" Development of Training package on Teaching of Hard spots in X standard Science at Secondary Level of Tamilnadu / Pondicherry "

(DECEMBER 2003)

REPORT

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PREFACE

The programme on " Development of Training package on Teaching of Hard spots in Science at Secondary level (Tamilnadu/ Pondicherry) " was organized at the Regional Institute of Education, Mysore in three phases from

(i) 15th to 17th September 2003 (3 days)
(ii) 13th to 17th October 2003 (5 days)
(iii) 8th to 12th December 2003 (5 days)

Fifteen Science teachers with 10 years or more teaching experience at X standard level of Tamilnadu syllabus were called for the programme .Selection was made to include five teachers each from Physics, Chemistry and Biology.

The main objective of this PAC programme (2003-04) was to identity the Hard spots in X standard Science (Physics/Chemistry/Biology), to develop a material for training the teachers to overcome their hard spots and to tryout the material on a small group of teachers, who will further train other teachers.

During the **first phase** of 3 days the fifteen teachers meticulously went through the X standard Science text book and identified the hard spots in their respective disciplines. After individual study, teachers were grouped in to 3 groups of 5 each and each interacted with the subject experts from local colleges and the faculty of the RIE science Department . The difficulties with reference to content, presentation evaluation items, teachers' and learners' ability were discussed threadbare and recorded in a proforma prepared for the purpose. (See Appendix for the proforma)

During the **second phase** of 5 days, the local and RIE resource persons together examined the list of hard spots identified by the teachers. After a thorough scrutiny prepared a resource material appropriate to overcome the identified hard spots. Included in this material are:

(i) Clarifications on content required by teachers

(ii) methods of approach to teach the content

(iii) figures, activities, corrections etc., that may be helpful in over coming the hard spots.

Only those content portions that are identified as ' hard spots' are included and rewritten, and not the entire text book.

During the **third phase** of 5 days the above teachers were called for a thorough reading of the draft material, and direct interaction with the authors. The feedback from the teachers was incorporated in the draft material and it was refined. The present volume is an outcome of such an exercise.

We hope that this material will help teachers to overcome their difficulties so that they can conduct their classroom transactions more meaningfully. Comments and suggestions for improvement are welcome and may be addressed to the undersigned.

I thank Prof. G.Ravindra, Principal, RIE, Mysore for motivating the teachers and his continued support for the programme. I also place on record the active participation and contribution of Tamilnadu and Pondicherry teahers and thank them for the same. The local resource persons and the RIE resource persons also deserve special thanks for their continuous interactions with teachers and for the contribution they have made towards the development of the package.

My heart felt thanks are due to Mrs.Imavathi of the Computer Processing Unit of our Institute who spared no efforts in typing the whole material neatly to present it in this form.

My thanks are also due to the administrative staff of the Extension Department for their help in conducting the programme.

(N.R.Nagaraja Rao)
ACADEMIC CO-ORDINATOR

CONTENTS

TRAINING PACKAGE ON HARDSPOTS IN X STD SCIENCE (PHYSICS) OF TAMIL NADU

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TRAINING PACKAGE ON HARDSPOTS IN X STD SCIENCE (PHYSICS) OF TAMIL NADU

Development of Certain Concepts

1. WORK

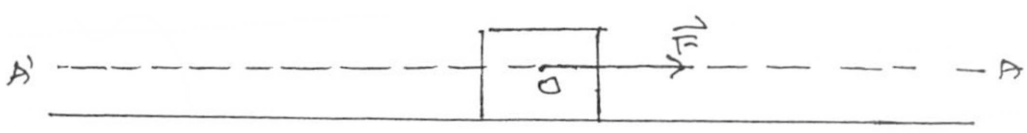
In our daily life, the word "Work" refers to any physical or mental activity. But in science, one term has one meaning only. Let us find out.

Consider the following activities listed in columns A and B.

A	B
Work is done	**Work not done**
i) Dragging a table on the floor	i) Pushing a rigid wall
ii) Lifting of a load to place it on the head	ii) Waiting for a bus with a load on the head
iii) An engine pulling a train	iii) A train at the station with its engine on.
iv) Walking	iv) Standing

Work involves two physical quantities, force and displacement (or motion) of bodies. A force has to have a point of application and a line of action. **Work is said to be done when the point of application of a force moves along the line of action.**

Thus, identify the physical quantities involved in these activities and relate them to the respective headings A and B.



O : The point of application of force; A'OA : Line of action of force.

Ask the students to cite some more examples and write them in the respective columns.

Measurement of Work

How does the amount of work depend on the force causing motion ?

Consider the movement of (i) loaded lorry and (ii) empty lorry between two cities. In which case the engine of the lorry has to exert greater force? What is required for the working of the engine ? Can this quantity be a measure of work done?

The lorry engine requires diesel as fuel. The fuel is mixed with air and combustion takes place in the engine. The burning of the fuel releases energy which develops a capacity in it to do work i.e. to transport the load over distances.

So the term "energy" can be considered as that physical quantity which enables one to exert force. Energy is released when 'fuel' is burnt in oxygen (air).

The amount of fuel consumed can be a measure of work done.

In the example cited above, in which case (loaded or empty lorry) more fuel is consumed? i.e. more force is exerted ?

The amount of work

$W \propto$ **F** (distance moved being constant) ..... (1)

Now, consider the loaded lorry moving over larger distances (S). How is the fuel consumed related to the distance travelled ? The amount of work

$W \propto$ **S** (F being a constant) ..... (2)

Combining equations (1) and (2), we write $W \propto FS$

Or in the form of equation

$$\boxed{W = kFS}.$$

In S.I., k has been made unity by defining the unit of work. When **F** = 1N and **S** = 1m if we let W = 1 Nm then k = 1. Therefore,

$$\boxed{W = FS} \qquad \ldots\ldots\ (3)$$

The unit of work Nm is given a special name joule (symbol J).

$$1J = 1\ Nm \qquad \ldots\ldots\ (4)$$

One joule is the work done when a point of application of 1 N force moves through 1m.

In general, the work of a force depends not only on **F** and **S**, but also on the angle between these two. To include all situations, the "work is measured as the product of force and the distance moved in the direction of the force" (or displacement).

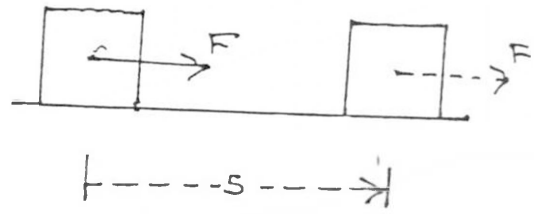
Work = force × distance moved in the direction of force

$$\boxed{W = FS}$$

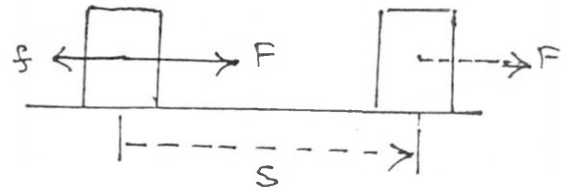
i) **When F and S are parallel. (F is the applied force)**

$$\boxed{W = FS}$$

It is positive and is maximum.



ii) **When F and S are antiparallel :**



Consider a body being dragged by the applied force $\vec{F}$ through a distance S on the floor. The floor exerts a frictional force f on the body. The work done by frictional force is

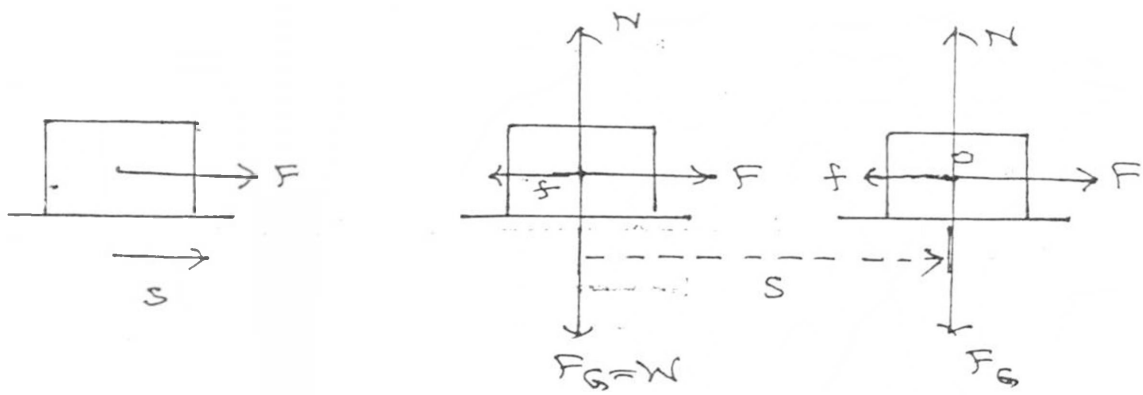
$$W = (-f)\,S$$
$$= -fS$$

work is negative.

Note: The applied force has to overcome the frictional force. The energy input equivalent to the work done by the applied force in overcoming the friction is converted into thermal energy or internal energy of the molecules of the floor and the body. Rub your two palms briskly and feel.

iii) **When F and S are normal to each other.**

Consider all the forces acting on the body which moves on a surface as shown in the figure.



In the diagram

(i) F_G is the force of gravity on the body (also called as weight **W**).

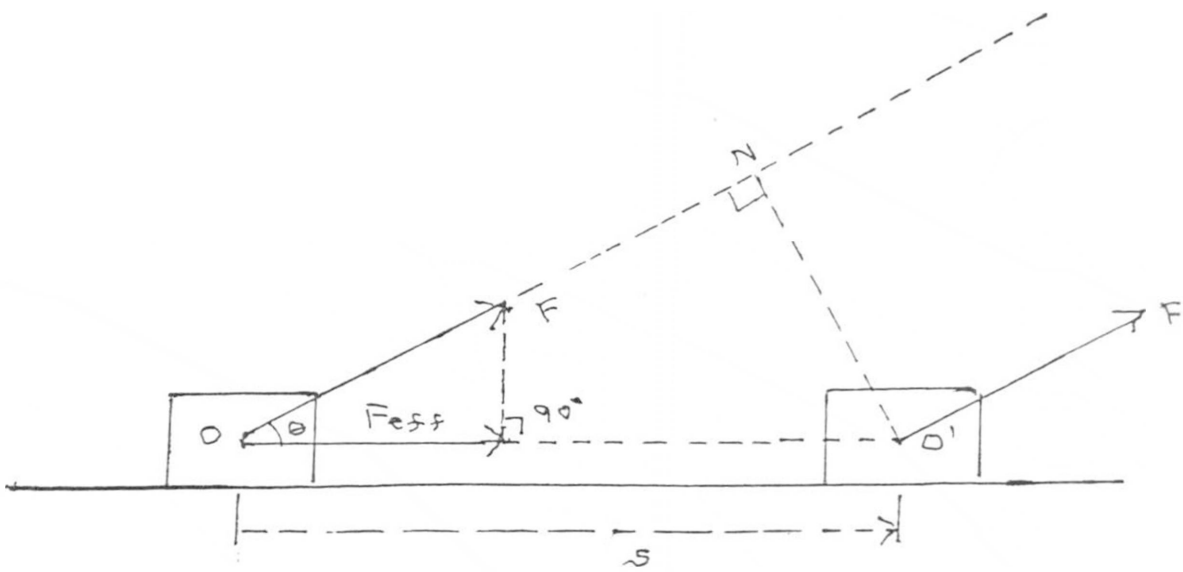
(ii) **N** is the reaction of the surface on the body (from Newton's Third Law – the body exerts a force W on the surface on which it moves). What is the work by force **N** ? force **W** ?

The displacement **S** = 0 for both the forces **N** and **W**. Work done by N (W_N) and by gravity $\vec{F}_G$ (W_G) = 0.

(iv) **When F and S are at an angle θ between them.**

Consider a heavy box being dragged by a man on the floor by tying one end of a rope to the box the other end, passing over the shoulder and pulling on the rope while walking. How much work is done by the force? The point of application of force moves horizontally through OO′. To calculate W, we need to find out the distance moved in the direction of force. It is the component of OO′ in the direction of **F**. This is done by drawing a normal from O onto the line of action of force. Then ON is the component of OO′ in the direction of **F**.

The work by force **F** is



∴ $$\boxed{W = F \,.\, (ON)}$$

∴ W = Force × component of displacement in the direction of force

This can also be calculated by finding the component of force along the direction of displacement. This force can be regarded as effective force F_{eff}. Work done (W) is

$$\boxed{W = F_{eff} \,.\, S}$$

Problems :

1. An engine exerts a force of 5000 N over a distance of 5m. What is the work done by the engine ?

   Data : F = 5000 N, S = 5m, W = ?

   Work done by the engine

   $$\boxed{W = FS}$$

   = (5000 N) (5 m)

   = 25,000 Nm or J

   = 25 kJ.

2. A labourer carrying a load of six bricks, each of mass 2 kg on his head goes up a ladder of length 12m to place them on a scaffold platform at the height 10 m. (a) What is the work done in lifting the bricks ?

   Data : Mass of the bricks = (2 × 6) kg

   Force applied **F** = mg = 12 × 10 = 120 N

   (Taking g = 10 N)

   Displacement upward **S** = 10 m

   (Note S ≠ 12 m, the length of the ladder).

   Work done W = (120 N) (10 m)

   = 1200 Nm = 1200 J

b) What is the work done by the force of gravity ?

   Data : Force of gravity $\mathbf{F_G}$ = 120 N (down)

   Displacement **S** = 10 m (up)

   Work by gravity W_G = (-120 N) (10 m)

   = -1200 Nm or J

Evaluation :

1. Cite examples for (i) non examples of work , (ii) work done is positive, (iii) work done is negative, (iv) work done is zero.
2. Let the students have a feel of 1 J of work. Let the students lift 100 g mass through a height of 1 m. (Assume g = 10 ms^{-2}).
3. We use our muscles to push or pull on bodies. How do we get the capacity to perform work? What is our fuel ?
4. Is the work positive, negative or zero when a person carrying a load on his head, gently shifts it to the ground ?

Potential Energy

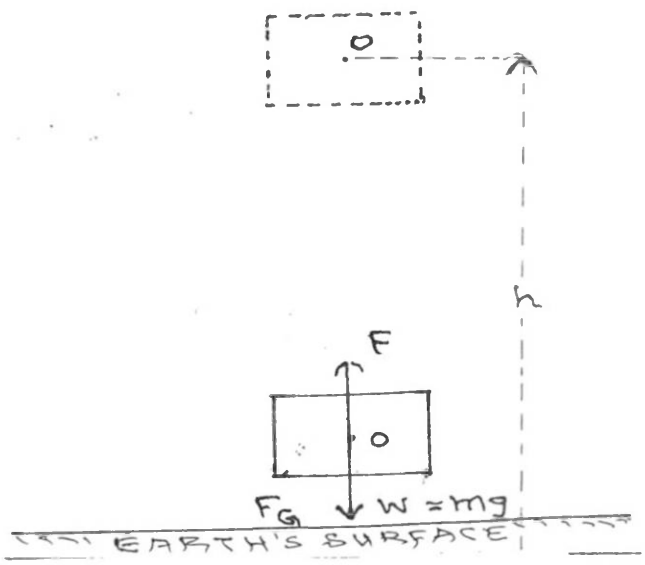
P.E. by virtue of position :

Any agency that is able to do work has energy – the capacity to perform work. In mechanics, energy is divided into two kinds.

i) Potential and (ii) Kinetic.

How does a body acquire Potential Energy ?

Consider a body of mass 'm', being displaced vertically with respect to the earth's surface through a height 'h' with constant speed.



The forces acting on the body are

i) the force of gravity F_G =mg in the downward direction and

ii) the lifting force **F** in the upward direction.

To lift the body with constant speed, the condition is $\mathbf{F} = \mathbf{F_G}$

Work of lifting force W = Fh ..... (1)

Note that it is positive :

Work by the force of gravity $W_G = F_G(-h) = -F_G h$.

$W = Fh = -W_G = -$ (work by the force of gravity)

It is negative since $\mathbf{F_G}$ and **h** are in opposite direction.

Raising the height of a body with respect to the earth's surface requires work input from the agent who lifts the body. The energy of the system (mass + earth) increases. We describe this by saying that the raised body has stored "potential energy". We consider its P.E. to be zero when it is on earth's surface (or any convenient surface from which we measure the vertical displacement of the body).

Thus, **a body has gravitational potential energy by virtue of its position (when there exists force of interaction such as gravitational force).**

Potential energy of a raised body U = Fh = mgh J (because $F = F_G = mg$)

Evaluation :

1. Cite some examples of bodies possessing potential energy by virtue of their positions.
2. Calculate the P.E. of a bucket of water weighing 5 Kg when it is lifted from a depth of 10 metre ?

Data W = 5 kg. Wt.

(Note : 5 kg refers to the mass of the bucket with water)

$= 5 \times 9.8$ N (take $g = 9.8\ ms^{-2}$ for better estimation)

= 49 N

h = 10 m

U = ?

P.E. of the bucket of water U = 49 N × 10 m

= 490 Nm (J)

What is the potential energy of the bucket when it is at the water level, if the P.E. at the ground level is zero?

P.E. by virtue of its state

There is another variety of P.E. due to the elastic properties of bodies. Consider the following situations :

i) Winding (or giving key) to grandfather's clock.

ii) Readying a bow to shoot an arrow.

iii) Compressing a spring

When we perform these operations, the bodies (coil, thread of the bow, spring) get deformed and elastic potential energy is stored up in them.

Evaluation :

i) Give some examples for storing of gravitational potential energy and elastic potential energy.

ii) What type of potential energy does water stored by a dam have ? Support your answer.

Kinetic Energy

Work can be done by moving bodies. Consider some examples.

i) An arrow shot from a bow can penetrate through a certain distance inside the target.

ii) A moving hammer can drive a nail into a wall.

iii) A moving train can drag a vehicle with which it collides at unmanned railway crossing.

Ask students to cite some other examples and lead them to the conclusion that **moving bodies do have the ability to do work and hence possess energy.** This form of mechanical energy is called "**kinetic energy".**

What are the physical factors on which kinetic energy may depend ? Naturally the K.E. depends upon

1. the mass (m) of the moving body : the greater the mass the greater is the K.E.
2. speed (v) of the body : the greater the speed of the body, the greater is the K.E.

The **kinetic energy of a moving body** is calculated by the formula.

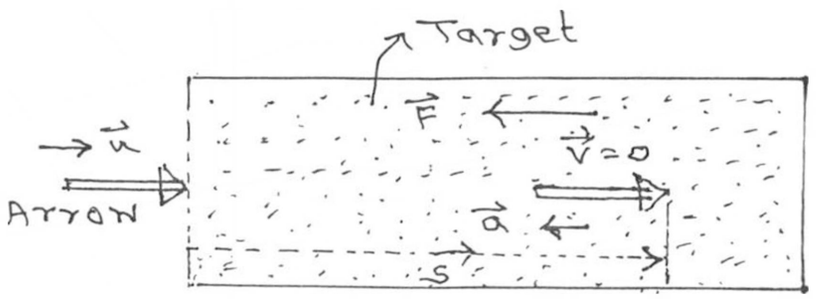
$$\boxed{K = \tfrac{1}{2} mv^2}$$

(This expression can be easily derived as follows :

An arrow moving with a speed u on hitting the target is slowed down and brought to rest upon traveling a certain distance S. The target offers resistance in a direction opposite to the direction of motion of the arrow. The resistance force

F = m**a** where a is the negative acceleration. Using the relation

$v^2 - u^2 = 2\,aS$



We have $a = \dfrac{-u^2}{2S}$ (because final velocity of the arrow is zero).

Substituting $F = -\dfrac{mu^2}{2S}$

and rearranging gives $-FS = \tfrac{1}{2} mu^2$.

The L.H.S. is the work by resistive force. The R.H.S. gives the K.E. of the arrow.

In practice, u is replaced by v.

Therefore, **the kinetic energy of a moving body $K = \tfrac{1}{2} mv^2$.**

The K.E. of the arrow disappears. Is it really lost? (Discuss this after dealing with conservation of mechanical energy).

Interchange of energy between P.E. and K.E.

A swinging pendulum bob is an example of a body whose energy can be either kinetic or potential or a mixture of both. Where is it all potential ? all kinetic ? What is it at other intermediate points? (It is all potential at the extreme ends of the swing, all kinetic when passing through the mean/rest position and partly kinetic and partly potential at intermediate points).

The total mechanical energy = max. K.E. = max. P.E.

Discuss the conservation of energy for a freely falling body as given in the textbook with diagram suitably modified. Replace the circle representing the body by shaded dots 'm'.

During the discussion the following point may be highlighted.

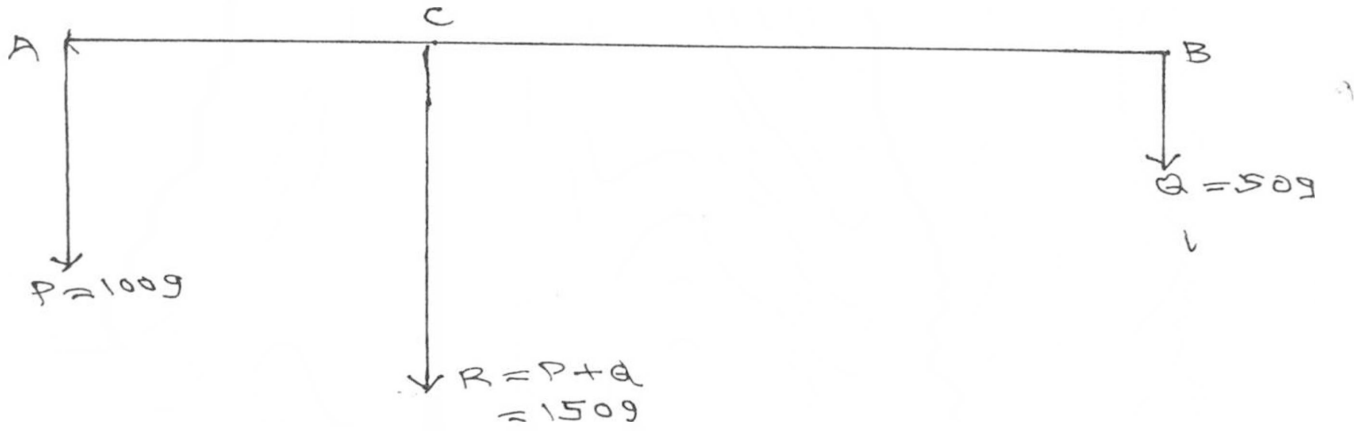
When the body falls freely work by gravitational force on the body is positive. The kinetic energy of the body increases. The change in kinetic energy equals the work done by the gravitational force. $\Delta K = W_G$. At the same time, the P.E. of the body decreases. The change in potential energy is negative

[$-\Delta U = \Delta K = W_G$]. ($\Delta$ represents a 'change').

Evaluation : A body is thrown vertically upwards with a speed u. Relate the changes in P.E. and K.E. to the work by the force of gravity.

Resultant Force

Resultant of Two like parallel forces (unequal)



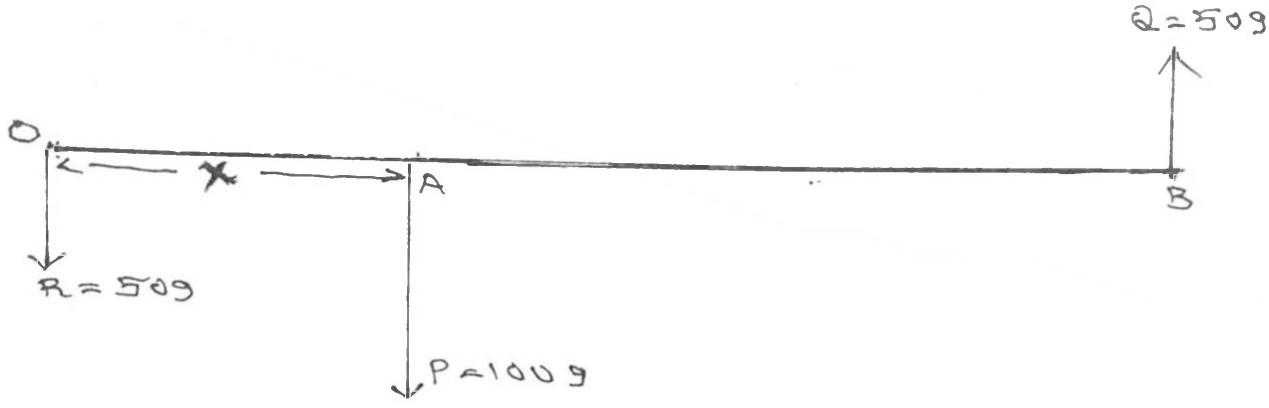
Consider two like parallel forces P and Q acting at A and B on AB. The resultant of these two, is that single force which would produce the same effect as P and Q acting simultaneously on AB. This resultant has magnitude R = P + Q and act at C in between A and B. Equilibrium is obtained by applying a force at C equal to R, in the upward direction. Mounting the beam on a fulcrum at C, balances it. The fulcrum exerts a normal reaction on the beam.

Point C is such that Moment of P (100 g) about C is equal and opposite to moment of Q (50 g) about C. (Moment of R about C = 0 is because R passes through C). Therefore, the beam has no rotatory motion.

To keep the beam in equilibrium, a single force equal and opposite to R should be applied at C. This is called the Equilibrant.

Resultant of two unlike unequal parallel forces

i) Let P > Q



The Resultant is found as follows :

a) **Magnitude** : R = P – Q = 100 - 50

= 50 g

b) **Direction** : Downward (along the direction of greater force).

c) **Point of action** : Can this act at a point in between AB ? If so, what would happen? Taking the moments of P and Q about a point (in between AB) the algebraic sum of the moments is **NON ZERO** i.e. there will be rotational motion.

Can this point be outside AB ? along BA produced ? If so, which side? P and Q should have opposite turning effects. Since Q < P, it has to be far away from Q i.e. along BA produced i.e. to the left of A, such that

$P \times OA = Q \times OB$

(clockwise) = (anticlockwise)

$\therefore \; OA = \left(\frac{Q}{P}\right) OB$

Let OA = x.

Moment of force Q about O = Moment of force P about O

i.e. $Q(x + AB) = Px$

$x + AB = \frac{P}{Q}x$

$$x\left(\frac{P}{Q} - 1\right) = AB$$

$$x = \left(\frac{Q}{P - Q}\right) AB$$

$$x = \left(\frac{Q}{R}\right) AB$$

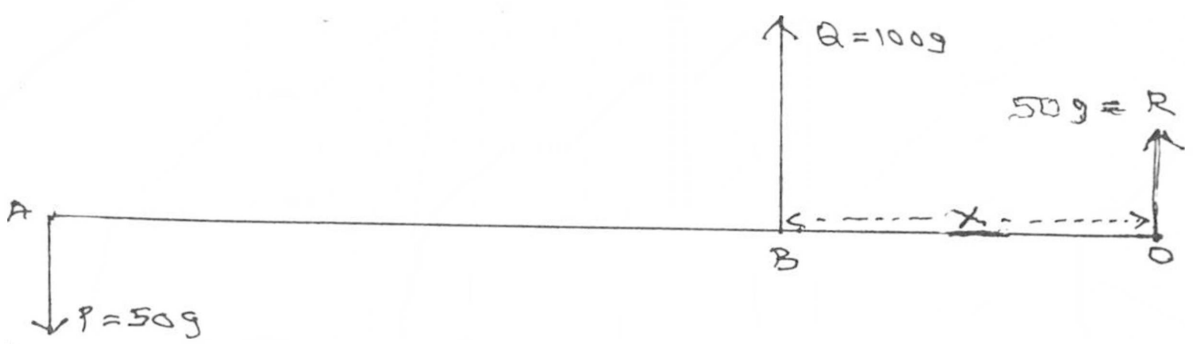
gives the point of action of the resultant.

For the equilibrium of the system, what is to be done ?

A force equal and opposite to R (i.e. in the upward direction) should be applied at O.

ii) Consider Q > P

Find the magnitude, direction and point of application of the resultant.



a) Magnitude = (Q – P) = R

b) Direction = upward, the direction of the greater force.

c) The point of application of the resultant force is obtained by taking the moments about O, a distance 'x' from B (i.e. BO).

i.e. $Qx = P(x + AB)$

$x(Q - P) = P.\ AB$

$$x = \left(\frac{P}{Q - P}\right) AB$$

$$x = \left(\frac{P}{R}\right) AB$$

The resultant R acts at a distance X from B i.e. on the nearer side of the greater force (Q).

To keep the system in equilibrium, a force equal in magnitude to R but opposite in direction has to be applied at O. This single force is called the *EQUILIBRANT.*

Equilibrant = - Resultant

It is the force required to balance the system, when subjected to forces which have non-zero resultant.

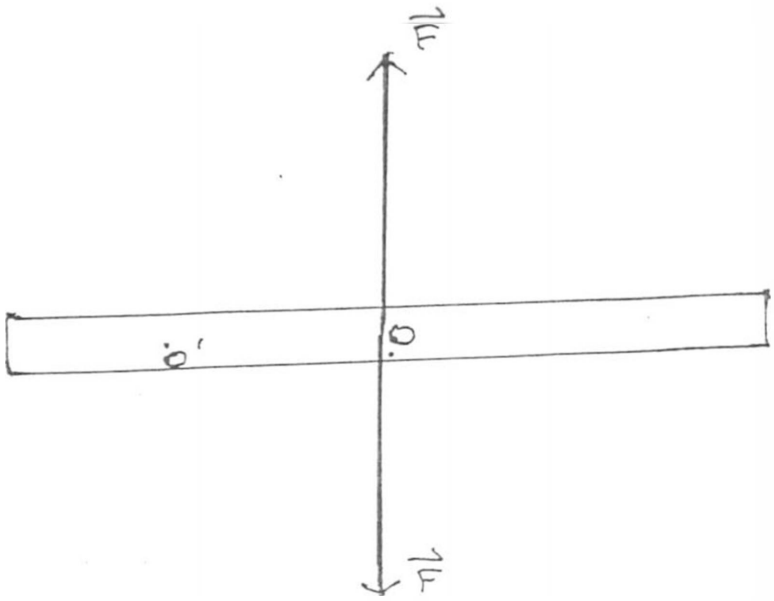
Couple

Parallel Forces – Couple

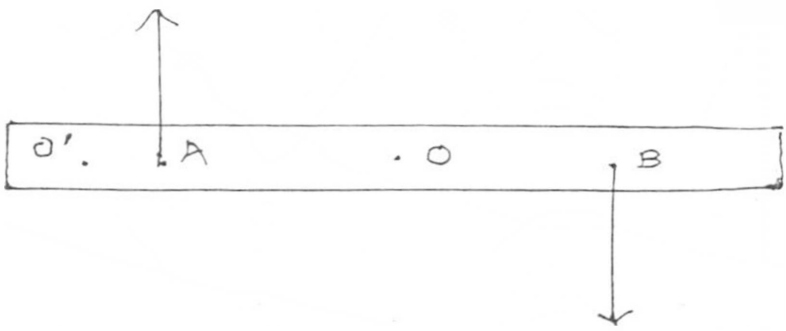
A body represented by a point is subjected to (i) two like parallel forces and (ii) two unlike parallel forces, (of different magnitude). In either of these cases, a single resultant can be found, i.e. its magnitude, direction and point where it acts.

What happens when a body is subjected to two equal but unlike parallel forces?

Consider a bar subjected to two unlike forces acting along the same line of action. The resultant force is zero. The bar does not have translatory motion. There is no rotatory motion too – as algebraic sum of moments of forces about any 0′ is zero. About O too, the forces do not have moments, as their lines of action coincide.



Let the two forces now act at points A and B. What is the resultant of these two forces ? It is zero, therefore, the body does not have translatory motion.



Does it have rotatory motion ? Yes. It has. The lines of action are separated by a perpendicular distance AB. Taking the moments of forces about the point O. We find that their algebraic sum is

$$\mathbf{M} = (-\mathbf{F} \times OA) + (-\mathbf{F} \times OB)$$

$$= -\mathbf{F} \times (OA + OB)$$

$$= -\mathbf{F} \times AB$$

Note that M is not zero i.e. the body has rotational motion. M is negative i.e. the body rotates in clockwise direction.

A pair of equal and opposite forces, having a moment of force constitute a couple.

Moment of couple M = Force × (the perpendicular distance between the lines of action of forces).

Unit of M is Nm. It has positive direction when rotation tends to be anticlockwise and negative direction for clockwise rotation.

How can one prevent the rotation of a body subjected to a couple ?

A counter couple or a balancing couple of moment M = **F** × AB has to be applied.

See a few examples where the couple is in action.

i) Turning a water tap.

ii) Fitting a screw-cap to a medicine bottle.

iii) Threading a nut onto a bolt.

Draw a figure to indicate the pair of forces involved in each case.

Evaluation :

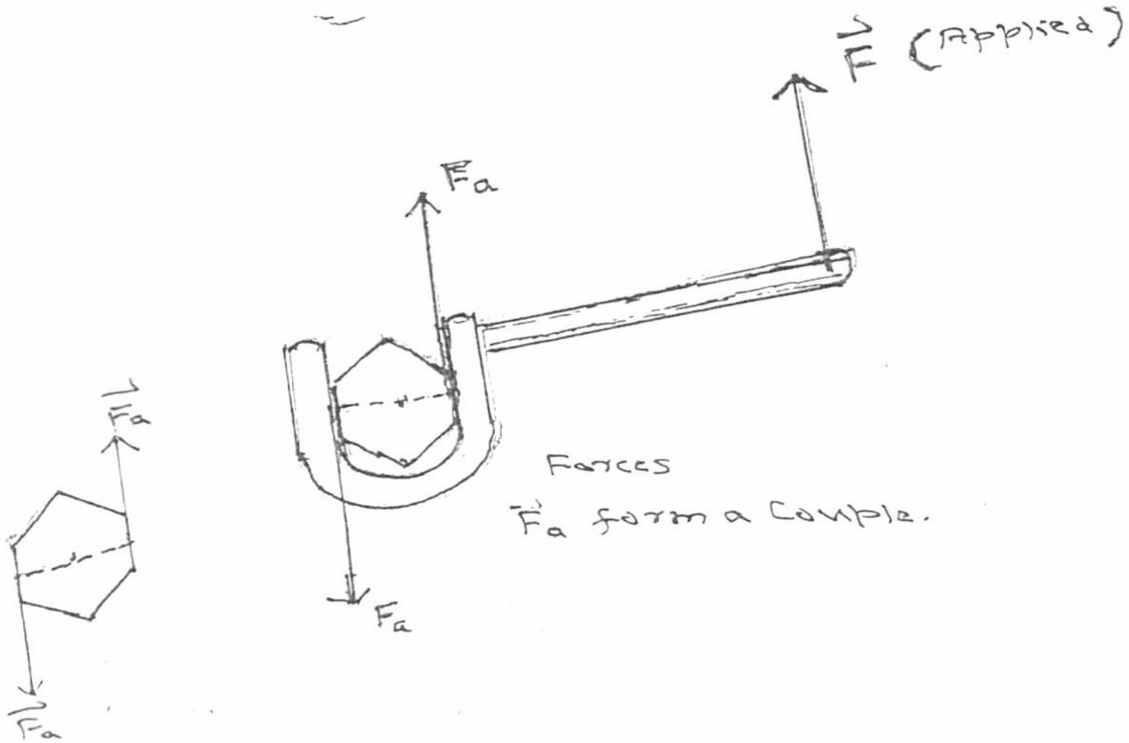
i) Give some more examples where a couple is involved. Draw the diagram in two cases indicating the pair of forces involved.

ii) A magnetic compass needle held in any direction (other than north south direction) is just released. What is observed and how do you account for the same ?

iii) Refer to the figure (b) given above in the text. Find the moment of couple about the point O′. Does the moment of couple depend on the position of points about which the moments of forces are taken?

iv) Compare the direction of the moments of the couple when a screw is (a) driven into and (b) taken out of a wooden plank.

