LABORATORY MANUAL

Science Class - X

DIRECTORATE OF
STATE COUNCIL OF EDUCATIONAL RESEARCH AND TRAINING
MIZORAM:AIZAWL

LABORATORY MANUAL

SCIENCE CLASS X

Directorate of
State Council of Educational Research and Training
School Education Department
Government of Mizoram

Published by

State Council of Educational Research and Training

Aizawl, Mizoram

Copies: 100

Printed at:

FOREWORD

Laboratory experiences are one of the most essential components for achievement of practical learning outcomes. They help students in comprehension of scientific concepts and acquiring basic experimental skills. It is necessary to derive practical learning outcomes for students especially in the light of the National Education Policy 2020.

This Laboratory Manual for Class 10 is developed based on Science textbook of Class 10 with an aim to help teachers and students to improvise in making use of materials available locally as and when required. This Manual takes the bi-lingual approach as encouraged by the National Education Policy 2020 where notes are provided in Mizo to enable better understanding for Mizo Students.

I believe that this **Laboratory Manual for Class 10** will serve as effective means of understanding scientific concepts and achievement of practical learning outcomes in Science. I commend the effort of the officers of the Science Promotion Wing in bringing out a Manual which will go a long way in the promotion of Science education.

29th March, 2022

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LIST OF EXPERIMENTS
Class X

Second Term:

Third Term

EXPERIMENT NO - 1 (A)

Aim : To determine the focal length of a concave mirror by obtaining the image of a distant object.

Apparatus : A concave mirror, white screen or a white sheet of paper, a meter scale.

Theory :

1. A distant object which is many time the focal length of the mirror is regarded as an object at infinity.
2. Rays coming from the object form a set of parallel rays.
3. Parallel rays coming from the object after reflection meet in the focal plane of the mirror and forms a real, inverted and diminished image.

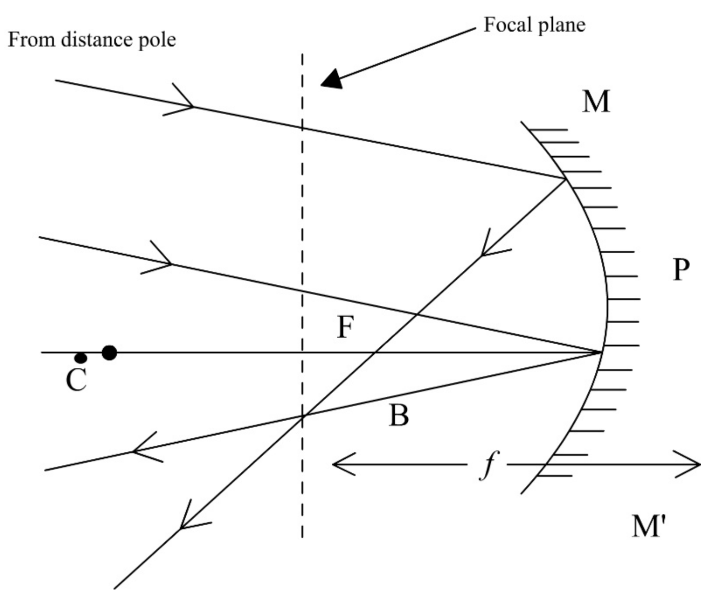


Fig. 1(a).1. Image of a distance object formed in the focal plane of the concave mirror. F = PF.

Procedure :

1. Hold the concave,mirror in your hand and select any object at a far distant outside the classroom. The object (say tree or house) at a far distance should be visible to our naked eyes.
2. Then adjust the distance of your concave mirror with the white screen or paper so that a clear image can be formed,
3. Measure the distance between concave mirror and the white screen using meter scale.
4. Repeat the experiment three times.

Observation: 1. f_1 =____cm 2. f_2 =____cm

Average focal length $(f) = \frac{f_1+f_2+f_3}{3}$ =____cm

Result **:** The focal length of the given concave mirror =____cm

Precautions :

1. The distant object should be clearly visible.
2. A clear image of the object should be obtained on the white screen.
3. While measuring the the distance between the mirror and the image, the meter scale should be kept horizontally and parallel to the horizontal ground.

Khaikhawmna

Concave mirror focal length zawn chhuah dan :

Concave mirror hi inenna darthlalang hma lam khuar hi a ni. Hla taka thil awm te object- a hmangin a focal length hi zawn chhuah theih a ni.

1. Object aṭanga ray chu focal length let tam tak a hi a, chung object chu ‘object at infinity’ an vuah.

2. Rays-te hi parallel rays an ni a, concave mirror a thlen hnuah insawh khawk lehin darthlalang focal plane-ah tak *real image*, a letling (inverted) leh object aia tein a lo lang ṭhin.
3. Image (thla) lanna turin screen var emaw lehkha puan hman ni se. Experiment hi vawi thum tal tih ni se, chumi a *average* reading chu lak tur a ni.
4. Image lanna screen leh concave mirror inkar hi metre scale-a ngil taka teh tur a ni.

Viva Voce

1. What is a concave mirror?
   = A spherical mirror in which the reflecting surface is curved inward.

2. What is meant by reflection of light?
   = The bouncing back of light rays by a reflecting surface is called refection of light.

3. What is the difference between regular reflection and diffuse reflection?
   = When a light rays fall on a smooth and polished surface it gets reflected along a definite direction. Such a reflection is called regular reflection.
   When a parallel beam of light falls on a rough surface, ray of light are reflected in all possible direction. Such an irregular reflection is called diffuse reflection.

4. What is the difference between real and virtual image?
   = A real image can be obtained on screen. It is always inverted and formed on the same side of the object. Whereas a virtual image cannot be obtained on screen. It is always erect and formed behind the mirror.

Important Terms

1. Optical medium – Any medium through which light can pass (propagate) is called optical medium.
2. Homogeneous medium – Medium having same optical properties at all points. Eg. Water.
3. Heterogeneous medium – Medium having different optical properties at various points. Eg. Atmosphere.
4. Ray of light – The straight line along which the light travels in a medium.
5. Beam of light – A group of rays of light travelling in a different direction.
   a) Parallel beam – A beam of light in which rays of light are parallel to each other.
   b) Convergent beam – A beam of light in which the light rays are directed towards a point.
   c) Divergent beam – A beam of light in which the light rays are directed away from a point.
6. Real image – Image which can be obtained on screen and it is always inverted.
7. Virtual image – Image which cannot be obtained on a screen and it is always erect.
8. Spherical mirrors – Mirrors which have curved reflecting surfaces-
   a) Convace Mirror – A spherical mirror who's reflecting surface is curved inwards.
   b) Convex mirror – A spherical mirror whose reflecting surface is curved outwards/bulging out.

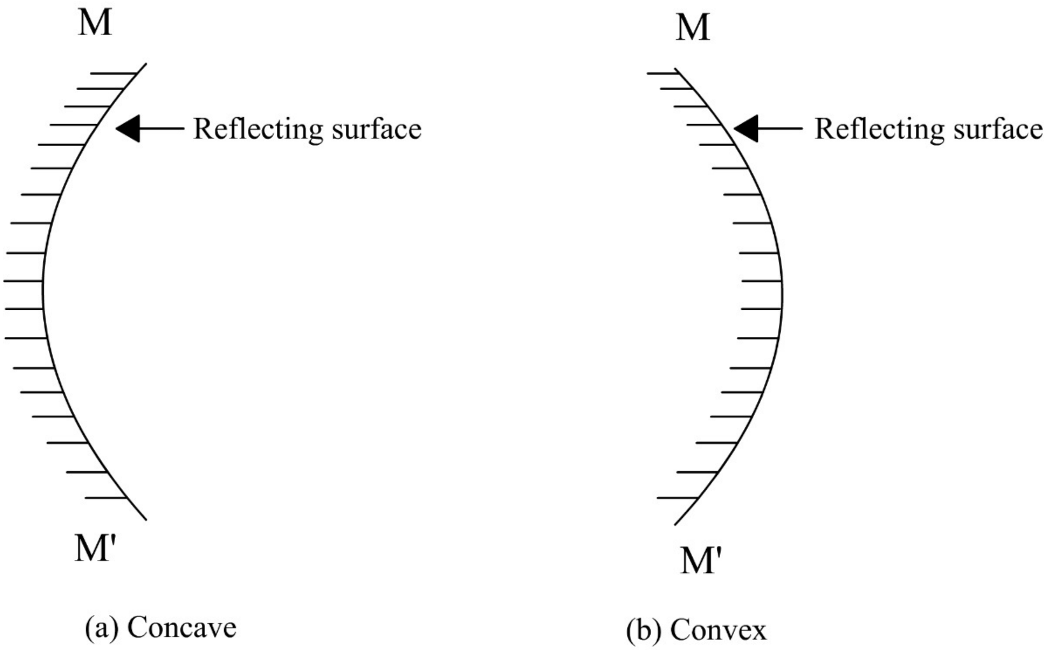


Fig. 1(a).2. Two types of spherical mirror

9. Aperture – The width of the mirror from which reflection.
10. Pole – Centre of the reflecting surface of the mirror.
11. Centre of curvature – The centre of the hollow sphere of which the reflecting surface of a spherical mirror forms a part.
12. Radius of curvature – The radius of hollow sphere of which the reflecting surface of a spherical mirror forms a part.
13. Principals axix – The imaginary straight line joining pole and the centre of curvature.

EXPERIMENT NO - I (B)

AIM : To determine the focal length of a convex lens by obtaining the image of a distant object.

Apparatus: A convex lens, white sheet/ cardboard, meter scale.

Theory :
1. An object is at many times the focal length '*f*' of the lens. It is regarded as an object at infinity.
2. Rays coming from the object form a set of parallel rays
3. Parallel beam of rays often refracted through convex lens, it converges at one point in the focal plane

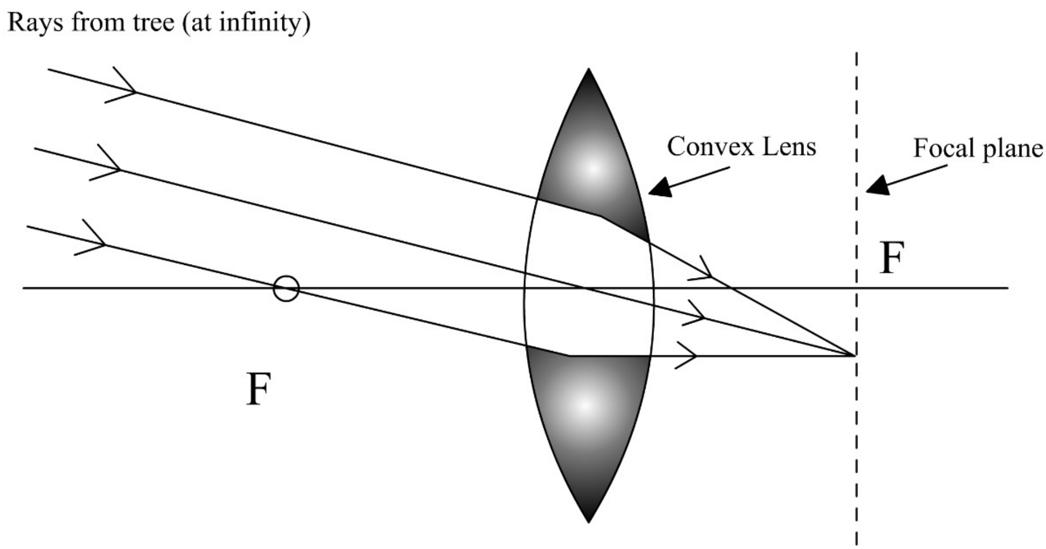


Fig 1(b).1. Rays from a distant object like the top of a tree outside the school laboratory converge in the focal plane of the lens.

Procedure:

1. Hold the convex mirror in your hand and select any object at a far distant outside the classroom.

2. The image of an object is obtained clearly on a white sheet/ cardboard which is inverted.
3. Measure the distance between the convex lens and the white sheet/ cardboard using a meter scale.

Observation : 1. f_1=______cm 2. f_2=______cm

Average focal length $(f) = \frac{f_1+f_2+f_3}{3}=$ _______cm

Result: The focal length of the given convex lens =_____cm

Precautions:

1. The object should be clearly visible.
2. Lens should be held properly and firmly so that it faces parallel to the screen.
3. While measuring the distance between the optical centre and the focal plane, the meter scale should be kept parallel to the principal axis.

Khaikhawmna

Convex lens focal length zawn chhuah dan :

1. Convex lens focal length zawn hi concave mirror aiin a awlsam zawk.
2. Convex lens uluk taka keng in classroom pawnah object atana thlan hmaah ken tur a ni.
3. Object atana thlan aṭanga parallel rays lokal in convex lens a kaltlang hnuah in sawrbing in thla (image) fiah tak screen-ah a lo lang ṭhin.

4. A thla lan fiah theih na ber a convex lens kan ken laiin a thla (image) lanna screen leh convex lens inkar chu meter scale hmangin uluk takin teh tur a ni.

5. Rays kal dan parallel-in meter scale pawh ken mai tur a ni.

6. Vawithum vel tihnawn hnuah average focal length lak tur a ni.

Important Terms

1. Incident ray – A ray of light from the object travel through the first medium towards another optical medium.
2. Point of incidence – The point (O) on the boundary of two media where the incident ray strikes it.
3. Normal – A perpendicular drawn at the point of incidence.
4. Angle of incidence – The angle between the incident ray and the normal. Li
5. Angle of refraction – The angle between the refracted ray and the normal. Li
6. Angle of emergence – The angle between the emergent ray and the normal.
7. Refraction of light – Change/bending of light rays when it enters from one medium to another.
8. Lens – A lens is a portion of a transparent refracting medium bounded by two curved surfaces.
9. Convex lens – It is thick in the middle and thin at the edges.
10. Convex lens – A lens which is thicks at the edges and thin in the middle.
11. Aperture (lens) – The size of a lens.

