kit
			622^{o}C.	
Instruments / tools	a) Stand with their clamps b) Syringe c) Tuning fork	a)  b)  c) 	a) **Ring stand with rings** are for holding pieces of glassware in place. b) **Syringe** is a simple pump consisting of a plunger that fits tightly in a tube. The plunger can be pulled and pushed along inside a cylindrical tube (called a barrel), allowing the syringe to take in and expel a liquid or gas through an orifice at the open end of the tube. Syringes are often used to administer injections, insert intravenous drugs into the bloodstream, apply compounds such as glue or lubricant, and measure liquids. c) **A tuning fork** is an acoustic resonator in the form of a two-pronged fork with the prongs (tines) formed from a U-shaped bar of elastic metal (usually steel). It resonates at a specific constant pitch when set vibrating by striking it against a surface or with an object, and emits a pure musical tone after waiting a moment to allow some high overtones to die out. The pitch that a particular tuning fork generates depends on the length of the two prongs. Its main use is as a standard of pitch to tune other musical instruments.	• Coil 400 turns (1) • Lead wires (6) • Copper wires 500mm (1) • Copper wires 500mm insulated (1) • Bulbs (3) • Penlight bulb (1) • Bulb holders (4) • Rheostat (1) • Spring (1) • Diode (1) • Syringe (2)

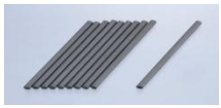
Category	Type	Picture	Use	Materials available in Science Kit
Others	a) Spatulas b) Tweezers c) Blade/knife/scalpel d) Rubber bungs		a) **A spatula** is used to take a sample from the bottle. b) **A tweezers** is used to hold a lump of a sample or a chemical c) **A scalpel** is a small straight knife with a thin sharp blade used in surgery and dissection. d) **A rubber bung** is used to close up a container tight or to fix a glass tube to a container. The bungs are usually made of rubber, some of which have one hole or some have two	➢ Forceps (1) ➢ Blade (1) ➢ Rubber bung (1), ➢ Cork stoppers large (4) ➢ Rubber bung large (1), with one hole (1), with two holes (1) ➢ Rubber bung

Annex V: Common laboratory chemicals, major properties and how to treat

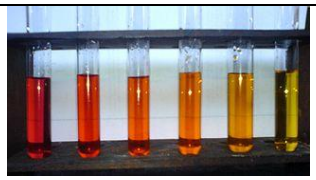
Name	Picture	Major properties and how to treat
Ethanol (C_2H_5OH)		It is a volatile, flammable, colorless liquid that has a slight odor. It burns with a smokeless blue flame that is not always visible in normal light. Do not use near flame. It has a sterilizing power, so it is also used as an antiseptic solution. Flammable
Hydrochloric acid (HCl)		It is a clear, colorless solution of hydrogen chloride (HCl) in water. It is a highly corrosive, strong mineral with many industrial uses. Hydrochloric acid is found naturally in gastric acid. Hydrogen chloride gas can be produced easily. Therefore when you use it, do use only necessary amount and make good ventilation. The one available in the market is 35~38% concentration. Always dilute it below 5% when it is used in the class.
Sulfuric acid (H_2SO_4)		It is a **highly corrosive** strong mineral acid with the molecular formulaH_2SO_4. It is a colorless to slightly yellow viscous liquid which is soluble in water at all concentrations. It damages skin and clothes, so if it gets on your skin or clothes, wash it immediately and then put dilute ammonia water (NH_4OH). When diluting it, add it little by little into water (But not vice versa). It is used in car batteries. The one available in the market is 98% concentration. Always dilute it below 5% when it is used in the class. **Corrosive, Dangerous for environment, Oxidizing agent, Toxic**
Nitric acid (HNO_3)	 Nitric acid 70%	It is a highly corrosive strong mineral. The pure compound is colorless, but older samples tend to acquire a yellow cast due to the accumulation of oxides of nitrogen. Most commercially available nitric acid has a concentration of 68%. When the solution contains more than 86% HNO_3, it is referred to as fuming nitric acid. **Corrosive, Oxidizing agent, Toxic**