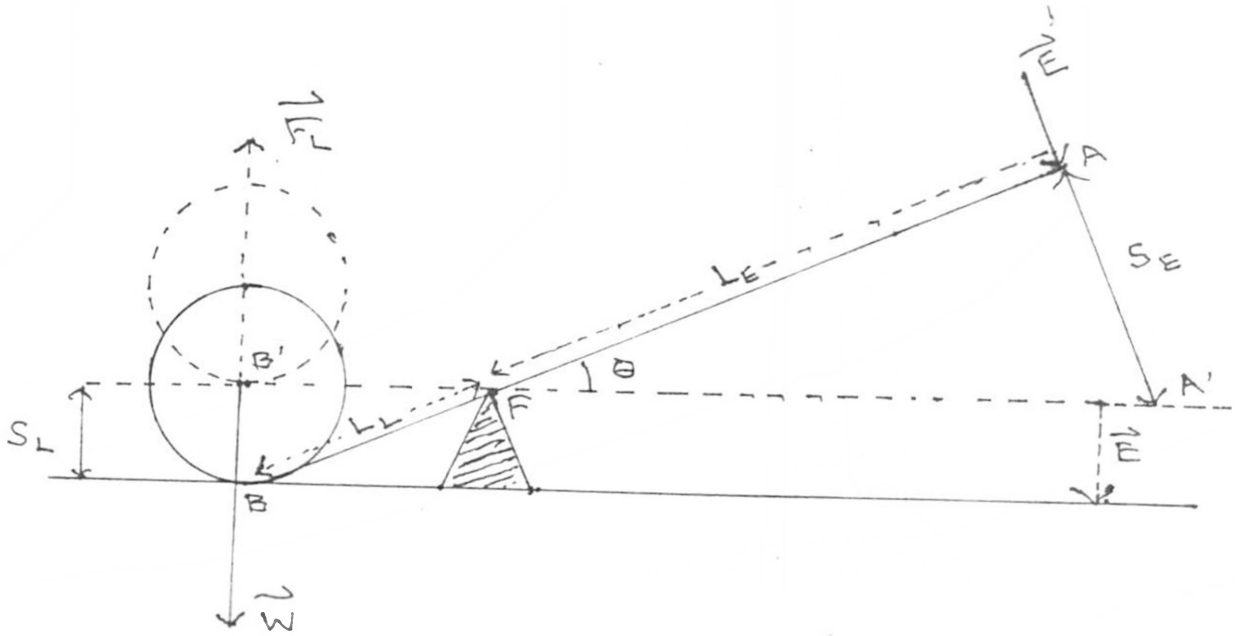
v) A bolt is being unscrewed by applying a force F at the end of the spanner. Show the pair of forces forming the couple on the bolt head.



Simple Machines

What is a simple machine ? What does it do? On what main principle does it work?

Discuss these general aspects with respect to a convenient simple machine – say a lever – (first order).



We apply effort at one end of a rigid bar capable of rotation about a fixed fulcrum F. The weight of the load (say a log of wood) acts on the other end of the bar. We put in effort E on the lever at one end A. When the lever lifts the load at the other end, it makes available a magnified force F_L acting in the upward direction at the other end B.

A general definition of a *simple machine* can be given. A machine is any device by means of which a force applied at one point can be used to overcome a force at some other point.

In this example, the effort is less than the load. The ratio of the load to effort is called the "*mechanical advantage*" of a machine.

Simple Machine – Velocity Ratio

In our daily life, we often use special aids to do some jobs more easily – such as a screw driver, a pulley, a cutting plier, knife, etc. Ask the students (i) to cite some more examples and (ii) to list the advantages of using them.

Discussion should cover the following advantages.

i) Overcoming a large force/ load/resistance by less effort e.g. a first order lever.

ii) Convenience of applying effort in downward direction – a fixed pulley.

iii) Doing the job faster – may be applying larger efforts – a pair of scissors.

By principle of work,

Work input = work output

$$W_{in} = W_{out}$$

$$E \times S_E = F_L \times S_L$$

$$MA = \frac{F_L}{E} = \frac{S_E}{S_L}$$

$$= \frac{\text{Distance moved by effort}}{\text{Distance moved by load}}$$

1. **Load > Effort when M.A. > 1:**

   distance moved by load < distance moved by effort.

   We can interpret this as follows : There is a *gain* in force (mechanical advantage), but a *loss* distance (distance / speed disadvantage).

2. **Load < Effort when M.A. < 1**

   i.e. Distance moved by load > distance moved by effort.

There is a loss in force (mechanical disadvantage) but a gain in distance or speed (advantage in distance/speed/rate of doing the job).

3. **Load = Effort when MA = 1**

i.e. Distance moved by load = Distance moved by effort.

What is the advantage ?

Advantage is in *direction*. Normally we find it convenient to apply force standing on the ground and pulling downward – drawing water from a well using a fixed pulley. (It is also a form of first order lever with M.A. = 1).

$$\text{Mechanical Advantage} = \frac{\text{load}}{\text{effort}}$$

Some examples where

i) M.A. > 1 (effort is less than load) [Crow bar, single pan balance]

ii) M.A. = 1 (effort = load) , (an equal arm balance, pulley)

iii) M.A. < 1, (effort > load), (toll gate near check posts, paper clips)

When the lever is in equilibrium, we have

load × load arm = effort × effort arm.

$$\text{M.A.} = \frac{load}{effort} = \frac{effort\ arm}{load\ arm}$$

In our example cited above, since MA > 1, effort arm > load arm.

Principle of Work Applied to a Simple Machine

Let the point of application of effort move through a distance S_E (AA') (see Fig.)

Work input to the simple machine $W_{in} = E \times S_E$

The point of application of the force applied by the lever on the load moves through a distance S_L (BB′). Work done by the machine on load can be regarded as output work.

$$W_{out} = F_L \times S_L$$

Assuming no energy is wasted, that is in an ideal simple machine.

Summarizing and in general

Energy input to the simple machine = Energy output of the simple machine

Or

Work done by the external agent on the simple machine = work done by the simple machine on the load

$$E \times S_E = F_L \times S_L$$

The Ideal Mechanical Advantage IMA or Theoretical Mechanical Advantage (TMA).

$$IMA = M_i = \frac{F_L}{E} = \frac{S_E}{S_L}$$

$$= \frac{\text{distance moved by the effort}}{\text{distance moved by the load}}$$

$$= \frac{S_E / t}{S_L / t} \quad \text{(because the interval of time is the same)}$$

$$= \frac{\text{velocity of the effort}}{\text{velocity of the load}}$$

= velocity (speed) ratio

= VR

In words, the ratio of the distance moved by the effort to the distance moved by the load in the *same time* is called the velocity (or speed), ratio of the machine.

Of what use is this VR ? Each device has its own geometry. Using that, can one determine the IMA of the device ?

Again refer to the fig of the lever. The geometrical lengths involved are effort arm, FA and load arm, FB. How are they related to the displacements of effort and load ?

In the diagram,

$$\Delta FAA' \;|||\; \Delta FBB'$$

$$\frac{AA'}{BB'} = \frac{FA}{FB}$$

$$\frac{S_E}{S_L} = \frac{L_E}{L_L}$$

So, $$IMA = \frac{S_E}{S_L} = \frac{\text{Effort arm}}{\text{Load arm}}$$

Similarly, we can determine the IMA of any simple machine from its geometry.

Efficiency :

The merit of a machine is indicated by the useful work accomplished by the machine in relation to the work input to it. The index of the efficiency is calculated by dividing the useful work done by a machine (output) by the quantity of work done on the machine (input). It is customary to express efficiency in percentage.

$$\text{Efficiency} = \frac{\text{output}}{\text{input}} \quad \text{(in terms of work / energy / power)}$$

In symbols, $$\eta = \frac{F_L\ S_L}{E\ S_E} = \frac{(F_L\ /\ E)}{(S_E\ /\ S_L)} \quad (\eta = \text{eta})$$

$$= \frac{AMA}{IMA} = \frac{AMA}{VR}$$

where $\frac{F_L}{E}$ is the Actual Mechanical Advantage (it is actual, because we are not ignoring frictional and other movements which consume the input energy). For real machines η is less than 1 or less than 100 percent.

The efficiency is unity only for an ideal machine.

Evaluation

1. Calculate IMA of the following simple devices : inclined plane, movable pulley, fixed pulley, screw jack.
2. a) Classify the following into three classes (orders) of levers :
   Claw hammer when used to pull out a nail from a wooden plank; wheel barrow, nut crackers, table knife, pliers, a pair of tongs. Crow bar used with the end as fulcrum, movable pulley.
   b) For each of these draw a diagram and indicate the forces F_L and E; Load and effort arm. Calculate the velocity ratio.
3. What simple device Archimedes had in mind when he exclaimed : "Give me a point of support and I can turn over the entire world".
4. Both mechanical advantage and efficiency are indices of the merit of a machine. Are they one and same concept? Distinguish between them. (Ans : The two are totally different concepts, M.A. is expressed in terms of forces – may have any value from a small fraction to a very large number.
   Efficiency is defined in terms of energy. Its value is less than unity, the value for an ideal machine).

5. A screw of head diameter 1.0 cm has to be unscrewed. You are given two screw drivers – one of width 0.5 cm and the other 1.0 cm. Which one will you select? And why ?

Relative Humidity

Comfort and Humidity

Consider that you are sweating or perspiring after a good game.
You tend to fan yourself in order to get the cooling effect as the sweat evaporate from the skin. The rate of evaporation is slow when the atmosphere contains large amount of water vapour as in coastal areas or after a heavy rainfall. The corresponding cooling or comfort level is also small. On the other hand, if the air is dry, the rapid evaporation of moisture from the skin causes us to feel uncomfortably dry. Moisture from the nose and throat passages evaporates in dry air and may cause cold. For our comfort there must be a certain level of humidity (or moisture or water vapour content) in air. This is indicated by a term 'relative humidity'. For our comfort a relative humidity in the range of 40% to 60% is desirable. Air conditioners maintain suitable temperature and humidity in a room.
If the room is dry, air is blown through a fine spray of water to increase the humidity to a comfortable level. In damp rooms, warm air is circulated since warm air can hold more water vapour.

Relative Humidity:

Does air contain water vapour?
What evidences are there? What is the main process, which is responsible?
Rain, snow, fog, mist, dewdrops on leaves or grass etc offer ample evidence that the atmosphere contains water vapour. The continuous evaporation mainly from the oceans and large lakes is the cause. Heat energy from the sun causes this evaporation. The humidity is the term used to describe the condition of the air containing water vapour. Air which does not hold as much water vapour as it can is said to be **unsaturated.** Air which holds as much water vapour as it can is said to be **saturated**. The maximum amount of the water which the air can hold increases with temperature. The level of humidity is measured in terms of **absolute humidity.** This is defined as the mass of water vapour present in a unit volume of the atmosphere. But a more

practical way of describing the humidity of air is to compare the amount of water vapour it holds to that needed to saturate the air at a given temperature. This ratio is called **relative humidity** (analogous to relative density).

$$\text{Relative humidity} = \frac{\text{Actual absolute humidity of air}}{\text{Absolute humidity of air saturated with water vapour at the surroundings temperature.}}$$

$$\text{Relative humidity} = \frac{\text{Mass of water vapour in a given volume of air}}{\text{Mass of water vapour required to saturate the same volume of air at the air temperature.}}$$

This is usually given in percentage

Instruments used to measure relative humidity are:

I) Wet & dry bulb thermometer.

II) Hair hygrometer

Evaluation:

Explain the following:

i) When a person breaths over a cold mirror or a polished metallic surface, the surface becomes moist (or dull).

ii) A mirror kept in bathroom becomes moist while taking a hot water bath.

iii) Appearance of moisture on the outside of a bottle containing cold water.

iv) Appearance of moisture is often deposited on the spectacle lenses as the wearer enters a warm room from a cold surroundings outside.

v) In hot continental climate (where atmosphere tends to dry) high temperature can be tolerated more comfortably than the tropical regions. (heavy rain fall regions).

Specific Heat Capacity and Thermal Capacity

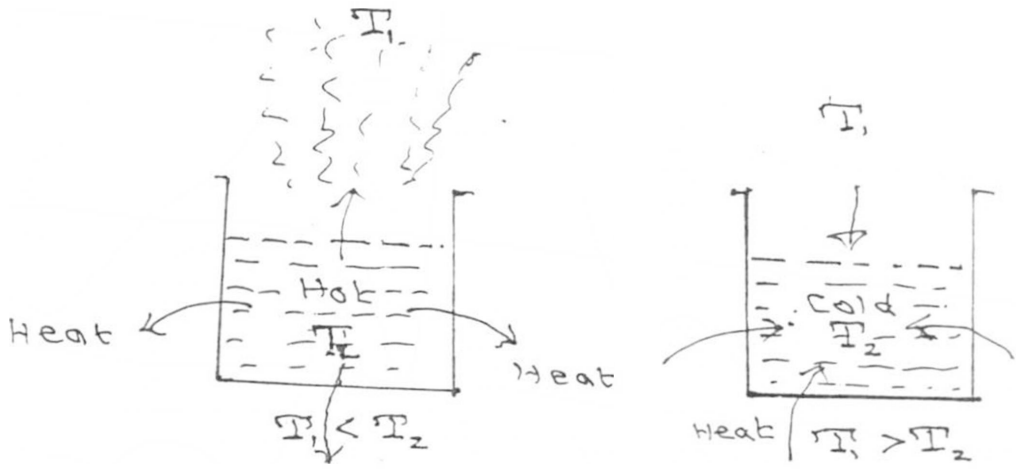
Specific Heat Capacity and Heat Capacity

Draw the attention of students to some situations involving absorption or liberation of heat to the surroundings.

i) A cup containing hot water placed on a table

ii) A glass of cool drink placed on a table

What happens in these cases after a long time ? How do you explain this?



The hot water cools by giving out thermal energy to the surroundings. The cool drink becomes warmer. It absorbs thermal energy from the surroundings. Both will tend to attain the temperature of the surroundings. The thermal energy that flows from one body to another by virtue of the temperature difference is called *heat*.

How much heat does hot body lose ? How much heat does cold body gain?

What are the factors that determine the quantity of heat (Q) given out or absorbed ?

The factors involved are

i) mass of the body (m)

ii) temperature difference (rise or fall) (ΔT)

iii) nature of the material (C)

Activity : Take 100 g of water in a beaker and note its temperature. Supply heat till the temperature rises by 20°C. Record the time of supplying heat. Let it to be t_1 s.

Repeat with masses, 200 g and 300 g, each case the temperature rise being kept constant and using the same source of supply. Let t_2 and t_3 be the durations of heating. It is found that $t_3 > t_2 > t_1$.

As the quantities of heat supplied $\propto$ time of heating.

Hence, $Q \propto m$ (ΔT constant) ..... (1)

Activity: The activity is repeated, now keeping m constant, but temperature rise (ΔT) being 20° C, 40°C and 60°C, and using the same burner.

The result leads to $Q \propto \Delta T$ (m constant). ..... (2)

Combining (1) and (2)

We have $Q \propto m\Delta T$, (for a given material). We write the equation as

$$Q = C\, m\, \Delta T \qquad \text{..... (3)}$$

where C is a constant for a given material and is called its "specific heat capacity".

Q = C, when m = 1 kg and ΔT = 1 K (or 1 C°).

"The specific heat capacity is numerically equal to the quantity of heat required to raise the temperature of unit mass (1 kg) of the material by 1 K".

Unit of C

Rewriting $C = \frac{Q}{m \Delta T}$

Unit of C = $J\ kg^{-1}\ K^{-1}$

Specific heat capacity and the nature of the material

Take same amount of different substances (such as coconut oil and water – or sand and iron filings or cement) and measure the time taken to raise the temperature of each by 20°C. Compare the time taken and draw conclusion regarding the specific heat capacity of different materials.

For example,

Specific heat capacity of water at 20°C is 4.2 $kJ\ kg^{-1}\ K^{-1}$ and of

Sea water = 3.9 $k\ J\ kg^{-1}\ K^{-1}$

Thermal capacity

Thermal capacity is the quantity of heat associated with a given specimen. It is defined as the quantity of heat required to raise the temperature of a body by 1 K.

$$\boxed{Q = m\ C\ \Delta T}$$

$= H\Delta T$ where H = thermal or heat capacity of the body.

$$H = \frac{Q}{\Delta T} = m\ C.$$

Unit of H is JK^{-1}.

Or $H = mC$ (because $Q = m\ C\ \Delta T$)

(Unit of H is $kg\ J\ kg^{-1}\ K^{-1} = JK^{-1}$)

H is a constant only for the given specimen. Different specimens of the same material will have *same* value for specific heat capacity but *different values* for thermal capacity.

Evaluation :

1. Land heats up or cools down faster than water. What can be said of the specific heat of land compared to that of water. (This fact causes the formation of land and sea–breezes).
2. Distinguish between thermal capacity and specific heat capacity.
3. Define the term heat.

Determination of specific heat capacity by the *method of mixtures.*

A hot material is mixed with a cold liquid (usually water). What happens to the hot body ? cold body ? What principle is applied ?

When a hot body comes in contact with a cold body, there is an exchange of heat energy between them till temperature equilibrium is attained. The hot body loses thermal energy and the cold body gains an equal amount of energy. This follows from the principle of conservation of energy, assuming that there is no loss of heat energy to the surroundings as the temperature of the cold body increases above the surrounding's temperature. (So in the experiments, the containers have to be insulated properly).

The quantity of thermal energy lost by a hot body is

$$Q_H = m_H C_H \Delta T_H$$

Where m_H = mass of the hot body

C_H = specific heat of the hot body

ΔT_H = decrease in temperature of the hot body

Quantity of thermal energy gained by the cooler body

$$Q_c = m_c C_c \Delta T_c$$

Where m_c = mass of the cooler body

C_c = the specific heat capacity of the colour body

ΔT_c = temperature rise of the cooler body

$Q_H = Q_c$ (subscripts $_H$ and $_C$ refer to hot and cooler body respectively).

$$m_H C_H \Delta T_H = m_c C_c \Delta T_c$$

$$C_H = \frac{m_c \; C_c \; \Delta T_c}{m_H \; \Delta T_H} \qquad J\ kg^{-1}\ K^{-1}$$

When we use a liquid as one of the bodies we have to take a container to hold it. When the liquid absorbs heat the container also absorbs heat. This has to be taken into consideration. In the expression for Q_c, the total heat capacity $m_c C_c$ has to be the sum of heat capacity of the container and that of the liquid.

$$(mC + m_L C_L)$$

where

m → mass of the container with stirrer

C → specific heat capacity of the material of the container

m_L → mass of the liquid taken

C_L → specific heat capacity of the liquid

Substituting in the expression for C_H we have

$$C_H = \frac{(mC + m_L C_L)}{m_H}\left(\frac{\Delta T_c}{\Delta T_H}\right)$$

In Regnault's method of determining the specific heat of a solid, the measured values can be given stepwise as follows instead of continuous matter as given in the text book :

Measurements :

Mass of the calorimeter + stirrer	M_1 =
Mass of the calorimeter + stirrer + liquid	M_2 =
Temperature of the calorimeter and contents	T_1 =
Temperature of the hot body	T_2 =
Resultant equilibrium temperature	T_3 =
Mass of the calorimeter + stirrer + Liquid + solid	M_3 =

Calculation (symbols as given in the text)

m	$= M_1$	=	.....	kg
m_L	$= M_2 - M_1$	=	.....	kg
m_H	$= M_3 - M_2$	=	.....	kg
ΔT_H	$= T_2 - T_3$	=	.....	°C
ΔT_C	$= T_3 - T_1$	=	.....	°C

Data to be used $C = \ldots\ldots\ J\ kg^{-1}\ K^{-1}$

$C_L = \ldots\ldots J\ kg^{-1}\ K^{1}$

From tables (either from textbook or from Clark's table).

While substituting the values in the formula, one system of units has to be used.

Suppose specific heat capacity of hot body is known and we have to determine the specific heat capacity of the liquid, then the formula can be rearranged as

$$m_H C_H \Delta T_H = (mC + m_L C_L)\Delta T_c$$

$$m_L C_L \Delta T_c = m_H C_H \Delta T_H - mC\Delta T_c$$

$$C_L = \frac{(m_H C_H \Delta T_H - mC\Delta T_c)}{m_L \Delta T_c}$$

Problem

An iron sphere of mass 200 g, heated by steam is quickly transferred to a wooden container with 95 g of water at 20°C. The temperature of the water rises to 40°C. What is the resultant temperature ? What is the specific heat capacity of iron? Given the specific heat capacity of water 1000 J kg K^{-1}.

Data: m_H = 200 g = 0.200 kg

C_H = ? $T_2 = 100°C$

$\Delta T_h = T_2 - T_3$

m_c = 96 g = 0.096 kg

$C_c = 1000\ J\ kg^{-1}\ K^{-1}$

$T_1 = 20°C$

$\Delta T_c = T_3 - T_1 = 40°C = (333\ K - 293\ K) = 40\ K$

Resultant temperature

$$T_3 = \Delta T_c + T_1$$

$$= 40 + 20 = 60°C$$

$$\Delta T_H = T_2 - T_3$$

$$= (100 - 60)°\ C$$

$$= 40°\ C = (373 - 333)\ K = 40\ K$$

Heat lost by iron = Heat gained by water

$$M_H C_H \Delta T_H = m_c C_c \Delta T_c$$

$$C_H = \frac{m_c \; C_c \; \Delta T_c}{m_H \; \Delta T_H}$$

$$= \frac{0.096 \times 1000 \times 40}{0.200 \times 40}$$

$$= \frac{96}{0.2} = \frac{960}{2} = 480 \text{ J kg}^{-1} \text{ K}^{-1}$$

Hydrostatics

Hydrostatic Pressure

Liquid is a form of matter. Matter is something which occupies space and has mass (and therefore weight). When a body is placed on a surface it exerts a force on the surface. The force exerted per unit area is called the pressure.

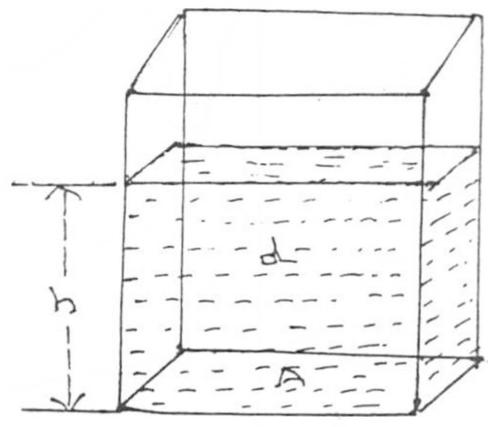
$$\text{Pressure } P = \frac{\text{Thrust}}{\text{Area}} \quad \text{Nm}^{-2} \text{ or pascal (symbol Pa).}$$

Liquid requires a container to hold it. Liquid has weight and therefore, it should exert a force on the bottom of the container. Let us calculate the downward pressure on the bottom of a rectangular tank of base area A m^2 containing a liquid of density d kg m^{-3} to a height h m.

The weight of the liquid

W = (volume) × (density) × (acceleration due to gravity)

= (Ah) (d) (g)



The force exerted by the liquid (or fluid) is generally called thrust. The pressure of the liquid on the bottom surface

$$P = \frac{\text{Thrust}}{\text{Area}} = \frac{Ahdg}{A} = hdg$$

The pressure due to a liquid is equal to the weight of the column of liquid above unit area. Thus,

The pressure P $\propto$ depth of the liquid from its free surface

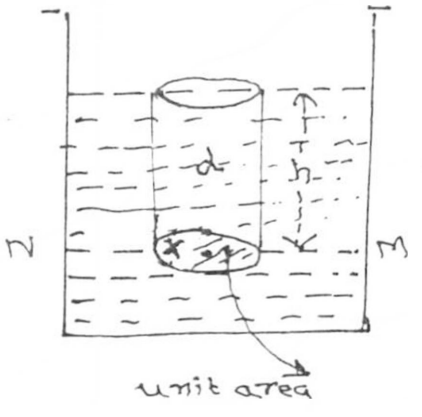
$\propto$ density of the liquid

(At a given place g is constant).

The density of a liquid (unlike in gases) is independent of the depth of the column of liquid, since liquid is incompressible).

Liquid pressure at a depth 'h' from the free surface of the liquid

We wish to calculate the liquid pressure at a point X, at a depth h m below the free surface of the liquid.



Consider unit area of the liquid surface enclosing the point X.

The pressure at this point

P_x = weight of a column of liquid above this unit area

= mass × acceleration due to gravity

= (volume × density) × (acceleration due to gravity)

= (base area × height) × density × acceleration due to gravity

= (l × h) × d × g

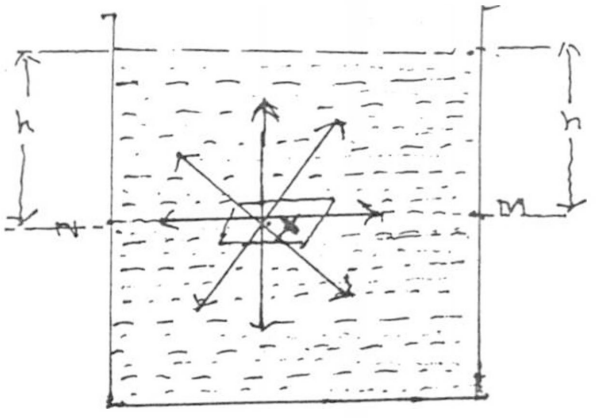
= hdg

The direction of this pressure is downward.

Pressure at a point – in different directions

The weight of the column of the liquid above unit area containing the point X is in the downward direction. The corresponding pressure on this area is downward. Is there upward pressure on this area ?

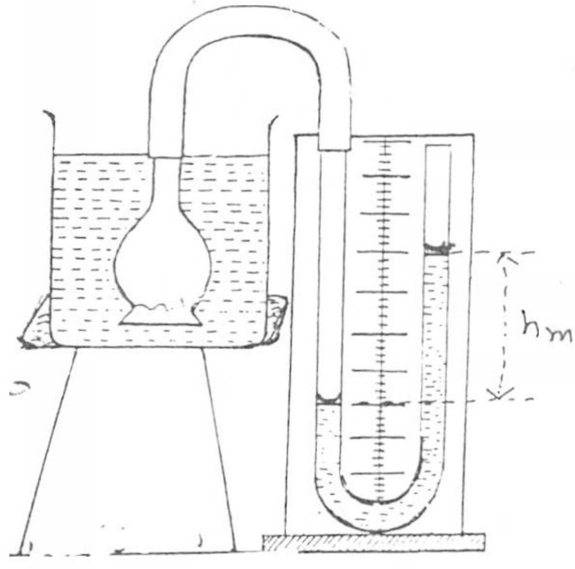
The liquid is at rest. That means the point X and the unit area containing X are at rest. This means the liquid below this column is exerting an equal pressure in the upward direction.



Suppose the container of liquid had a small hole at the same depth as of the point A, such as at M, N, etc. The liquid would issue from the hole to the point just outside hole M (Why ?). The pressure must also act horizontally. Liquid flows when there is a pressure difference. Thus we conclude that the pressure at a given depth within a liquid acts equally in all directions.

Demonstration :

A U tube with coloured water can be used as a manometer. The pressure probe is a thistle funnel (whose stem is cut to – about 3 cm) to whose mouth a stretched membrane is tied. The end (stem) of this thistle funnel and one end of the U tube is connected by a rubber tube.

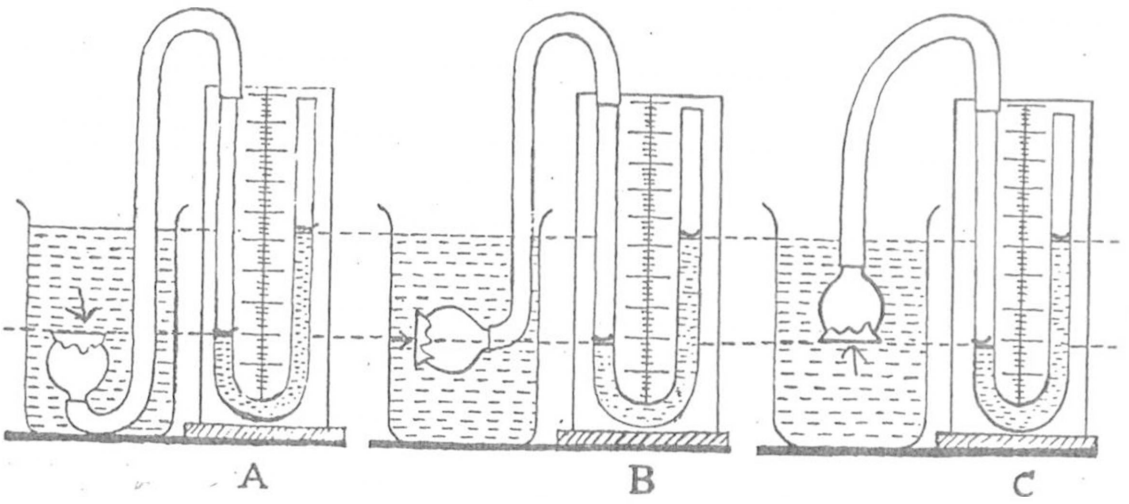


Press gently on the membrane. What is observed ? Press a bit hard. What happens to the difference in the heights of manometer columns ?

The difference in the heights (h_m) of the two columns of the manometer is a measure of the pressure on the membrane.

Dip the pressure probe to a *given depth* and hold it such that the membrane is subjected to pressure acting (i) downward, (ii) up ward (iii)

horizontally from left side and (iv) horizontally from right side and (v) oblique direction.



Each time record h_m. Draw your conclusion.

This set up can be used to demonstrate the liquid pressure.

$P \propto h$ (in a given liquid of uniform density)

$P \propto d$ (at a given depth in different liquids)

Problem :

1. Calculate the pressure at a depth of 1.0 cm in mercury of density 1.36×10^4 kg m^{-3}

Data $h = 1.0$ cm $= 1.0 \times 10^{-2}$ m

$d = 1.36 \times 10^4$ kg m^{-3}

$g = 10$ ms^{-2}

$P = ?$

Pressure at a depth of 1.0 cm in mercury $P = 1.0 \times 10^{-2} \times 1.34 \times 10^{4} \times 10$

$= 1.36 \times 10^{3}$ Pa

2. At what depth in water the pressure equals 1.36×10^{3} Pa.

(i.e. pressure of mercury at a depth of 1.0 cm).

Density of water 1000 kg m^{-3}

Data $P = 1.36 \times 10^{3}$ Pa

$d = 1000$ kg $m^{-3} = 10^{3}$ kg m^{-3}

$g = 10$ ms^{-2}

$h = ?$

Depth of water $h_w = \dfrac{P}{dg}$

$$= \frac{1.36 \times 10^{3}}{10^{3} \times 10}$$

$= 0.136$ m

$= 13.6$ cm

3. Find the ratio of $\dfrac{h_w}{h_{Hg}}$ in the above example. What does this represent ?

$$\frac{h_w}{h_{Hg}} = \frac{13.6}{1.0} = 13.6$$

But $P = h_w d_w g = h_{Hg} d_{Hg} g$

$\dfrac{h_w}{h_{Hg}} = \dfrac{d_{Hg}}{d_w}$ = Relative density (R.D.) of mercury

4. The normal atmospheric pressure as measured by a mercury barometer is 76 cm. What is the height of the water barometer ?

$h_w = \text{R.D. } h_{Hg}$

$= 13.6 \times 76.0$ cm

$= 1034$ cm

$= 10.34$ m

(Is it convenient to set up such barometer?)

5. A liquid is taken in vessels of different shapes but of same base area to same height in each vessel. How do the pressures on the bases compare? Account for your conclusion.

Hydrometer

The conditions of equilibrium of floating bodies are applied in designing an instrument called hydrometer. We use this instrument to measure relative density/ specific gravity of liquids. [To measure the purity of milk, we use a hydrometer called lactometer. The condition of a car battery is monitored by measuring the relative density of the sulphuric acid in it].

Hydrometers are of two types. (a) variable immersion and (b) constant immersion. The first one is mostly used in practice. The principle of its construction can be understood by the following activity :

Take a long test tube and add enough lead shots (or sand/ iron filings) so that it floats vertically in water. Mark the position upto which the float is submerged in water.

A rubber band can be used to mark the position. Measure the depth of immersion h_w.

From Archimede's principle, we have the weight of the hydrometer balanced by the weight of the water displaced.

Let W be the weight of the hydrometer.

Volume of the water displaced = Ah_w

where A is the area of cross section of the test tube.

Mass of the water displaced = volume × density = $Ah_w d_w$

where d_w is the density of water

Weight of the water displaced = mass × acceleration due to gravity

$= Ah_w d_w g$

Therefore, from Archimede's principle

$$W = Ah_w d_w g \quad \ldots\ldots \quad (1)$$

Next, the same test tube is placed in a liquid of density d_L and depth of immersion is measured. Pass another rubber band over the test tube and adjust its position to coincide with the free surface of the liquid.

From Archimede's principle, we write

$$W = Ah_L d_L g \quad \ldots\ldots \quad (2)$$

From (1) and (2), $h_w d_w = h_L d_L$ ..... (3)

From (3), the depth of immersion in a liquid is inversely proportional to its density

$$h \propto \frac{1}{d} \quad \ldots\ldots\ldots \quad (4)$$

Relative density of the liquid

$$d = \frac{d_L}{d_w} = \frac{h_w}{h_L} = \frac{\text{depth of immersion in water}}{\text{depth of immersion in the liquid}}$$

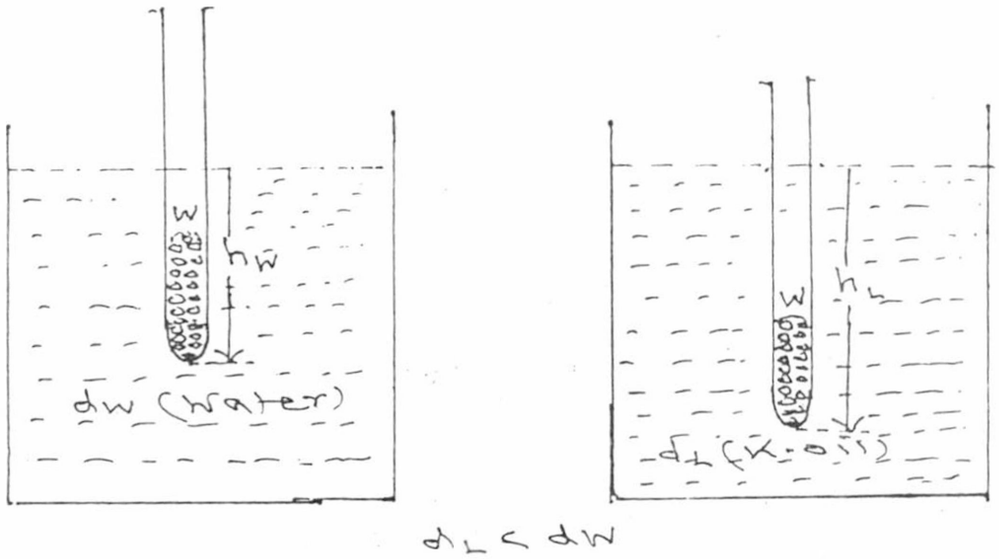
Repeat the measurement using a liquid of lower density than that of water.

Care has to be taken to see that the test tube hydrometer floats vertically in the liquids chosen, by preliminary trial.

(The semi spherical bottom portion does not introduce any error in the above calculation if the same tube is introduced into both liquids).