EXPERIMENT NO – 2

Aim : To trace the path of a ray of light through a rectangular glass slab and measure the angle of incidence and the angle of emergence.

Apparatus : Drawing board, white sheet of paper, drawing pins, glass slab, protractor, pencil and scale.

Theory :

1. A ray of light travelling from a rarer medium to a denser medium bends towards the normal.
2. A ray of light, travelling from a denser to rarer medium bends away from the normal.
3. The angle of incidence is equal to the angle of emergence.

Procedure :

1. Fix a white sheet of paper on a drawing board with the help of drawing pins.
2. Place a glass slab on the paper. Draw the boundary of the glass slab (ABCD) with a pointed pencil and then remove it.
3. Take a point O on the side CD of the slab and draw normal N_1N_2 with the protractor.
4. Draw a straight line PO at any angle, the angle N_1OP is then the angle of incidence ($\angle i$).
5. Keeping the eye towards CD look through the glass slab at the two pins 'W' and 'X'.
6. Fix another pin 'Y' such that the eye and the feet of all the pins are in the same pins.

7. Now fix another pin 'Z' keeping the eye in line with the feet or all the four pins.

8. Remove the glass slab and the pins.

9. Mark the pin points W, X, Y and Z with a pencil encircling them.

10. Joint YZ and produce the line on both sides, Emergent ray RS is obtained.

11. Draw normal N_3N_4 at a point R. Measure angles of incidence and angle of emergence.

12. Repeat the whole experiment by changing angles of incidence.

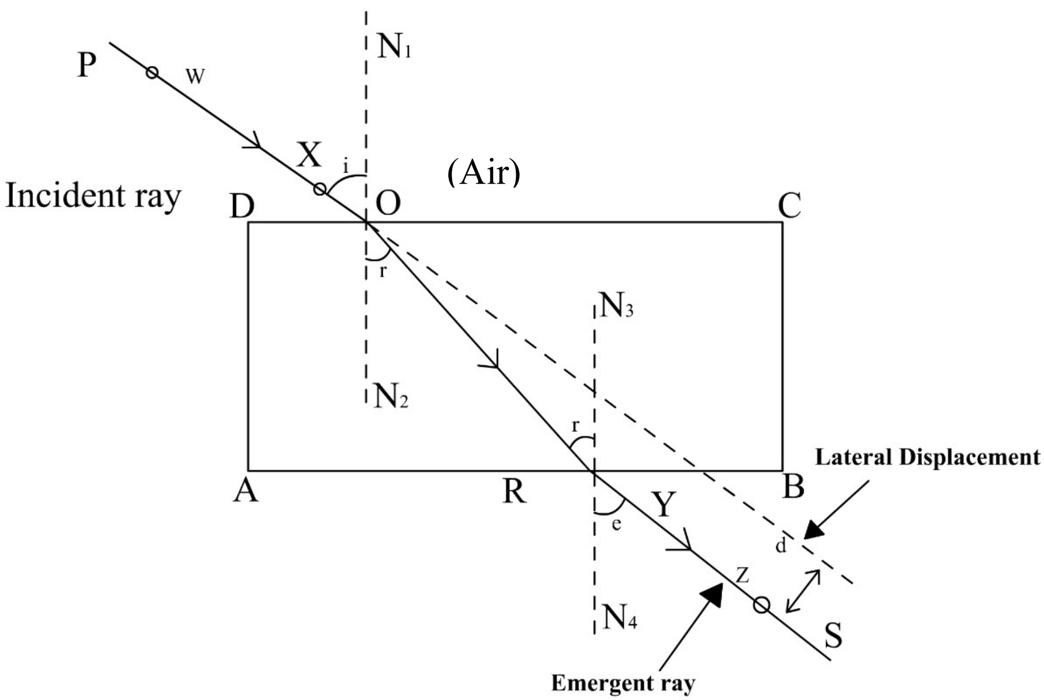


Fig. 2.1 Refraction through a glass slab.

Table 2.1

OBSERVATION TABLE

Sl. No	Angle of Incidence $\angle i$	Angle of emergence $\angle e$
1	30°	
2	35°	
3	40°	
4	45°	
5	50°	
6	55°	

Result : From the above informations it is found that :

1. Angle of incidence $\angle i$ is equal to the angle of emergence $\angle e$.
2. The incident ray (PQ) and the emergent ray (RS) are parallel to each other.
3. The incident ray bends towards the normal as it travels from rarer medium (air) to denser medium (glass slab) and it bend away from the normal as it travels the glass to air.

Precautions :

1. Glass slab should be clean.
2. The eye must be in line with the feet of the pins while fixing pins for emergent ray.
3. The distance between the pins on the incident ray or the emergent ray should not be less than 10 cm.
4. We must look at the feet of the pins from a minimum distance of 25 cm
5. The angle of incidence should be taken between 30° to 70°.
6. Measure the angles exactly, do not use approximation.

Khaikhawmna

Glass slab hmang a ray kal phung zirna leh angle of incidence leh angle of emergence teh dan :

1. Dawhkan rualrem takah lehkha khawng mam ṭha tak dah tur a ni. Chumi atan chuan Artui bawm emaw parcel bawm ruak paper size a siam hman a ṭha hle. Drawing pin nem luh a awlsam bik.

2. White paper chungah glass slab dah a, a tlang kualin pencil-a rin tur a ni.

3. CD-ah point 'O' siam tur a ni a, hetah hian normal N_1N_2 perpendicular-a rin tur a ni.

4. Straight line PO incident ray hmangin angle of incidence $\angle i$ siam tur a ni. Glass slab leh lam aṭanga thlirin CD line lo chhuahna lai takah pin pakhat 'Y' ah vih bur tur a ni a.

5. Incident ray-ah hmun hnih 'W' & 'X' ah pawh pin pahnih vih bur tur a ni a, tichuan glass slab lehlam aṭanga thlir in pin 'Y' hnungah 'Z' vih bur leh tur a ni. Tichuan WXYZ te hi straight line-in an awm tur a ni.

6. Heng point WXYZ te hi pencil in chhun han tur a ni, glass slab lak sawn hnuah YZ te rin zawm la, chumi bakah incident ray PO line ngil takin rintlang bawk la, emergent ray RS a lo chhuak ang.

7. Emergent ray RS lo chhuahna a point 'R' hmangin perpendicular-in Normal N_3N_4 rin tur a ni. Hemi Normal leh

emergent ray 'RS' inkar hi angle of emergence chu a ni. Hetiang bawk hian incident ray 'PO' leh normal N_1N_2 inkar protractor hmangin teh la, angle of incidence a ni.

8. A chung a ziah lan khian angle of incidence atan angle hrang hrang hmang la experiment hi vawithum tal tih nawn a reading lak tur a ni.

9. Lateral displacement hi emergent ray leh refracted ray inkar perpendicular a teh tur a ni.

VIVA VOCE

1. What is refraction?

= The bending of light rays as it passes from one medium to another medium is called refraction.

2. Why does bending the light take place?

= The ray of light bends because it travels with different velocity in different media.

3. For which incident ray, the refracted ray will be show any deviation?

= Normal.

4. How does light bend when it travels from (i) air into glass (ii) water into air.

= (i) The light will bend towards the normal as it travels from air into glass.

(ii) The light will bend away from the normal as it travels from water into air.

5. What is the other name given to the second law of refraction?

= Snell's Law.

6. State laws of refraction.

= There are two laws of refraction :

a) The incident ray, the refracted ray and the normal at the point of incidence all lie in the same plane.

b) The ration of the sine of the angle of incidence to the sine of the angle of refraction is constant for a medium called the refractive index of the medium.

7. Give the S.I units of refractive index.

= Refractive index has no units because it it a ratio.

8. Does light travel faster in glass or water?

= Water.

9. Does light travel faster in glass or air?

= Air.

10. What is angle of emergence?

= The angle between the emergent ray and the normal is called angle of emergence.

EXPERIMENT No. – 3

Aim : To prepare SO_2 gas, observe its following properties and draw inference in respect of
(1) Colour
(2) Solubility in Water
(3) Effect of Litmus paper
(4) Action on acidified potassium dichromate solution.

Material required :

(a) Apparatus : Round bottom flask, thistle funnel, cork with two holes, delivery tube bent at two places at right angles in the same direction, gas jars, spirit lamp, tripod stand, wire gauze, iron stand with clamp, match box, boiling tube.
(b) Chemicals : Copper turnings, concentrated sulphuric acid, blue litmus paper, red litmus paper, potassium dichromate solution.

Basic Principle involved :

When copper turnings are heated with concentrated sulphuric acid, a chemical reaction takes place and sulphur dioxide (SO_2) gas is formed.

Chemical reaction:

$$Cu\,(S) + \text{Conc}\ 2H_2SO_4\,(aq) \rightarrow CuSO_4\,(aq) + 2H_2O\,(l) + SO_2(g)$$

Copper Sulphuric acid Copper sulphate Water Sulphur dioxide

(i) Sulphur dioxide is heavier than air.
(ii) Sulphur dioxide is Colourless Gas.
(iii) Sulphur dioxide has suffocating odour (Smell) like burning sulphur.
(iv) Sulphur dioxide is highly soluble in water.
(v) Sulphur dioxide turns blue litmus red. Therefore, has acidic nature.
(vi) Sulphur dioxide changes oranges colour of acidified solution of $K_2Cr_2O_7$ (Potassium dichromate solution) to green colour.

Procedure :

1. Take Copper turnings in a round bottom flask.
2. Close the mouth of the flask with the rubber cork fitted with a delivery tube bent twice at right angles and a thistle funnel.
3. Place the fitted flask on the wire gauze placed at tripod stand and clamp it with iron stand.
4. Pour concentrated sulphuric acid in such a quantity that the copper turnings should be dipped in the acid. The lower end of the thistle funnel should also be immersed in the acid. On the other hand, the mouth of the delivery tube should not be immersed in the acid.
5. Place the other end of the delivery tube in an empty gas jar.
6. Heat the flask gently and then strongly with the help of the spirit lamp.
7. Collect the gas evolved in gas jar by upward displacement of air.
8. Study the properties of SO_2 as shown in the table.

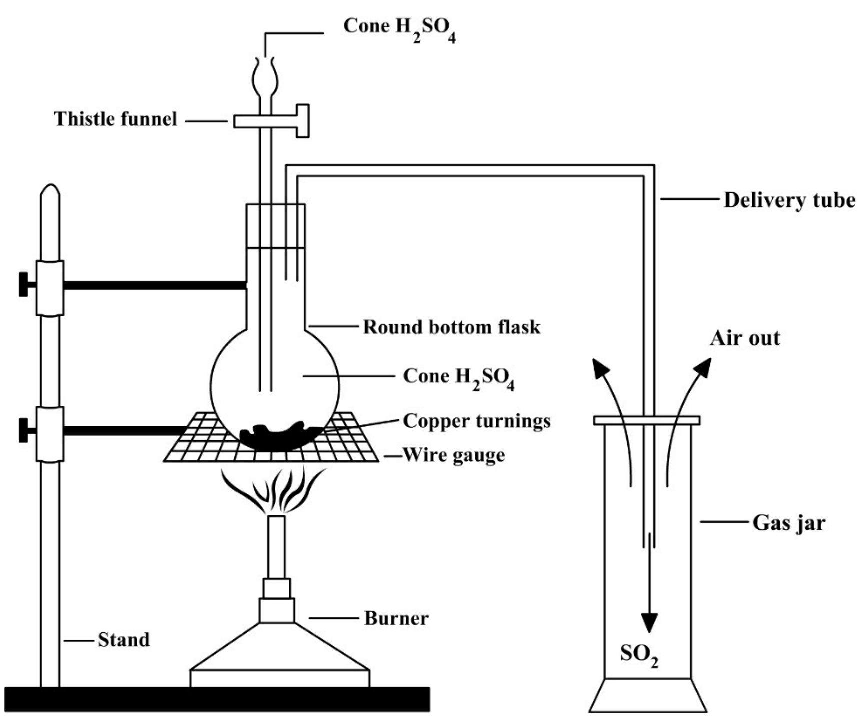


Fig. 3.1 Preparation of SO_2 by heating copper turning and conc. H_2SO_4

Steps for testing the properties of Sulphur Dioxide (SO_2)

Experiment	Observations	Inference
(A) <u>Odour of SO_2</u> Smell the gas carefully.	Suffocating and pungent smell.	SO_2 has suffocating and pungent colour.
(B) <u>Effect of SO_2 on litmus paper</u> Bring a moist blue litmus paper near the mouth of the gas jar full of SO_2.	The blue colour of litmus paper becomes red.	Sulphur dioxide has acidic character.
Bring a moist red litmus paper near the mouth of the gas jar full of SO_2.	There is no change in the colour of red litmus paper.	SO_2 has acidic character.
(C) <u>Solubility of SO_2 in Water</u> Invert the boiling tube full of SO_2 in a trough of water containing blue litmus. Fig. 4.	Water becomes red and rises in the boiling tube.	SO_2 is soluble in water.
(D) <u>Action of SO_2 on acidified solution of Potassium dichromate.</u> Add acidified solution of potassium dichromate in the gas jar full of SO_2.	The orange colour of the solution in the jar turns green.	Sulphur dioxide acts as reducing agent.

Conclusion :

1. Sulphur dioxide is a colourless gas with suffocating pungent smell.
2. Sulphur dioxide is highly soluble in water.
3. Sulphur dioxide has acidic nature.
4. It acts as reducing agent.

Precautions :

1. Concentrated Sulphuric acid should be handled with care because its contact with skin can cause serious burn injury.
2. Sulphur dioxide gas should not be inhaled because it causes suffocation, headache, vomiting and even death from respiratory ailments.
3. Sulphur dioxide acts as a bleaching agent . Therefore, the litmus paper should not be kept in contact with it for a longer time to prevent its decolourization.
4. The whole apparatus should be air tight.
5. Use completely dry gas jars for collecting the gas.