Name	Picture	Major properties and how to treat
Sodium hydroxide (NaOH)		It is a highly caustic metallic base which is a white solid available in pellets, flakes, granules, and as a 50% solution. It is soluble in water, ethanol and methanol. This alkali is deliquescent and readily absorbs moisture and carbon dioxide in air. Thus it should be kept airtight. Its strong solution hurts a skin and clothes. Thus when you touch it or it got on your clothes, wash it with a large amount of water, and then wash it again with dilute acetic acid (CH_3COOH). **Corrosive**
Calcium hydroxide ($Ca(OH)_2$)		It, traditionally called slaked lime, is an inorganic compound with the chemical formula $Ca(OH)_2$. It is a colorless crystal or white powder and is obtained when calcium oxide (called lime or quicklime) is mixed, or "slaked" with water. It has many names including hydrated lime, builders lime, slack lime, cal, or pickling lime. Calcium hydroxide is used in many applications, including food preparation. **Corrosive, Irritant** **Limewater** is the common name for hydroxide solution. Calcium hydroxide ($Ca(OH)_2$) is sparsely soluble, at 1.5 g per liter at 25 °C. Pure limewater is clear, visually indistinguishable from water, but with a slightly earthy smell. It is clearly distinguishable by the alkaline taste of the calcium hydroxide. Limewater strongly absorbs carbon dioxide. When limewater absorbs carbon dioxide, it turns into a milky solution.
Calcium carbonate ($CaCO_3$)		It is a chemical compound with the formula$CaCO_3$. It is a common substance found in rocks in all parts of the world, and is the main component of shells of marine organisms, snails, coal balls, pearls, and eggshells. When diluted hydrochloric acid is added on it, the carbon oxide will be produced.
Magnesium (Mg)		It is a fairly strong, silvery-white, light-weight metal (two thirds the density of aluminum). It tarnishes slightly when exposed to air, although unlike the alkali metals, storage in an oxygen-free environment is unnecessary because magnesium is protected by a thin layer of oxide that is fairly impermeable and difficult to remove. Like its lower periodic table group neighbor calcium, magnesium reacts with water at room temperature, though it reacts much more slowly than calcium. When submerged in water, hydrogen bubbles will almost unnoticeably begin to form on the surface of the metal, though if powdered it will react much more rapidly.

Name	Picture	Major properties and how to treat
	 Magnesium ribbon	Magnesium (Mg) is flammable, burning at a temperature of approximately 3,100 °C, and the auto ignition temperature of magnesium ribbon is approximately 473 °C. It produces intense, bright, white light when it burns. Magnesium's high burning temperature makes it a useful tool for starting emergency fires during outdoor recreation. It is dangerous to burn big amount of magnesium ribbon at once, as it burns violently in the air. Be careful not to be burnt.
Sodium bicarbonate / Sodium hydrogen carbonate ($NaHCO_3$)		It is a white solid that is crystalline but often appears as a fine powder. It has a slightly salty, alkaline taste resembling that of washing soda (sodium carbonate). Since it has long been known and is widely used, the salt has many related names such as baking soda, bread soda, cooking soda, and bicarbonate of soda.
Hydrogen peroxide (H_2O_2)		It is the simplest peroxide (a compound with an oxygen-oxygen single bond). It is also a strong oxidizer. Hydrogen peroxide is a clear liquid, slightly more viscous than water. In dilute solution, it appears colorless. Due to its oxidizing properties, hydrogen peroxide is often used as a bleach or cleaning agent. 3% diluted hydrogen peroxide is used as an antiseptic solution. **Oxidant, corrosive and harmful**
Methylene blue		At room temperature it appears as a solid, odorless, dark green powder that yields a blue solution when dissolved in water. Methylene blue is widely used as a redox indicator in analytical chemistry. Solutions of this substance are blue when in an oxidizing environment, but will turn colorless if exposed to a reducing agent. In biology methylene blue is used as a dye for a number of different staining procedures, such as Wright's stain and Jenner's stain. Since it is a temporary staining technique, methylene blue can also be used to examine RNA or DNA under the microscope or in a gel.
Sulfur		It is a bright yellow crystalline solid when at room temperature. Chemically, sulfur can react as either an oxidant or reducing agent.

Name	Picture	Major properties and how to treat
Potassium chlorate ($KClO_3$)		In its pure form, it is a white crystalline substance.
Carbon (C)	 Graphite  Carbon point	it is nonmetallic and tetravalent—making four electrons available to form covalent chemical bonds. There are three naturally occurring isotopes, with ^{12}C and ^{13}C being stable, while ^{14}C is radioactive, decaying with a half-life of about 5,730 years. Carbon is one of the few elements known since antiquity. You may find carbon point from a dry cell.
Manganese dioxide (MnO_2)		Manganese (IV) oxide is the inorganic compound with the formula MnO_2. This blackish or brown solid occurs naturally as the mineral pyrolusite, which are the main ore of manganese and a component of manganese nodules. The principal use for MnO_2 is for dry-cell batteries, such as the alkaline battery and the zinc-carbon battery

Annex VI: Common indicators

Name	Picture	Use
Litmus papers (blue&red)		The main use of litmus is to test whether a solution is acidic or basic. It does not tell the degree of acidity or basicity/ alkalinity.
Universal indicator		It is a pH indicator composed of a solution of several compounds that exhibits several smooth color changes over a pH value range from 1-14 to indicate the acidity or basicity/ alkalinity of solutions.
Phenolphthalein		**Phenolphthalein** is a chemical compound with the formula $C_{20}H_{14}O_4$. It turns colorless in acidic solutions and pink in basic solutions. If the concentration of indicator is particularly strong, it can appear purple.
Methyl orange		**Methyl orange** is a pH indicator frequently used in titrations. In a solution becoming less acidic, methyl orange moves from red to orange and finally to yellow with the reverse occurring for a solution increasing in acidity.
Iodine		It is used to detect the presence of starch. It should be kept in the brown bottle and in a dark place.
Benedict's reagent		It is used as a test for the presence of sugars. Benedict's solution contains copper sulfate that reacts with sugar to form copper oxide, a reddish brown powder.