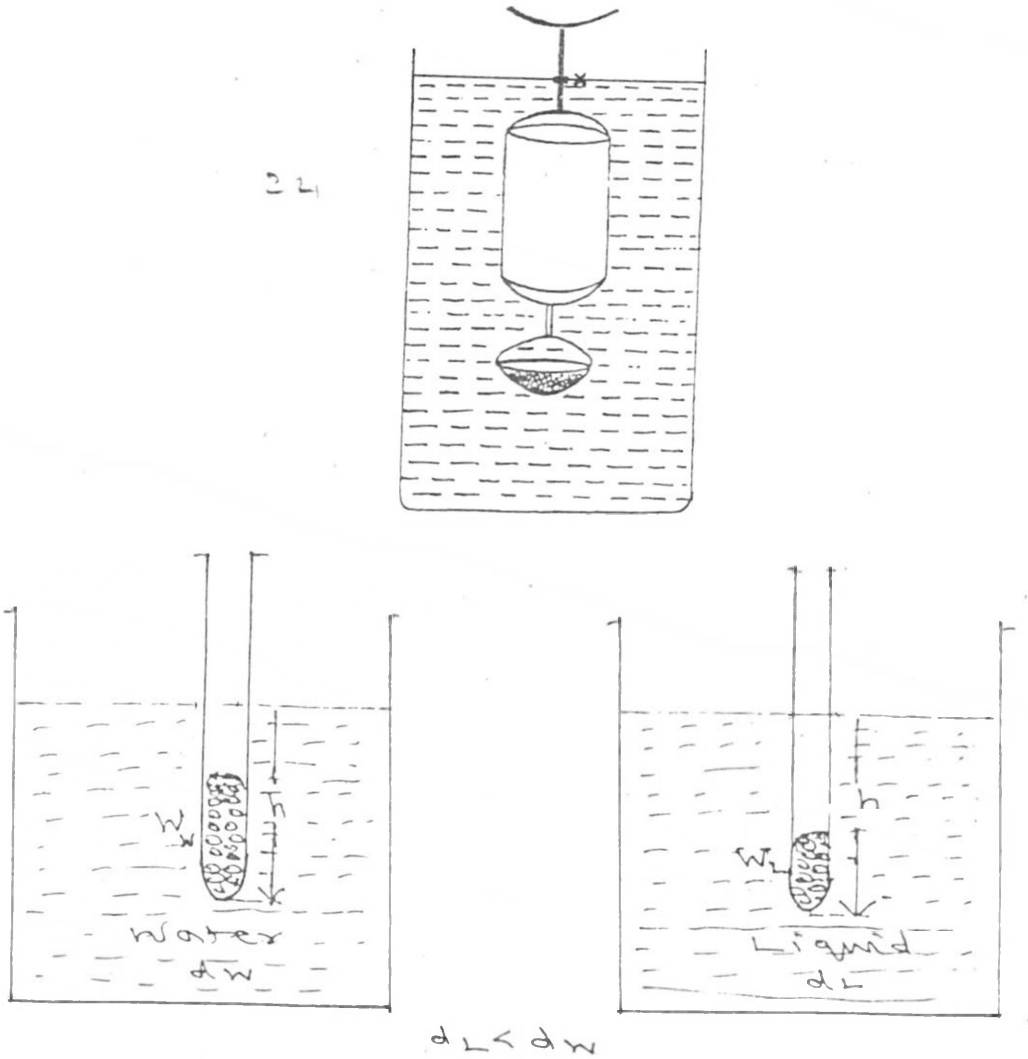
A calibrated scale can be prepared by measuring the distances between rubber bands and transferring them onto a graph sheet strip which can thus be pasted inside the test tube.

From the relation indicated in (4), it is obvious that the scale is '*not*' linear.



Constant immersion hydrometer

In this design, the weight of the (test tube) float is adjusted in different liquids so that it immerses to the *same* depth in all of them. Test tube must float vertically in the liquid. Nicholson Hydrometer is commercial version of this hydrometer.



The expression (1) in the case of water

$$W_w = Ahgd_w \quad \text{.....} \quad (5)$$

$$W_L = Ahg\, d_L \quad \text{.....} \quad (6)$$

Relative density of the liquid $d = \frac{d_L}{d_w} = \frac{W_L}{W_w}$ ..... (7)

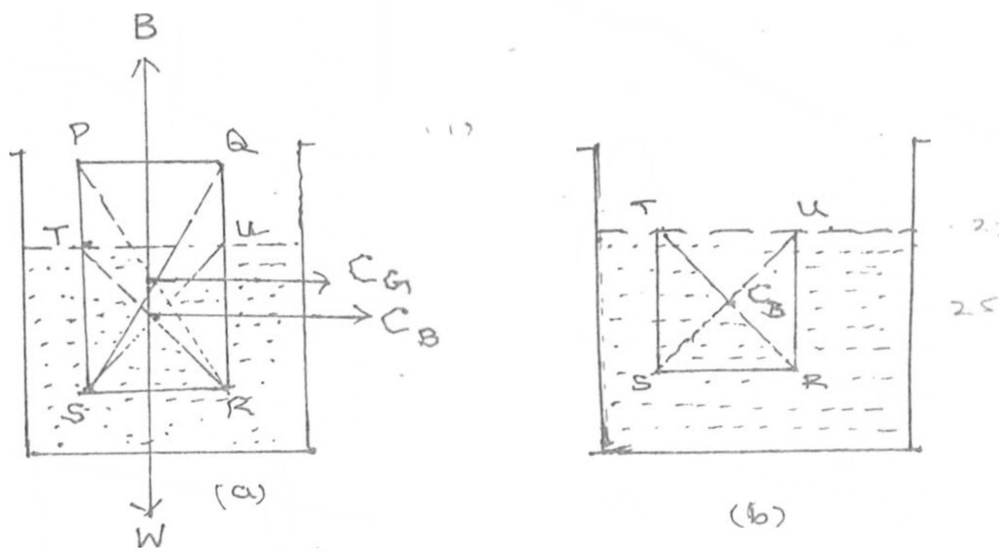
$$\therefore d = \frac{\text{weight of the hydrometer in equilibrium in the liquid}}{\text{weight of the hydrometer in equilibrium in the water}}$$

From (7) $d \propto W$.

For constant immersion, the weight of the float is *proportional* to the density of the liquid.

Floatation – centre of buoyancy

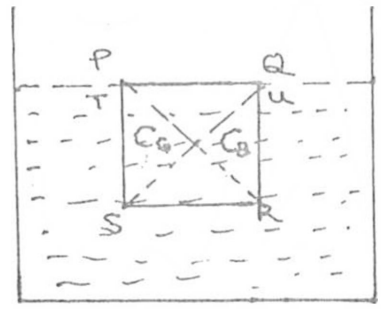
Consider a body PQRS floating in a liquid two-thirds immersed in a liquid. The centre of gravity of the body is at C_G. What are the forces acting on the body ? The forces are (i) the weight of the body acting vertically downwards and (ii) the buoyancy force B (or the upthrust) acting vertically upwards. From the Archimede's principle, buoyant force equals the weight of the displaced liquid. The lines of action of the forces coincide. This is one conditions for the equilibrium of the floating bodies.



In the figure (b), the volume TURS represent the volume of the displaced liquid (equal to the volume of the body immersed). The density of the liquid is uniform. Its geometric centre G_B represents the *centre of buoyancy*.

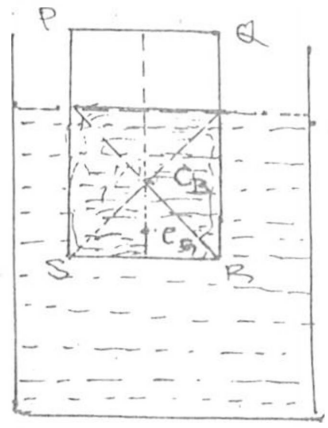
In such cases, "*The centre of buoyancy is the centre of gravity of the volume of the liquid displaced i.e. the volume of liquid occupied by the floating body*".

In fig. (a), when the floating body is in equilibrium its CG must be in the same vertical line as the centre of buoyancy C_B. This is another condition for equilibrium of a floating body.



When the uniform body is floating just submerged the C.G. of the body also coincides with the centre of buoyancy of the displaced liquid.

Suppose that the body PQRS in Fig. (a) is not uniform, and its bottom is heavy to such an extent that the CG is below the centre of buoyancy the floating body such as a ship will be in stable equilibrium. This is why you are asked to sit rather than stand up by a boat man, while crossing a river in a boat.



Light

Light is a form of energy. It produces the sensation of vision when it falls on the retina of the normal eye. An object is seen when light scattered (or reflected) from it falls on the eye.

A lens is a transparent medium bounded by two refracting surfaces.

Convex or Converging Lens

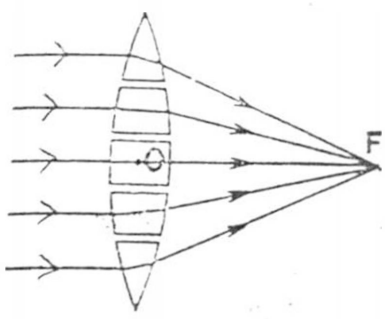
The lenses that are thick at the centre and thin at their periphery are called convex lenses. In such lenses, parallel beams of rays incident on them, *converge* to a fixed point on the principal axis. Hence they are called **converging lenses**.

Concave or Diverging Lens

The lenses that are thin at the centre and thick at their periphery are concave lenses. In such lenses, parallel beams of rays incident on them *diverge* and appear to come from a fixed point on the principal axis. Hence, they are called **diverging lenses.**

A lens may be regarded as made up of sections of several prisms.

Convex Lens

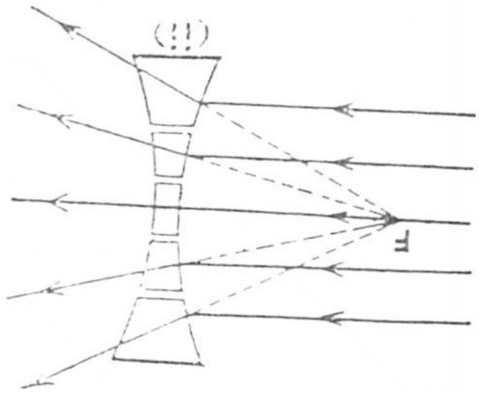


(i)

Different shapes of prisms are arranged as shown in the diagram. The upper half of the sections of prisms have their bases downward and the lower half of such prisms have their bases upward. The central section acts as a thin parallel glass plate.

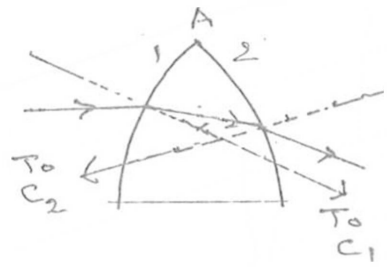
A ray passing through a prism is always bent towards the base. Therefore, all the rays bend towards the base and meet at one point on the other side of the lens. This point is referred to as principal focus 'F'. Similarly, the divergent action of a concave lens can be explained with the help of figure such as below :

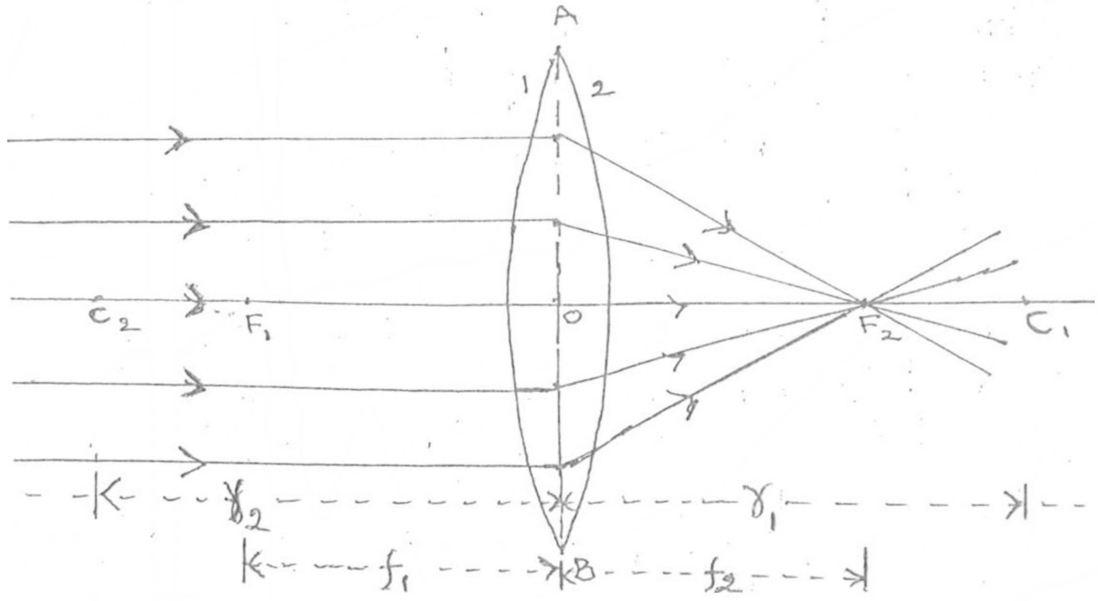
Concave Lens



Drawing Convex and Concave Lenses

A) Convex Lens :





C_1, C_2 = Centres of curvature of surface 2 and surface 1 respectively.

F_1 = Principal focus on side 1 of the lens for parallel rays incident on side 2.

F_2 = Principal focus on side 2 of the lens for parallel rays incident on side 1.

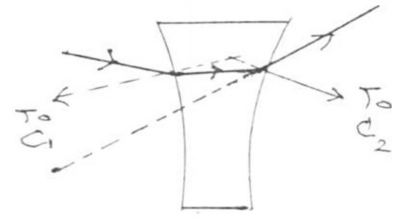
Draw a line of required length, with a point O marked on it. Mark two points F_1 and F_2 on it such that $OF_1 = OF_2$. Mark two more points C_1 and C_2 on either side of 'O' such that $OC_1 = OC_2$. With C_2 as center and radius slightly (about 2mm) greater than C_2O draw an arc as shown. With C_1 as center with the same radius, draw another arc to cut the first arc at A and B. AB is the convex lens formed. The radii of curvature C_1O and C_2O are so chosen that a ***thin*** lens is formed. The line passing through C_1 and C_2 is called ***Principal axis***.

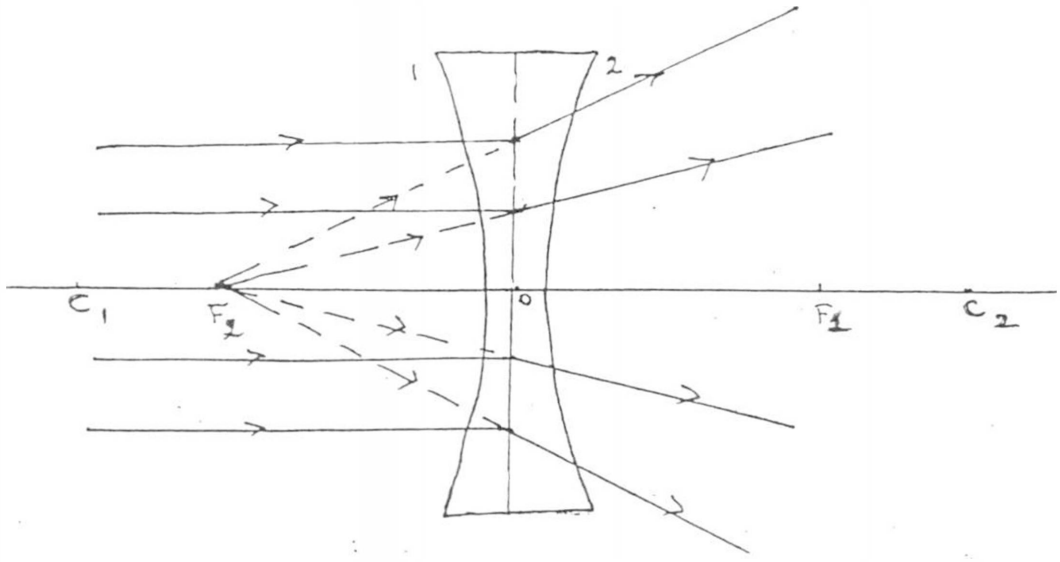
A lens is *thin* if its thickest portion is thin compared to the object distance, image distance and radii of curvature of two surfaces (i.e. C_1O and C_2O)

Consider rays incident on the side 1 of the lens, parallel to the principal axis. All these rays meet at a point F_2. Parallel rays that fall on the side 2 are refracted and meet at F_1. F_1 and F_2 are called ***Principal Foci***. For a thin lens, they are equidistant from O and are denoted by F on either side. F_1O (f_1) and F_2O (f_2) are called ***focal lengths*** of the lens. For a thin lens, $f_1 = f_2 = f$ and for a biconvex lens, $r_1 = r_2 = r$.

[Rays incident on the center O of the lens pass through the lens without deviation. The center 'O' of the lens is called '**optic centre**'.

B. Concave Lens





Draw a line. Mark a point 'O' on it. Mark two more points F_1 and C_2 on one side of the point O and F_2 and C_1 on the other side at equal distances respectively. With C_1 as centre and the radius slightly less than C_1O draw an arc. Similarly draw another arc of the same radius from C_2 as shown. Join the two arcs as shown which gives the concave lens. The line which is passing through C_1 and C_2 is called **principal axis.** Now consider a few rays parallel to the principal axis. These rays are refracted as shown. The refracted rays when produced backwards meet at F_2. When observed through the side 2, the refracted rays seem to come from F_2. This is called the **principal focus** (F_2). Since the rays appear to come from F_2, it is a virtual focus. Similar to a convex lens, the concave lens has two principal foci and two centers of curvature.

Sign Conventions

To derive a relation between the **object distance (u), the image distance (v)** and **focal length (f)** of a lens, a proper sign convention has to be used. In case such a convention is not followed and u,v and f are used only as pure numbers, we get formulae with different signs of terms for different cases. With a uniform convention a single formula can be obtained and used for all cases. But care should be exercised for using quantities with proper signs. Both 'Real is positive' and 'New Cartesian sign conventions' are described for ready reference.

SIGN CONVENTIONS FOR MIRRORS AND LENSES

Mirror :

Real is positive	New Cartesian
1. All distances are measured from the pole of the mirror	1. All distances are measured from the pole of the mirror as the origin.
2. Distances of real objects and real images are positive.	2. Distances measured in the same direction of incident light are positive.
3. Differences of virtual objects and virtual images are negative.	3. Distances measured against the incident light are negative.

4. Focal length of the i) concave mirror is positive. ii) convex mirror is negative.	4. Focal length of the i) concave mirror is negative. ii) convex mirror is positive.
5. $\frac{1}{v}+\frac{1}{u}=\frac{1}{f}$	5. $\frac{1}{v}+\frac{1}{u}=\frac{1}{f}$

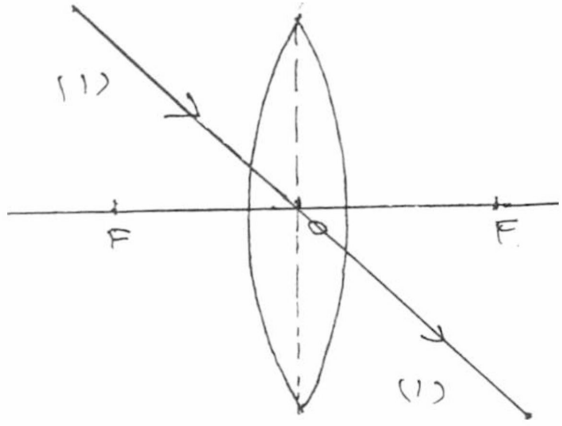
Thin Lens

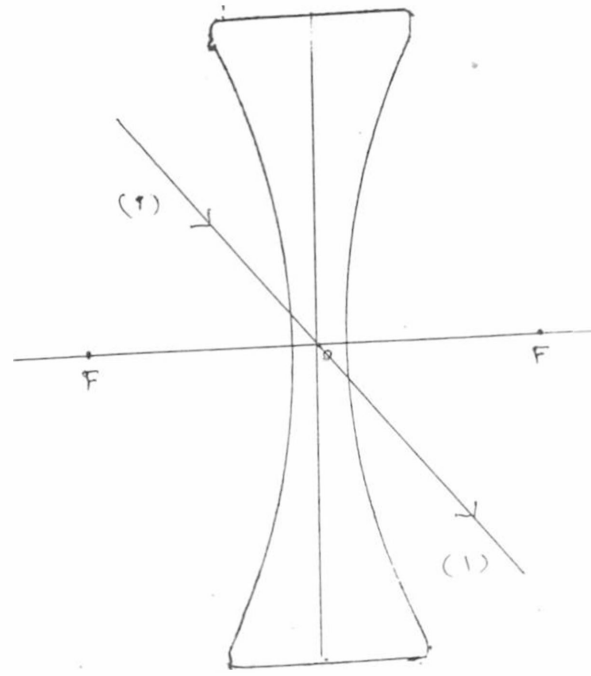
Real is positive	New Cartesian
1. All distances are measured from the optical center of the lens.	1. All distances are measured from the optical center of the lens.
2. Distances of real objects and real images are positive.	2. Distances measured in the same direction as that of incident light are positive.
3. Distances of virtual objects and virtual images are negative.	3. Distances measured against the direction of incident light are negative.
4. Focal length of the i) converging lens is positive. ii) diverging lens is negative.	4. Focal length of the i) converging lens is positive. ii) diverging lens is negative.
5. With usual notation $\frac{1}{v}+\frac{1}{u}=\frac{1}{f}$	5. With usual notation $\frac{1}{v}-\frac{1}{u}=\frac{1}{f}$

Location of images produced by lenses using Ray diagrams

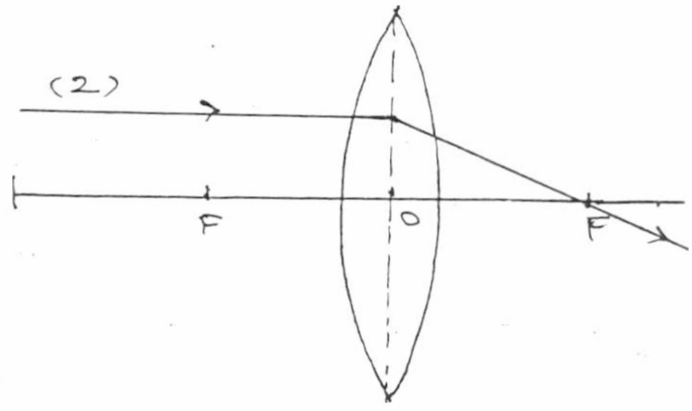
It is very easy to locate the images if we consider the following rays coming from the object:

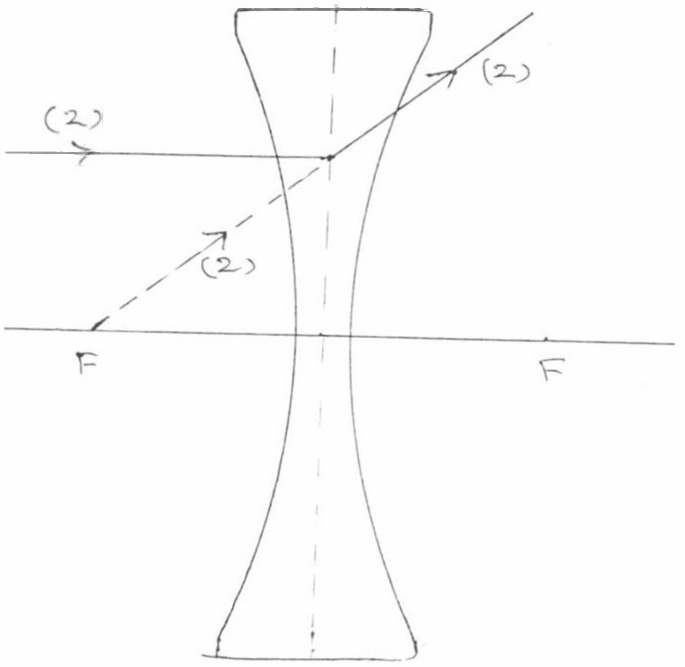
Ray (1) : A ray incident on the lens along the optic centre goes undeviated, because the lens near the centre behaves like a thin glass plate with parallel sides. (Note : For thin lenses, the lateral shift is almost zero).



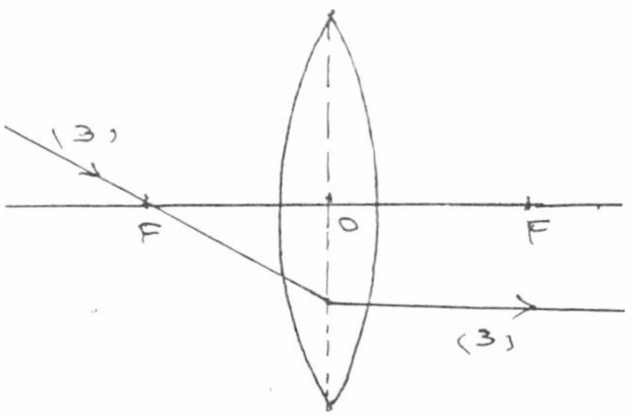


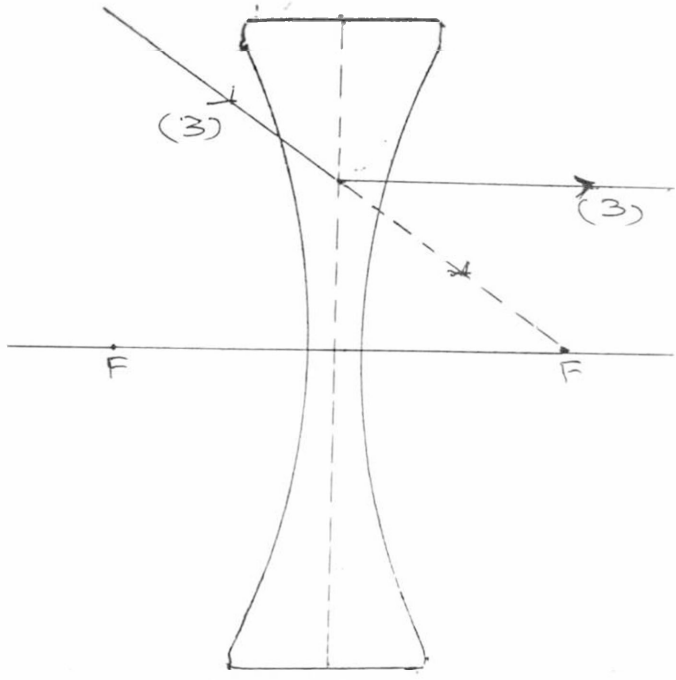
Ray (2) : A ray parallel to the principal axis and falling on the lens, passes through the focal point F on the other side (in a convex lens) or when extended passes through the focal point F on the same side (in a concave lens).





Ray (3) : A ray passing through the focal point F of the lens (or when extended after passing through it) emerges parallel to the principal axis on the other side.





In order to obtain the position of the image for any position of the object,

i) consider **any two** of the above rays.

ii) The point of meeting of the rays after refraction gives the position of the image.

iii) If the rays meet **actually**, the image is **real** (can be caught on a screen).

iv) If the rays meet **when extended** the image is **virtual** (cannot be obtained on a screen).

Location of the images : (An example)

Convex Lens (object between F and 2F)

a) **Using rays (1) and (2)**

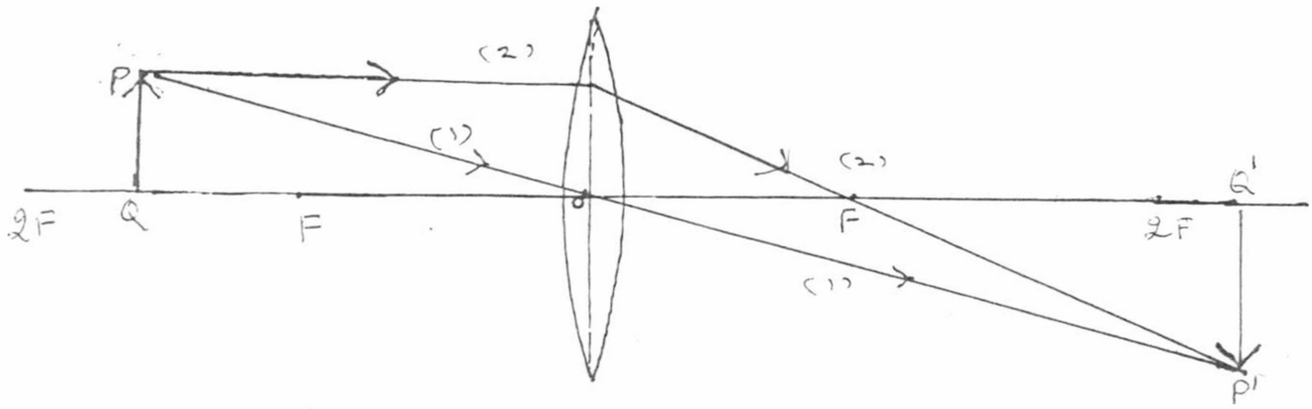
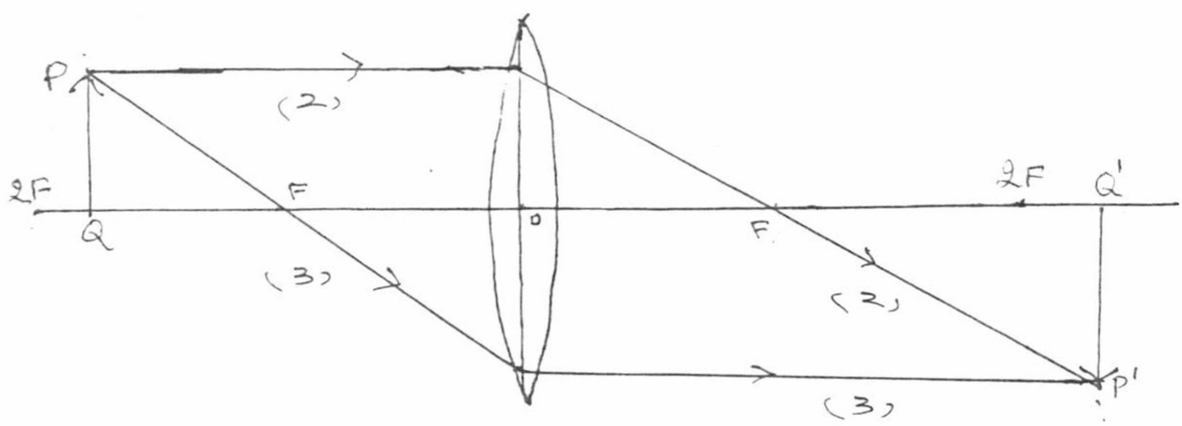


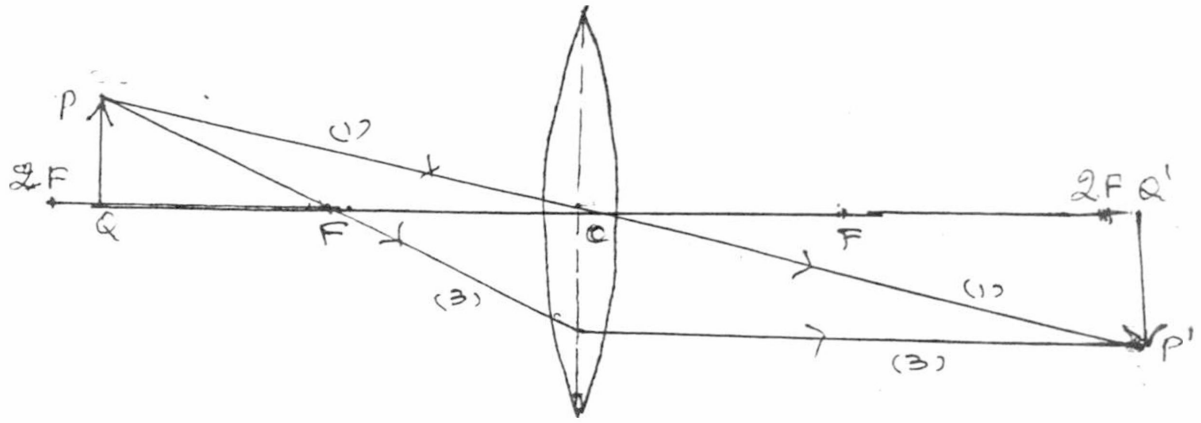
Image : Beyond 2F

Nature : Real, Inverted and Magnified.

b) **Using rays (2) and (3)**



c) **Using rays (1) and (3)**

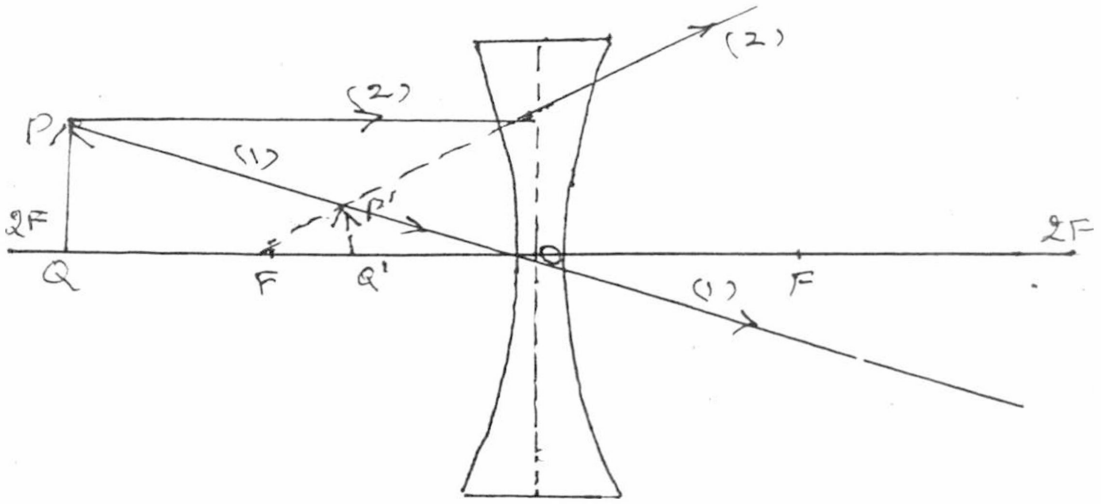


In all the above cases, where rays (1) and (2), (2) and (3) and (1) and (3) are used to obtain the position of the image, for a given position of the object (between F and 2F), the image is always beyond 2F. Since the rays **actually** meet, the image is **real**. According to the ray diagram, it is **inverted** and **magnified**.

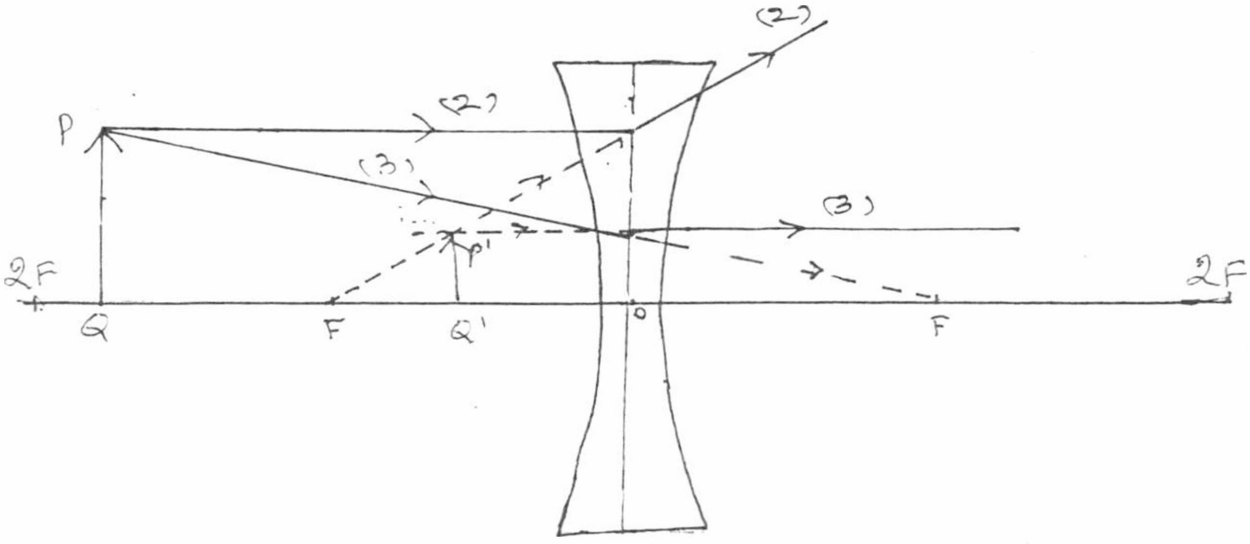
Concave Lens

We can locate the image using

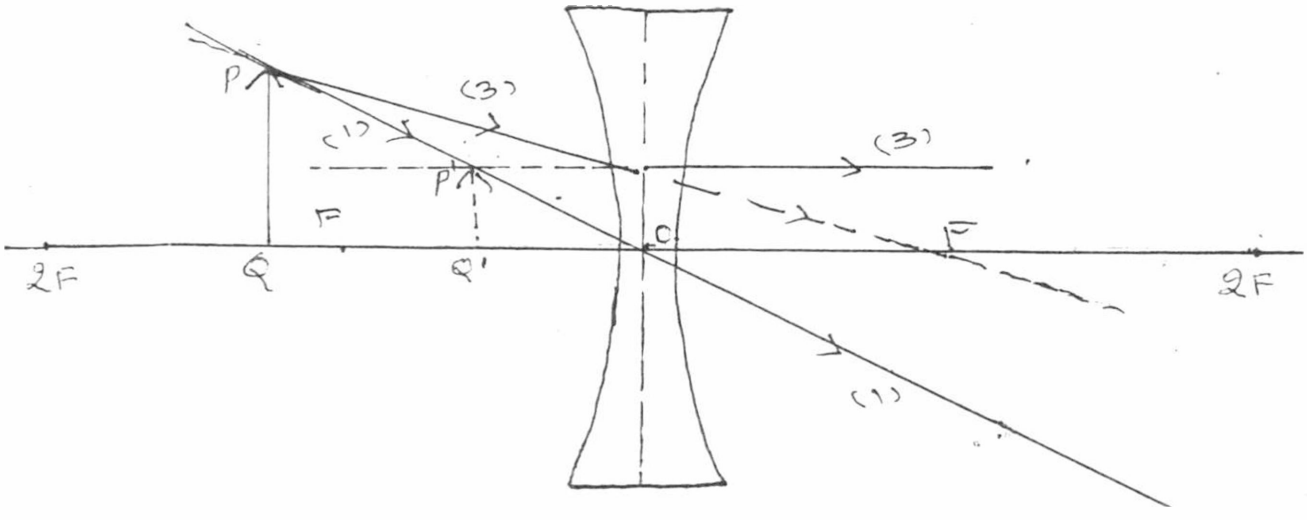
a) rays (1) and (2).



b) rays (2) and (3)



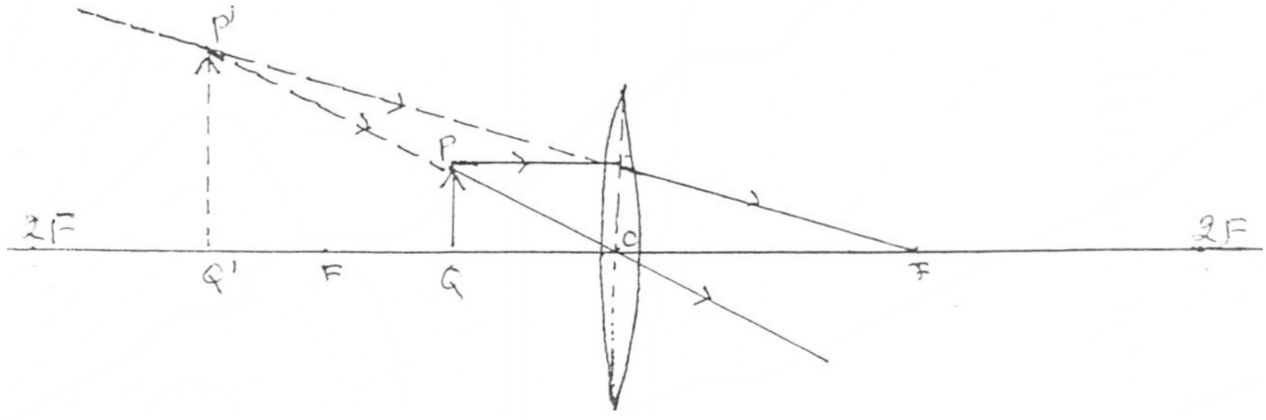
c) rays (1) and (3)



For **any** position of the object, for a concave lens, the image is always obtained by extending the refracted rays. Hence the images are **always virtual**, they are **erect** and **diminished** in size.