Khaikhawmna

He experiment in a tum chu Sulphur dioxide gas siam a, heng a hnuaia a nihphung hrang hrang aṭanga thutlukna siam –

(i) A rim hriat chian
(ii) Tuia a zawp ral theih dan
(iii) Litmus paper a tihdanglam theih dan
(iv) Acidified Potassium dichromate nen reaction aṭanga thutlukna siam

Hriatttur pawimawh

1. Sulphur dioxide gas kan hnim chuan thawk a ti harsa thei a, hnar verh deuh, rimchhia a hriat theih bawk.
2. Litmus paper pawl tihhnawn (moist) hi Sulphur dioxide gas ah thlak ila a sen thei, hei hian Sulphur dioxide hi a thur tih a en tir.
3. Litmus paper sen tihhnawn (moist) hi Sulphur dioxide gas in a rawng a ti danglam lo, hei hian Sulphur dioxide gas hi a thur tih a en tir.
4. Tube ah Sulphur dioxide tikhat in, litmus pawl nena chawhpawlh tui ah a letlingin dah ila, tube ah tui a lawn chho ang, tin, tui a sen bawk ang. Hei hian SO_2 hi tui ah a zawp ral thei tih a en tir.
5. SO_2 leh acidified Potassium dichromate chawhpawlh ta ila, serthlum rawng tui chu a lo hring ang, hei hian SO_2 chu reducing agent (ti danglam tu) angin hna a thawk tih a en tir.
   (Acidified Potassium dichromate = Conc. Sulphuric acid + Potassium dichromate)

Important Terms

1. <u>Oxidation-Reduction(Redox) Reaction</u> : A redox reaction is a complete chemical reaction in which both oxidation as well as reduction takes place simultaneously.
2. Oxidation is loss of electrons.
3. Reduction is gain of electrons.
4. <u>Bleaching action of SO_2</u> : The decolourization of a fresh red rose kept in SO_2 gas is an example of bleaching action of SO_2.

EXPERIMENT NO – 4

AIM : (a) To observe the action of Zn, Fe, Cu and Al metals on the following salt solutions.

1. $ZnSO_4$ (aq)
2. $FeSO_4$ (aq)
3. $CuSO_4$ (aq)
4. $Al_2(SO_4)_3$ (aq)

(b) To arrange Zn, Fe, Cu and Al metals in the decreasing order of reactivity based on the above result.

Requirements : Solutions of Zinc Sulphate, Ferrous Sulphate, Copper Sulphate, Aluminium Sulphate, Test tubes, pieces of metals namely- Zinc, Iron, Copper and Aluminium, Marker and Test Tube stand.

Basic Principles involved :

(A) Original colours of various solutions

Sl. No	Name of Substance	Formula of Substance	Original Colour of Solution
1	Zinc Sulphate	$Zn\ SO_4$	Colourless
2	Ferrous Sulphate	$Fe\ SO_4$	Light Green
3	Copper Sulphate	$Cu\ SO_4$	Blue
4	Aluminium Sulphate	$Al_2\ (SO_4)_3$	Colourless

(B) Reactivity of Metals :

(i) If Metal X replaces metal Y from its aqueous solution, then

a) Metal X is more reactive than metal Y.
b) Metal Y is less reactive than metal X

(ii) If metal Y replaces metal X from its aqueous solution, then

a) Metal Y is more reactive than metal X
b) Metal X is less reactive than metal Y

1.(A) Procedure for the Interaction of Metals with Zinc Sulphate Solution

1. Take four clean test tubes and paste a strip of paper no each one.
2. Mark the test tubes as A, B, C and D respectively.
3. Take Zinc Sulphate Solution in each test tube.
4. Dip a clean piece of Zinc metal in the solution of test tube A.
5. Dip a clean nail of iron in the solution of test tube B.
6. Dip a clean wire of copper in the solution of test tube C.
7. Dip a clean wire of aluminium metal in the solution of test tube D.
8. Record your observations as shown in the table.

Interaction of Zn, Fe, Cu and Al Metals with Zinc Sulphate Solution

Sl.No	Experiments	Observations	Inference
A.	Solution of Zinc Sulphate + Zinc Metal	There is no change	There is equilibrium between Zn^{+2} and Zn.
B.	Solution of Zinc Sulphate + Iron Metal	There is no change	Iron is less reactive than Zinc (or Zinc is more reactive than iron
C .	Solution of Zinc Sulphate + Copper metal	There is no change	Copper is less reactive than Zinc (or Zinc is more reactive than Copper).
D.	Solution of Zinc Sulphate + Aluminium Metal	There is a new coat on Aluminium Metal	Aluminium is more reactive than Zinc

Conclusions : From this set of experiment it is concluded that :

1. Fe is less reactive than Zn or Zn is more reactive than Fe.
2. Cu is less reactive than Zn or Zn is more reactive than Cu.
3. Al is more reactive than Zn

1(B): <u>Procedure for the Interaction of Metals with Ferrous Sulphate Solution</u>

1. Take four clean test tubes and paste a strip of paper on each one.
2. Mark the test tube as A, B, C and D respectively.
3. Take ferrous Sulphate Solution in each test tube.
4. Dip a clean piece of Zinc metal in the solution of test tube A.
5. Dip a clean nail of Iron metal in the solution of test tube B.
6. Dip a clean wire of copper metal in the solution of test tube C.
7. Dip a clean wire of aluminium metal in the solution of test tube D.
8. Record your observations as shown in the table.

Interaction of Zn, Fe, Cu and Al Metals with Ferrous Sulphate Solution

Sl. No	Experiment	Observation	Inference
A	Solution of ferrous sulphate + Zinc metal	The original green colour of the Solution fades and finally becomes colourless. There is grey deposit on zinc metal.	Zn^{+2} ions replace Fe^{2+} ions from the solution. Thus Zn is more reactive than Fe.
B	Solution of ferrous sulphate + Iron metal	There is no change	There is equilibrium between Fe^{2+} and Fe.
C	Solution of ferrous sulphate + Copper metal	There is no change in the original colour of the solution	Copper is less reactive than iron.
D	Solution of ferrous sulphate + Aluminium metal	The original green colour of the Solution fades and finally becomes colourless. There is grey deposit on aluminium metal.	Al^{3+} ions replace Fe^{2+} ions from the solution. Thus Al is more reactive than Fe.

Conclusions : From the experimental observations of the interactions of Zn, Fe, Cu and Al with $FeSO_4$ (aq), it is concluded that :

1. Zn is more reactive than Fe.
2. Cu is more reactive than Fe.
3. Al is more reactive than Fe.

1(C): <u>Procedure for the Interaction of metals with Copper Sulphate Solution</u>

1. Take four clean test tubes and paste a strip of paper on each one.
2. Mark the test tube as A, B, C and D respectively.
3. Take Copper Sulphate Solution in each test tube.
4. Dip a clean piece of Zinc metal in the solution of test tube A.
5. Dip a clean nail of Iron metal in the solution of test tube B.
6. Dip a clean wire of copper metal in the solution of test tube C.
7. Dip a clean wire of aluminium metal in the solution of test tube D.
8. Record your observations as shown in the table.

Interaction of Zn, Fe, Cu and Al Metals with ferrous Sulphate Solution

Sl. No	Experiment	Observation	Inference
A	Solution of Copper sulphate + Zinc metal	Blue colour of original solution fades and finally becomes colourless. There is brown coat on zinc.	Zn^{+2} ions replace Cu^{2+} ions from the solution. Thus Zn is more reactive than Cu
B	Solution of Copper sulphate + Iron metal	The Solution changes from blue to light green. There is brown coat on iron.	Fe^{+2} ions replace Cu^{2+} ions from the solution. Thus, Fe is more reactive than Cu.

Sl. No	Experiment	Observation	Inference
C	Solution of Copper sulphate + Copper metal	There is no change	There is equilibrium between Cu^{2+} and Cu.
D	Solution of Copper sulphate + Aluminium metal	Blue colour of original solution fades and finally becomes colourless. There is brown coat on Aluminium.	Al^{3+}ions replace Cu^{2+} ions from the solution. Thus Al is more reactive than Cu.

Conclusions : From the experimental observations of the interactions of Zn, Fe, Cu and Al with $CuSO_4$ (aq), it is concluded that :

1. Zn is more reactive than Cu.
2. Fe is more reactive than Cu.
3. Al is more reactive than Cu.

1(D): <u>Procedure for the Interaction of metals with Aluminium Sulphate Solution</u>

1. Take four clean test tubes and paste a strip of paper on each one.
2. Mark the test tube as A, B, C and D respectively.
3. Take Aluminium Sulphate Solution in each test tube.
4. Dip a clean piece of Zinc metal in the solution of test tube A.
5. Dip a clean nail of Iron metal in the solution of test tube B.
6. Dip a clean wire of copper metal in the solution of test tube C.
7. Dip a clean wire of aluminium metal in the solution of test tube D.
8. Record your observations as shown in the table.

Interaction of Zn, Fe, Cu and Al metals with Aluminium sulphate solution.

Sl.No.	Experiments	Observations	Inference
A	Solution of Aluminium sulphate + Zinc metal	There is no change	Zinc is less reactive than aluminium
B	Solution of Aluminium sulphate + iron metal	There is no change	Iron is less reactive than aluminium.
C	Solution of Aluminium sulphate + copper metal	There is no change	Copper is less reactive than aluminium.
D	Solution of Aluminium sulphate + Aluminium metal	There is no change	There is equilibrium between Al^{3+} and Al

Conclusion : From this set of experiment it is concluded that :

1. Al is not replaced by Zn, Fe and Cu. Therefore, these metals are less reactive than aluminium.

   Decreasing order of Reactivity of Metals based on the results of above experiments

2. Zinc replaces iron ions from ferrous sulphate ($FeSO_4$) solution and copper ions from copper sulphate ($CuSO_4$) solution. Therefore, Zinc is more reactive than iron and copper.

   Zn > Fe > and Zn > Cu.

3. Iron replaces copper ions from copper sulphate ($CuSO_4$) solution. Therefore, iron is more reactive than copper.

   Fe > Cu

4. Aluminium replaces Zinc ions from zinc sulphate ($ZnSO_4$) solution, iron ions from iron sulphate ($Fe\ SO_4$) solution and copper ions from copper sulphate ($CuSO_4$) solution. Therefore, aluminium is more reactive than Zinc, iron and Copper.

$$Al > Zn > Fe > Cu$$

Khaikhawmna

He experiment in a tum ber chu metal chi li (4) Zinc, Iron, Copper leh Aluminium te zing ah reactivity-a sang ber leh hniam ber zawn chhuah a ni.Tin, reactivity san dan indawta rem tur a ni bawk.

Bawlhlo zing ah zinc sulphate ,ferrous sulphate, copper sulphate leh aluminium sulphate kan mamawh. Tin, zinc, iron, copper leh aluminium metal te laboratory ah kan neih loh pawh in a remchan anga zawn hmuh theih a ni.

Experiment hi a hran ṭheuh in vawi 4 tih a ngai a, metal solution (eg. Zinc sulphate) tinah metal chi li (4) te hi test tube paliah dahin chiah ṭheuh tur a ni. Chuta ṭang chuan metal pali te reactivity hriat tum tur a ni. Reactivity a sang ber chu Al a ni a,a dawt ah Zn, a dawt leh ah Fe, a hniam ber chu Cu a ni. A rem dan chu Al>Zn>Fe>Cu.

Important Terms

1. Activity series of metals : Arrangement of metals in the decreasing order of their reactivity is called activity series of metals.
2. Displacement reaction : The reactions in which more active element displaces less active element from its aqueous solution.

EXPERIMENT NO - 5

Aim: To prepare temporary mount of a leaf peel to show its stomata.

Material Required: Leaf of a plant like Lily, Petunia, Bryophyllum or Tradescantia, forceps, watch glass, slide, coverslip, brush, needles, safranine, glycerine and compound microscope.

Basic Principle involved: Stomata (singular stoma) are minute aperture (openings) present on the surface of a leaf. They are generally more on the lower epidermis. Each stoma is surrounded by two bean-shaped cells called guard cells These cells have differential thickenings i.e. thicker inner wall facing the stoma and thinner outer wall. The turgidity of guard cells controls the opening and closing of stomata. Stomata help in exchange of gases and water vapour between the atmosphere and leaf.

Procedure:
1. Peel off the leaf from the under surface and put the peel in a watch glass containing water
2. Add a few drops of safranine stain into the watch glass to stain the peel
3. After staining put the peel on a clean slide and cut it in a rectangular or square shape
4. With the help of a filter paper, remove the excess of stain and water
5. Put a drop of glycerine on the slide over the peel, gently put the the coverslip and observe under the microscope.

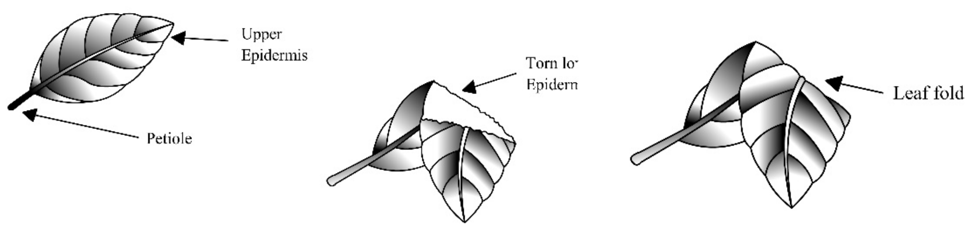
Observation:
1. Epidermis consist of a single layer of cells which are irregular in outline and without inter cellular spaces
2. Minute apertures are seen wchich are embedded in the epidermal cell

Result:

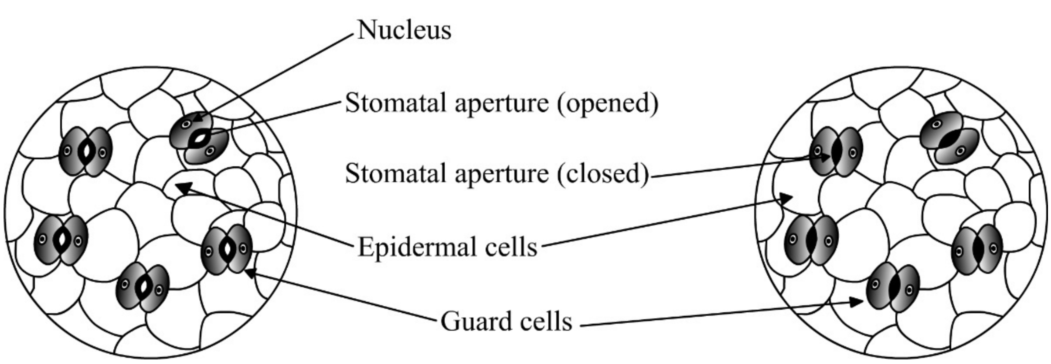
The minute apertures seen in the mount are stomata. Each stoma is surrounded by two bean-shaped cells called guard cells.

Precautions:

1. The epidermal peel should be taken from a freshly plucked leaf
2. Always hold the slide by its edges to avoid making the slide dirty
3. Always use a brush to transfer the peel from petri dish to the slide.
4. The peel should be cut to a proper size and its curling must be avoided.
5. The peel shluld be mounted in the centre of the slide.
6. The peel should not be allowed to dry.
7. Always keep the coverslip gently to avoid the entry of air bubbles
8. Oozing of glycerine should not be there



(a) Taking a leaf peel form a leaf



(b) Leaf peel with open stomata (c) Leaf peel with closed stomata

Fig. 5.1 Experiment to prepare a temporary mount of a leaf peel to show its stomata

Khaikhawmna

Thlai hnah chhah chi, Lily emaw Petunia emaw hnah pan tein han hik khawk hlek ila, microscope-a enin stomata hi chiang takin a lang thei.

A nih loh pawhin stomata en tur hian hnah chu kut pahniha chelhin hnah hnuai lam chu chung lamah dah tur a ni. Elh tur a ni a, han elh chiah khan elh chhumna laiah chuan rang ang deuh pan te a lo lang ang a, chu chu microscope-a en theih tawk turin tan tur a ni a, en mai tur a ni.

Hnah hnuai lamah hian stomata a tam zawk ṭhin avangin a hnuai lam hih a ṭha. Stomata chu hnah a\anga tui leh boruak paih chuahna kaw tereuh te a ni a, boruak (CO_2) luhna a ni bawk. Kaw tereuh te a ni a, a sir tawnah Guard Cell-in a chep a, heng guard cell-te thununna hian stomata hi a inhawngin a inkhar ṭhin.

He Experiment-a kan tum ber chu thlai hnaha thil ṭangkai tak, mit lawng hmuh tham si loh stomata-te kha microscope hmanga en a, chiang taka a pian phung leh a nih dan hriat a ni. Procedure-a tih dan tur tarlante hi uluk taka zawmin tih ni se. Microscope-a thil en tur hi pan tak a ni tur a ni a, safranine-a stain-in a lang chiang bik a, theihnghilh loh tur a ni. Hnah aṭanga kan thil hih thlak pan tak kha slide-a dah turin zai tet mai tur a ni. A ro mai tur ven nan glycerine far leh a ṭha a, chu chu coverslip-a khuh tur a ni.

Microscope-a en dawnin eng awm ṭhatna hmunah a lang chiang bik. Low power objective lens hmang en ṭan phawt tur a ni. Chiang taka a lan hnuah high power objective lens hmanga en duh tan en leh chauh tur a ni.

EXPERIMENT NO - 6

Aim: To study the dependence of current (I) on the potential difference (V) across a resistor and to determine its resistance. Also plot a graph between V and I.

Apparatus: A D.C. voltmeter of 1.5 V range, given resistor (*i.e.* a resistance wire, say constant wire of unknown resistance), an ammeter (1.5 ampere range), a rheostat (of about 10 ohm), plug key, dry cell or an accumulator and connecting wires.

Theory: According to Ohm's law, the potential difference V developed across the ends of a conductor is directly proportional to the current I flowing through it. Symbolically,

$$V \propto I$$

Or $$V = RI \quad \ldots\ldots(1)$$

Where R is the constant of proportionality and is known as the resistance of the conductor. Relation (1) can also be put in the form,

$$R = \frac{V}{I} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

When V is measured in volt, I in ampere then resistance R is expressed in Ohm (Ω).

To study the dependence of current on potential difference (p.d.), different values of potential difference V are applied across the ends of the conductor. The corresponding values of current I are recorded using an ammeter. The ratio of $\frac{V}{I}$ is determined in each case. It will be found that the ratio $\frac{V}{I}$ is found to be the same in each set of observation. *The mean value of* $\frac{V}{I}$ *gives the resistance R of the conductor.*

The variations of V vs I are represented by plotting V along X-axis and I along Y-axis. The graph will be found to be a straight line.

Procedure:

1. Draw a neat circuit diagram on your notebook as shown in the Figure.

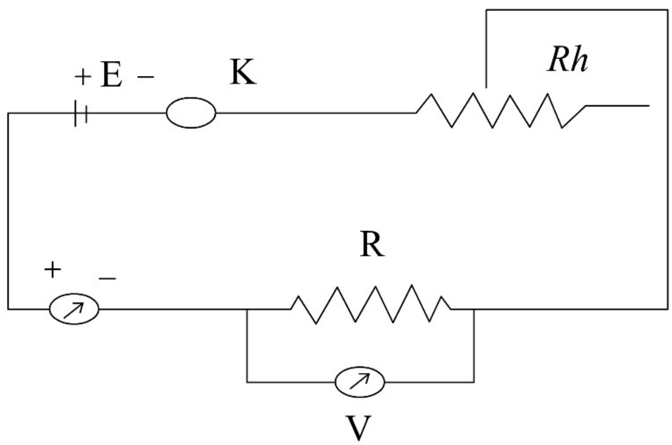


Fig. 6.1 Circuit diagram

2. Arrange the apparatus on the working table in the laboratory and make the circuit connections as shown in the figure. Ammeter is connected in series with the given resistor and voltmeter is connected in parallel, *i.e.* across it. Record the zero errors in ammeter and voltmeter, if any.
3. Insert the plug-key, K and adjust the rheostat (Rh) to pass a small current through the given resistor. Note the ammeter and voltmeter readings.
4. Increase the current step-by step by adjusting the slider of the rheostat and take about 5 or 6 sets of readings. Note carefully the ammeter and voltmeter readings in each set.

5. Tabulate the observations as given in the table.
6. Find $\frac{V}{I}$ ratio for each set of observations and record it in the observation table.

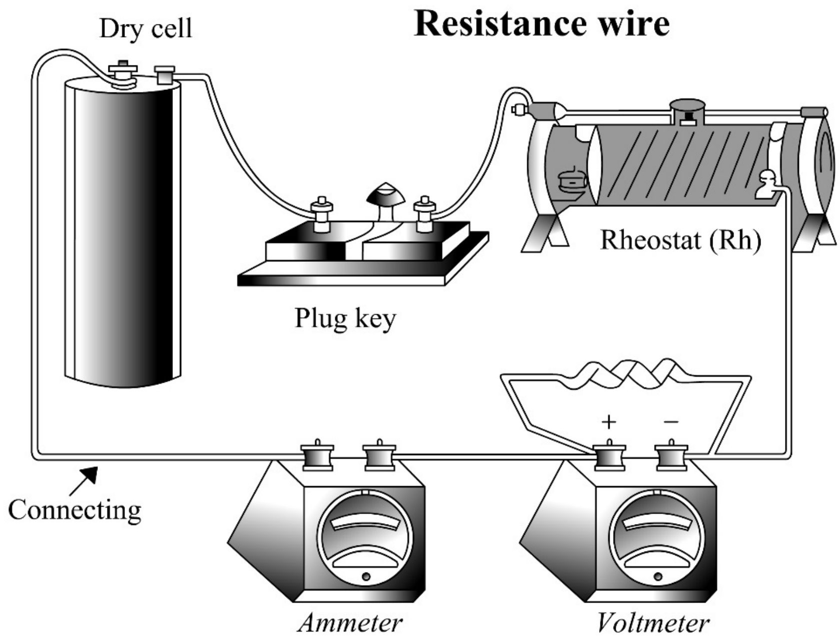


Fig. 6.2 Arrangement diagram for the study of dependence of current (I) on potential difference (V) for the given resistor.

7. Draw a graph by plotting ammeter readings (I) along *y*-axis and the corresponding voltmeter readings (V) along *x*-axis as shown in the figure

Observations and calculations

Least count of the ammeter	= ……...amp
Least count of the voltmeter	= ……..volt
Range of the ammeter	= ……...amp
Zero error of the ammeter	= ……...amp
Range of the voltmeter	= …….. volt
Zero error of the voltmeter	= ……...volt

Note

If the zero error of the instrument is negative, then it must be added to the observed value to get the corrected value and vice versa.

Table 6.1

Obs. No	*Ammeter readings (I)*		*Voltmeter readings (V)*		$\frac{V}{I} = R$ (Ohm)
	Observed (amp)	***Corrected (amp)***	***Observed (amp)***	***Corrected (amp)***	
1.					
2.					
3.					
4.					
5.					
6.					

$$\text{Mean } \frac{V}{I} = R = \ldots\ldots.. \text{ ohms}$$

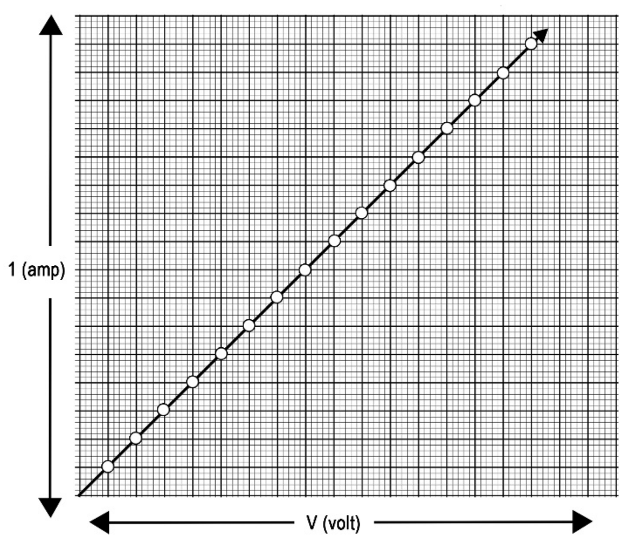


Fig. 6.3 V-I graph is a straight line which means $V \propto I$.

Graph

The plot of V and I is a straight line passing through the origin as shown in the figure. To determine the resistance R from the graph, read the current value, in amperes corresponding to a given voltmeter reading and take the ratio $\frac{V}{I}$. Thus the resistance of the conductor AB is determined in ohms.

Result:

1) The straight line graph between I and V shows that the potential difference developed across ends of a conductor (or resistor) is directly proportional to the current flowing through the conductor.
2) The resistance of the given resistor is ……..Ω.

Precautions:

1. Draw a circuit diagram showing the scheme of connections and get it checked by the teacher.
2. Clean the ends of the connecting wires by sand paper and then make neat, clean and tight connections.
3. Get your circuit *connections* checked by the teacher before passing the current.
4. Close the key only when you are taking readings.
5. Take care that the cell is not *short-circuited* because by doing so, a heavy current is suddenly drawn from the cell due to which the plates of the cell may be damaged.
6. Note the zero errors and the ranges of the ammeter and voltmeter.
7. Positive terminals of ammeter and voltmeter should be connected to the positive pole of the cell and the higher potential terminal of the resistor AB respectively.
8. A low resistance rheostat should be used in order to change the current smoothly.
9. The voltmeter must be of high resistance.

10. Excessive current should not be passed in the resistor otherwise due to large heating its temperature may increase. Due to increase in temperature the ratio *V/I* may not remain constant.

Khaikhawmna

Current inghahna chu Resistor-te *Potential Difference* a ni tih fiah kan tum a, resistance kan zawnchhuah bakah graph aṭanga rinngil lo chhuak aṭangin *current* leh *potential difference* te inlaichinna mumal chu lantir kan tum a ni.

Heng experiment No 4, 5 leh 6 ah hian *current* kal a mumal theih nan kan hmanrua te a fai ṭha tur a ni a, lehkhathap in nawtfai hmasa ila a ṭha ang. *Current* sang tak hman chi a ni lo, *current* a san chuan *temperature* a sang tel ve a, chu chuan *resistance* a tisang ve leh zel tih hriat a ṭha a, a reading kan chhinchhiah dawn lai tak chauhin *current* kaltir tur a ni. *Current* kan kal tir hmain *Positive terminal* leh *Negative terminal* te a dik thlap in vuah tur a ni a, inkalthelh a awm chuan *short circuit* a awm ang a, *battery* cell thlengin a chhiat phah thei a ni.

EXPERIMENT NO - 7 (A)

Aim: To study the properties of an acid (for example, dilute HCl) by its reactions with

(i) Litmus solution or paper (blue and red)
(ii) Zinc metal
(iii) Solid sodium carbonate

Materials required:

(a) Apparatus: Litmus solutions or paper (blue and red), test tubes and dropper

(b) Chemicals: Hydrochloric acid, litmus solutions or paper (blue and red), zinc metal, sodium carbonate, test tubes, droppers.

Basic Principles

Hydrochloric acid turns blue litmus to red litmus but it does not affect red litmus.