Students may be asked to draw ray diagrams for various positions of the object in a convex lens making a convenient choice of **any two** of the above cited rays.

Though the concave lens produces a virtual image **always**, the convex lens can produce virtual image **as well as** real images. The virtual image is obtained only in one case when the object is within F (i.e. object distance less than the focal length) of the lens. It is erect and magnified. The corresponding ray diagram is given below.



This principle is used in a simple microscope or Hand magnifier. The distance between the observer's eye and the hand magnifier is to be adjusted in order to see a clear virtual image.

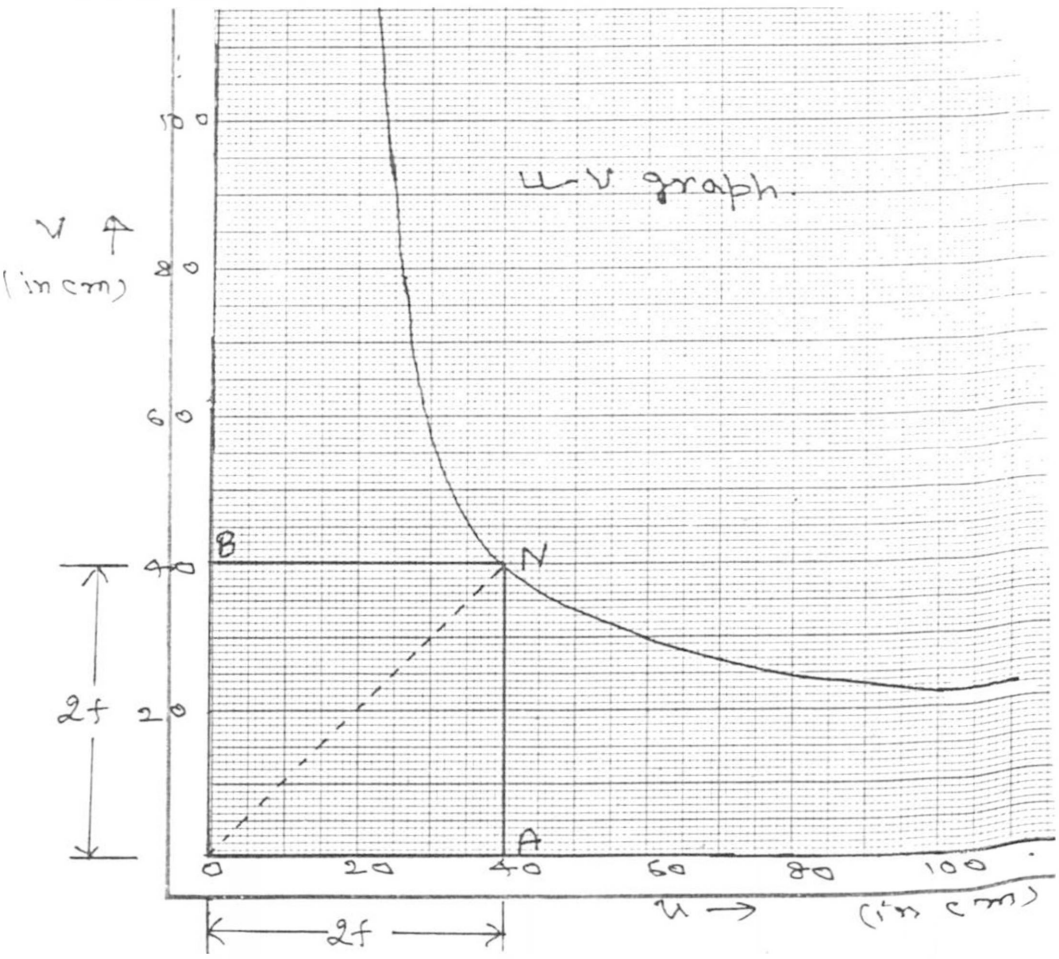
Variation of the image distance (v) with the object distance (u) for a convex lens :

If we carefully observe the ray diagrams, the variation of v with u, can be known and a graph can be drawn between u and v to understand the nature of variation.

Refer to a typical data given below for which a u – v graph is presented here.

u (cm)	∞	60	40	30	20(F)
v (cm)	20(F)	30	40	60	∞

Note that as the object approaches the principal focus from infinity, the image recedes from the principal focus to infinity. In particular, when the object is at 2F, the image is also at 2F. i.e. the object distance and image distance are equal to 2F. At this position, (i.e. at 2F) the object and image are of the same size.



If we draw a straight line from the origin O, at 45° to the u-axis, i.e. a line equally inclined to x and y axis, it meets the u – v curve at a point N. If a perpendicular is drawn from N to u and v axes respectively, i.e. NA and NB, the intercepts on the u and v axes, i.e. OA and OB represent u = v = 2f. This corresponds to the case of an object at 2F producing an image at 2F. Half the value of the intercept gives the focal length of the lens. Since we get two values for the focal lengths through the two intercepts, the average focal length can be calculated.

Relation among u, v and f for a convex lens

The following information may be kept in mind while deriving the above result.

1. Draw a ray diagram to locate a real image in a convex lens.
2. Consider the following pairs of similar triangles in the ray diagram.

a) A triangle that contains the object and the object distance. Compare it with the triangle that contains the image and image distance.
Show that the two are similar and write the ratio of the corresponding sides in terms of u, v and f.

b) Consider another triangle that contains the Principal Focus F and the line that joins the principal focus F with the tip of the object (i.e. its head) inside the lens.
Compare it with the triangle that contains the image and the line that joins its tip (head) with the principal focus F. Show that the two triangles are similar and write the ratio of the corresponding sides in terms of u, v and f.

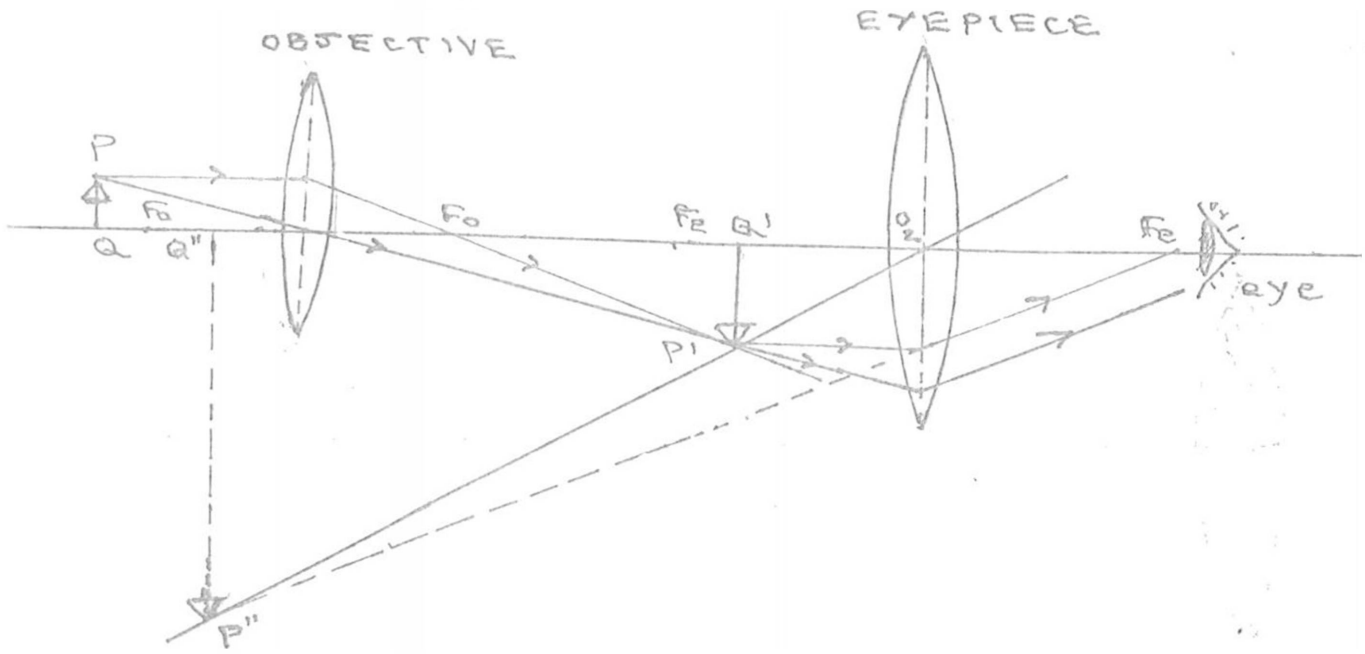
Equating the ratios in (a) and (b) the relation can be obtained. (Refer to the relations given under sign conventions). This holds good only for thin lenses.

Compound Microscope

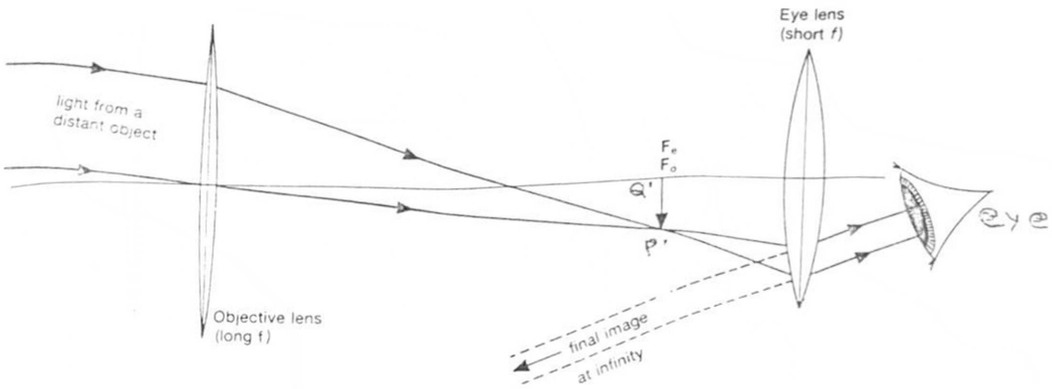
Compound Microscope is a system of combination of two convex lenses. The lens facing the object is called **objective** and the lens near to the eye is called **eye-piece.** The objective has a smaller focal length than that of the eye-piece.

Construct the ray diagram as shown below. The object PQ is just beyond F_o. Real, inverted and magnified image P'Q' is formed beyond $2F_o$ of the objective. The eye piece is adjusted in such a way that P'Q' is in between F_e and O_2. Now the enlarged virtual image P''Q'' is formed at the near point of the eye.

Compound Microscope.



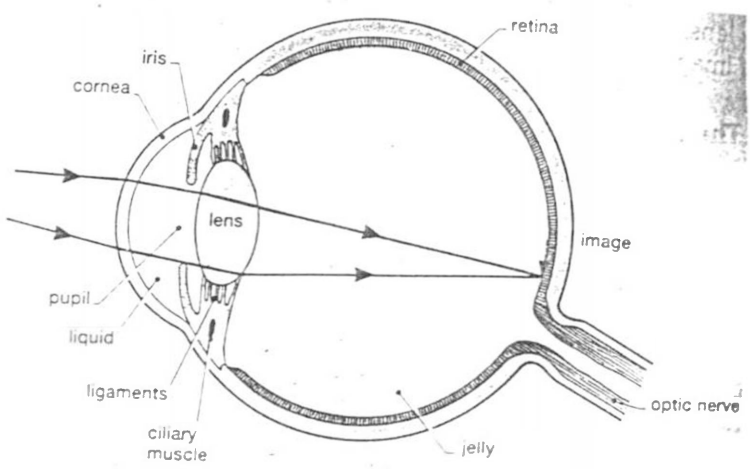
Telescope :



Astronomical Refracting Telescope

This consists of an objective of a large focal length f_o and an eye piece of a short focal length f_e. Parallel rays from a distant (say, heavenly object) object falls on the objective which forms its real, inverted image P'Q' at its focus F_o. Now eyepiece is so adjusted that P'Q' is at its principal focus F_e same as F_o. The final image, which is inverted, magnified and virtual forms *at infinity*.

Human Eye



top view of your right eye

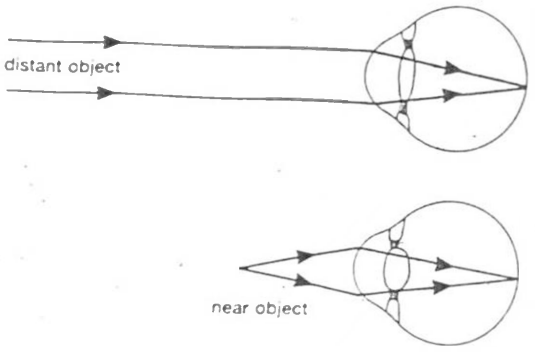
The '**Human eye**' is the window to the world around us. Its functions can be briefly outlined as follows:

The light enters the eye through the transparent cornea and passes through the eye-lens and gets focused on the retina.

The retina is sensitive to light and sends messages to the brain through the optic nerve. The eye is only a receiver of message in terms of light. Interpretation of the message is done at the brain which involves interaction of light with the object, the eye and the brain.

The iris diaphragm controls the amount of light that enters the pupil. To focus light from different objects, the bending is mostly by the cornea itself.

But the curvature of the lens can be slightly controlled by the ciliary muscles which hold the lens.



The figure above shows that when the ciliary muscles are relaxed the curvature of the lens increases, the lens appears 'thin' and can focus distant objects. When the ciliary muscles squeeze the eye lens, its curvature decreases, the lens appears thick and can focus nearby objects.

Defects of Eye:

People with normal vision can focus very clearly distant objects at infinity. Their 'far point' is at infinity. They can also focus very clearly nearby objects. The closest point at which they can see nearby objects clearly is

called the 'near-point'. This is about 25 cm for adults and slightly less for younger ones. Here we discuss two types of eye defects, arising due to abnormal size or shape of eye balls. They are 'long sight' and 'short sight'.

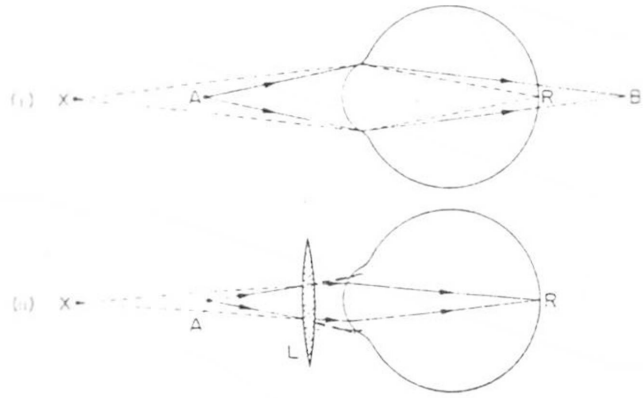
'Long sight' (Hypermetropia)

A person who can see distant objects clearly but cannot focus nearby objects is having long sight. This is because his eye ball is **too short** or the eye-lens is **too thin** in spite of the full squeezing of the ciliary muscles.

His 'far point' F is normal i.e. at infinity but *his near point (X)* is farther from the eye than the *normal eye's near point (A)* which is about 25 cms. Rays from X are brought to a focus on the retina (R). Rays from the 'normal' near point A are brought to a focus at B, behind the retina.

Remedy

A suitable convex *lens* L is required to correct this defect. Rays from A then appear to come from X. After refraction through L, an image is formed on the retina (R) and can be focused by his eye.



(i) Long sight (ii) Correction for near point

Short sight (Myopia)

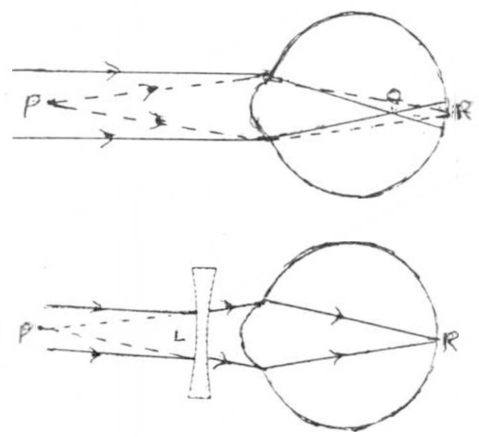
A person who can see nearby objects clearly but cannot focus distant objects is having short sight.

This is because his eye ball is **too long** or the eye-lens is **too thick** even though the ciliary muscles are fully relaxed.

The person's 'far point' is not at infinity but at a point P nearer to the eye. Parallel rays coming from infinity will be brought to a focus at a point Q *in front* of the retina, but rays from *his far point P* are brought to focus *on* the retina.

Remedy

A suitable concave lens L is required to correct this defect. Rays from 'the normal far point F (at infinity)' are made divergent and appear to come from P, the far-point of the person, and brought to a focus on the retina R.



(i) Short sight (ii) Correction for far point

The Electromagnetic Spectrum

In 1864 J.C. Maxwell made a remarkable suggestion that accelerated electric charges generate electric and magnetic disturbances mutually linked with each other. These travel in space in the form of waves when the charges oscillate periodically. In such waves, the electric and magnetic components are perpendicular to each other and to the direction of propagation. Such waves are called *electromagnetic waves.*

Faraday had established that a changing magnetic field can induce a current in a loop and is equivalent to an electric field in all respects. Maxwell made a hypothesis simply based on symmetry that the converse should also be true i.e. a changing electric field has a magnetic field associated with it. At that time, Maxwell had no experimental evidence to support this. But he argued that if his hypothesis was correct, electromagnetic waves in which the electric and magnetic components (fields) are mutually perpendicular to each other should occur. He also calculated the velocity of such waves to be

$$C = \frac{1}{\sqrt{\mu_o \varepsilon_o}} \approx 3 \times 10^8 \ ms^{-1}$$

where $\in_o$ is the permittivity of free space and μ_o is the permeability of free space. This velocity, by a rare coincidence, happened to be the same as velocity of light. This made Maxwell to conclude that light is an electromagnetic wave.

In 1888, Hertz experimentally demonstrated the existence of such electromagnetic waves and also measured their velocity, which coincided with Maxwell's calculations.

Later discoveries showed that visible light is only one example of an electromagnetic wave over a narrow span of about 4000 Å to 6900 Å

There are others of very short wave length like gamma rays to very long wavelengths like radio waves. This whole range forms the electromagnetic spectrum.

The classification of electromagnetic spectrum according to wavelength is given in the table.

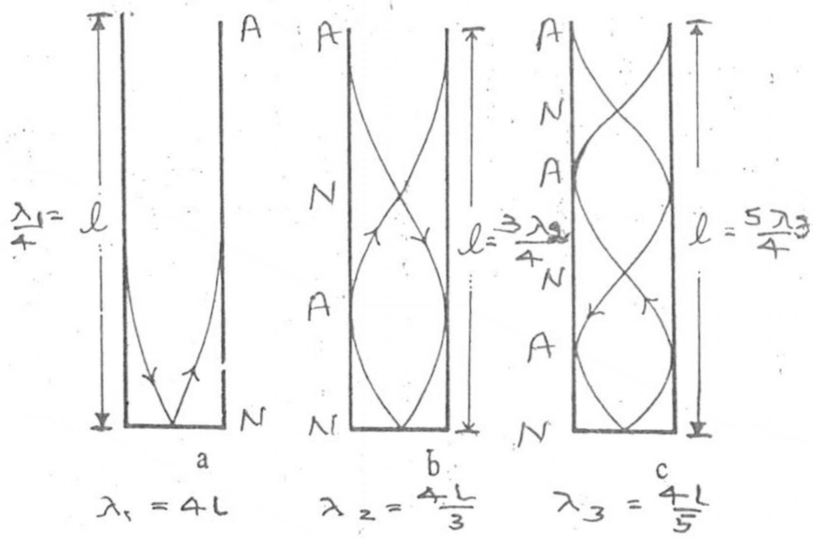
THE ELECTROMAGNETIC SPECTRUM

Components	Sources	Detectors	Uses
γ - rays ($\lambda \approx 10^{-12}$ m) (10,000,000,000 waves in 1 cm)	Radioactive substances like uranium.	Geiger-Muller tube.	To kill unwanted tissues in human body (radio therapy). To check welds, joints in a metal.
X- rays ($\lambda \approx 10^{-10}$ m) (100,000,000 waves in 1 cm)	X-ray tubes (bombarding a heavy metal by fast electrons)	Photographic films.	To check bone and teeth cracks by doctors. To check weld and metal joints.
UV rays ($\lambda \approx 10^{-8}$ m) (1,000,000 waves in 1 cm)	Very hot objects, sun, sparks, mercury lamps	Photographic film, fluorescent substances, darkens skin.	For electric welding using electric arc. UV absorbed in washing powders makes clothes brighter.
Visible light ($\lambda \approx 5 \times 10^{-1}$ m) (20,000 waves in 1 cm)	Hot objects, sun, lasers, fluorescent lamps, LDR (light dependent resistor)	Eye, photographic film, LDR	For vision All human activity Photosynthesis
Infrared ($\lambda \approx 10^{-5}$ m) (1000 waves in 1 cm)	Sun, warm and hot objects, irons, fire, toasters, etc.	Skin A blackened thermometer A thermistor	Physical therapy in medicine. To detect cancer, arthritis, etc.
Radio/waves a) Short waves ($\lambda \sim 10^{-2}$ m) b) Long waves ($\lambda \sim 10^{-2}$ m to 1 km)	Microwave ovens Klystrons and magnetrons (specific vacuum tubes) Radio transmitters Radars TV transmitters.	Aerial with a TV set, a radio set or a mobile phone.	Micro wave ovens, communications, radar. Local radio and police communication, TV telecast, radio broadcast, mobile phones.

λ = wavelength of the component waves

Sound

Closed Pipe



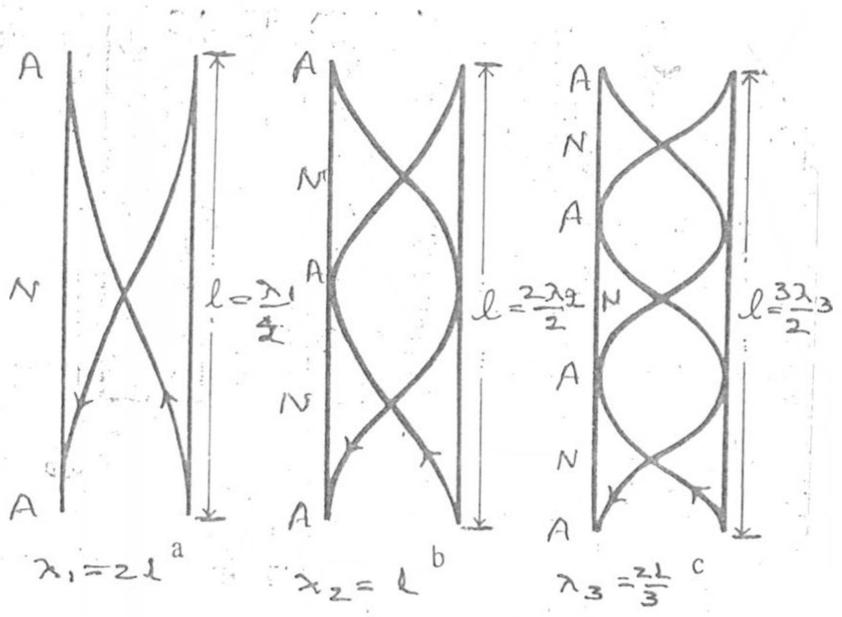
A closed pipe is a cylindrical tube with one end closed, enclosing an air column inside.

Sound waves are sent down in a tube of length 'l' cm by a tuning fork placed very near to the open end of a tube. Progressive waves travel down and are reflected by the closed end. The reflected wave moves up and combines with a new wave created by the tuning fork and produces the standing wave. Even nodes and antinodes are formed in the tube. Only antinodes are formed at the open end and nodes at the closed end. The points where the particles are at rest are called Nodes (N) and the points having the maximum vibration are called the Antinodes (A). In the diagram (a) the length of the tube is one-fourth of the wavelength λ_1 of the wave. In (b) the length of the tube is three-fourth of the wavelength λ_2 of the wave and in c) the length of the tube is five-fourth of the wavelength λ_3 of the wave. Notes of higher frequencies are produced by using tuning forks of higher frequencies. Alternatively, other resonating lengths for the same frequency can be obtained by lengthening the pipes.

Ratio of wavelength = $1 : \frac{1}{3} : \frac{1}{5} \ldots\ldots\ldots$

Hence the ratio of frequencies of vibrations in a closed pipe = 1 : 3 : 5 : .....

Open Pipe



An open pipe is a cylindrical tube with both ends opened enclosing an air column inside.

A tuning fork is made to vibrate at one end of an open pipe. Progressive waves travel down and are reflected at the other end due to low pressure in this region. The reflected wave moves up and combines with the new wave generated by the tuning fork and produces the stationary wave. Nodes and antinodes are formed in the tube as shown in the diagram. Since the air is free to vibrate at both open ends, with maximum amplitude, an antinode is formed at the open ends (free ends). Nodes are formed in between.

In the diagram,

a) the length of the tube is one-half of the wavelength λ_1 of the wave.

b) the length of the tube is the same as the wavelength λ_2 of the wave and

c) the length of the tube is three-half of the wavelength λ_3 of the wave.

Ratio of wavelength = $1 : \frac{1}{2} : \frac{1}{3}$ .....

Therefore, the ratio of frequencies of vibrations in an open pipe = 1:2:3:....

Recording and Reproduction of Sound

Recording and Reproduction (play back) of sound is usually done on a device called **tape recorder.**

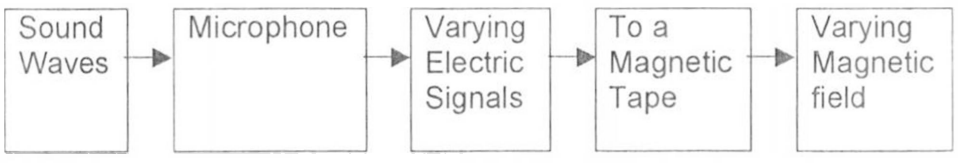
Audio recording tape is a thin plastic ribbon coated on one side with an easily magnetizable substance like iron oxide or chromium-di-oxide.

Principle of working :

Recording

A tape recorder receives sound in the form of electric signals from a microphone which vary according to sound signals. The varying electric signals create a changing magnetic field. This magnetic field magnetizes the particles on the tape and the tiny magnetic elements on it are aligned in a specific pattern depending upon the variations in incoming sound signals.

Thus the original electric signals are converted into a characteristic magnetic field pattern on the tape. This is called recording of sound.



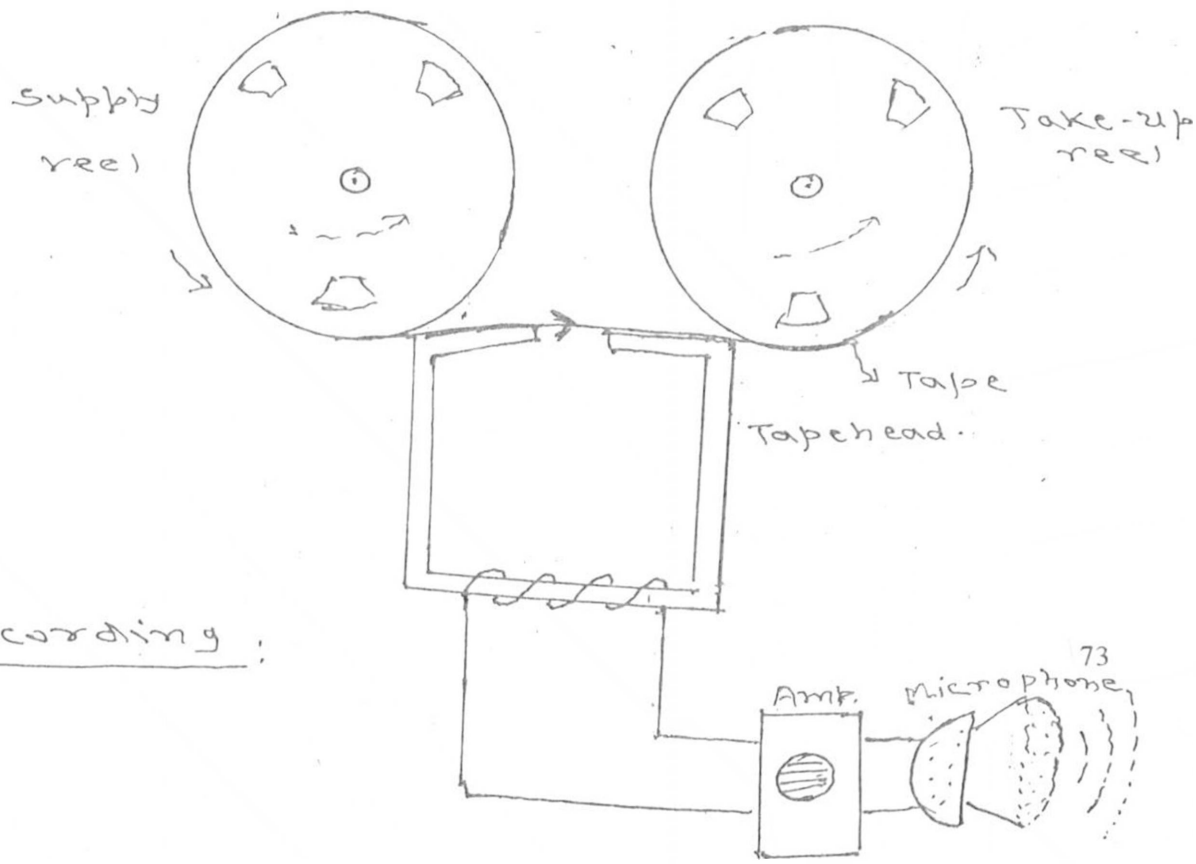
During reproduction of sound, the varying magnetic fields produced by the magnetic patterns create a changing electric field, which when fed to a loud speaker, change the electrical signals into original sound signals. This is called Reproduction of sound.

Working of a Typical Tape Recorder

Usually a tape recorder has two reels – a supply reel and a take-up reel. The magnetic tape is rolled on the supply reel and the take-up reel is empty. One end of the magnetic tape from the supply reel is attached to the take-up reel through a soft rubber pad which presses the tape tightly, against a metal rod. As the tape recorder is switched on, the magnetic tape from the supply reel is pulled by the take-up reel and the tape passes over a small gap (of about $\frac{1}{1000}$ mm wide) of an electromagnet, called the tape head.

The head in between the reels magnetizes and records the sound on the tape, as described earlier.

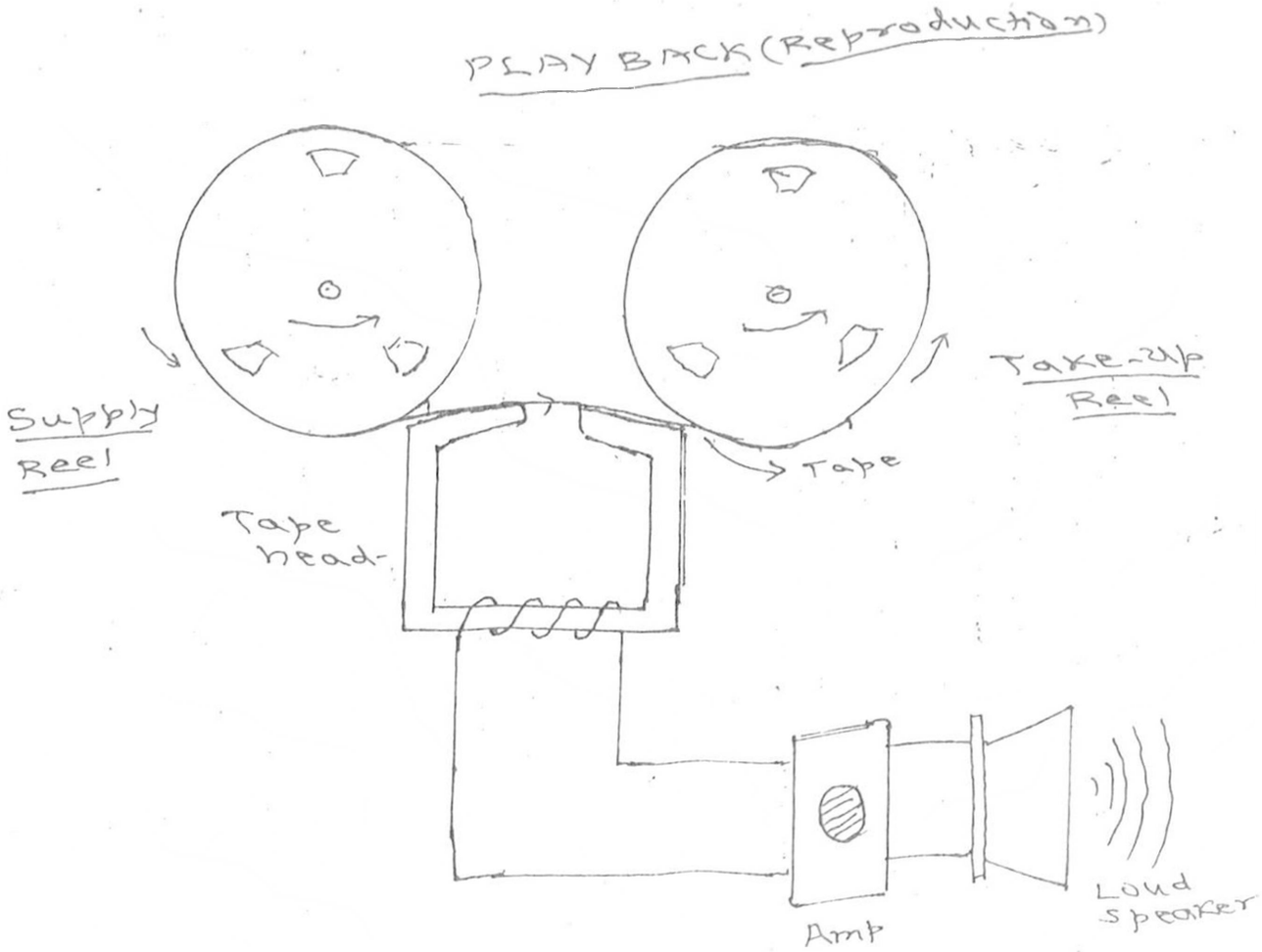
The magnetized tape, with the sound signals recorded on it moves further and gets wound on the take-up reel.