1. When zinc metal is added to hydrochloric acid, hydrogen gas is liberated.

   $Zn(s) + 2HCl(aq) \rightarrow H_2(g) + ZnCl_2(aq)$

2. Hydrogen gas burns in oxygen with a pop sound.

   $2H_2(g) + O_2(g) \longrightarrow 2H_2O(l)$

3. Hydrochloric acid reacts with sodium carbonate so that carbon dioxide gas (CO_2) is liberated.

   $Na_2CO_3(aq) + 2HCl(aq) \longrightarrow 2NaCl(aq) + H_2O(l) + CO_2(g)$

4. Carbon dioxide gas turns lime water milky due to the formation of calcium carbonate.

   $Ca(OH)_2(aq) + CO_2(g) \longrightarrow CaCO_3(s) + H_2O(l)$

Procedure:

S.No.	Experiments with	Observations	Inference
1.	**Litmus solutions**		
	a) Take 1 ml of HCl in a test tube and add a few drops of blue litmus solution.	Blue litmus turns red.	HCl has acidic character.
	b) Take 1 ml of HCl in a test tube and add a few drops of red litmus solution.	There is no change in the colour of red litmus.	HCl is an acid as it does not affect red litmus.
2.	**Zinc metal**		
	a) Take about 2ml of hydrochloric acid in a clean test tube and add two or three pieces of zinc metal.	Small bubbles of hydrogen gas are formed.	Zinc reacts with HCl to liberate H2.
3.	**Sodium carbonate**		
	b) Take solid sodium carbonate in a dry test tube and add hydrochloric acid drop wise.	Brisk effervescence is produced.	Sodium carbonate reacts with HCl to produce CO2.
	c) Pass the gas through lime water.	Lime water turns milky.	CO2 reacts with lime water and forms calcium carbonate.

Conclusions:

1) Hydrochloric acid turns blue litmus red but it does not affect red litmus.
2) Hydrochloric acid reacts with zinc metal liberating hydrogen gas and zinc chloride is also formed.
3) Hydrochloric acid reacts with sodium carbonate and it liberates carbon dioxide.
4) Hydrochloric acid (HCl) has acidic nature.

Precautions:

1) Hydrochloric acid should be handled with care because it can burn skin and clothes.
2) Only small quantity of chemicals should be used.
3) Hands must be cleaned properly after completing the experiment.

Khaikhawmna

He Experiment-in a tum ber chu acid ṭhenkhat (dil. HCl), thil chi thum nena reaction a neih dan aṭanga a nih phung zir chian a ni; chungte chu - (1) litmus pawl leh sen hmangin: dil.HCl chuan litmus pawl a tisen thei a, a sen erawh a tidanglam lo. (2) Chu dil.HCl-ah chuan zinc metal kan telhin Hydrogen gas a rawn insiam a. (3) Sodium carbonate nen an inpawlh ve thung erawh chuan carbon dioxide gas a siam chhuak ṭhin. Chu gas chu CO_2 a ni ngei tih fiah dawn chuan chinai tui fimah chu gas chu pawlh(pass) la, chinai tui fim chu a lo pawt (var dal) raih chuan CO_2 a ni ngei tihna a ni. CO_2 hi boruak pangngai aia a rih laiin Hydrogen erawh chu a zâng zawk. Chinai tui fim (lime water) chu $Ca(OH)_2$ a ni a; tui leh Calcium Hydroxide chawhpawlh a ni bawk.

Acid hian vun leh thawmhnaw a ei theih avangin fimkhur hle tur. Tin, acid leh thildang kan chawhpawlh dawnin kan dahna (beaker, test tube, etc) kha ken awn deuhva, a bang hrut thlaa pawlh a him fo. 1ml hi far (drop) 18 vel a ni.

EXPERIMENT NO - 7(B)

Aim: To study the properties of a base (for example, dilute solution of NaOH) by its reaction with

(i) Litmus solution (blue and red)
(ii) Zinc metal
(iii) Hydrochloric acid

Materials required:

(a) Apparatus: Test tubes, litmus solutions (blue and red) and droppers

(b) Chemicals: A dilute solution of sodium hydroxide, hydrochloric acid and zinc metal

Basic Principles

1) Sodium hydroxide turns red litmus blue but it does not affect blue litmus.
2) When zinc metal is added to sodium hydroxide hydrogen gas is liberated. This gas burns with a pop sound.
3) Hydrochloric acid neutralizes sodium hydroxide so that the pink colour of phenolphthalein is discharged.

$$HCl(aq) + NaOH(aq) \longrightarrow NaCl(aq) + H_2O(l)$$

Procedure:

S.No.	Experiments with	Observations	Inference
1.	**Litmus solutions** a) Take 1 ml of NaOH (aq) in a test tube and add a few drops of red litmus solution.	Red litmus blue.	NaOH has basic character.

S.No.	Experiments with	Observations	Inference
	b) Take 1ml of NaOH (aq) in a test tube and add a few drops of blue litmus solution.	There is no change in the colour of blue litmus.	NaOH is a base as it does not affect blue litmus.
2.	**Zinc metal**		
	a) Take about 2 ml of NaOH (aq) in a clean test tube and add two or three pieces of zinc metal.	Small bubbles of hydrogen gas are formed.	Zinc reacts with NaOH to liberate H_2.
	b) Bring a burning match stick to the mouth of a test tube.	The gas burns with a pop sound.	The gas liberated is a hydrogen gas.
3.	**Hydrochloric acid**		
	a) Take 2 ml of NaOH (aq) in a clean test tube and add two drops of phenolphthalein.	The solution of sodium hydroxide turns pink.	Sodium hydroxide is alkali.
	b) Add hydrochloric acid to the above pink solution.	Pink colour disappears.	Hydrochloric acid neutralizes NaOH.

Conclusions:

1) Sodium hydroxide turns red litmus blue but it does not affect blue litmus.
2) Sodium hydroxide reacts with zinc metal and liberates hydrogen gas. During the reaction sodium zincate is also formed.
3) Sodium hydroxide is neutralized by hydrochloric acid.
4) Sodium hydroxide (NaOH) is a base.

Precautions:

1) Sodium hydroxide should be handled with care because it can burn skin and clothes.
2) Only small quantity of chemicals be used.
3) Hands must be washed properly after completing the experiment.

Khaikhawmna

He experiment-in a tum ber chu base chi khat, dilute solution of NaOH nihphung, thil chi thum hmanga zir chian a ni, chungte chu: (i) NaOH solution chuan litmus sen a tipawl a, litmus pawl erawh a rawng a thlak danglam lo. (ii) NaOH solution chu zinc metal nena pawlhin hydrogen gas a pe chhuak. (iii) NaOH solution chu phenolphthalein nena pawlhin a lo sendang (pink) a, chu chu hydrochloric acid nena pawlh leh erawh chuan rawng sendang chu a bo va, a lo fim ṭhin.

Sodium Hydroxide (NaOH) hian vun leh thawmhnaw a ei chhiat theih avangin fimkhur tur a ni. Litmus hi a tui (solution) aiin a paper-a hman tam zawk a ni. Litmus paper i hman chuan i damdawi (chemical) tui kha litmus paper-ah chuan i far thei mai a; a nih loh pawhin litmus paper zawk kha i damdawi tui (solution)-ah khan i zuk chiah zauh thei bawk. Zinc metal a awm loh chuan dry battery (torchlight-a hman ang chi hi)-a a ṭin (container) hi zinc a nih ve tho avangin tih nawia hman mai theih a ni.

Important Terms

1. ***Base*** : A substance that will neutralize an acid by accepting hydrogen ions.

2. ***Alkali*** : A base which is soluble in water and produces Hydrogen ions (OH^-) in solution.
3. ***Acid*** : A compound containing Hydrogen which dissolves in water to produce Hydrogen ions (H^+) in the solution.
4. ***Litmus*** **:** An indicator which shows whether a solution is acidic or alkaline.
5. ***Indicator*** : A substance whose colour depends on the pH of the solution it is in.
6. ***Catalyst*** **:** A substance that increases the rate of a chemical reaction, but is chemically unchanged itself at the end of the reaction.
7. ***Chemical reaction***: Any change which alters the chemical properties of a substance or which forms a new substance.

EXPERIMENT NO – 8

Aim: To study the following properties of acetic acid CH_3COOH(Ethanoic acid)

1. Odour.
2. Solubility in water.
3. Effect on litmus.
4. Reaction with sodium bicarbonate.

Materials Required

Apparatus: Test tubes, blue litmus paper, dropper, (Thermometer: for optional experiments).

Chemicals: Sample of acetic acid, water, sodium bicarbonate, freshly prepared lime water cold water and ethyl alcohol for optional experiments).

Basic principles involved:

1. Acetic acid has vinegar like smell.
2. Acetic acid is highly soluble in water.
3. Acetic acid turns blue litmus red.
4. Acetic acid produces effervescence with sodium bicarbonate liberating carbon dioxide gas.
5. Carbon dioxide turns lime water milky due to the formation of insoluble calcium carbonate.
6. Pure acetic acid freezes at 16.6° C.
7. Acetic acid reacts with ethyl alcohol in the presence of sulphuric acid so that ethyl acetate is formed. This reaction is called Esterification.
8. Ethyl acetate is an ester and it has fruity smell.

Steps of Experimental Procedure to study the properties of Acetic Acid:

Experiments	Observations	Inference
1. Odour of acetic acid. a) Take the given sample in a test tube and smell it carefully.	It smells like vinegar.	Acetic acid has vinegar like odour.
2. Solubility of acetic acid in water. a) Take 2ml of water in a test tube. Add 10 drops of acetic acid and shake it carefully. b) Add more acetic acid into the same test tube.	A homogenous solution is formed. It also dissolves	Acetic acid is soluble in water. Acetic acid is· highly soluble in water.
3. Effects of acetic acid on litmus paper. a) Place a strip of blue litmus paper on a dry and clean tile and put two drops of acetic acid solution on it. b) Place a strip of red litmus paper on a dry and clean tile	Blue litmus turns red. There is no changes in the colour of red litmus.	Acetic acid shows **acidic** character. Acetic acid has acidic character.

Experiments	Observations	Inference
and put two drops of acetic acid solution on it.		
4. Reaction of acetic acid with sodium bicarbonate. a) Take 2ml solution of acetic acid in a clean test tube and add a pinch of sodium bicarbonate.	Effervescence is produced.	Acetic acid liberates carbon dioxide with sodium bicarbonate.
b) Pass carbon dioxide gas through lime water.	Lime water turns milky.	CO2 forms calcium carbonate with lime water.

Optional Experiments:

Experiments	Observations	Inference
1. Freezing of acetic acid. Take about 2ml of pure acid in a clean and dry test tube and introduce a thermometer in it. Keep the test tube in the ice cold water and wait for some time.	Acetic acid begins to solidy at about 16.6° C.	Freezing point of pure acetic acid is 16.6°C.

Experiments	Observations	Inference
2. Esterification of acetic acid with ethyl alcohol. Take 2ml of pure acetic acid in a test tube, add 2 ml of, ethyl alcohol and 4 drops of Conc. H_2SO_4. Heat the test tube in a water bath.	As reaction takes place fruity smell is felt coming out of the test tube.	Acetic acid reacts with ethyl alcohol and an ester is formed.

Results and Conclusions:

1) Acetic acid has vinegar like smell.
2) Acetic acid is highly soluble in water.
3) Acetic acid changes blue litmus red.
4) Acetic acid liberates carbon dioxide from sodium bicarbonate.
5) Acetic acid forms ester with ethyl alcohol.

Precautions:

1) Acetic acid should be handled with care.
2) The vapour of the chemicals should not be inhaled.
3) Carbon dioxide should be passed through freshly prepared lime water only for a short duration.
4) Every care should be taken while using concentrated sulphuric acid.
5) Mixture of acetic and ethyl alcohol should never be heated directly on the flame. It should be heated in a water bath.

Khaikhawmna

He experiment in a tum ber chu a hnuaia mite hmang a nih phung hrang hrang zir chian a ni.

(i) A rim (odour).
(ii) Tuia a zawp ral theih dan.
(iii) Litmus nena reaction nghawng dan hriat.
(iv) Sodium bicarbonate(soda) nena reaction siam dan.

Hriat tur:

1) Acetic acid hi hnim ila vinegar rim a nam. (Vinegar hi sa chiah hnip nan leh chawhmeh sawngbawl nan a hman a ni a acid chikhat a ni.)
2) Test tube-ah tui 2ml leh acetic acid far sawm test tube ah chawhpawlhin thing fai la, a inchawhpawlh vek chuan acetic acid hi tuiah a inchiah darh (dissolve) thei tihna a ni.
3) Litmus paper pawlah acetic acid far ta ila litmus paper rawng a lo sen chuan acetic acid hi a thur (acid) tih a entir.
4) Test tube ah acetic acid 2ml leh Sodium bicarbonate tlem thlak la, boruak puar pep pep leh ri ser ser (bubble & hiss) a lo chhuak ang. Hei hian Sodium bicarbonate nen reaction an siam avangin acetic acid aṭangin CO_2 a ti chhuak tih a entir.

Important Terms

1. **Esterification:** The reaction between acetic acid and ethyl alcohol is called esterification.
2. **Glacial acetic acid:** Pure acetic acid solidifies at 16.6°C and thus floats on water just like glaciers. Therefore, it is called glacial acetic acid.
3. **Ethanoic acid**: The IUPAC name of acetic acid is ethanoic acid.
4. **Ethanol**: The IUPAC name of ethyl alcohol is ethanol.
5. **IUPAC**: International Union of Pure and Applied Chemistry.

EXPERIMENT NO - 9

Aim : To show experimentally that carbon dioxide is given out during respiration

Material required : Test tube, bent tube, lime water.

Basic Principle involved :
During respiration oxygen is inhaled in the form of air and carbon dioxide is exhaled which turns lime water milky.

Procedure :
1. Take a test tube and keep lime water in it.
2. Insert a bent tube in the lime water.
3. Blow air into the bent tube as shown in the figure and observe the result.