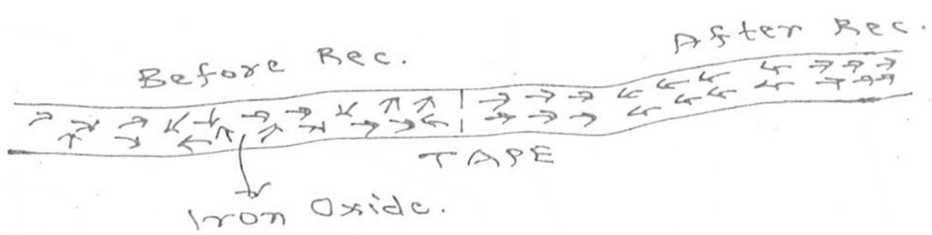


Recording :

Play-back (Reproduction of sound)

Before reproducing, the tape must be rewound on the supply wheel and sent through the recorder again. The 'play-back' head is switched on. The magnetic patterns on the tape generate a weak current in the electro-magnet. This is amplified by an amplifier before it reaches a speaker, which reproduces the original sound.





Magnetism

1. The word 'magnet' comes from the term 'magnetite'. In the earlier days the magnetic phenomenon was used to play tricks and black magic. Now we know from Oersteds experiment that current carrying conductor produces a magnetic field. An electron moving in a circle in an atom constitutes electric current and it produces a magnetic field and accounts for the magnetism of certain materials. From Faraday's experiments we know that changing magnetic field produces current. Thus, magnetism and electricity are two sides of the same coin. In fact, magnetism is the main source of electric energy.

Magnetic Poles

When a magnet is dipped in iron filings, the filings cling to it near the ends. The magnet behaves as though the magnetism is concentrated at two points near the ends of the magnet. These are called the magnetic poles.

Coulomb's Inverse Square Law

Coulomb studied the force of attraction and repulsion between two magnetic poles and found that

(i) The force of attraction or repulsion between two magnetic poles is directly proportional to the product of the pole strengths.

(ii) The force of attraction or repulsion between two magnetic poles is inversely proportional to the square of the distance between them.

If m_1 and m_2 are the pole strengths of two poles at a distance d, then force between the poles,

$$F \propto \frac{m_1 m_2}{d^2}, \text{ or } F = \frac{\mu_0}{4\pi} \frac{m_1 m_2}{d^2}$$

Here $\frac{\mu_0}{4\pi}$ is a constant. μ_o is called the *permeability* of free space. The value of μ_o is $4\pi \times 10^{-7}$ henry/metre.

In a medium other than free space, say glass, the force between two poles is,

$$F = \frac{\mu}{4\pi} \frac{m_1 m_2}{d^2}$$

Here μ is the permeability of the medium. μ is different for different media. μ_g for glass is less than μ_o for free space but μ_f for iron is greater than μ_0 for free space. **The force between the poles is different when they are kept in different media.**

If a unit pole is kept at a distance 'd' from a pole of pole strength m in vacuum, it will experience a force equal to

$$\frac{\mu_0}{4\pi} \frac{m \times 1}{d^2} \text{ or } \frac{\mu_0}{4\pi} \frac{m}{d^2}$$

Magnetic Field

The region around a magnet in which a magnetic substance experiences a force is called the magnetic field.

Magnetic lines of force or Magnetic flux

A magnetic field can be represented by a number of magnetic field lines. *A magnetic field line is a line along which an isolated north pole, free to move, would travel when placed in a magnetic field.*

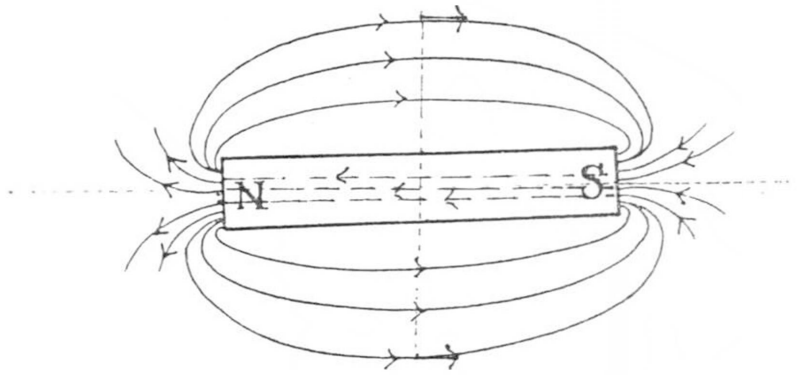
Properties of Magnet lines of force :

1. Magnetic field line is the path followed by a free and hypothetical north pole.

   Outside the magnet, they always start from the north pole and terminate at the south pole of the magnet. But inside the magnet they start from the south pole and terminate on north pole. Hence they form closed loops.
2. The magnetic lines of force exist in all the possible planes in the magnetic field. To get an idea, rotate the lines of force(confined to a plane) about the axis of the magnet. The direction of the tangent

drawn at a point on the curve gives the direction of the magnetic field at that point.

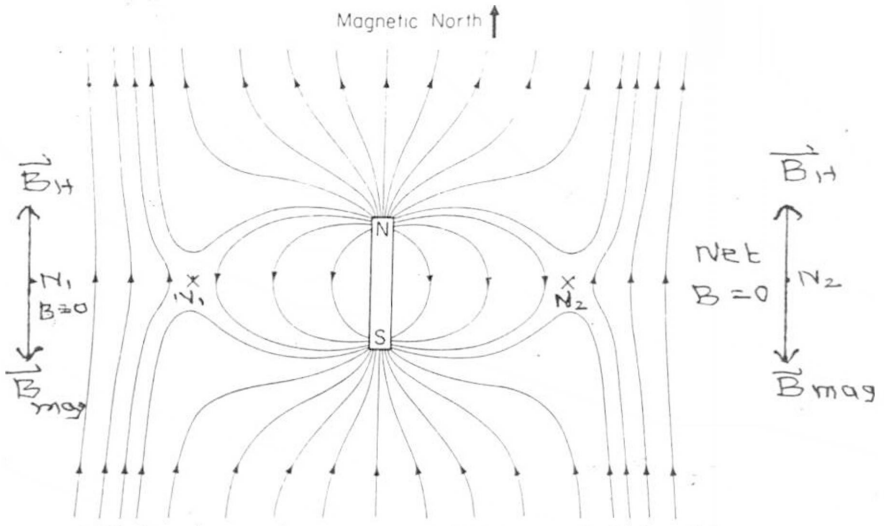
3. They never intersect with one another.
4. Magnetic lines of force are very close near the magnetic poles.



Mapping the magnetic field around the bar magnet placed along the magnetic meridian :

i) North pole pointing the geographic north :

Fix a white sheet of paper on a drawing board and draw the magnetic meridian at the centre by means of a compass needle. Now place the given bar magnet along the magnetic meridian symmetrically with its north pole pointing north and draw its outline on the paper.



.. Horizontal magnetic flux pattern near a bar magnet with its axis in the meridian and its N pole pointing north

Place the compass needle at the north pole of the magnet. It sets along the magnetic lines of force. Mark the two points corresponding to the north and south poles. Then place the compass needle so that its south pole is on the previous position of the north pole. Corresponding to the new position of the north pole make a mark. Repeat this process till the south pole of the magnet is reached. Join these marks by a smooth curve.

Start from different points near the north pole of the bar magnet and trace similar curves on both the sides of the magnet. **The lines away from the magnet are primarily due to earth's magnetic field.**

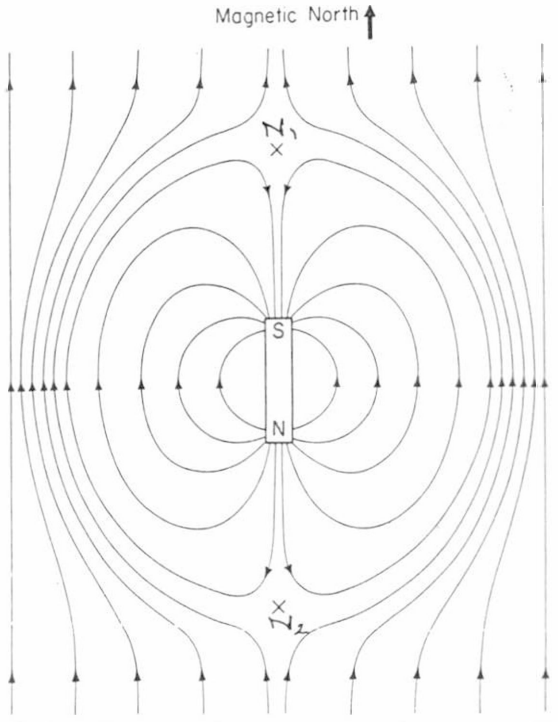
Null Points

On the equatorial line and on either side of the bar magnet, there are two points N_1 and N_2 through which no magnetic line pass. These points are called as Null Points.

We know that the earth acts as a bar magnet whose north pole is near the geographic south pole. Magnetic lines of the earth start near the geographic south pole and end near the geographic north pole. Lines of force due to the bar magnet start from the north pole to the south pole. **We get null points when the magnetic field intensity due to the bar magnet is balanced by the magnetic field intensity due to the earth.**

ii) North pole pointing geographic south

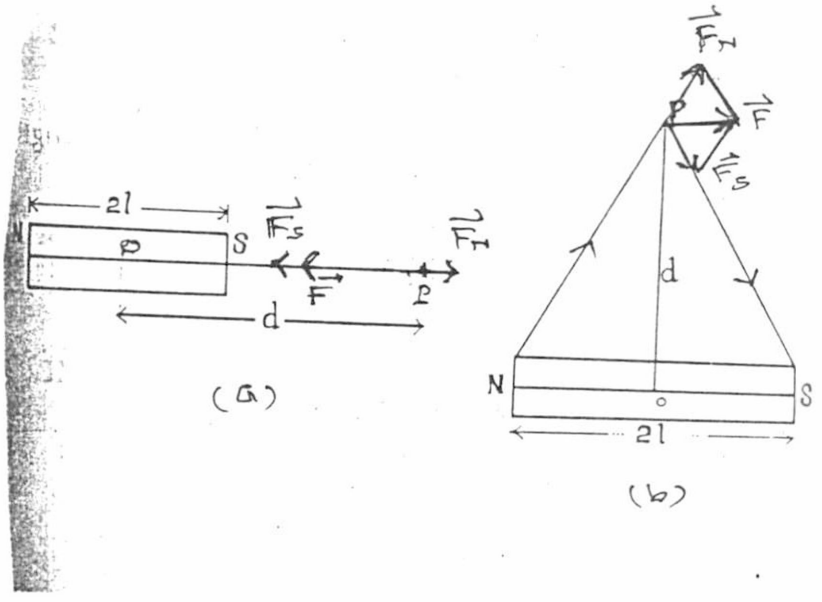
When the north pole of the bar magnet is pointing geographic south, the null points are obtained on the axial line of the bar magnet.

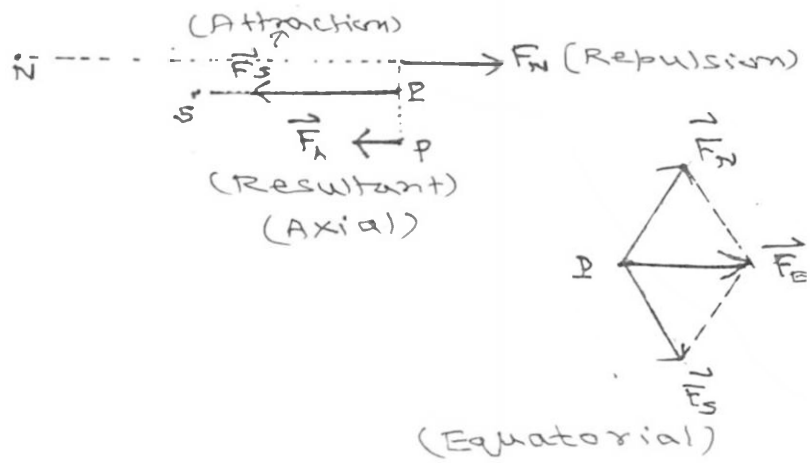


Horizontal magnetic flux pattern near a bar magnet with its axis in the magnetic meridian and its S pole pointing north

(i) Magnetic field intensity at a point on the axial line of the bar magnet :

The magnetic field intensity is given by the flux density i.e. number of magnetic lines of force normal to unit area. The direction of the resultant force in diagram (a) show the direction of the magnetic force on the axial line.





The direction of the resultant force in the diagram (b) shows the direction of the magnetic force on the equatorial line.

ii) Magnetic field intensity on the equatorial line of a bar magnet :

Observe that the direction of the force on the equatorial line is opposite to the direction of the force on the axial line.

Carefully observe the number of lines of force due to a bar magnet. Half the number of lines originating from the north pole are directed upwards and other half are directed downwards. This suggests that the magnetic force on the axial line is twice that on the equatorial line.

Electricity

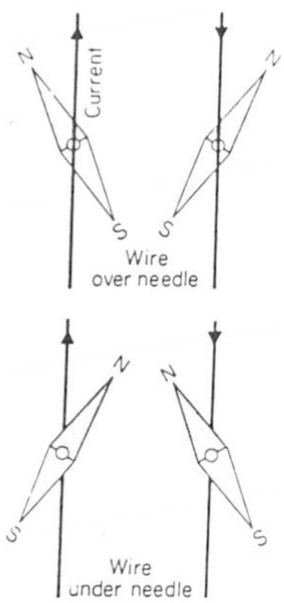
We all know the importance of electricity in our day to day life. Imagine the inconveniences that we are put to in our house when there is a power failure! This all-important source of energy namely electricity, can be obtained from magnetic energy, heat energy, mechanical energy, chemical energy, wind energy and tidal wave energy to mention a few.

Magnetic effect of current

Oersted's experiments

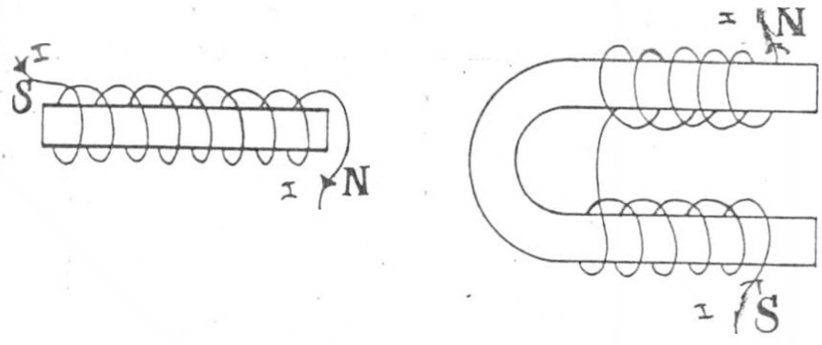
Oersted observed the magnetic effect of current in 1820. He placed a magnetic needle near a current carrying conductor. He observed that the needle was deflected. This can be illustrated by the following experiment.

Pass the current through a straight conductor which is placed in the north-south direction (magnetic meridian). Place a pivoted magnetic needle below it. The needle will be found to deflect in one direction. When the direction of the current is reversed, it will deflect in the opposite direction. The direction of deflection also reverses, when the needle is placed above the conductor instead of below. This shows that there is a magnetic field surrounding the current carrying conductor.



. Oersted's experiment

Electromagnet



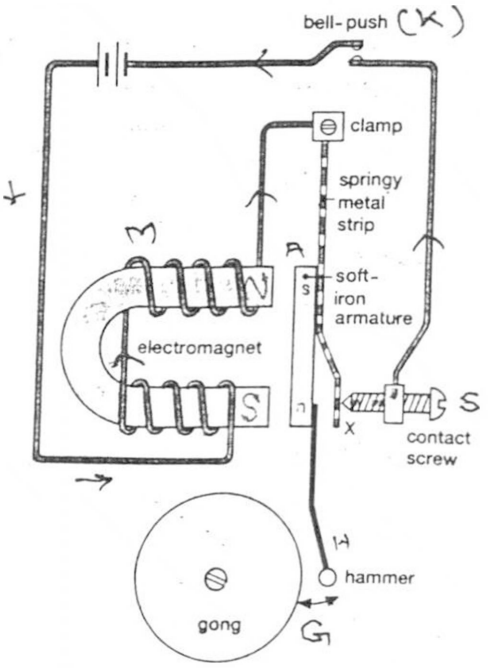
An electromagnet consists of a soft iron piece on which a coil is wound. The soft iron would become a strong magnet when a current is passed through the coil. But, it is almost demagnetized when the current is stopped. The electromagnet is thus a temporary magnet.

The soft iron piece may be straight or U shaped as shown in the figure. Electromagnets are usually made in the horse shoe form. The advantage of the horse shoe form is that both poles are nearer to each other and hence this electromagnet acquires very high magnetic property. Due to this reason large iron bars can be attracted and lifted by these electromagnets.

Uses of Electromagnets

(i) Electromagnets are used in electric instruments such as the electric bell, telegraph, etc. (ii) They are used in cranes for lifting up iron girders to a multi-storeyed building or from shore to ship, (iii) They are also used to remove pieces of iron from debris (iv) Electromagnets are used for making new magnets or remagnetising the old ones.

The Electric Bell



The Electric Bell

Construction

The electric bell consists of an electromagnet M. In front of the poles, there is a soft iron piece A attached to the vibrator and strip having a hammer H at its free end. Here G is the gong of the electric bell. By adjusting screw S, the contact – maker, contact is made with a metal strip fixed to the vibrator. Electrical connections are as shown in the fig.

Working

When the key K (button) is pressed, the circuit is complete and the current flows as shown by arrows in the diagram.

The electromagnet becomes magnetized and attracts the soft iron piece. When the iron piece is attracted, the hammer strikes the gong which

produces the sound. Now the contact between the screw and the connecting iron strip fixed to the vibrator gets automatically broken. When the current stops, the electromagnet gets demagnetized and thereby the soft iron piece is released.

The strip falls back to the original position and makes contact with the contact makers. The circuit is completed again and the above process keeps on repeating, giving rise to the continuous ringing of the bell.

Microphone and Loud Speaker

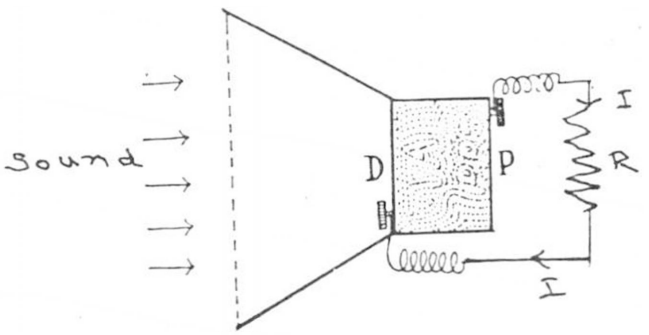
Telephones are used to send and receive messages through electric signals between two stations.

As the electric signals can flow round closed circuit, two live wires are required.

At both the ends of the line, a mouth piece and an ear piece are provided.

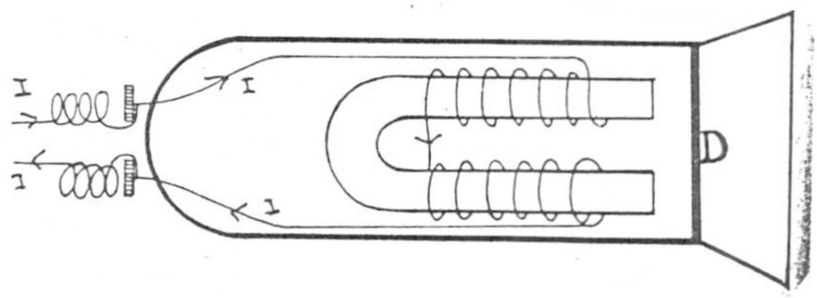
Here, the mouth piece works on the principle of microphone and the ear piece works as a small loud speaker.

Microphone



The microphone consists of a small ebonite box (Fig.). Between the diaphragm D and the thin metal disc P, the space is filled with carbon granules. The leading wires are taken from P and D. When a person speaks before the microphone the diaphragm D vibrates. Due to this vibrations of the diaphragm, the pressure on the carbon granules continuously changes. Due to this pressure variation, the density of the granules changes and the electric resistance between P and D varies and varying electric signals are produced. Thus, sound energy is converted into varying electric signals across R.

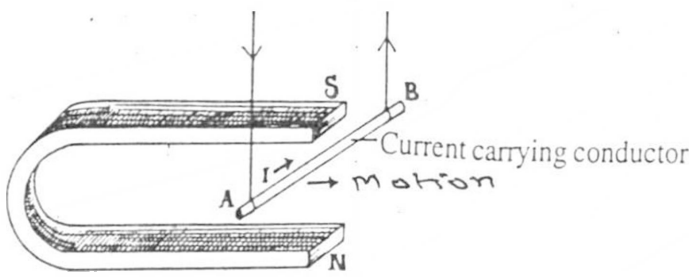
Loud Speaker



The loudspeaker consists of a diaphragm D and an electromagnet.

When the changing electric current flows through the coil of the electromagnet, the magnetic flux changes. Due to the change in the magnetic flux, the diaphragm is set into vibration. Here electrical energy is converted into sound energy. Thus the original sound is reproduced.

Mechanical effect of current

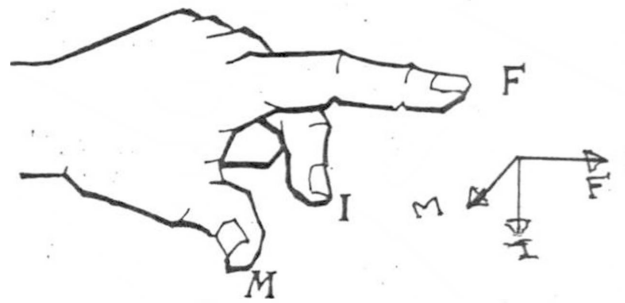


The magnetic effect of an electric current gives rise to the mechanical effect.

When a current carrying conductor is placed in a magnetic field, it experiences a force. If it is free to move, the force produces motion in the conductor. The direction of motion is given by Fleming's left hand rule.

The moving coil galvanometer works on the principle of mechanical effect of current. Using the moving coil galvanometer, strength of the current is measured in a circuit.

Fleming's Left Hand Rule



Fleming's Left Hand Rule

*"Stretch the **Fore finger,** the **(middle**) finger and the **thuMb** of the left hand mutually perpendicular to each other. If the **Forefinger** points in the direction of magnetic **Field** and the **middle finger** points in the direction of the **Current** then the direction of the **thuMb** gives the direction of the **Motion** of the conductor" (force experienced by the conductor).*

However, when the current or the conductor is parallel to the direction of magnetic field, no force is experienced by the conductor.

Electric Motor

An electric motor is a device which converts electrical energy into mechanical energy. It is used to drive a mixi, grinder, printing press, sewing machine, fan, etc.

Construction :

It consists of the following parts :

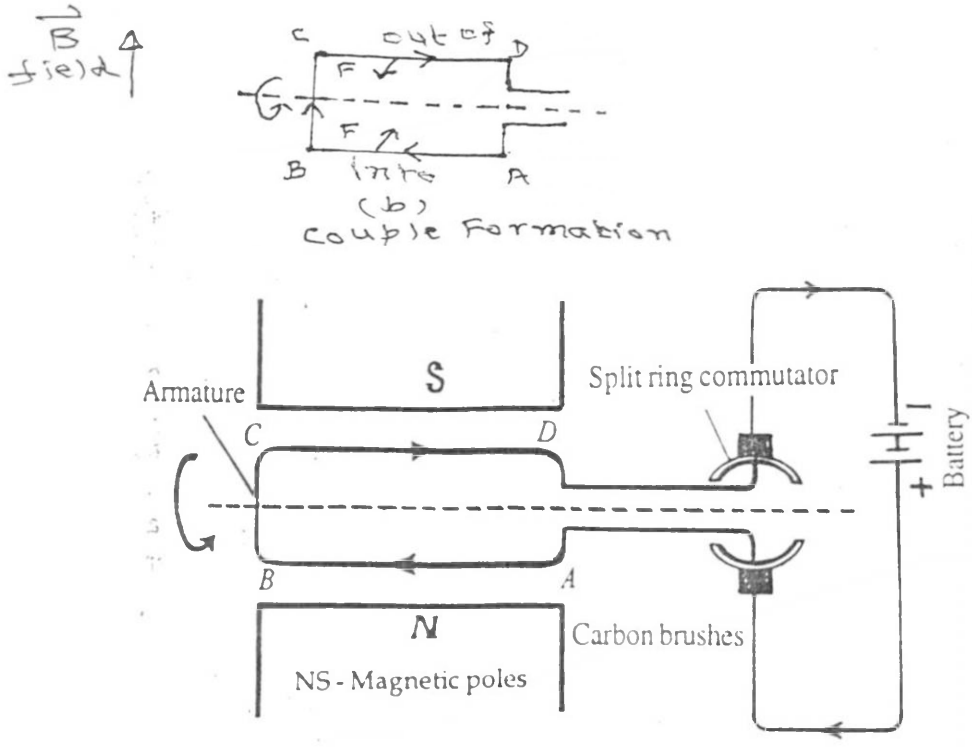
i) **Armature :** An armature which is a rectangular coil ABCD is capable of rotation about an axis in its plane (Fig).

ii) **Field magnet:** The field magnet offers a very strong magnetic field.

iii) **Commutator:** It is a split copper ring.

iv) **Fixed carbon brushes :** These fixed carbon brushes are always in contact with the commutator and press against it.

v) **Battery :** Through this battery, current flows to the coil.



An Electric Motor

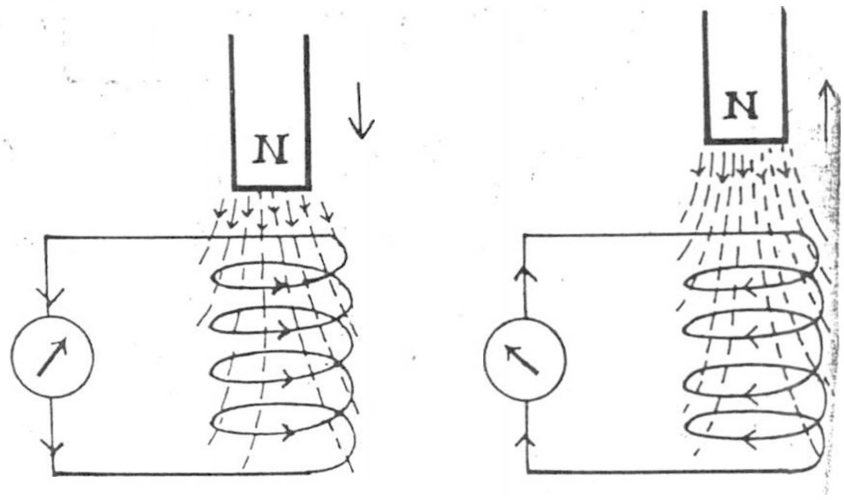
Principle

It works under the principle that a current carrying conductor experiences a force when placed in a magnetic field.

Working

When a direct current is passed in the coil through the brushes, a force acts on each arm of the coil. The direction of the force is given by Fleming's left hand rule. Since the current in the two arms AB and CD are equal and opposite a couple is set up. This couple rotates the coil.

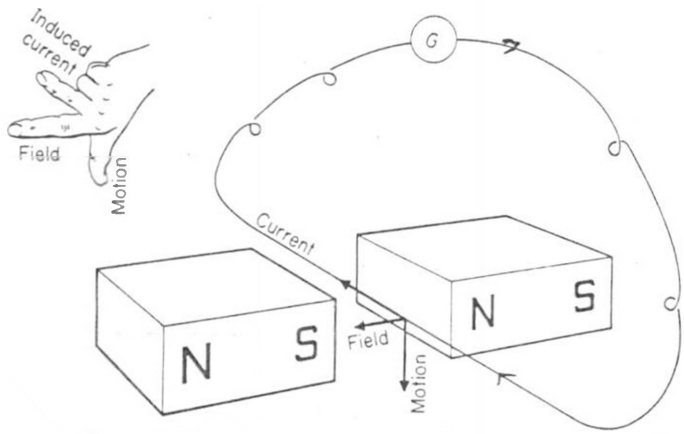
Electromagnetic Induction



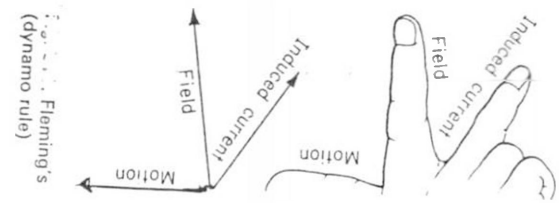
Whenever a magnet is moved through a coil, magnetic lines of force due to the magnet are cut by the coil. This induces a current in the coil. This is known as *induced current*. This process of producing induced current is called *electromagnetic induction*.

Faraday's Experiments on Induced Current

In one of his experiments, Faraday showed that a current was induced in a straight wire when it was moved at right angles to the magnetic field lines due to a bar magnet.



. Current induced in a wire moving at right angles to a magnetic field



. Fleming's (dynamo rule)

Fleming's right hand rule

A center-zero galvanometer G is connected to the ends of a straight wire placed at right angles to the magnetic field lines between two opposite poles of a bar magnet as shown in the figure. If the wire is moved downwards the galvanometer indicates that an induced current flows in a direction as shown in the figure. When the wire is moved upwards, the direction of the induced current is reversed.

Faraday also showed that no current is induced in the wire when it moves parallel to the magnetic field lines of the bar magnet. Whatever may be the direction of the magnetic field, no current is induced in the wire if the wire moves parallel to itself or if the wire is at rest.

The direction of the induced current is stated by Fleming's right-hand rule (dynamo rule).

Fleming's right hand rule

Stretch the thuMb, the Forefinger and the mIddle finger of the right hand mutually perpendicular to each other. If the ***thuMb*** *represents the*

*direction of **Motion** of the conductor, the **Forefinger** represents the direction of the **magnetic Field**, then the **middle finger** represents the direction of the **induced current**.*

A.C. Dynamo

The main parts of an A.C. dynamo are

i) Field magnet

ii) Armature

iii) Slip rings

iv) Carbon brushes

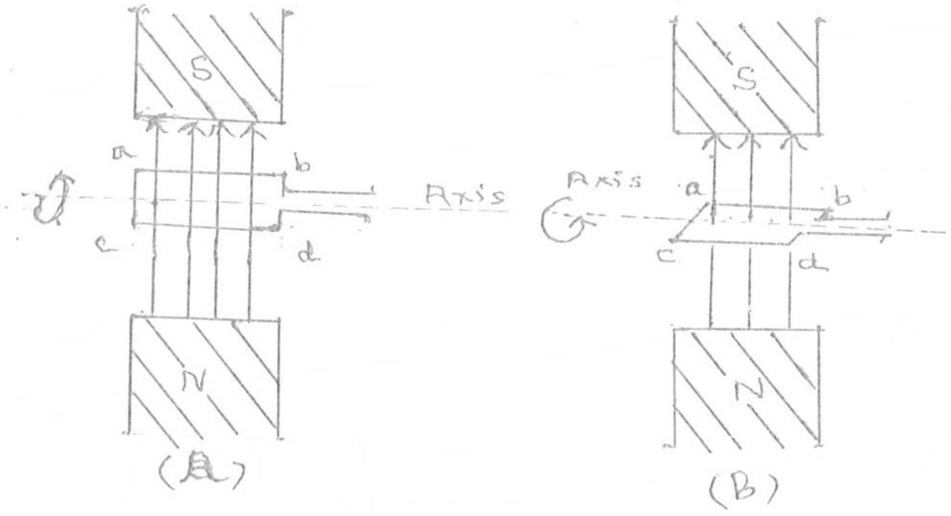
An AC generator consists of a rectangular coil of wire ABCD wound over a soft iron cylinder. This arrangement is called armature.

It is mounted between the poles of an electromagnet (field magnet) such that its axis of rotation is perpendicular to the magnetic field. The ends of the coil are connected to the slip rings S_1 and S_2 which rotate along with the coil. Two brushes B_1 and B_2 made of carbon separately touch the slip rings. Current flows to the outer circuit through these brushes.

Working

Let the coil be rotated continuously about an axis perpendicular to the direction of the magnetic field. Hence, the magnetic lines of force due to the magnet are cut by the coil.

If the coil is rotated in the anti-clockwise direction continuously, there is a continuous change in the magnetic lines of force cut. Hence an alternating current of a varying emf is induced in the coil.



When the coil starts rotating the plane of the coil will be parallel to that of the lines of force and so it cuts few lines. (A)

After it rotates by 90° the plane of the coil will be perpendicular to that of the lines of force. At this position when it rotates it will cut more number of lines of force because its direction of motion will be at right angles to that of the lines of force (Fig. B). The current will be more in the second case than in the first case.

When it rotates further by 90° it will come back to the initial position and further motion will be in opposite direction.

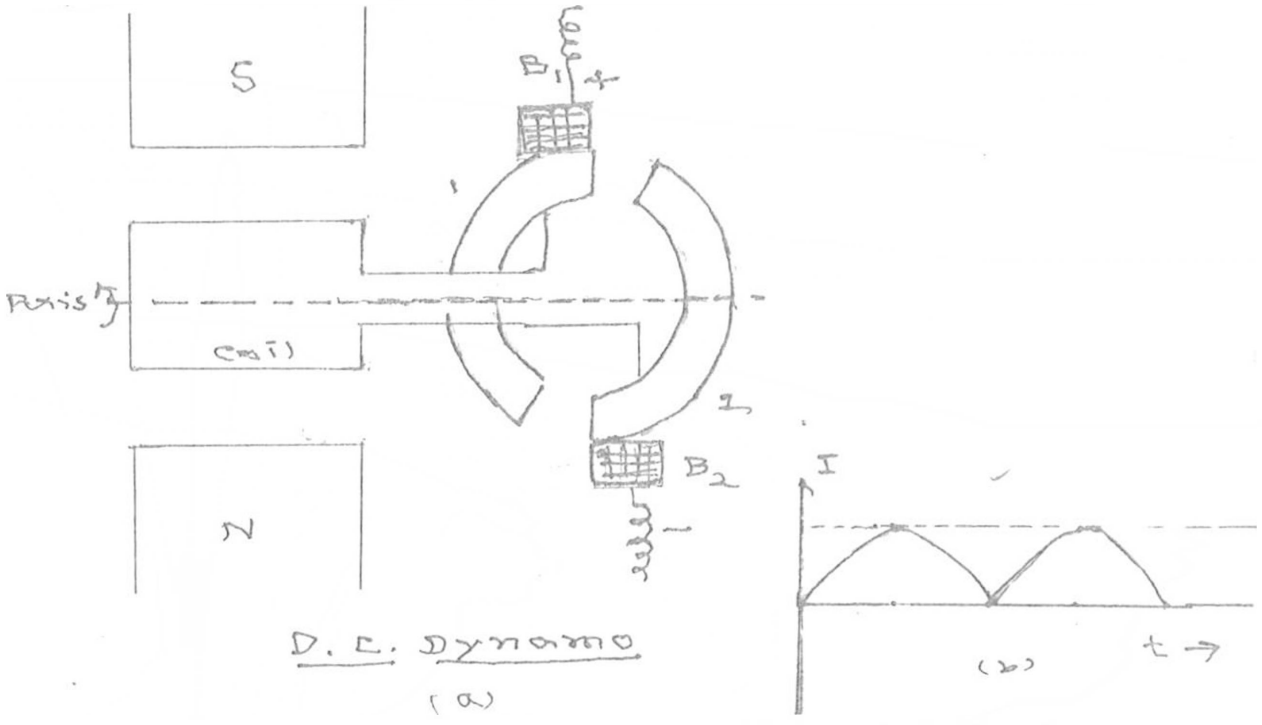
During the first half of the rotation, it gives a current in one direction. And during the second half of the rotation, it gives a current in the opposite direction. The current thus produced will be in the form of sine curve as shown in figure. The direction of the induced current is given by Fleming's right hand rule.

D.C. Dynamo or D.C. generator

In the case of an A.C. dynamo the current changes its direction at regular intervals. But in the D.C. generator, the current flows in the same direction.