Observation :
Lime water turns milky after blowing air into the test tube.

Result:
The turning of lime water to milky shows that carbon dioxide is given out during respiration

Precaution :
1. Do not suck back lime water while blowing
2. Do not blow in excess. If CO_2 is passed through lime water in excess the solution becomes clear due to the conversion of $CaCO_3$ into soluble calcium bicarbonate.
3. Lime water should be freshly prepared.

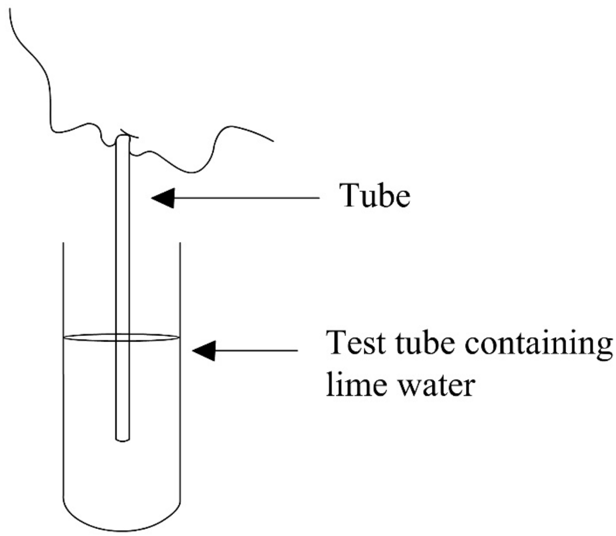


Fig. 9.1 *Experiment to show that carbon dioxide is given out during respiration*

Khaikhawmna

He experiment hi kawng dang, sei zawk leh chipchiar deuh zawkin a tih theih tho va. Geeta Publishing Company lehkhabu leh Class X Science Practical Manual dangah pawh chutiang chu tarlan a ni.

Tuna kan han tarlan hi a awlsam a, result a chiang bawk a. Chu bakah, hmanraw hman tur a ngai tlemin hmuh mai tur a awm thei bawk nen, experiment awlsam leh ṭha tak a ni.

Test tube-ah lime water dah a, bent tube pawh ngai lovin tube pangngaiin ham mai theih a ni a, lime water a lo pawt (milky) veleh duhtawk tur a ni.

Lime water hi siam sa a awm loh chuan chinaiah tui leih la, chawk la, thlifim (filter) la chu chu lime water chu a ni.

EXPERIMENT NO – 10

Aim : To study a) Binary Fission in Amoeba and b) budding in yeast with the help of prepared slide

Materials required : Microscope, prepared slides of binary fission of Amoeba and budding in yeast.

Basic Principle involved :

Reproduction is a process by which a living organism can produce more of its own kind.

It is of two types.

A. **Asexual Reproduction :** It is a common type of reproduction in lower plants and some animals. In this type only one organism is involved and all divisions are amitotic or mitotic. Is it rapid mode of multiplication in which new organisms produced are genetically identical to the parent. It is of various types as listed in the following table.

Reproduction
- (A) Asexual reproduction (Apomixis)
  - (a) Binary fission
  - (b) Multiple fission
  - (c) Budding
  - (d) Fragmentation and regeneration
  - (e) Sporulation
  - (f) Vegetative propagation
    - (i) Natural
      - (1) Root
      - (2) Leaf
      - (3) Stem
    - (ii) Artificial
      - (1) Cutting
      - (2) Grafting
      - (3) Layering
      - (4) Tissue Culture
- (B) Sexual reproduction

Table 10.1 *An outline classification of reproduction*

B. Sexual Reproduction : It is a type of reproduction present in higher plants and most of the animals. In this type two organisms are involved. Meiosis occurs in this type of reproduction and organisms produced are not genetically identical to the parents.

Procedure :

1. Focus the slides under microscope and observe carefully under low power then under high power objective lens
2. Note down their features, compare with the figure 4.1 and 4.2 for identification and draw diagrams in practical record file.

Observation :

Binary Fission

1. It is a type of asexual reproduction in which two individuals are formed from a single parent and parental identity is lost.
2. Here, nucleus divides amitotically into two, which is follwed by the division of cytoplasm
3. Observe the various stages of dividing nucleus and cytoplasm.
4. This type of reproduction is common in unicellular organisms like Amoeba, Paramecium, Euglena etc.

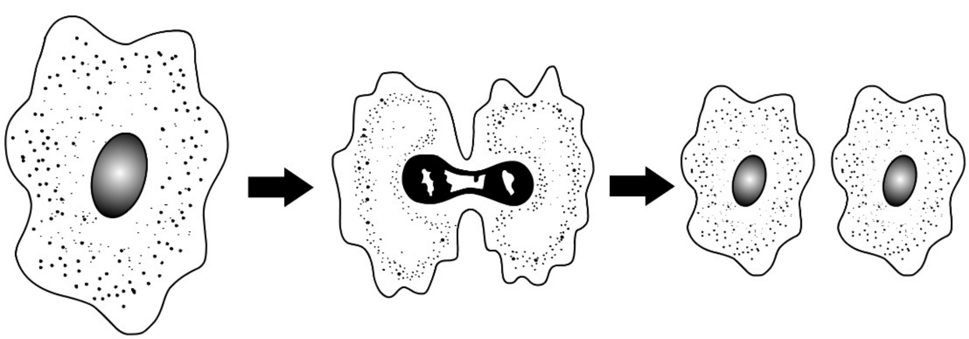


Fig. 10.1 *Binary Fission in Amoeba*

Budding

1. It is a type of asexual reproduction in which a bulb like projection or outgrowth arises from the parent body called bud.

2. The nucleus divides by mitosis and one of the daughter nuclei passes into the bud.
3. The bud is ultimately detached from the parent cell, grows to full size and forms a new individual. In budding, parental identity is maintained.
4. This type reproduction is common in Yeast, Hydra etc.

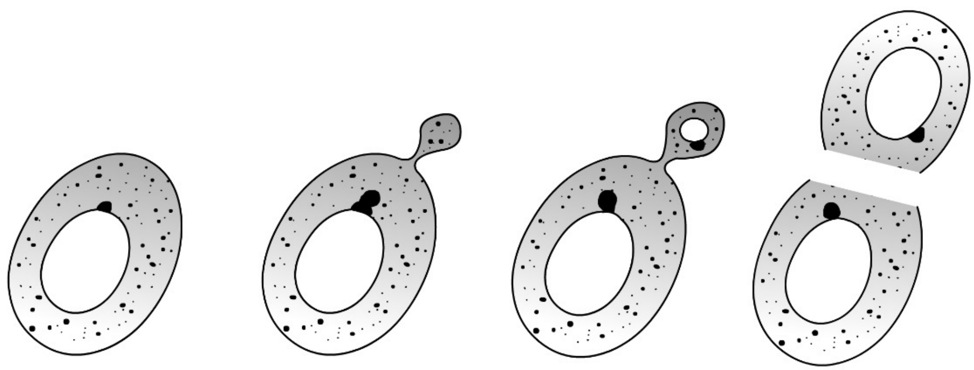


Fig. 10.2 *Budding in Yeast*

Result :

The given slides show binary fission in Amoeba and budding in Yeast.

Precautions :

1. First observe the slide under low power, then high power
2. Always draw the labelled diagrams, first by observing the slide under the microscope, then compare them with the diagrams given in the book.

Khaikhawmna

He experiment-in a tum ber chu thil nung tereuh te te inthlahchhawn dan zir a ni. Amoeba leh Yeast-te hi thil nung zingah a te pawl, mit lawnga hmuh tham loh an ni. Hmuh tham loh khawpa te thilnungte pawh hian inthlah pun dan mumal tak an nei a, chu chu he experiment-a kan zir hi a ni.

Mit lawnga hmuh tham loh an nih avangin Compound microscope hmangin a hmuh theih a, Amoeba leh Yeast-te low power objective-a en hmasaka, fiah taka an lan hnuah high power objective lens-ah en leh chauh tur a ni.

Microscope hi dim taka khawih a ṭha a, chawi sawn lai pawhin kut lehlama a hnuaia dawm ṭhin tur a ni.

Binary Fission-ah chuan Amoeba-a nucleus chu pahinhah a inṭhen phawk a, chumi hnuah cytoplasm a inṭhen leh a, Amoeba pakhat kha pahnihah a lo insiam ta a ni.

Budding-ah chuan Yeast taksa khawi laiah emaw khan bawk (bud) a lo awm a, a ṭhang lian zel a, a tawpah chu bawk chu a thlawn a, yeast thar a lo ni ta a ni.

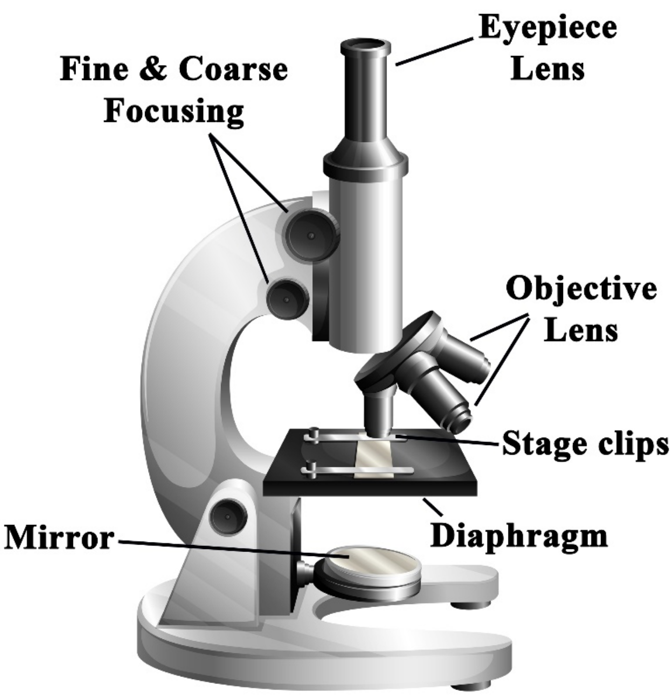


Fig. 10.3 *Compound Microscope*

EXPERIMENT NO – 11

Aim : To determine the equivalent resistance of two resistors connected in series.

Apparatus : Two given resistors of unknown resistances, an ammeter, a voltmeter of suitable range, rheostat of about 10 Ω resistance, an accumulator or a dry cell, a plug key, connecting wires, sand paper etc.

Theory: Two resistors are said to be connected in series if they are connected end as shown in the figure. The equivalent resistance of the series combination, i,e, R is given as

$$R = r_1 + r_2$$

Where r and r are the individual resistances of the resistors connected in series as shown in the Figure

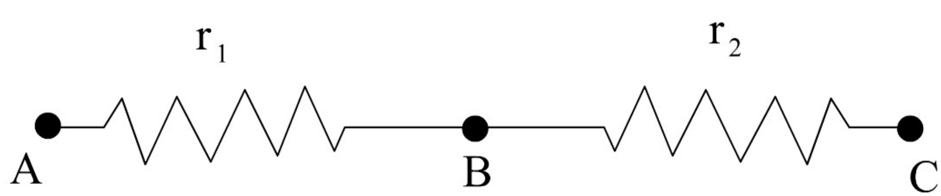


Fig 11.1. *r_1 and r_2 are connected in series.*

Procedure

1. Determine the individual r_1 and r_2 of the given resistors by following the circuit diagram and procedural steps of Experiment No. 4.

2. Study the following circuit diagram for series combination of r_1 and r_2 as given in the Figure. Make the connections of various pieces of apparatus as shown in arrangement diagram given in the Figure.

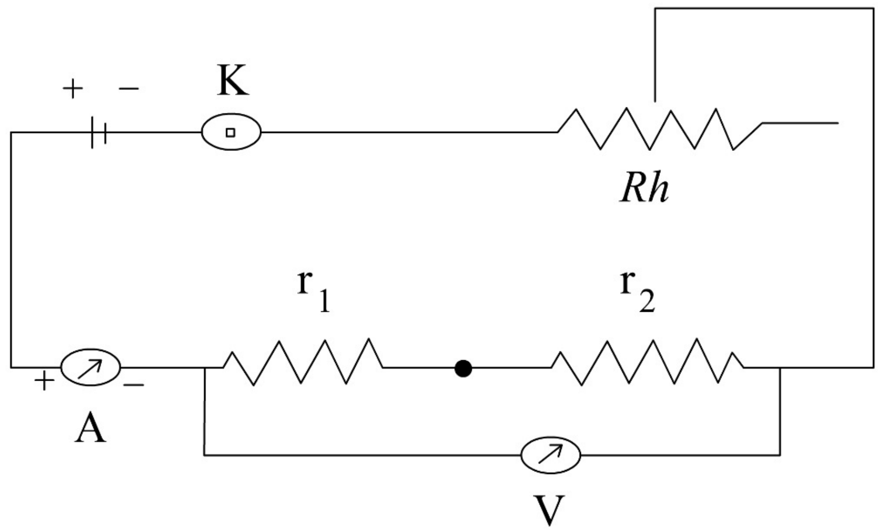


Fig 11.2. *Circuit diagram to determine the equivalent resistance of two resistors connected in series.*

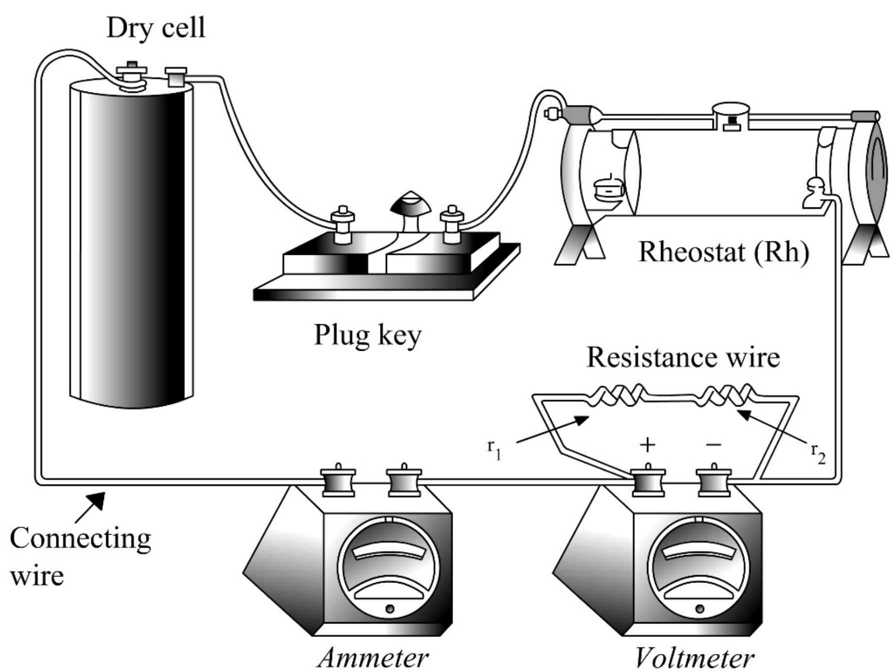


Fig. 11.3 *Arrangement diagram for series combination of the given two resistors.*

3. Insert the key (K) and adjust the rheostat (Rh) for a small current as indicated by ammeter A. Record the ammeter and voltmeter readings.