A D.C. dynamo is similar to an A.C. dynamo in construction. But in the D.C. dynamo the slip rings are replaced by split ring commutator arrangement. This commutator arrangement converts A.C. to D.C.

Split rings are semi circular in shape. They are attached to the ends of the coil as shown in diagram (a). The brushes B_1 and B_2 have fixed position.



Initially split ring 1 carrying positive current is in contact with carbon brush B_1 and split ring 2 carrying negative current is in contact with B_2.

After rotating through 180° split ring 1 will carry negative current and split ring 2 will carry positive current. But at this point of the time split ring 1 will lose contact with B_1 and will come into contact with B_2 split ring 2 will come into contact with B_1. Thus brush B_1 will always be positive similarly brush B_2 will always remain negative. Thus a.c. is converted into d.c. and current will always be in positive half as shown in the figure(b).

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TRAINING PACKAGE ON HARDSPOTS IN X STD SCIENCE (CHEMISTRY) OF TAMIL NADU

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General discussion

1. Conceptual mistakes have been rectified in this supplementary material.
2. Some of less important grammatical mistakes are ignored.
3. Additional information beyond the scope of the text book is not included.
4. The following observations have to be incorporated in general throughout the chemistry section.
   a) 18 groups long form of the periodic table
      Eg: IIIA group to be taken as 13A
   b) Electronic configurations upto first 18 elements can be given in the s,p,d,f notation. This facilitates the discussion on s,p,d and f blocks. Beyond the 18th element, the valence electrons may be shown preceeded by the noble gas configuration.
      Eg: Bromine Atomic No.35 [Ar] $3d^{10}\ 4S^2\ 4p^5$
      This will avoid an explanation arising out of Aufbau principle.
5. Atomic masses and atomic numbers denoted along with the element is better represented on the same side of the symbol
   Eg: $^{35}_{17}Cl$
6. Conditions of the reactions are given wherever found necessary.
7. The title 'Basic concepts' in each unit can be indicated as 'Summary'.
8. Teacher may note the faulty diagrams particularly in respect of discharge tube, (Page No.143) Rutherford's experiment (page 145),Lab preparation of ethylene (page No. 217) and provide appropriate diagrams while teaching.
9. While naming some compounds, unnecessary spaces are provided, which may be corrected by the teacher.
   Eg: Carbon di Oxide is correctd as carbon dioxide.
10. Where there is only one example is given, at least one or two more simple examples may be provided in the summary or additional information sections if not in the body of the text.
11. The plate given probably referring to chemistry on the cover page is fictitious.

Atomic Structure

John Dalton did pioneering work on the Atomic structure. According to Dalton's atomic theory matter is made up of extremely small particles called atoms. Atoms were supposed to be indivisible till sub atomic particles were discovered.

10.1 Electrical nature of matter

A glass rod on rubbing with silk acquires positive charge. Similarly, an ebonite rod on rubbing with fur acquires negative charge. Metals are good conductors of electricity. Many salt solutions also conduct electricity and are called electrolytes. These observations made scientists think that matter is electrical. Discharge of electricity through gases confirmed this and led to the discovery of negatively charged electron and positively charged protons.

Electric discharge through gases under reduced pressure (J.J Thomson's experiment)

A discharge tube is a glass tube containing two electrodes and an outlet to be connected to a vacuum pump. The gas (air) taken in the discharge tube will not conduct electricity at ordinary pressure and temperature. However, by decreasing the pressure to 0.01 mm. of Mercury and applying a high Voltage of about 10,000 V, a beam of rays are produced. The rays originate from the cathode and more towards the anode. These rays were called Cathode rays (Fig.10.2 (i)).

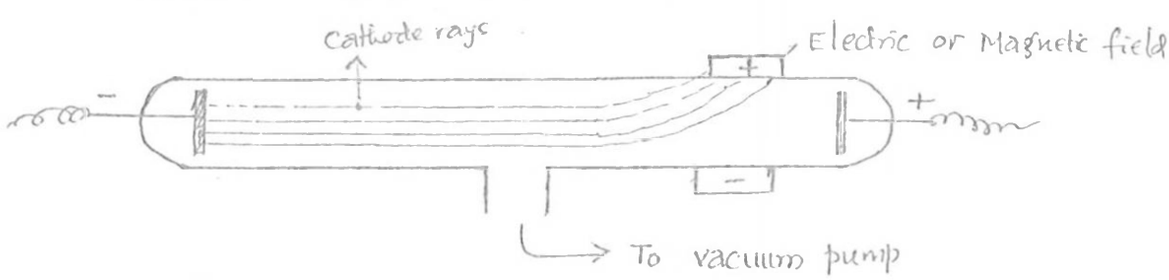


Fig.10.2(i)

Under the influence of applied electric or magnetic field the Cathode rays bend towards positive electrode showing that they are negatively charged. The Cathode ray particles are called electrons.

Goldstein used a perforated Cathode in the discharge tube and found that some rays start from anode and pass through the holes in the cathode. These rays are known as positive rays or anode rays (canal rays) (Fig.10.2(ii)).

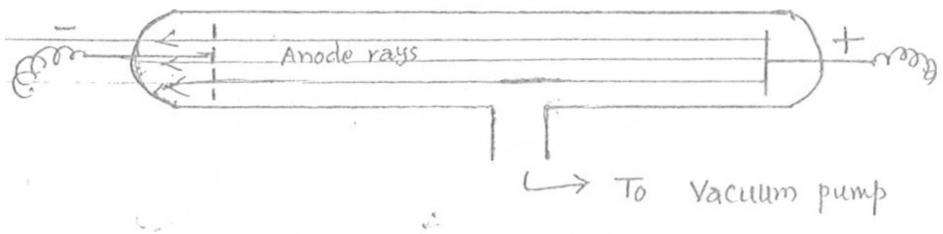


Fig.10.2(ii) Production of anode rays

Anode rays consist of positively charged particles. If hydrogen gas is used in the discharge tube the positive particles emitted are called 'protons'.

10.2 Cathode rays and Anode rays

Properties of Cathode rays

(i) Cathode rays consist of negatively charged particles called electrons.

(ii) They travel in straight lines.

(iii) They are deflected by magnetic and electric fields like negative particles. This proves that the particles are negatively charged.

(iv) They are material particles and possess momentum and kinetic energy. Hence, they rotate a small paddle wheel kept on their path.

(v) They produce a glow when they strike the walls of the glass tube coated with zinc sulphide.

Properties of anode rays:

(i) Anode rays consist of positively charged particles.

(ii) They travel in straight lines in a direction opposite to that of cathode rays.

(iii) They are deflected in electric and magnetic fields in a direction opposite to that of the cathode rays. Hence they are positively charged.

(iv) They are material particles having momentum and kinetic energy, hence they rotate a small paddle wheel kept on their path.

(v) They produce a glow on zinc sulphide screen.

The charge of a proton and charge of an electron are equal magnitude but opposite in sign. An atom is electrically neutral and hence the atom must contain equal number of protons and electrons.

Chadwick discovered later another subatomic particle called neutron. A neutron is an electrically neutral particle (no charge) with a mass almost the same as that of a proton.

10.4 Evidence for the existence of nucleus:

Earnest Rutherford proved by his scattering experiment that a heavy nucleus is present at the centre of the atom and it consists of positively charged particles.

10.5 Rutherfords' experiment on scattering of alpha particles:

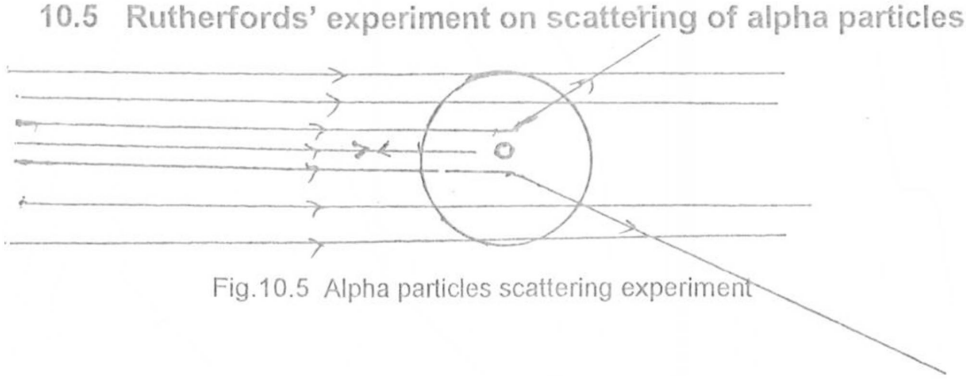


Fig.10.5 Alpha particles scattering experiment

Rutherford bombarded thin foil of gold with high velocity alpha particles. The alpha particles have a charge of +2 units and mass of 4 units. The alpha particles after striking the atoms in the gold foil, led to the following observations and conclusions.

1. Most of the alpha particles pass through the foil straight. This led to the conclusion that most of the space in the atom is empty.
2. A few alpha particles are deflected through large angles. This must be due to the repulsion between alpha particles and protons within the atom.
3. Very few alpha particles were deflected back through 180° . Rutherford concluded that this must be due to the presence of heavier particles in a very small region.

Rutherford described that in an atom at the centre all the protons and neutrons of the atom will be present. The central portion was called 'nucleus' of an atom. The electrons were supposed to be revolving round the nucleus.

Mass and charge of the sub atomic particles

Particle	**Relative mass**	**Relative charge**
Proton	1 (equal to a hydrogen atom)	+1
Neutron	1 (-do-)	0
Electron	$1/1840^{th}$ of Hydrogen atom	-1

The average size of an atom is approximately 10^{-8} cm and that of a nucleus is about 10^{-12} cm. The electrons have a negligible mass and the nucleus has all the mass.

10.7 Composition of atomic nucleus:

Electrons have very little mass. Hence the entire mass of the atom is due to the nucleus. Therefore nucleus contains the particles with mass, namely protons and neutrons.

10.8 Location of electrons, protons and neutrons in atom:

1. Protons and neutrons are located inside the nucleus at the center of the atom.
2. According to Neils Bohr, electrons revolve around the nucleus in definite circular paths called orbits or shells or energy levels.
3. Starting from the nucleus, the shells are denoted as K,L,M,N,O, P etc. The numbers for the energy levels are given as n=1,2,3,4,5,6 respectively.
4. According to Bohr-Bury principle, the maximum number of electrons that can be present in any energy level (n) is given by the formula $2n^2$.

Energy level		Maximum number of $\bar{e}$s
K	n=1	$2 \times 1^2 = 2$
L	n=2	$2 \times 2^2 = 2 \times 4 = 8$
M	n=3	$2 \times 3^2 = 2 \times 9 = 18$
N	n=4	$2 \times 4^2 = 2 \times 16 = 32$
O	n=5	$2 \times 5^2 = 2 \times 25 = 50$

5. Each shell is made up of sub shells or sub energy levels called s,p,d,f. They can have maximum 2,6,10,14 electrons respectively.

6. The outermost shell of an atom is called valence shell. The electrons present in the valence shell are called valence electrons. These electrons are responsible for chemical bonding. They determine the valency or combining capacity of the element.

Diagramatic reprsentation of atom model:

Examples:

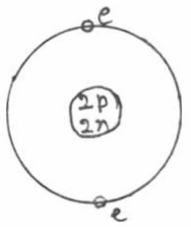
1. **Helium:**

number of protons = 2

number of electrons = 2

number of neutrons = 2

electronic configuration [2] or $1s^2$



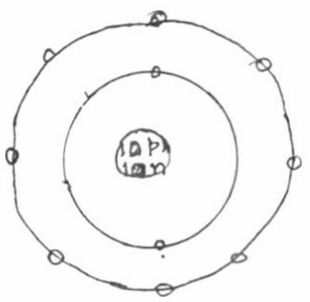
2. **Neon:**

number of protons = 10

number of electrons = 10

number of neutrons = 10

electronic configuration [2,8] or $1s^2 2s^2 2p^6$



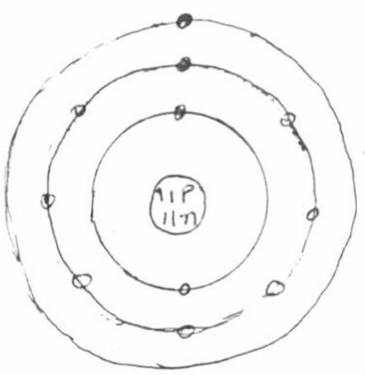
3. **Sodium:**

number of protons = 11

number of electrons = 11

number of neutrons = 12

electronic configuration [2,8,1] or $1s^2\ 2s^2\ 2p^6\ 3s^1$



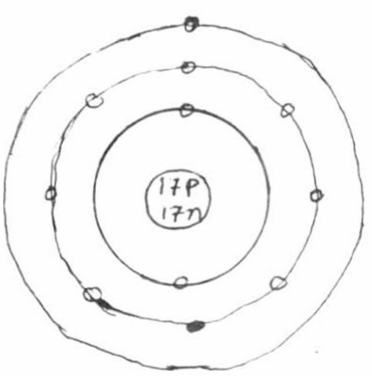
4. **Chlorine:**

number of protons = 17

number of electrons = 17

number of neutrons = 18

electronic configuration [2,8,7] or $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^5$



10.9 Atomic number, Mass number and Isotopes:

Atomic number (Z)

Atomic number of an element is equal to the number of protons present in the nucleus of its atom. It is denoted by the symbol Z. It is also equal to the number of electrons in the atom.

Atomic number (Z)= Number of protons = Number of electrons

Mass number (A):

Mass number is the total number of protons and neutrons present in the nucleus of an atom. It is denoted by the symbol A.

Mass number = Number of protons + Number of neutrons
(A) (Z) (n)

(Number of proton is atomic number Z)

Number of neutrons = Mass number - atomic number
n (A - Z)

The nuclear composition of an atom is usually represented as $^{A}_{Z}X$. The mass number A is written at the top and the atomic number Z at the bottom.

Example : Sodium has atomic number = 11 and mass number = 23.

It is denoted as $^{23}_{11}Na$.

No. of protons = No. of electrons = atomic number = 11.

No. of neutrons = Mass number – Atomic number = 23-11=12.

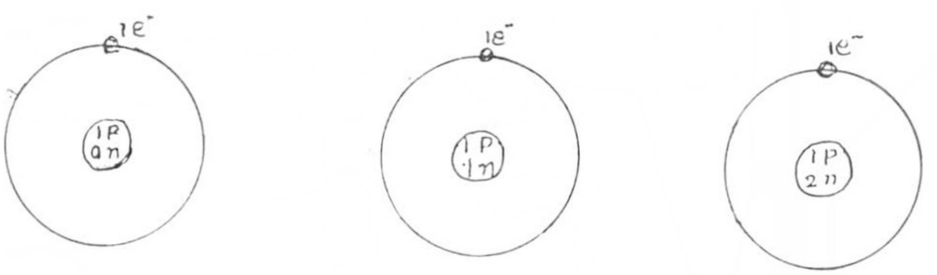
Isotopes:

Atoms of the same element with the same atomic number but different mass numbers are called isotopes.

Same atomic number implies that isotopes have the same number of protons and same number of electrons. Hence, isotopes differ only in the number of neutrons.

There are 3 isotopes of hydrogen with mass numbers 1,2,3 respectively. They are represented as follows:

${}^{1}_{1}H$	${}^{2}_{1}D$	${}^{3}_{1}T$
Protium	Deuterium	Tritium
(ordinary hydrogen)	(heavy hydrogen)	(Radioactive hydrogen)
1 proton	1 proton	1 proton
1 electron	1 electron	1 electron
(1-1)=0 neutron	(2-1) = 1 neutron	(3-1) = 2 neutrons



They are also denoted as ${}_1H^1$, ${}_1H^2$, ${}_1H^3$ respectively.

As the isotopes of an element have the same number of electrons, they have similar chemical properties. But as the mass number is different they differ in physical properties.

${}^{1}_{1}H$ (protium) combines with oxygen to form water (H_2O). Similarly ${}^{2}_{1}D$ (deuterium) combines with oxygen to form D_2O called heavy water. It has slightly higher boiling point and higher density that ordinary water. Protium and deuterium are stable but tritium nucleus is unstable (radio active)

The isotopes of Uranium are ${}^{233}_{92}U$, ${}^{234}_{92}U$, ${}^{235}_{92}U$, ${}^{236}_{92}U$

TOPIC: PERIODIC CLASSIFICATION OF ELEMENTS

UNIT: 9

Page Number : 129

Line Number : 1

Hard spot : Number of elements known from time to time.

Teachers may equip themselves with upto-date information through journals or internet.

Page Number : 129

Line Number : 2 and 3

Hard spot : Second and third sentences.

Remedy : Elements have similar as well as dissimilar properties. So elements with similar properties are grouped.

Page Number : 130

Line Number : 5

Hard spot : Newland classification of all known elements not given.

Remedy : The sentence may be changed as follows.

An example for Newland's classification of elements is as follows.

Or

The following table can be provided.

H 1.008	19F 19	Cl 35.5	Co and Ni 59 58.7
Li 6.9	Na 23	K 39.1	Cu 63.54
Be 9	Mg 24.3	Ca 40	Zn 65.4
B 10.8	Al 27	Cr 52	Y 68.9
C 12	Si 28	Ti 47.9	In 114.8
N 14	P 30.9	Mn 54.9	As 74.9
O 16	S 32	Fe 55.8	Sc 44.95

Page No : 130

Hard spot : Second line of 9.2 sub unit.

Remedy : Elements with similar properties

(Instead of similar elements)

Page No : 130

Line numbers : 25 to 29 (Last paragraph)

Correct : Mendeleef predicted the properties of elements not known at his time and left blank spaces for them. Elements discovered later were placed in appropriate places. Ex: Scandium, Gallium and germanium.

Page No : 131

Suggestion : Teacher may use charts (periodic table chart) showing atomic weights and atomic numbers of elements.

Page No : 132

Line number : 8

Correction : The sentence – ' The long Bohr's form of the periodic table' is corrected as –'The long form of the periodic table.

Page No : 133

Line no : 9

Instead of the word 'inert gases', the word 'Noble gases' is more appropriate and the same word should be used wherever applicable.

Page No : 133

Line No : 10

Correction : This sentence should be

The lanthanides and actinides are placed separately below the main body of periodic table.

Page No : 133

Last paragraph

Instead of the word electro positive, the word electro postivity should be used.

Page No : 134

Line No : 5 (Note)

Instead of the sentence 'the electron can be easily lost', 'electron can be easily removed' is more appropriate.

Page No : 134 and 135

Suggestion : Electro negativity values should be included along with atomic sizes in the examples.

Eg:- Halogens

VIII A	Size (A^0)	Electro negativity
F	0.72	4.0
Cl	0.99	3.0
Br	1.14	2.8
I	1.33	2.5

Page No 135:

Additional information.

Atomic Size:- It is the distance between the centre of the nucleus and the electron present in the valence shell.

Atomic size decreases along the period and increases down the group.

Page No : 136

Last paragraph:

Clarification : Valency is the 'combining capacity of an element' and it is not a 'measure of combining capacity'.

Page No : 137

Suggestion : Some examples may be given as follows:

Element	Valency
H	1
Na	1
Cl	1
O	2
N	3
C	4

Page 137:

Line – 9 onwards

Suggested sentences: Generally the group number (from 1 to 13) or 18 minus the group number (from 14 to 18) gives the common valency of the elements.

Eg:- Element hydrogen present in the group 1 has the valency 1 and the element oxygen present in the group-16 has the valency 18 minus 16, i.e., the valency is '2'.

Page No : 139

Remedy : Unit 9 and unit 10 should be interchanged.

Page No : 140

Question No 32 & 37

It may be rewritten as follows.

32) Mention the physical states of VII A group elements.

33) Discuss the trends down a group in modern periodic table.

Page No : 141

Point : 3

Definition for Ionization energy:- It is the energy required to remove the valance electron from the gaseous neutral atom.

Point 4

Correct definition for Electron affinity:- It is the energy released when an electron is added to a neutral gaseous atom.

TOPIC: CHEMICAL BONDING

UNIT NUMBER: 11 (Eleven)

Page No : 157

Line No : 2

Instead of the word 'linkage' the word 'force' is more appropriate.

Page No: 157

Line : 15

Instead of the word 'bondages', the word 'bonding' is more appropriate.

Page No : 158

Line No's : 2 and 3 – change of sentence

An electrovalent bond is formed by the complete transference of one or more electrons from the valence shell of an electro/positive element to the valence shell of an electronegative element.

Page No: 158

Line No : 18

Instead of the word 'inert gas', the word ' noble gas' should be substituted. The same to be followed wherever applicable.

Page No: 162

Line No : 10

Electronic configuration of hydrogen atom should be written as $1S^1$. (instead of 1)

Page No : 162

Line No : 12

Hydrogen atom gets electronic configuration of helium (not as helium structure)

Page No : 163

Hard spot : Molecular structures suggested contradict the orbital participation and the geometry of the compound.

Remedy : This can be avoided by taking simpler examples for single, double and triple covalent bonds as follows.

Eg: 3 Oxygen molecule (O_2)

Electronic

Configuration

$1S^2\ 2S^2\ 2P^4$

Eg: 4 Nitrogen molecule (N_2)

Electronic

Configuration

$1S^2\ 2S^2\ 2P^3$

Page No : 164

Line No : 3

Hard spot : $H_3N \longrightarrow BF_3$

Remedy: BF_3 is not a common example. Therefore H^+ can be used as a simpler acceptor species to begin with. Later BF_3 cab be considered as an example.

$NH_3 + H^+ \rightarrow NH_4^+$ (Ammonium ion) $H^+ \leftarrow NH_3$

Page No: 164

A comparative study.

Item No: 2,3 and 4 are misleading.

Electrovalent compounds	Covalent compounds
Ions are held to each other by strong electrostatic force of attraction. Hence, they possess high melting and boiling points.	Comparatively atoms are held to each other by slightly weak forces. Hence they possess low melting and boiling points.
They are crystalline solids. Eg: NaCl, $MgCl_2$, $CuSO_4$, etc.	Generally solids, liquids and gases at room temperature Eg: CH_4, CCl_4 , urea.

Item No : 1

For covalent compounds H_2 stands as simple example instead of CH_4.

Page No : 167

Line No. 12

Correction : item : additional information. Caesium is the most electro positive element known Fluorine is the most electronegative element known. So ionic character in caesium fluoride is maximum. This information can be given.

TOPIC : PHOSPHORUS

UNIT NO. 12

Page No: 168

Line No : 04

White phosphorous glows in dark, but not the red phosphorus. This should be noted.

Page No: 170

Item 12.2 Allotropes of phosphorous

Instead of 'same chemical properties', words 'similar chemical properties' is more appropriate.

Page No: 171

Item 12.3 properties and uses of phosphorus.

Point 3 : Instead of 'This glow is called phosphorescence', ' This phenomenon is called phosphorescence' is correct.

Line no.8 "Physical properties of white phosphorus" instead of "Physical properties"

Page No. 172

Line No. 3

Other product formed in this reaction is sodium hypo-phosphite. This information should be included.

Page No. 174

Question No: 12

Instead of 'state allotropy', define allotropy should be used.

Spelling for the word 'phorphorous' is wrong throughout this topic. It should be written as 'phosphorus'.

TOPIC : HALOGENS

Unit No. 13

Page No: 176

Item 13.1 Electronic configuration.

Electronic configuration given in this table in the text book is confusing. Instead of this notation, it may be represented in terms of noble gas configuration as follows.

Element	At.No	Electronic configuration
F	9	[He] $2S^2 2P^5$
Cl	17	[Ne] $3S^2 3P^5$
Br	35	[Ar] $3d^{10}\ 4S^2\ 4P^5$
I	43	[Kr] $4d^{10}\ 5S^2\ 5P^5$

Page No: 177

Item (iii) physical properties

Since, the physical states mentioned in this table are true at room temperature, this condition should be clearly mentioned to avoid confusion.

Page No: 177

Item: Action with hydrogen.

The reaction of halogens with hydrogen decreases in the following order.

$$F > Cl > Br > I$$

Iodine combines with hydrogen in the presence of heated platinum catalyst.

Page No : 178

Item (Vi) Displacement reactions.

Electronegativity data for halogens should be provided for clear understanding of the concept.

The sentence, 'The more reactive halogen displaces less reactive halogen' should be modified as-

The more reactive halogen displaces less reactive halogen from its salt solution.

Element	Electro negativity
F	4.0
Cl	3.0
Br	2.8
I	2.5

Instead of the word 'liberates', the word **'displaces'** would be more appropriate in displacement reactions.

Additional information:

The data about astatine is missing in the text book. This could be justified by the teachers by informing the students about the relative low abundance of the elements and difficulties in handling since it is radio active. However, the element is supposed to have similar chemical properties.

Page No : 180

Item: Bleaching action of Chlorine

Instead of the sentence **'It is very powerful'**, **'Nascent oxygen is very powerful'** is appropriate.

Page No : 183

Line no: 6

The composition of aqua regia should be Conc HCl: Conc HNO_3 in the ratio of 3:1 by volume.

Page No: 183

Item: Tests for chloride (Test 2)

In the observation of third test it is given that chlorine gas bleaches moist leaves. However, this can be extended to any vegetable coloured and flowers also.

Page No: 184

Item : Preparation of bleaching powder.

Correct representation of molecular formula of bleaching powder is $CaOCl_2$ or Ca(Cl) OCl. The name is Calcium Oxychloride.

UNIT 14

METALS

3rd difference: Metals are good conductors of heat and electricity instead of good conductor of electricity. Non metals are bad conductor of heat and electricity

Page No : 189

Last line : Instead of the word 'plate' use the word 'sheets'.

Page No : 190

Definition for metallurgy & some basic terms are not included. This should be considered.

1) Metallurgy :- The process of obtaining a metal in its pure form from its ore is called Metallurgy.
2) Gangue:- Earthy impurities like clay, sand etc present along with the metallic compound in the ore.
3) Flux:- It is a substance which is added to the ore to remove the earthy impurties in the form of slag. Eg: Limestone.
4) Slag:- Slag is the substance formed when flux reacts with gangue.

Page 190

Hard spots: General steps in metallurgy

They are,

1) Ore concentration
2) Calcination (heating the concentrated ore in the absence of air) Or Roasting (heating the concentrated ore in excess of air).
3) Smelting / Roasting (Reduction of the ore)
4) Refining (Purification of the impure metal)

Page No 191:

The term electronic configuration should be used in place of electronic arrangement.

Electronic configuration of aluminum is $1S^2\ 2S^2\ 2P^6\ 3S^2\ 3P^1$.

Page No 191 :

Item: 14.2.1. (III-Point)

Correct Spellings for Felspar is Feldspar.

Page No 191:

Item : Diagram

In the diagram, instead of 'molten mixture of the ore', the labellling should be. ' molten mixture of the ore +cryolite'

Page No 192:-

Hard spot: Role of cryolite and graphite powder not mentioned.

Remedy:

1) Role of cryolite:

   Al_2O_3 is a bad conductor of electricity. Hence it is dissolved in molten cryolite, to increase the conductivity.

2) Role of graphite powder

   i) To prevent the burning of anode rods.

   ii) To prevent the loss of electrolyte by evaporation.

Page No: 193

Line No : 2

The word '***gives out'*** should be corrected as 'liberates'.

Page No: 193

Item: Reaction with acids (Point-c)

Correction: Aluminium does not react with conc-nitric acid, but it reacts with dilute nitric acid to form aluminium nitrate and ammonium nitrate.

Page No: 194

Item No: 14.2.5. (I use & II Use)

Correction: Magnalium is used to make parts of balances and machines. Duralluminium should be corrected as Duralumin.

Page No: 196

(Hard spot)

Item: Reduction of iron (iii) oxide to iron.

The simple reaction can be given as follows.

$$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2 \uparrow$$

Page No : 197

Hard spot: Name of Fe_3O_4.

Fe_3O_4 is named as magnetic oxide or ferroso ferric oxide.

Page No: 201

Correction:

$$2\ NaCl \rightarrow 2Na + Cl_2$$ is wrong.

It may be corrected as,

$$NaCl \rightarrow Na^+ + Cl^-$$

At cathode; $Na^+ + e^- \rightarrow Na$.

At anode; $Cl^- - e^- \rightarrow Cl$

$$Cl + Cl \rightarrow Cl_2 \uparrow$$

$$2Na + 2H_2O \rightarrow 2NaOH + H_2 \uparrow.$$

UNIT 15

ORGANIC CHMISTRY

Page No: 211

Item: Differences between Organic and Inorganic compounds.

In this table some defects are found which may be rectified as follows.

1) Organic compounds are formed mainly from carbon with H, O, N, S, P or halogens.

   It should be noted that exceptions have to be pointed out both in the case of isomerism & ploymerisation. All these discussions should be dealt in general way. (as there are exceptions for each statement).

   However, it is suggested to discuss this item at the end of the unit.

Page No: 215

Hard spot : Definition for substitution reaction.

Definition: A reaction in which an atom or a group of atoms of a compound is replaced by another atom or a group of atoms.

Page No: 216

Item: Unsaturated hydrocarbons.

The appropriate definition for alkenes is, 'the unsaturated hydrocarbons containing one carbon carbon double bond' are called alkenes or olefins.

The correct definition for alkynes is, 'the unsaturated hydrocarbons containing one carbon carbon triple bond are called alkynes.

Page No: 218

Item: Combustion (chemical properties)

Correction: Since ethylene is an aliphatic compound, it burns with non smoky flame.

Page No: 218

Hard spot: Addition reaction

Addition reactions are characteristic of unsaturated compounds. They can be converted to saturated compounds by the addition reactions.

Page No: 218

Item : Addition of bromine

Correction : Color of bromine is reddish brown.

Page No: 219

Item: Polymerisation (Hard spot).

More appropriate definition for polymerisation is, 'It is a reaction in which simple molecules are linked together to form a large molecule of high molecular mass'.

Some more examples for polymers may be given.

Eg: Bakelite, Nylon, Terylene etc.

Page No: 219

Item: Uses of ethylene.

Correction: Ethylene is used for artificial ripening of fruits.

Page No: 220

Item: uses of acetylene

It is given that vinyl acetylene is used in preparing artificial rubber. It is incorrect & hence it should be removed.

Page No: 221.

Item: Formation of ethyl alcohol.

Addition: Molasses is the mother liquor left behind after the crystallization of sugar from sugar cane juice.

Additional informations like maintaining of acidic medium and addition of ammonium sulphate as food for yeast should be given.

Page No: 222

Line No: 1

Suggestion: The percentage of ethyl alcohol in fermented liquor which is called as wash should be mentioned as 10%.

Correction: (III para) : Instead of the word 'unfit', the word 'unsuitable' is to be used. Methylated spirit is also called denatured alcohol which may be included.

TOPIC: CHEMICAL INDUSTRY

UNIT NO:16

Page No: 227

Item: Petroleum industry (16.1)

Instead of the sentence , the decomposition of plants and animal remains buried inside the earth, the sentence 'the decomposition of plant and animal remains buried inside the earth for a long time' is correct.

Page No. 229

Item: Petrochemicals

Formaldehyde is a gas at room temperature and as such it is not used to preserve biological specimens. A 40% aqueous solution of formaldehyde called '**formalin'** is used as preservative.

Page No: 231

Item: Manufacture of soap (hot process)

Vegetable oil **or** fat and 10% sodium hydroxide solution is correct.

Page No: 231

Item: Detergents

Hard spots: Definition for detergents not given

Definition for detergents

Detergents are derivatives of sodium alkyl benzene sulphonates. They have the formula, $RC_6H_4SO_3Na$

Where R is an alkyl group.

General formula of soap is RCOONa

Page No: 235

Item: Prevention methods

Point: 3

It should be – By adding harmless, biodegradable microorganisms to decompose the organic wastes and toxic materials.

Page No: 235

Item: Soil pollution-prevention methods

Point No.1

Judicial use of insecticides and fertilizers is more appropriate.

Page No: 236

Item: Some basic concepts

Point No.8

Instead of 'composition of match head', the composition of match sticks head is correct.

Page No: 237

Item: II chose the correct answer.

It is 'the essential nutrient of the plants is'

Page No: 238

Item: Answer in detail

Question No. 29

Question may be asked in this way

Discuss the steps involved in the soap manufacture.

TRAINING PACKAGE ON HARDSPOTS IN X STD SCIENCE (BIOLOGY) OF TAMIL NADU

Programme Coordinator

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DEVELOPMENT OF TRAINING PACKAGE ON HARDSPOTS IN X STD SCIENCE BIOLOGY OF TAMIL NADU (II PHASE)

Unit : 17 Page No : 240, Prokaryotes and Eukaryotes

Based on cellular organization, two different kinds of organisms are identified. They are Prokaryotes and Eukaryotes.

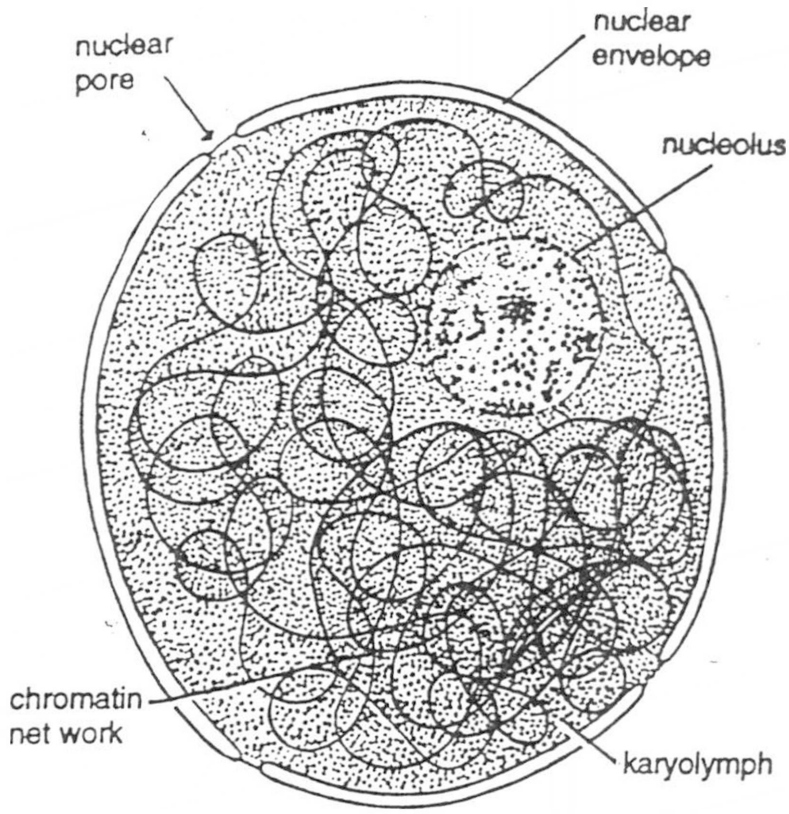
A Prokaryote is an organism without well organized nucleus. These organisms have incipient (primitive) nucleus. Incipient nucleus is one which lacks Nucleolus and Nuclear membrane.

Ex : Bacteria and Blue-green algae.

Eukaryote is an organism with a definite nucleus having nuclear membrane, nucleolus, nucleoplasm and chromatin network.

Ex : Higher plants and animals.

2. **Unit No. 17, Page No. 240 – 17.1, Nucleus**



Structure of a nucleus

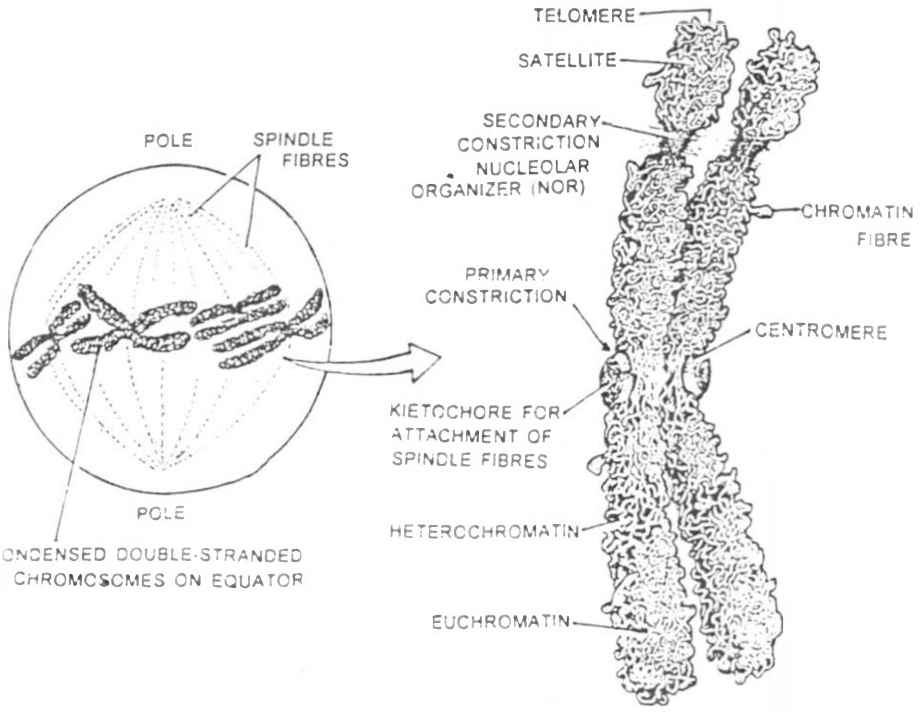
Nucleus : It is the principle organelle of the cell which is covered by double membrane called Nuclear envelope, traversed by many pores. Nuclear envelope separates the contents of the nucleus from the cytoplasm. Nuclear pores facilitate the movement of molecules between the Nucleus and Cytoplasm. It encloses a fluid called Nucleoplasm. In which one or more definite nucleoli and chromatin occur. Chromatin fibers are made up of DNA and proteins. During cell division, the chromatin condense and becomes separated into distinct threads called chromosomes. Each species of living organisms has a characteristic number of chromosomes in a nucleus. Chromosomes bears genes. Nucleus controls all cellular metabolic activities.

Name of Organism	Number of Chromosome (diploid)
Roundworm	02
Housefly	12
Frog	26
Man	46
Gorilla	48
Dog	78
Pea	14
Onion	16
Maize	20
Paddy	24
Coffee	44

3. Unit No. 17, Page No. 241 Chromosome

Chromosomes: Chromosomes can be defined as deeply stained protoplasmic bodies found within the nucleus.

Function : They carry hereditary information from one generation to next generation. Hence chromosomes are often described as "Vehicles of Heredity".



Structure of a chromosome: The metaphase of cell division showing double-stranded chromosomes. At right is a metaphase chromosome enlarged to show linear structure.

4. Unit No. 17, Page No. 249 Sl. No.4, Centromere

Centromere : Chromosome shows a constricted region that holds two chromatids together called **centromere.** It may occur anywhere along the length of the chromosome. During cell division, centromere becomes functional. The region of the centromere gets attached to the spindle fibre and helps in movement of chromosome to opposite poles.

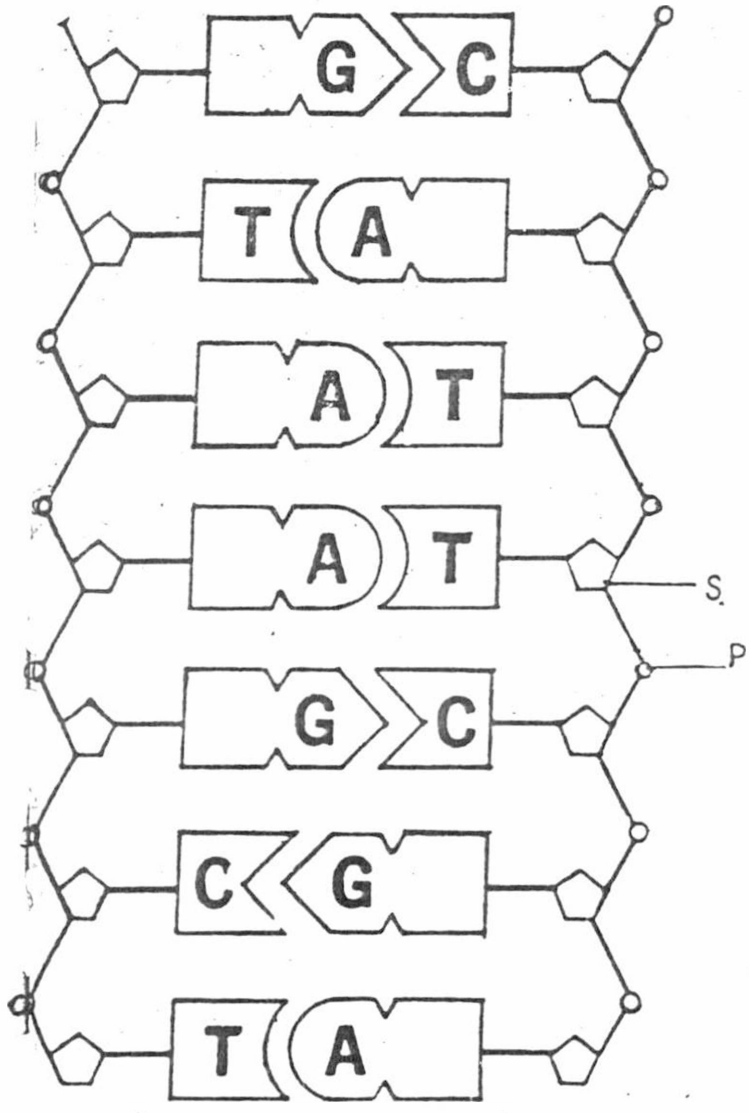
(Additional reading for teachers).

5. Unit No.17, Page No. 242, Nucleic Acids

Nucleic Acids : Nucleic acids are largest and fascinating molecules, found in living systems. These are found in nucleus and cytoplasm of the cell.

There are two types of Nucleic acids. Viz.

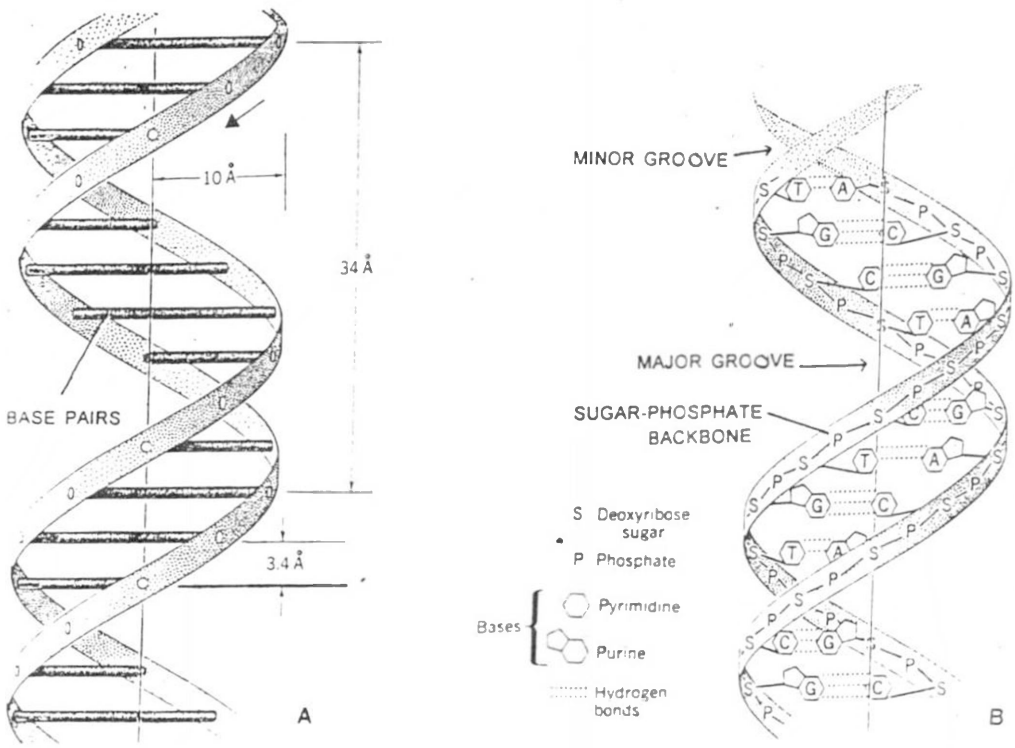
1. DNA – De-oxyribo nucleic acid
2. RNA – Ribo nucleic acid



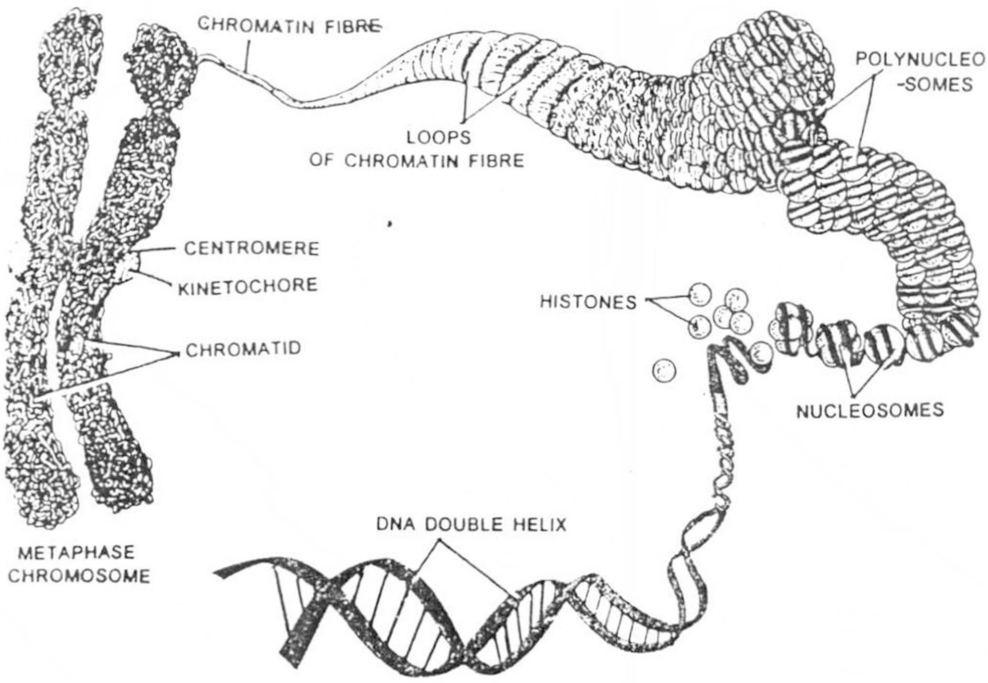
S–Sugar
P–Phosphate
A–Adenine
T–Thiamine
C–Cytocine
G–Guanine

A = T
G ≡ C

A DNA molecule



Structure of DNA: A. The duplex or double helix model proposed by Watson and Crick; B. Details of the model showing a repeating sugar-phosphate backbone and complementary base-pairing between purines and pyrimidines.



A diagrammatic representation of ultrastructure of a chromosome and the relationship between DNA, histones and the chromatin fibre.

6. **Unit 17, Page No. 244, 17.3, Cell Division**

Cell Division : A process by which living cells multiply is called cell division. In general, cell division includes 2 types of division viz.

1. Karyokinesis
2. Cytokinesis

Karyokinesis : The division of nucleus

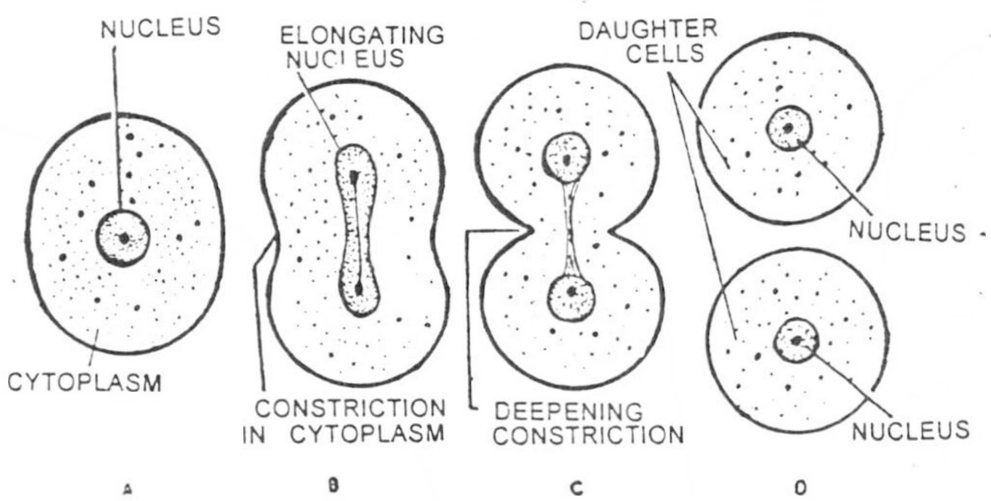
Cytokinesis : The division of cytoplasm

Astral and Anastral Mitosis

In animal cells, the centrioles duplicate and move apart to occupy the opposite poles of the cell. Numerous delicate microtubules appear around the centrioles to form star like structures called Asters. Hence Mitosis in animal cells is called "**Astral Mitosis**".

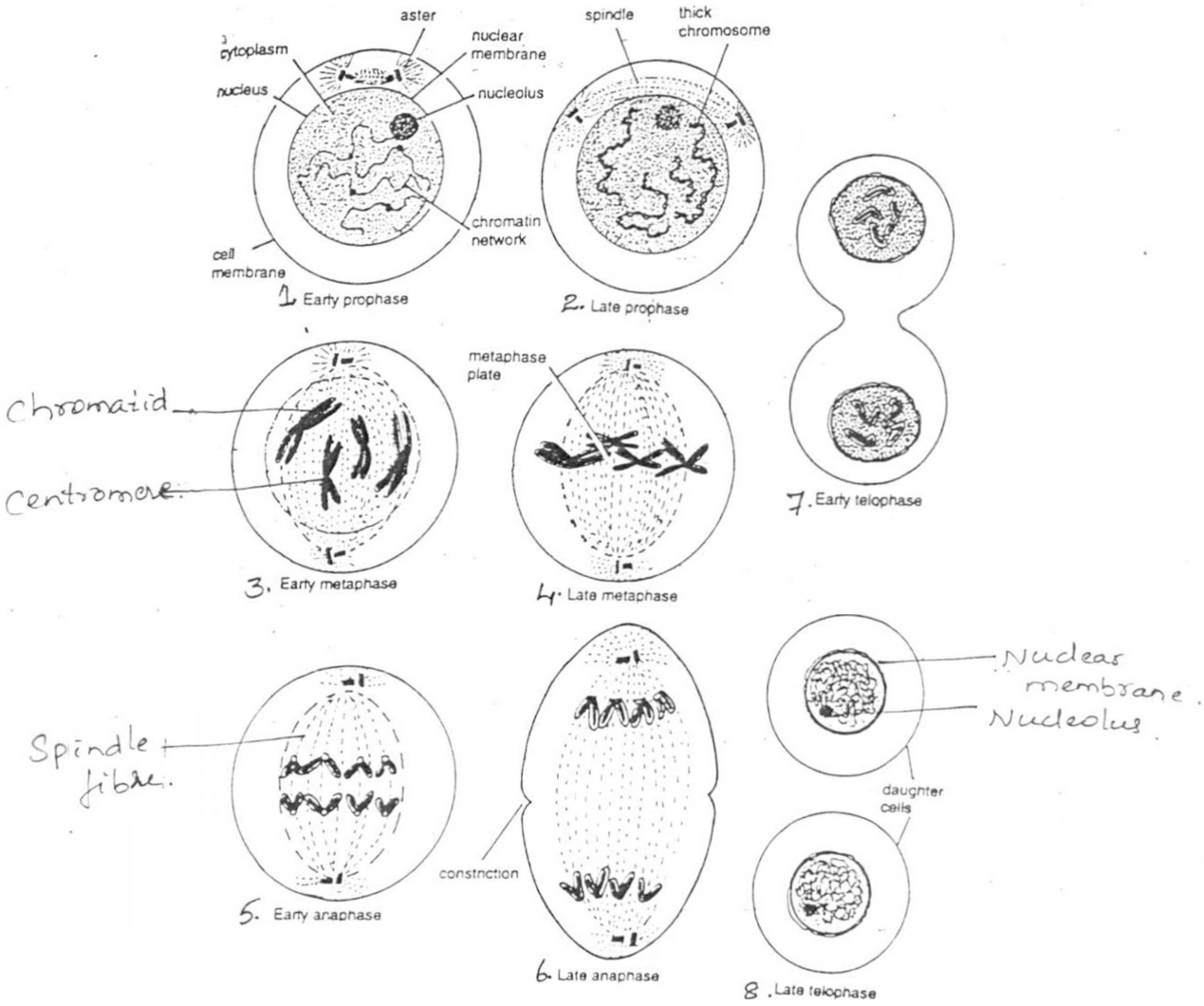
In plant cells, centrioles are absent and therefore, asters are not formed. Hence mitosis in plant cells is called "**Anastral Mitosis**".

7. **Unit 17, Page No. 244, 17.3, Amitosis**



Amitosis: Direct nuclear division.

8. **Unit No. 17, Page No. 246, Mitosis (Labelled Diagram)**



Stages of mitosis (diagrammatic) in animal cell.

9. **Page No. 247, 17.4.1, Monohybrid cross**

Gene : This is the unit of genetic material localized in the chromosome and responsible for determining a hereditary character or sequency of a nucleotide in DNA molecule which specifies the order of amino acids in a protein molecule.

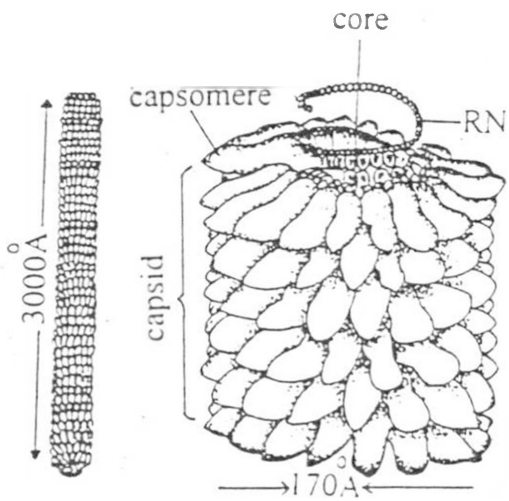
Alleles : Alleles are alternate forms of a Gene occupying the same positions on the homologous chromosomes.

10. Unit No. 18, Page No. 252, Viruses

Viruses : Viruses are ultramicroscopic particles and are considered as living entities.

18.1 Structure of TMV : (Labelled Diagram)

Tobacco LEAF INFECTED BY TMV.



. Ultrastructure of TMV

Biological Dimensions

1mm = $\frac{1}{10}$ cm

1 O (Angstrom) = $\frac{1}{10}$ million mm

1 μ (micron) = $\frac{1}{1000}$ mm

1 nm (Nanometer) = $\frac{1}{1000}$ micrometer

Page No.255 18.2.1 Pathogen and Bacteriophage

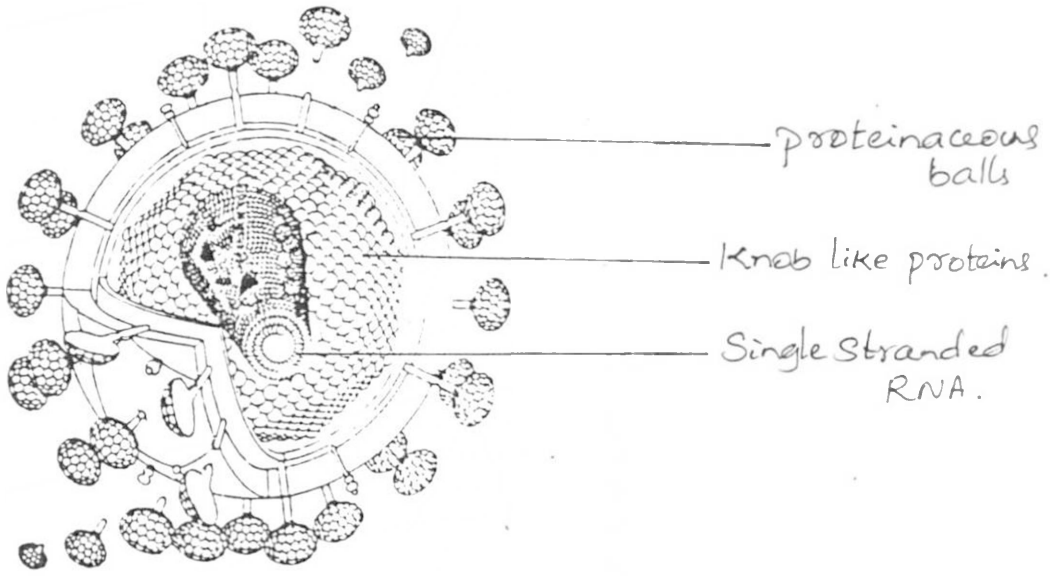
Pathogen : Disease causing organism is called pathogen.

Bacteriophages : Bacteriophages are commonly called "Bacteria eaters". A virus which infects bacteria is called Bacteriophage.

Page No. 256 and 257 AIDS

HIV : Human Immuno-deficiency Virus that causes AIDS.

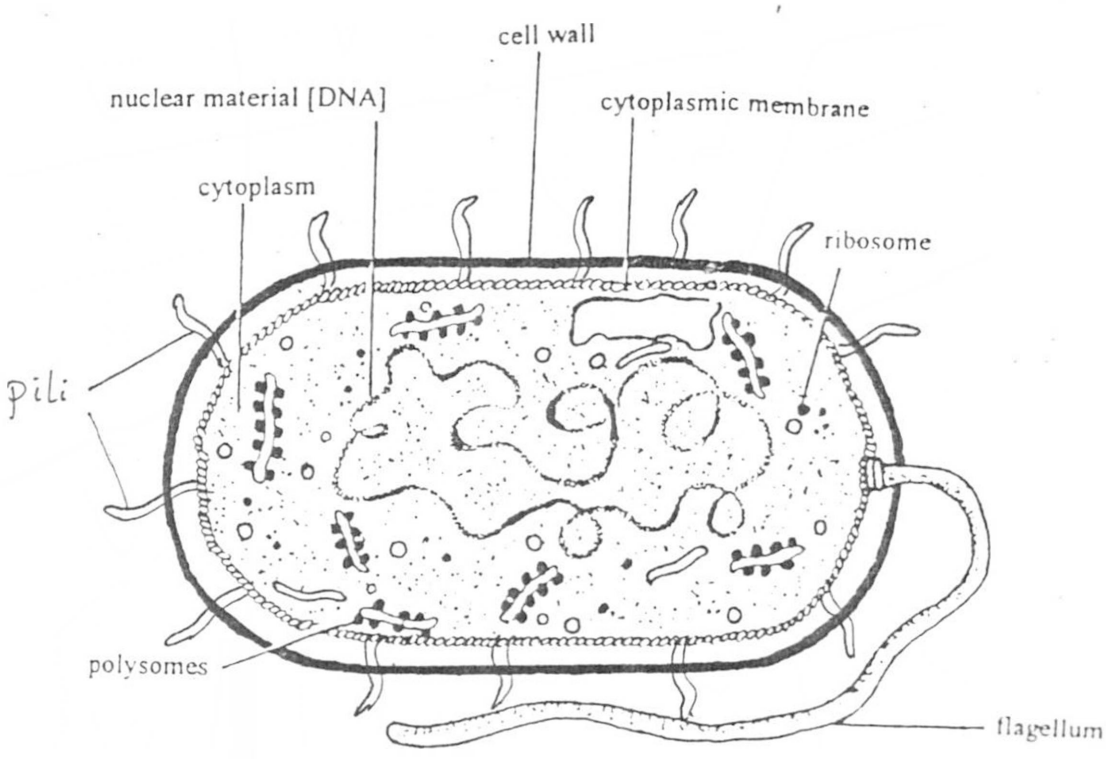
AIDS : Acquired Immuno Deficiency Syndrome



A view of HIV

11. Unit No. 19, Page No. 260 & 261, Bacteria

Bacteria :



Ultrastructure of a bacterial cell

Flagella : Thin hair like structures found on the cell wall of Bacteria are called flagella. They are made up of protein. Flagella help in locomotion.

Pili : Pili are fine proteinaceous structures which are shorter and thinner than flagella, help in sexual reproduction.

12. Unit No.19, page 262, Conjugation and Mutation

Conjugation : A special type of sexual reproduction by temporary union of cells with exchange of genetic material between two individuals. Ex. Bacteria, Paramecium and Spirogyra.

Mutation : A spontaneous change in a gene or chromosome which may affect the appearance of an organism is known as mutation. Artificially mutation can be induced by exposing ultra-violet rays and chemicals.

Page 266, Tetanus and Anthrax

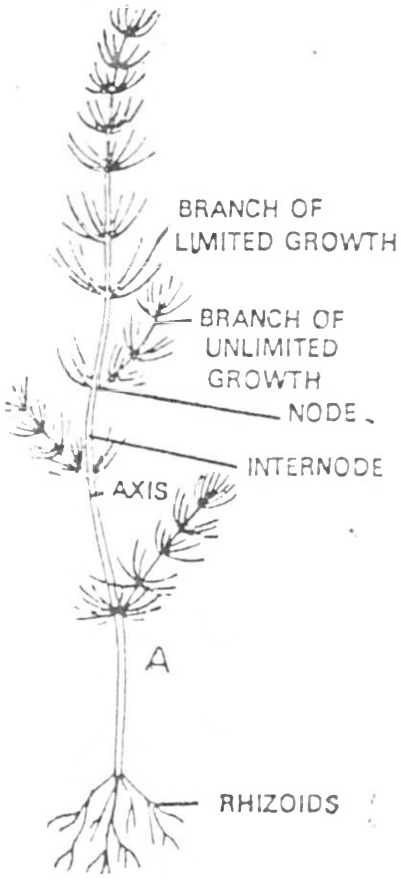
Tetanus: This disease is caused by Bacteria called **Clostridium tetani.**

Infection occurs through open wounds, cuts and broken skin surfaces. These bacteria are present in soil and enter the body through the wounds. Incubation period is 4 days to 3 weeks. Patients will be having painful contraction of muscles in neck and jaw.

To prevent tetanus wounds and cuts are to be cleaned with alcohol or an antiseptic solution. Antiseptic powder is to be sprayed on the wound and it should be dressed with a dry, clean and sterilized dressing material and an injection anti-tetanus should be given.

Anthrax : Anthrax is a disease caused by rod shaped bacteria called **Bacillus anthracis.** This is brought about by streams, biting flies, wild birds, bone meal, hair and wool. Incubation period is from one to 14 days. Spores can remain viable for as long as 15 years in the soil. The bacilli reach the tonsil where they proliferate reaching subsequently the lymphatic glands where they multiply. The symptoms are high temperature, diarrhoea and they are found dead with oozing of dark coloured blood from mouth, ear, nose and anus.

Unit 20, Page 271, 20.1, Chara External Structure



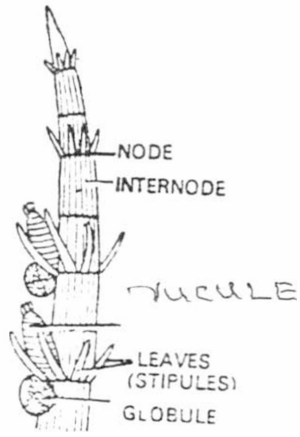
Chara. A, habit

Page No. 270, Algae

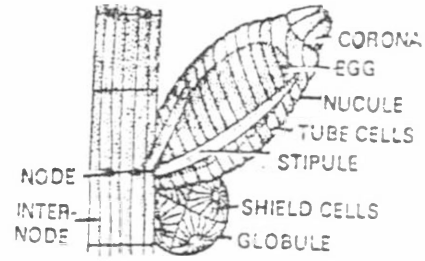
Algae : Algae are lower group of chlorophyll bearing plants which are unicellular or Multicellular.

Thallus : In lower forms like Algae the plant body cannot be differentiated into root, stem and leaves, such an undifferenciated plant body is called thallus.

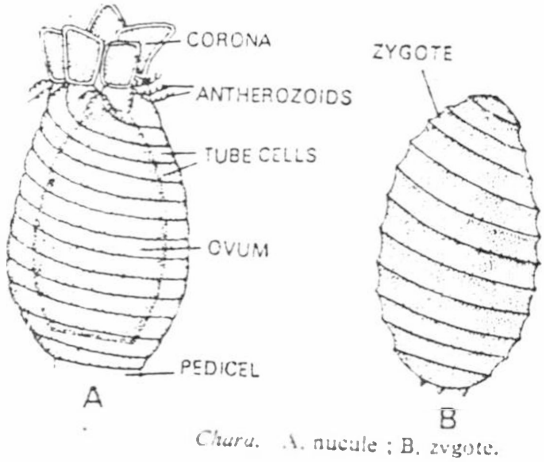
Unit : 20, Page 273 and 274, Chara



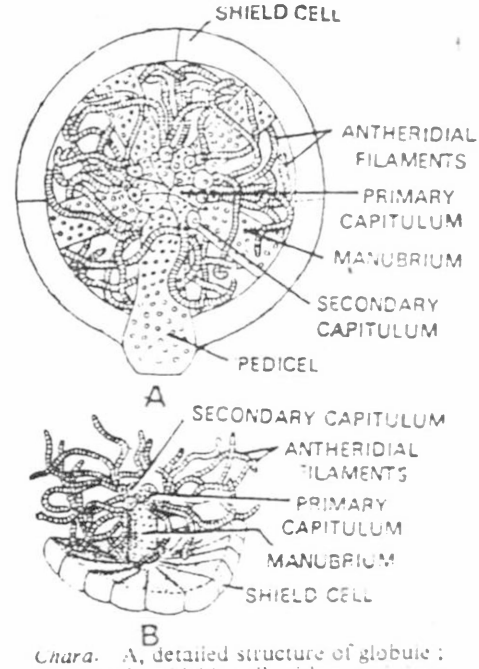
Chara. a fertile branch with sex organs.



Chara. part of fertile branch with nucule (female) and globule (male).



Chara. A, nucule ; B, zygote.



Chara. A, detailed structure of globule ; B, a single shield cell with manubrium primary capitulum secondary capitula and antheridial filaments.

Unit : 21, Page 279, Fungi Eg. Penicillium

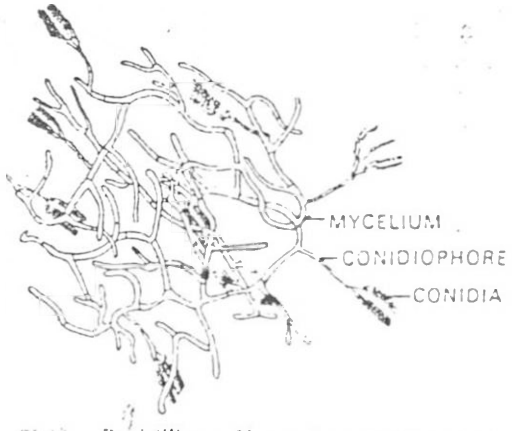
A brief description of fungi

Fungi : Fungi are achlorophyllous organisms leading either saprophytic or parasitic life.

Saprophytes derived food from dead and decaying organic matter whereas parasites derived food from living organisms.

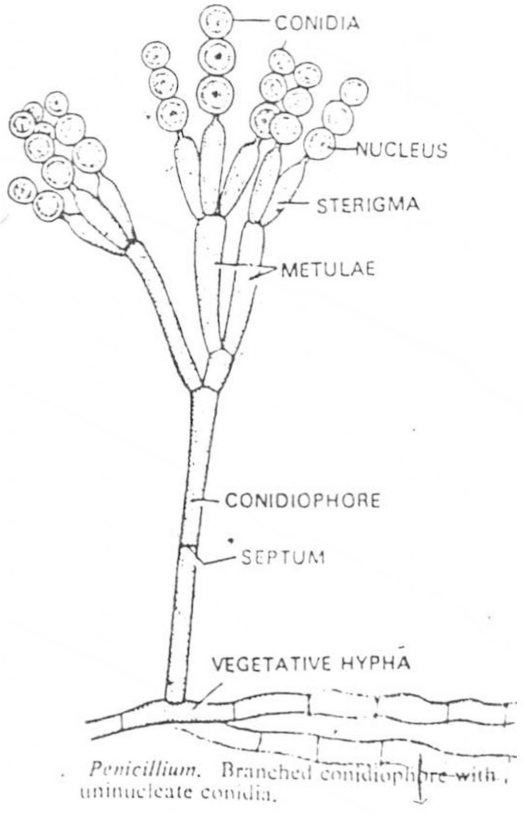
Penicillium: This fungus is commonly known as 'Green-mould', because of the presence of green coloured conidia in abundance. Alexander Fleming discovered the antibiotic penicillin from this fungus. This is a saprophytic fungus and usually grows on vegetables, fruits and many moist dead organic substrata.

Penicillium



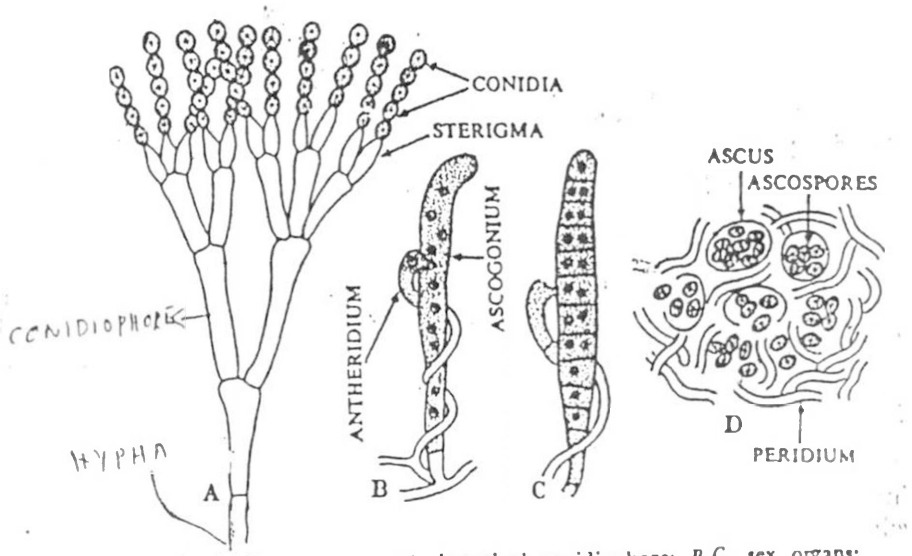
Penicillium. Vegetative structure and asexual reproduction.

Vegetative Structure :



Penicillium. Branched conidiophore with uninucleate conidia.

MYCELIUM



Penicillium. *A*, branched conidiophore; *B-C*, sex organs; *D*, cleistothecium..

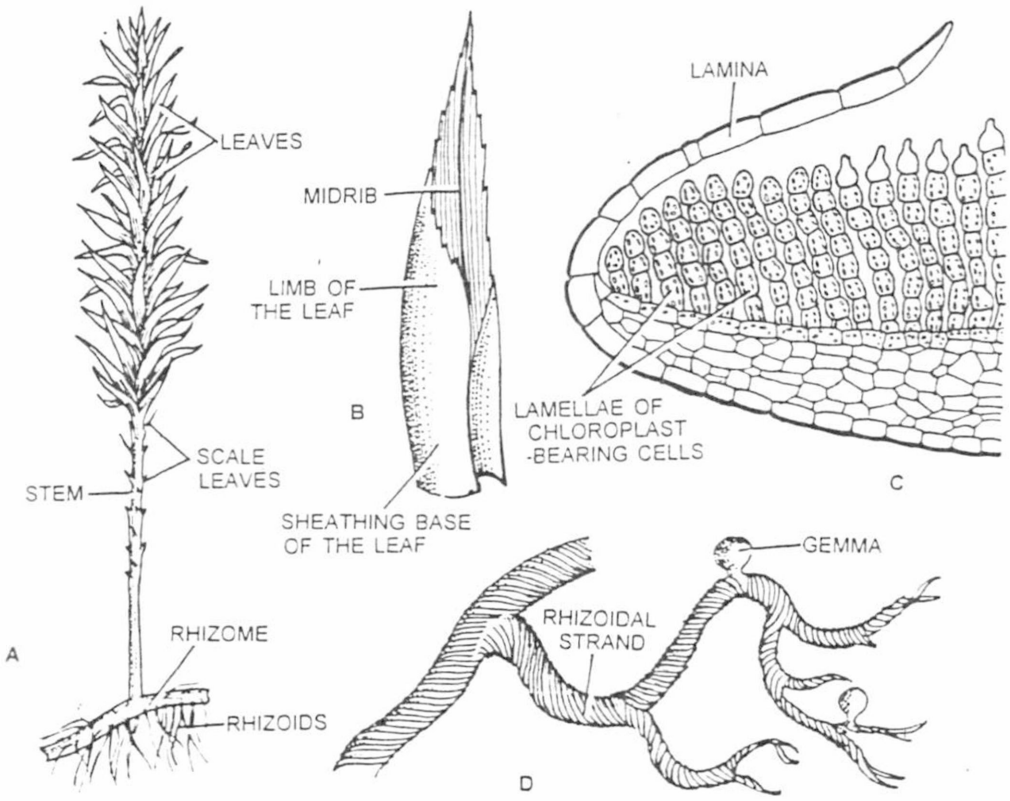
Page No. 282, Sec. 21.3

Sexual reproduction

Sexual reproduction takes place between the ascogonial filament (female) and antheridial (male) filament. The ascogonium is long and straight. At first it is uninucleate but later becomes multinucleate. Uni nucleate slender antheridium arises from vegetative hypha and grows twining around the ascogonium. Protoplasm fusion takes place at the point of contact called plasmogamy. After pairing of nuclei the ascogonium divides into a number of binucleate cells which produces numerous ascogenous hyphae. The terminal cell of each such Hypha produces ascus and which later forms into closed fruiting body called cleistothecium. Zygote divides meiotically within ascus and develops into 8 ascospores, which are liberated from ascus, fall on a suitable substratum and develops into new mycelium.