4. Increase the current by adjusting the position of slider of the rheostat and note down the corresponding readings of ammeter and voltmeter. Thus take three sets of observations and determine mean value of the equivalent resistance R of the series combination.

5. Record the observations as detailed below :

Observations

Zero error of voltmeter = ……. volt

Zero error of ammeter = ……. amp

Least count of the voltmeter = ……. volt

Least count of the ammeter = ……. amp

Range of ammeter = ……. amp

Range of voltmeter = ……. volt

Note

If the zero error of the instrument is negative then it must be added to the observed value to obtain the corrected value and vice versa.

Table 11.1

Resistance (Ohm)	*Obs. No.*	*Voltmeter reading (V)*		*Ammeter reading (I)*		*Resistance = V/I (ohm)*	*Mean resistance (ohm)*
		Observed (volt)	*Correct (volt)*	*Observed (amp)*	*Corrected (amp)*		
	1						
r_1	2						
	3						
r_2	1						

	2						
	3						
	1						
R	2						
	3						

Calculations

Resultant resistance of the resistors in Series

(i) By experiment, R = …….ohm

(b) By calculations, $R = r_1 + r_2$ = ……ohm

Result

Within the limits of experimental error, the experimental value of F is equal to its calculated value. Thus the relation $R = r_1 + r_2$ for series combination is verified.

Precautions

1. Draw a circuit diagram as given in the book and get it checked by your teacher.
2. Clean the ends of the connecting wires by sand paper and then make neat, clean and tight connections.
3. Get your circuit connections checked by your teacher before passing current.
4. Close the key (K) only when you are taking readings.
5. Take care that the source of current, i.e. dry cell is not short circuited.
6. not the zero errors and the ranges of the ammeter and voltmeter.

7. Positive terminals of ammeter should be connected to the positive pole of the cell.
8. The positive terminal of the voltmeter should be connected to the higher potential ends of the resistors r_1 and r_2 in series combination.
9. A suitable rheostat of about 10 Ω should be used to change the current smoothly.
10. Excessive current should not be passed, otherwise due to excessive heating, temperature increases. With increase in temperature the resistance of the resistor changes.

Khaikhawmna

Resistor pahnih, series-a thlunzawm ten resistance an neih zat zawnchhhuah kan tum a ni a, he zawnchhuahna formula awmsa $R = r_1 + r_2$ finfiah hi kan tum ber chu a ni.

EXPERIMENT NO – 12

Aim: To determine the equivalent resistance of two resistors connected in parallel.

Apparatus

Two given resistors of unknown resistances, an ammeter, a voltmeter of suitable range, rheostat of about 10 Ω resistance, an accumulator or dry cell, a plug key, connecting wires, sand paper etc.

Theory

Two resistors are said to be connected in parallel if one end of each resistor is connected to one common point A and the other end of each resistor is connected to another common point B as shown in the Figure.

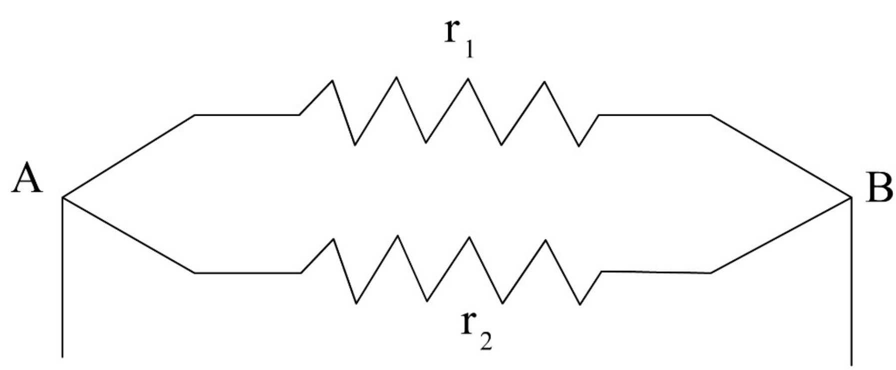


Fig. 12.1 *Parallel combination of resistors* r_1 *and* r_2

The equivalent resistance F of the parallel combination is given by the relation

$$\frac{I}{R} = \frac{I}{r_1} + \frac{I}{r_2}$$

Procedure

1. Determine the individual resistances r_1 and r_2 of the given resistors following the procedural steps and circuit diagram of the experiment No.4.

2. Study the circuit diagram for parallel combination of r_1 and r_2 as given in the Figure. Make the connections of various pieces of apparatus as shown in arrangement diagram given in the next Figure.

3. Insert the key (K) and adjust the rheostat (Rh) for a small current as indicated by ammeter A. Note the ammeter and voltmeter readings.

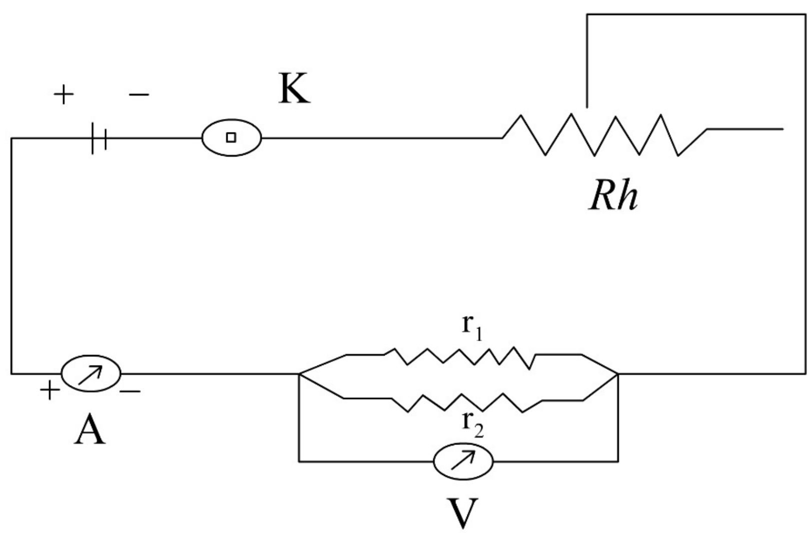


Fig 12.2 *Circuit diagram for parallel combination of* r_1 *and* r_2

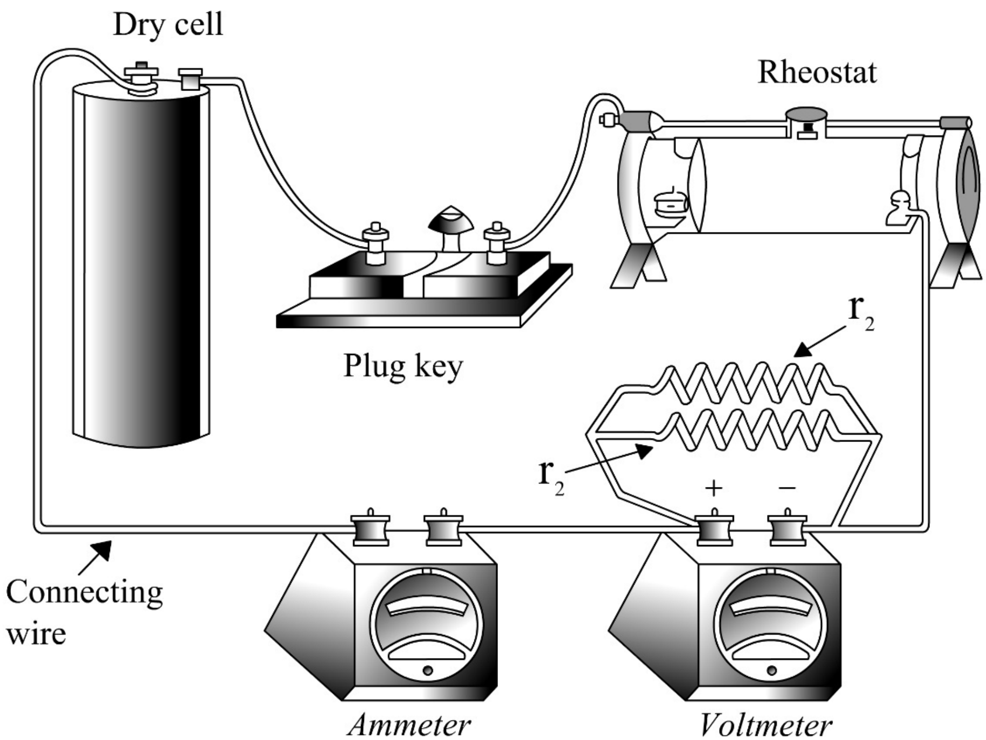


Fig 12.3 *Arrangement diagram for parallel combination of* r_1 *and* r_2.

4. Increase the current by adjusting the position of the slider of the rheostat suitably. Record the corresponding readings of ammeter and voltmeter. Take three sets of observations and determine the mean value of the equivalent resistance R of the parallel combination.

5. Record your observations as given below :

Observations

Zero error of the voltmeter = …volt

Least count of the voltmeter = ….volt

Zero error of the ammeter = …amp

Least count of the ammeter = …amp

Note
If the zero error of the instrument is negative, then it must be added to the observed value to get the corrected value and vice versa.

Table 12.1

Resistance (Ohm)	Obs. No.	Voltmeter Reading (V)		Ammeter Reading (I)		Resistance V/I (Ohm)	Mean Resistance (Ohm)
		Observed (Volt)	Corrected (Volt)	Observed (amp)	Corrected (amp)		
	1						
r_1	2						
	3						
	1						
r_2	2						
	3						
	1						
R	2						
	3						

Calculations : Resultant Resistance of Resistors in Parallel

(i) By experiment R = ….ohm

(ii) By calculation $\frac{I}{R} = \frac{I}{r_1} + \frac{I}{r_2} = ...(ohm)^{-1}$ or R = ….ohm

Result
Within the limits of experimental error, the experimental value of *R* equals the calculated value of **R**.

Precautions.

1. Draw a circuit diagram as given in the book and get it checked by your teacher.
2. Clean the ends of the connecting wires by sand paper and then make neat, clean and tight connections.
3. Get your circuit connections checked by your teacher before passing current.
4. Close the key (K) only when you are taking readings.
5. Take care that the source of current, i.e. dry cell is not short circuited.
6. Note the zero errors and the ranges of the ammeter and voltmeter.
7. Positive terminals of ammeter should be connected to the positive pole of the cell.
8. The positive terminal of the voltmeter should be connected to the higher potential ends of the resistors r_1 *and* r_2 in series combination.
9. A suitable rheostat of about 10 Ω should be used to change the current smoothly.
10. Excessive current should not be passed, otherwise due to excessive heating, temperature increases. With increase in temperature the resistance of the resistor changes.

Khaikhawmna

Resistor pahnih, parallel-a thlun zawm ten *resistance* an neih zat zawnchhhuah kan tum a ni a, he zawnchhuahna formula awm sa $\frac{I}{R} = \frac{I}{r_1} + \frac{I}{r_2}$ finfiah hi kan tum ber chu a ni.

EXPERIMENT NO – 13

Aim: To find the pH of the following samples using pH paper/ Universal indicator.

(i) Dilute hydrochloric acid
(ii) Dilute solution of sodium hydroxide
(iii) Dilute solution of ethanoic acid
(iv) Lemon juice
(v) Water
(vi) Dilute solution of sodium bicarbonate.

Materials Required

Apparatus: Test tubes, pH paper (or Universal indicator), droppers, white tile.

Chemicals: Samples of dilute hydrochloric acid, dilute solution of sodium hydroxide, dilute solution of ethanoic acid, lemon juice, water dilute solution of sodium bicarbonate,

Basic Principles

1. pH is a measure of the hydrogen ion concentration $[H^+]$ of a solution.

2. For an acidic solution $[H^+] > 10^{-7}$. Therefore, its value is less than seven (pH < 7). For example, the pH values of dilute hydrochloric acid, ethanoic acid and lemon juice are less than 7.

3. For a basic (alkaline) solution $[H^+] < 10^{-7}$. Therefore, its pH value is greater than seven (pH > 7). For example, the pH value of dilute solution of NaOH is greater than 7.

4. For a neutral solution $[H^+] = 10^{-7}$. Therefore, its pH value is equal to seven (pH = 7). For example, the pH value of pure/distilled water is 7 at 298 K.

5. The pH of a sample can be measured by the use of pH paper or universal indicator.

Procedure

(i) Take the given solutions in separate clean test tubes and mark them as A, B, C, D, E and F respectively.

(ii) Place a strip (test strip) of the pH paper on a clean and dry glazed white tile.

(iii) Withdraw the solution from test tube A in a clean dropper and put two drops of it on the pH paper.

(iv) Compare the colour developed on the test strip with the colour given on the chart of the pH paper.

(v) Record the pH value corresponding to the colour.

(vi) Perform similar experiments with the other solutions and record your observations as indicated in the table.

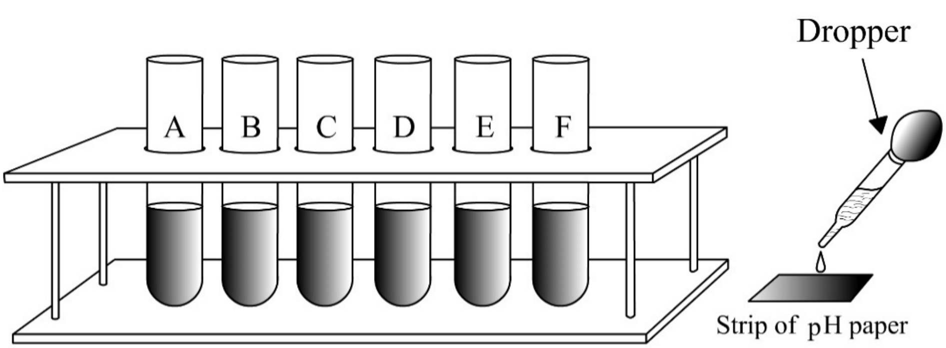


Fig. 13.1 *Experimental steps to measure the pH of different samples*

(a) HCI *(b) NaOH* *(c) Ethanoic Acid*

(d) Lemon Juice *(e) Water* *(f) Sodium Bicarbonate*

Observations:

S.No.	Name of Sample	Colour developed on pH paper	pH value (from chart)	Nature of samples
1	Dilute hydrochloric acid			Acidic
2	Dilute solution of sodium hydroxide			Basic
3	Dilute solution of ethanoic acid			Acidic
4	Lemon juice			Acidic
5	Water			Neutral
6	Dilute solution of sodium bicarbonate			Basic

Results:

In the given samples we have observed that:

1. The pH values of dilute hydrochloric acid, solution of ethanoic acid and lemon juice are less than 7. Therefore, these have acidic character.
2. The pH values of dilute solution of sodium hydroxide and dilute solution of sodium bicarbonate are more than 7. Therefore, these have basic character.
3. The pH of distilled water is 7. Therefore, it has a neutral character.

Precautions

1. The pH paper should not be touched with unclean and wet hands.
2. Clean the dropper removing each solution for testing.
3. One strip of pH paper may be divided into three or more parts for judicious measure.

Khaikhawmna:

pH (puissance d'hydrogen) chu *Power of Hydrogen* (Hydrogen chakna) tihna a ni ber mai a, thil tui (solution)-a hydrogen ion ($H+$) tam lam tehna a ni. Thil engpawh, a tuiril (*solution)*-a a awm laiin a thur (*acidic)* nge a kha (*basic)* nge a pangngai (*neutral)* tih hriat nana hman a ni. Acid tamna solution-ah chuan pH value chu 7 aiin a hniam a, basic/alkaline-ah chuan 7 aiin a sang ṭhin. Neutral solution-ah erawh chuan 7 a ni thung. Tui thianghlim ṭha tak pH value chu 7 a ni a, a thianghlim ṭhat loh erawh chuan 7 a ni thei lo. pH paper chu *paper* te tak te, *indicator*-a tuam a ni a; *solution* hrang hrang a chiahin a rawng a danglam ṭhin. He pH papers siamna atana hman *universal indicators* siam dan hi a inan thlipthlep kher loh avangin pH papers rawng pawh a in ang lo hret hret thei.

Dropper kan tih hi naute damdawi tui pekna ang hi a ni a. *Glazed tile* aiah hian thil var fai ṭha tak, rawng kal lo eng pawh hman theih a ni; eg. Sunglows'. Sodium bicarbonate hi chawhmeh baina atana kan hman soda tho hi a ni. Ethanoic acid hi a awm loh chuan ei tur (eg sa, etc) chiah hnip/vawn ṭhat nana kan hman thin '*vinegar*' hi a hman ve theih mai; ethanoic acid pawlh dal a ni.

EXPERIMENT NO – 14

Aim: To show experimentally that light is necessary for photosynthesis

Materials required: Ganong's light screen or black paper, a potted plant, alcohol, beaker and Iodine solution

Basic Priciple involved

Photosynthesis is a biochemical process by which plants manufacture their food (glucose) using carbon dioxide and water as raw materials in presence of sunlight and chlorophyll. The reaction is represented as follows:

Green leaves have chloroplast which contains chlorophyll and it is used to convert solar energy into chemical energy. Sunlight (solar energy) is the ultimate source of energy for all biological reaction.

Dark Reaction

$$6\,CO_2 + 12\,H_2O \xrightarrow[\text{Chlorophyll}]{\text{Light Energy}} C_6H_{12}O_6 + 6H_2O + 6O_2$$

Glucose

Light Reaction

Procedure

1. Destarch the leaves of a potted plant by keeping it in darkness for 2-3 days.
2. Cover a part of leaf tightly with Ganong's light screen or black paper.
3. Place this plant in sunlight for 3-4 hours.

4. Pluck the covered leaf and remove the Ganong's light screen or black paper.
5. Put the leaf in a test tube containing ethanol and boil it in a water bath to remove all chlorophyll from the leaf
6. Take out the leaf and put it inhot water to make it soft.
7. Keep this leaf in a petridish and add a few drops of Iodine solution in it.

Observation:
The uncovered part of leaf turns blue-black, whereas the covered part turns brownish-yellow.

Result:
The experiment shows that light is necessary for photosynthesis

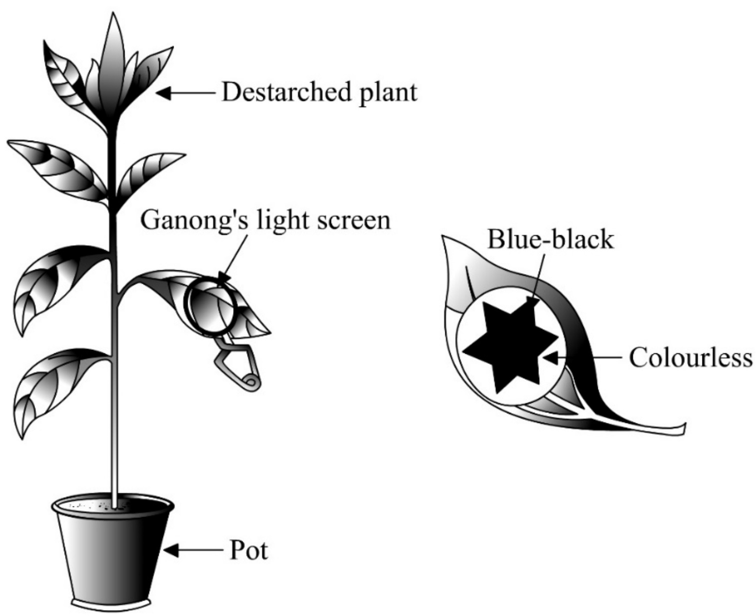


Fig 14.1 *Experiment to show that light is necessary for photosynthesis*

Precautions:

1. Leaves must be destarched before starting the experiment
2. Boiling should be carried out in water bath.

Khaikhawmna

He experiment-ah hian eng (light) hi photosynthesis atan a pawimawh tih lantir kan tum ber a ni. Photosynthesis chu **carbon dioxide** leh **tui** hmanga **eng** leh **chlorophyll** awmnaa thlai ten chaw an siam dan hi a ni a. Photosynthesis awm thei turin thil pawimawh pali a awm tih kan hre tawh a. Chung zinga mi eng eng hi a pawimawh tih kan entir dawn a ni.

He experiment ti tur hian hun a duh rei hle a, a hma ni 2-3 aṭanga lo inbuatsaih a ngai. Pot-a thlai chu thimah ni 2-3 lo dah lawk a ngai. Hetia kan tih chhan hi thlaia starch awm zawng zawng kan tih bo duh vang a ni. Hei vang hian he experiment hi Science Practical examnaah chuan tih a buaithlak deuh ṭhin. Mahse sikulah a hma aṭanga inbuatsaih sain he experiment hi tih theih a ni. Pot-a khawi lai thlai hnah khawi lai emaw kha khuh tur a ni. Ganong’s light screen-a cheh mai hi a awl a, a awm loh chuan lehkha duma khuh mai tur a ni.

A tawpa Iodine kan thlawr chhan chu Iodine hi starch-a thlawrin a rawng chu a dum pawl (blue black)-ah a inthlak ṭhin vang a ni. Hei hian thlai hnaha starch awm leh awm loh a lantir avangin he experiment-a a pawimawh lai tak a ni.

Water bath kan tih hi beaker thuah chhunga tui chhuan lum tihna a ni ber. Beaker lianah tui chhuan tur a ni a, chumi chhungah chuan beaker te zawk dah leh tur a ni Chumi beaker te zawk chhungah chuan ethyl alcihol dah tur a ni. Ethyl alcohol hi kang thut thei a nih avangin direct-a meia hliau loh tur a ni.. Hetianga ethyl alcohol chhuan so hi water bath-a chhuan so dan chu a ni.

EXPERIMENT NO – 15

Aim : To determine the percentage of water absorbed by raisins.

Materials required :
A few raisins with intact stalks, blotting paper, physical balance or digital balance, weight box, forceps, water and capped tubes/ petri dishes

Basic Principle involved :
Raisins are dehydrated grapes. They swell when kept in hypotonic solution. Entry of water basically depends on three factors :
1. Toxicity
2. Solute concebtration of raisins
3. Temperature of solution

It is because of endosmosis. The percentage of water absorbed can be calculated by knowing the increase in weight of raisins.

Similarly, if grapes are kept in hypertonic solution, then water will come out from the grapes. This process is called Exosmosis.

Procedure:
1. Take 5 - 6 raisins with intact stalks, weigh and place them in capped tube / petri dish having water for about 2-3 hours.
2. Take out the swallen raisins and gently dry them with the help of blotting paper and weigh them.

Observation :
1. Weight of dry raisins = $W_1 g$
2. Weight of wet raisins = $W_2 g$
3. Weight of the water absorbed by raisins = $(W_2 - W_1)\ g = W\ g$
4. Percentage of water absorbed by raisins = $\frac{W}{W_1} \times 100$

Result:
The percentage of water absorbed by raisins = ...%

Precautions :
1. Raisins must be with intact stalks.
2. Weighing must be accurate.
3. In capped tube/petri dish, there should be sufficient water.
4. Before taking final weight, gently dry the raisins with the help of blotting paper. They should not be pressed.

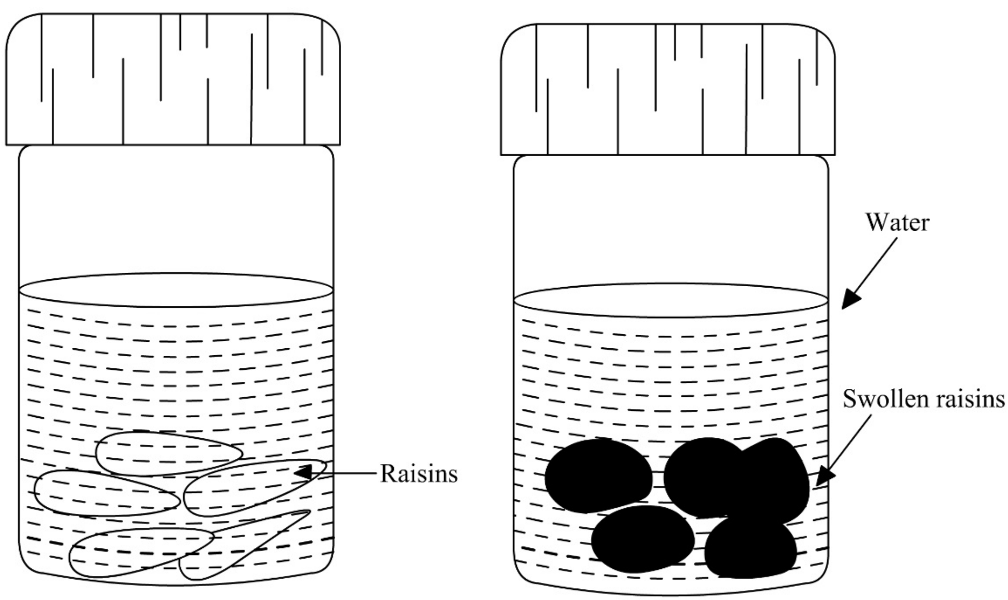


***Fig 15.1** Experiment to show absorption*

Khaikhawmna

Raisin hi grape ro a ni a, hmun ṭhenkhatah a van ṭhin avangin chana emaw bean mu emaw pawh a hman theih. Tuia chiah hmain buk tur a ni a, tuia chiah vang vang hnuah buk leh tur a ni. A rih zawng inthlauhna aṭangin a tui hip tam zawng a hriat theih a, a percentage pawh awlsam takin formula tarlan hmang hian chhut chhuah tawh mai tur a ni.

Tuia chiah rei poh leh tui a hip tam a, chiah rei loh lutuk chuan a rih zawng inthlau lovin a awm theih avangin experiment a hlawhchham thei.

Buk nan hian digital balance a hman theih a, a number-in a rih zawng a lan mai avangin a awlsam hle. Hetiang a awm loh chuan physical balance hman a ngai a, a harsa deuh va, uluk taka bukin a rih zawng dik tak a hriat theih tho.

Important Words :

Osmosis : The movement of water from low concentration solution to high concentration solution through a semipermeable membrane.

Endosmosis : The movement of water in the cell or a body through semipermeable membrane.

Hypotonic solution : The solution whose concentration is less than the internal concentration.

Hypertonic solution : The solution whose concentration is more than the internal concentration.

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