Unit 22, Page No. 286, 22.1

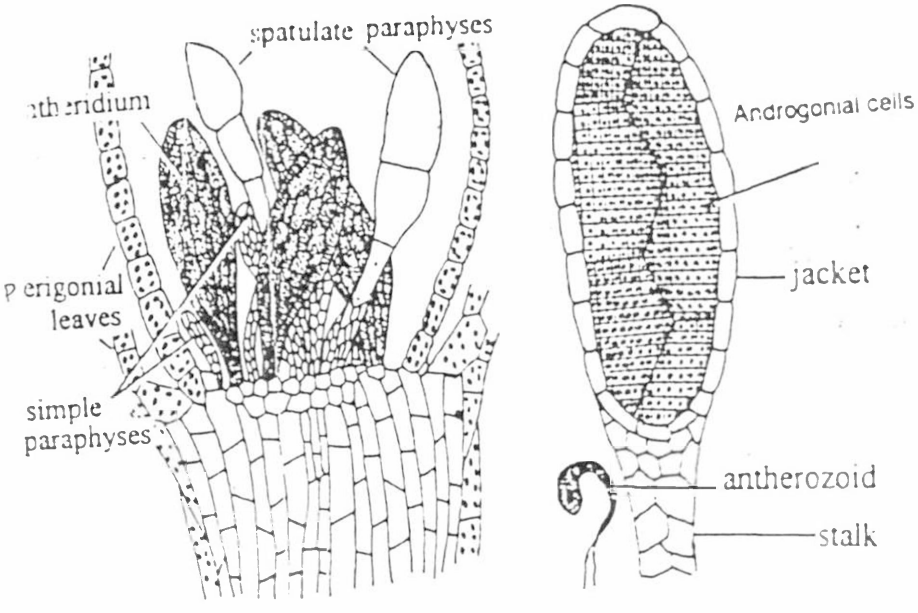
Labelled diagram of Gametophyte of Polytrichum



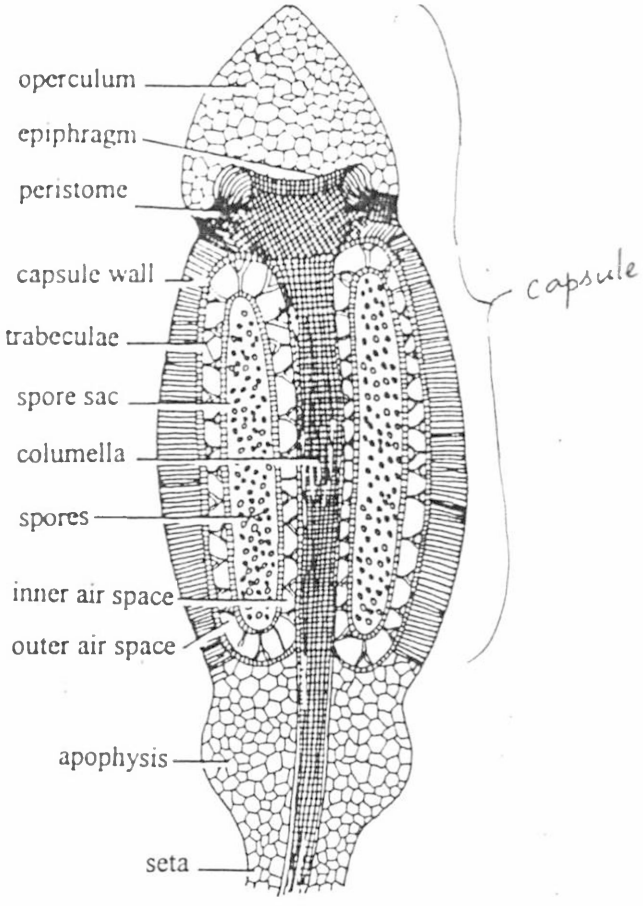
Polytrichum: A. Structure of the gametophyte; B. Single leaf showing sheathing leaf base. C. Section through a leaf to show the lamellae; D. Rhizoids with twisted rhizoidal strands and gemma.

Unit 22, Page No. 288 – 289, Antheridium (Labelled Diagram)

Unit 22, Fig. No. 22.5, Page No. 290



A. V.S. of antheridial head B. V.S. of an antheridium



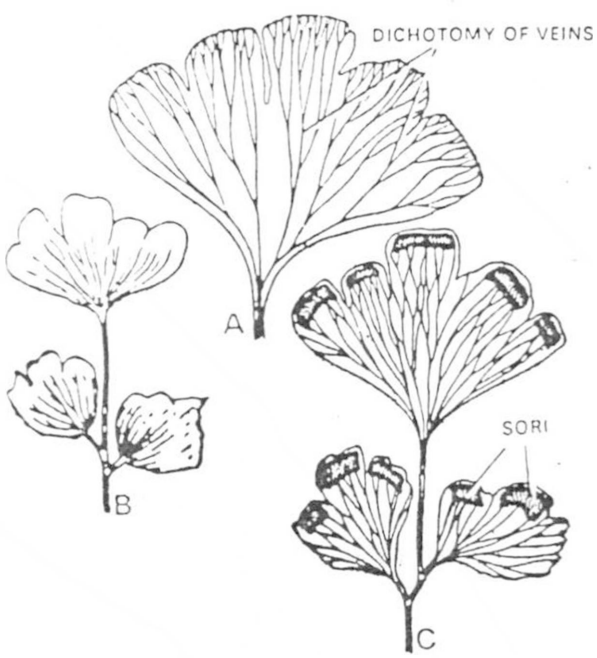
V. S. of capsule

Unit 23, Page 294, Pteridophyta

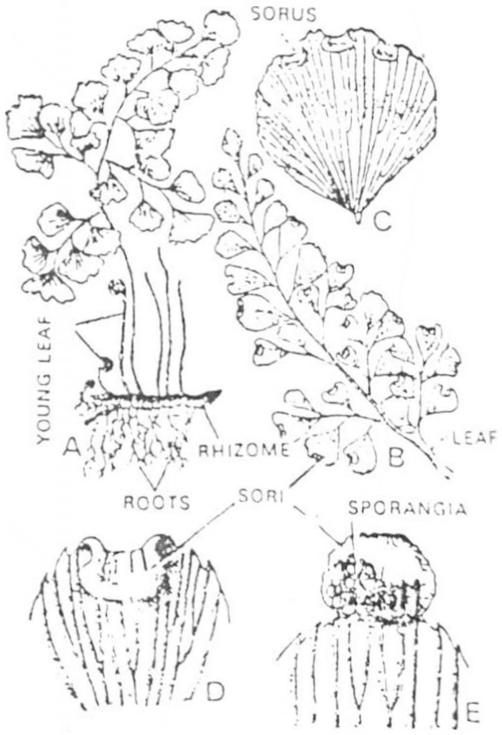
Pteridophytes includes lower vascular plants. These plants possess conducting tissue phloem and xylem. Plant body is differenciated into root, stem and leaves. Both sporophytic and gametophytic generations are independent and alternate with each other.

Unit 23, Fig. 23.1, Page 295, Adiantum

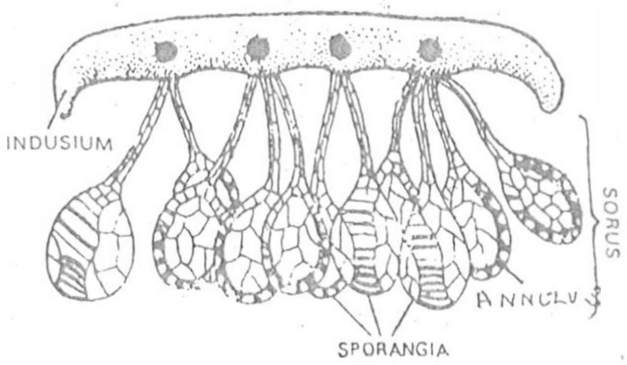
Page 296, 23.1.1 Labelled diagram of sporangia and sorus



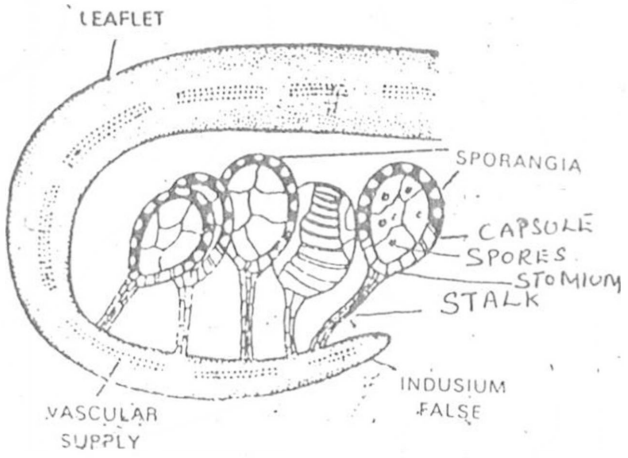
Adiantum spp. A, a pinnule of *A. capillus-veneris* showing venation; B, sterile pinnules; C, fertile pinnules as seen from ventral side in *A. capillus-veneris*.



Adiantum; A, habit; B, underside of primary pinna of *Adiantum venustum*; C, underside of leaf of *Adiantum parishii*; D-E, parts of a fertile pinna.



Adiantum sp. T.S. through sorus showing stalked sporangia.



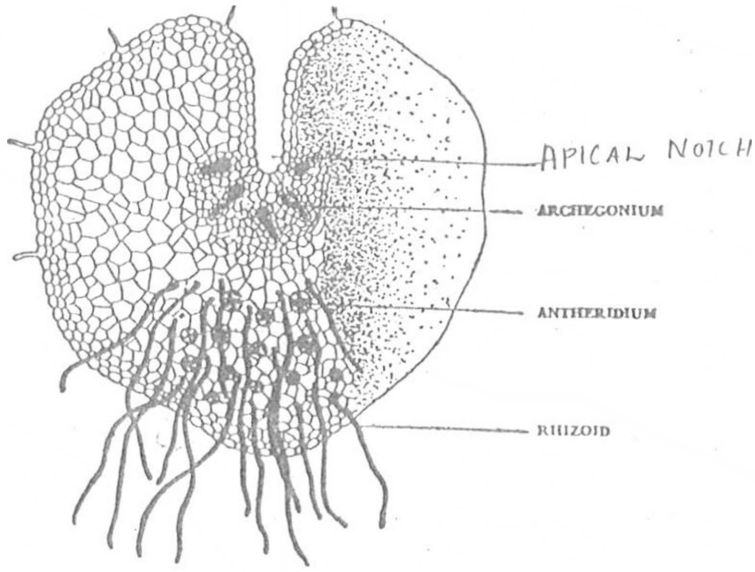
Adiantum sp. L.S. of the marginal part of leaflet with stalked sporangia.

The leaves are arranged on the rhizome, either spirally or alternately. The stalk of the leaf called petiole, which is shining, black and brittle. The leaf blade may be entire, simple or repeatedly branched. The forking veins traverse the leaf blade. Usually the veins are free and branching of the leaf is of dichotomous type.

The sporangia are inserted upon the distal region of the veins traversing the fertile lobe. Fertile lobes bear a group of sori situated upon parallel veins.

Page 297

Labelled diagram of Gametophyte of Adiantum



Prothallus (gametophyte)

Sporophyte and Gametophyte

Sporophyte : Spore producing plant body.

Gametophyte : Gamete producing plant body.

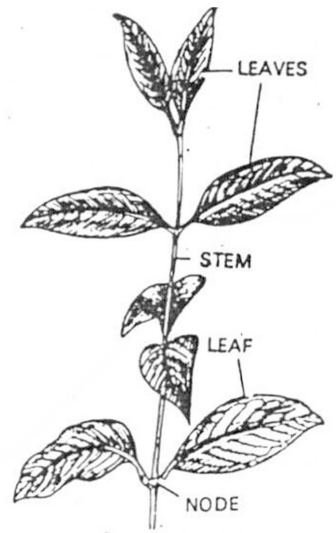
Alternation of Generation : In Bryopytes and Pteridophytes life cycle shows two distinct stages namely Sporophytic and Gametophytic.

Gametophyte reproduces sexually by producing gametes and gives rise to sporophyte. Sporophyte reproduces asexually by producing spores and gives rise to gametophyte. These two stages alternate with one another. This is known as alternation of generation.

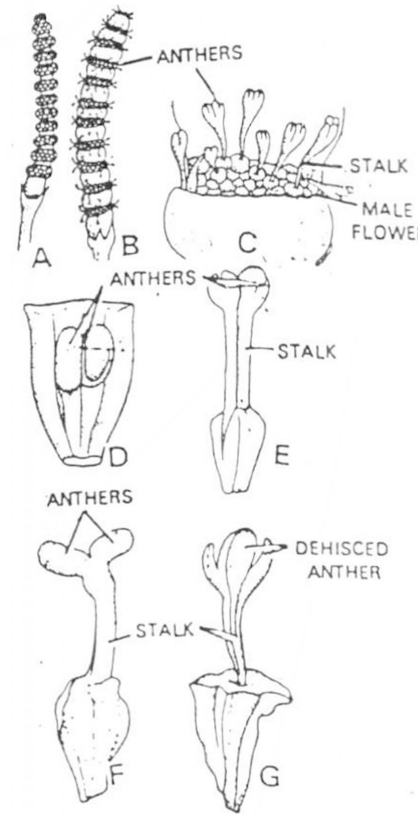
Unit 24, Page 303, Line No. 6, Definition of inflorescence

Inflorescence : The arrangement of flowers on a branch of the plant body.

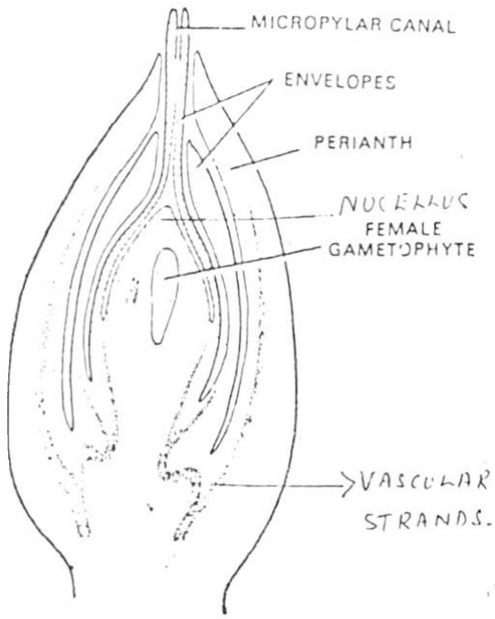
Unit 24, Page 305, Fig No. 24.2.2 Proper labelled diagram of L.S. of ovule of Gnetum.



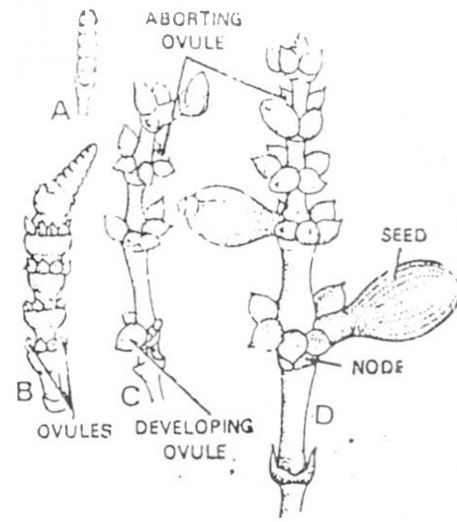
Gnetum. A twig.



Gnetum ula. A, young male cone ; B, mature male cone ; C, portion of male cone with dehiscing male flowers ; D, L.S. of male flower ; E—F, male flowers with anthers ; G, dehisced male flowers.



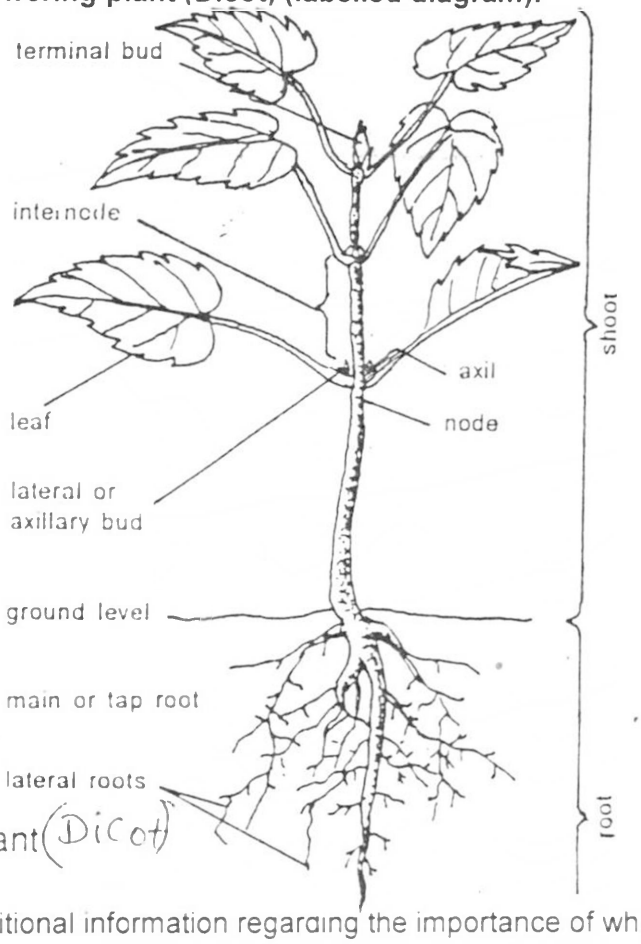
Gnetum sp. L.S. of the ovule with mature gametophyte and vascular supply.



Gnetum sp. A, young female cone ; B, old female cone ; C, aborting and normal ovules on ovulate branch ; D, seed on ovulate branch.

Unit 25, Page No. 312, 25.3, Wheat

Typical flowering plant (Dicot) (labelled diagram).



A Flowering Plant (Dicot)

[Additional information regarding the importance of wheat is added.]

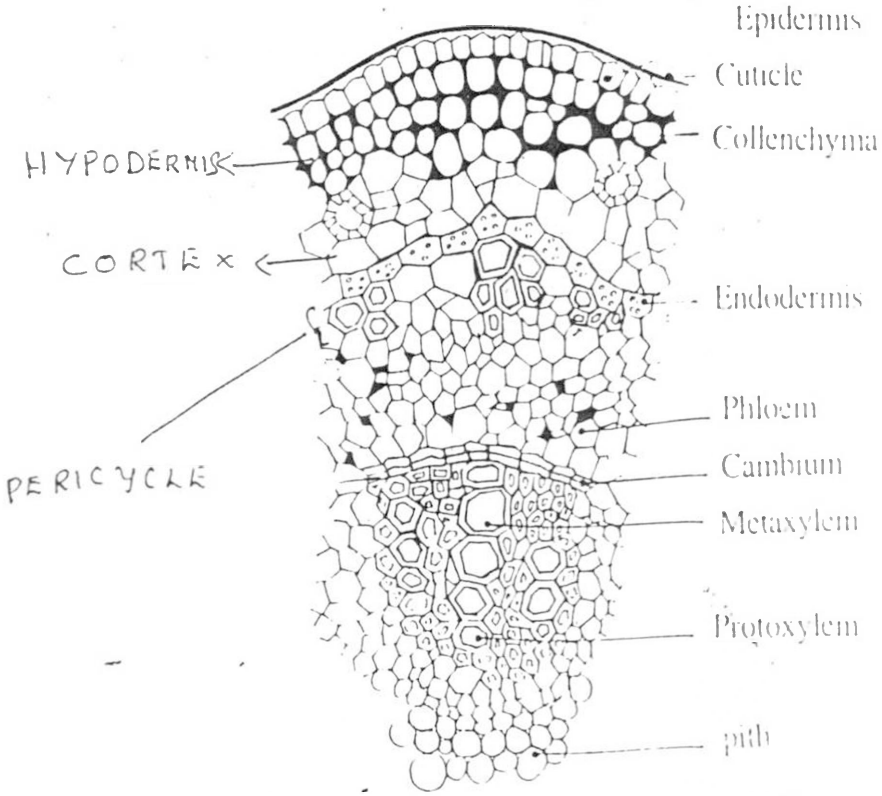
Wheat is the staple food of one thirds of the world's population. This has been cultivated even from ancient times. The improved hybrid varieties of wheat shows the characters like early maturity, disease resistance, pest resistance with better baking qualities. Some of the important varieties of wheat are,

Red fibre : This is a red grain variety mainly grown in Canada.

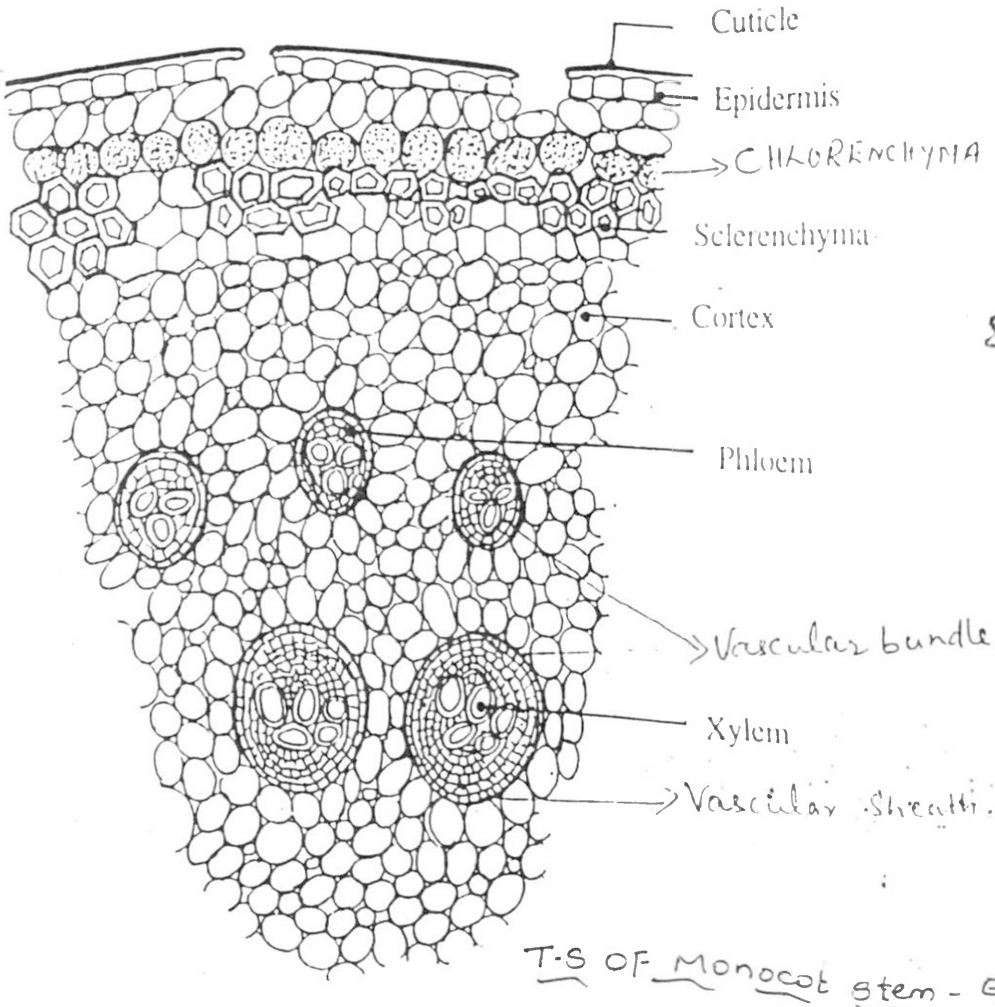
Turkey Wheat : Popular variety in USA.

Marquis : It was a 'King of Wheats" in Canada and USA in the early part of the twentieth century.

Some of the other famous wheat varieties are Bunyip, Aurora, Florence, Jonathan and Red wave.

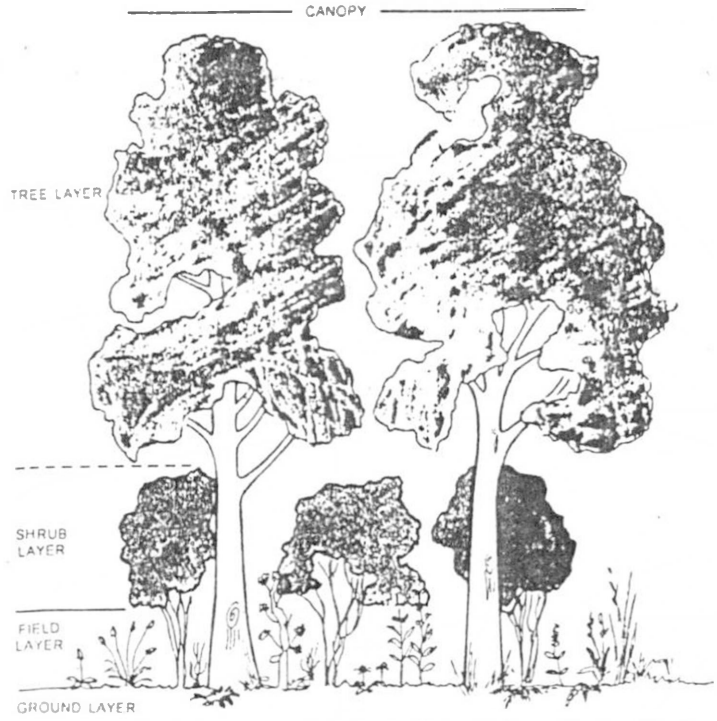


T.S of Dicot stem - Ricinus Communis



T.S OF Monocot stem - Eg:- chloris barbata

Unit 26, Page No. 321, 26.2.2 Deforestation and Afforestation



The plant layers in a tropical deciduous forest. The tree layer forms a canopy of 10 to 30 m. height.

Tropical deciduous forest diagram included.

Deforestation : The cutting down of large number of trees.

Afforestation : Establishment of forest cover by planting trees on a large scale.

ZOOLOGY

Unit 27, Page No. 328, Diversity of living organisms

Introduction to the chapter

Animal diversity

The earth is inhibited by innumerable number of organisms and no two individuals are alike. To get a clear picture (perspective) of the living thing, there should be systematic and orderly classification of the living things. The branch of Biology which deals with the classification of organisms is called Taxonomy.

Unit 27, Page No. 328, Definition for Invertebrates and Vertebrates

Animals can be broadly classified into two groups viz. Invertebrates and Vertebrates.

Invertebrates are group of primitive animals which do not have backbone whereas vertebrates are highly organizing animals which have backbone. Ex. Earthworm, cockroach, etc. Vertebrates are highly organized animals which have backbone. Eg. Fish, Frog, Pigeon, etc.

Unit 27, Page No. 329, Function of Setae

Setae are stiff bristle like structures found on the surface of the body of Earthworm helps in locomotion.

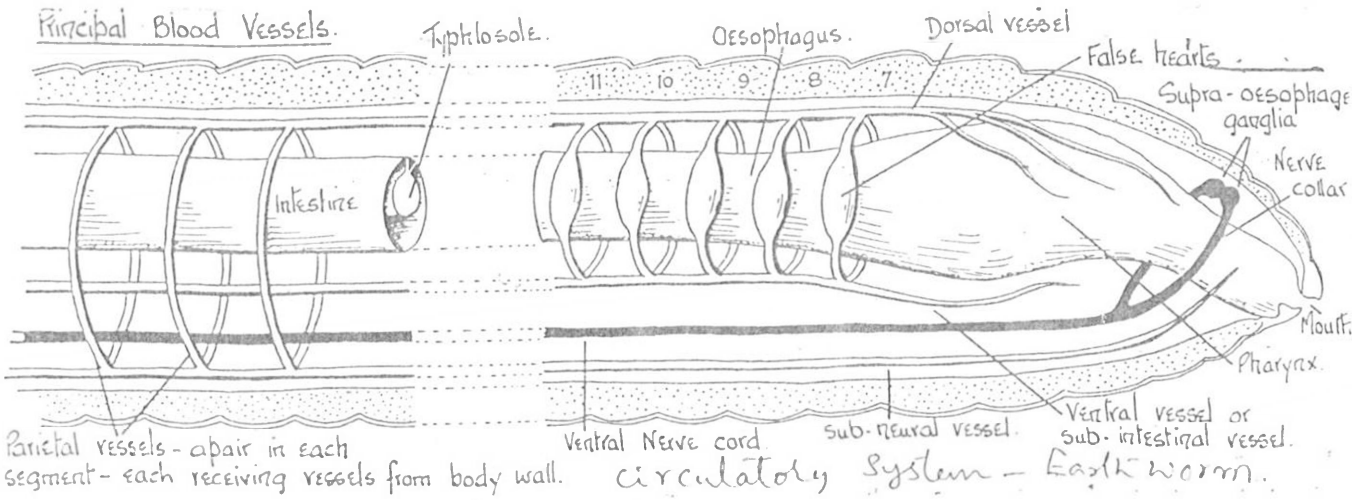
Unit 27, Page No. 331, Definition of Open and Closed circulatory system

There are two types of circulatory systems namely open and closed type.

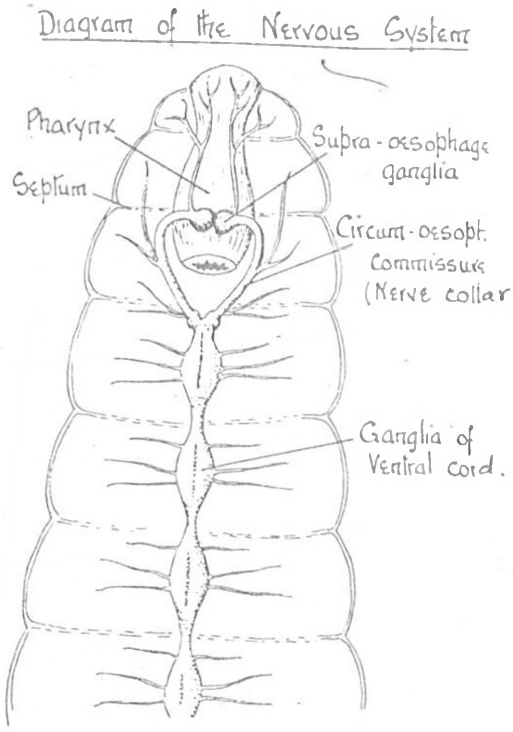
Open Circulatory System : In lower animals, blood is pumped by heart directly into the body cavity. This type of circulatory system is called open circulatory system. It is found in many invertebrates such as cockroach, prawn, grasshopper, etc.

Closed Circulatory System : In higher animals, blood flows in definite blood vessels. Such a type of circulatory system is called closed circulatory system.

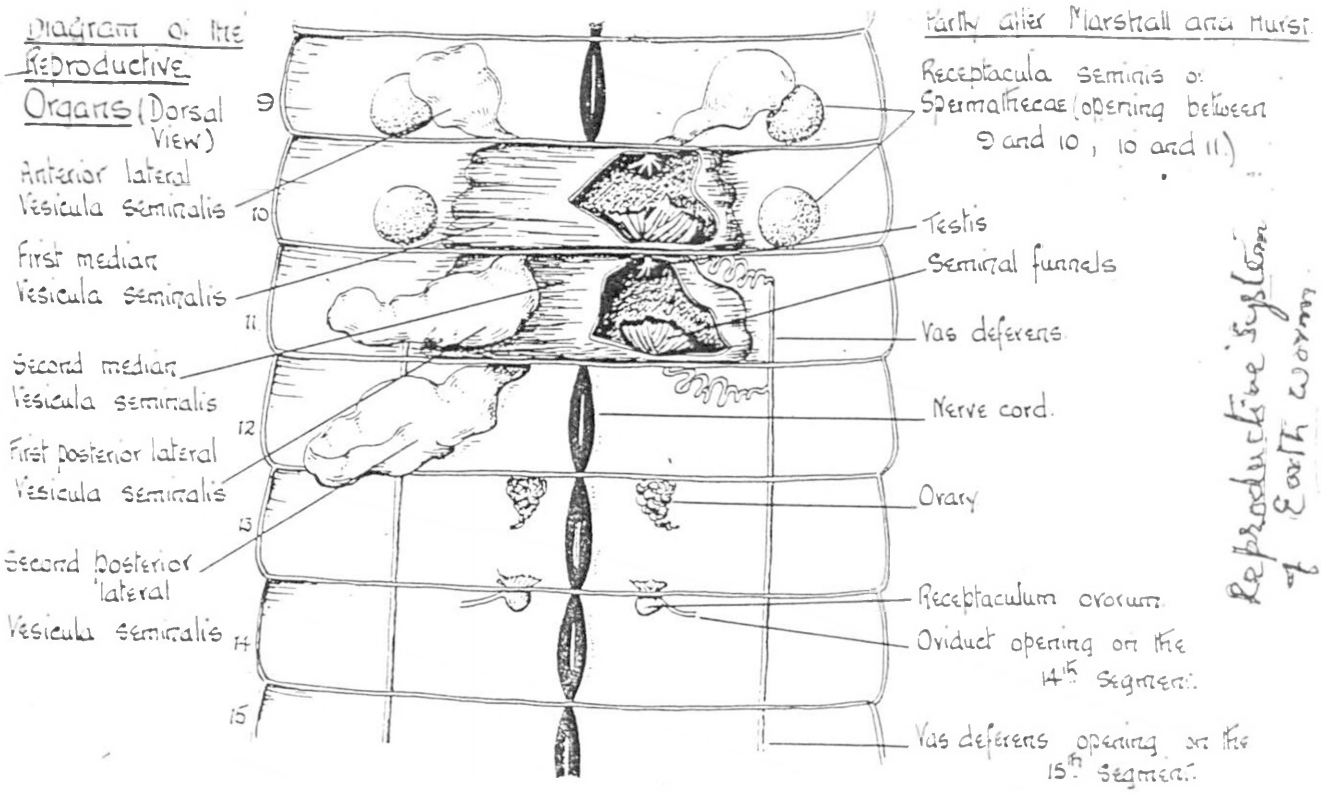
Unit 27, Page No. 331, Circulatory System of Earthworm



Unit 27, Page No. 332, Labelled diagram of Nervous system of Earthworm



Unit 27, Page No. 332, Labelled Diagram of Reproductive System of Earthworm



Unit 27, Page No. 335, Pigeon

Pigeon belongs to class Aves or Birds.

Birds are adapted to Aerial mode of life. Birds are one of the most interesting and widely known animals distributed all over the world.

Unit 27, Page No. 335, Bilateral Symmetry

A symmetry such that body can be divided by one median plane into two similar parts which are mirror images of each other.

Poikilothermic or cold blooded : Animals such as fishes, amphibians and reptiles can change their body temperature according to their environmental temperature. Such animals are described as poikilothermic or cold blooded.

Homeothermic or Warm blooded animals

Animals such as birds and mammals cannot change their body temperature. Hence their body temperature is maintained at constant level to the irrespective environmental temperature. Such animals are described as Homeothermic or warm blooded.

Unit 28, Page 345, Capillaries

Definition of capillaries

Capillaries : The arteries end in small branches called *arterioles* which in turn divide into very thin narrow smallest tubes called capillaries.

Blood Vessels : Blood flows around the body in tubes called blood vessels.

Arteries and Veins: These are two principal types of blood vessels. Blood is pumped from the heart into and along arteries and is emptied back into the heart by way of veins.

Arterioles : Arteries progressively divide and sub divide as they carry blood from the heart into the various body organs. In each organ, the artery divides into smaller thinner-walled vessels called **arterioles**.

Capillaries : Arterioles themselves divide into a network of the smallest of all blood vessels called **capillaries.**

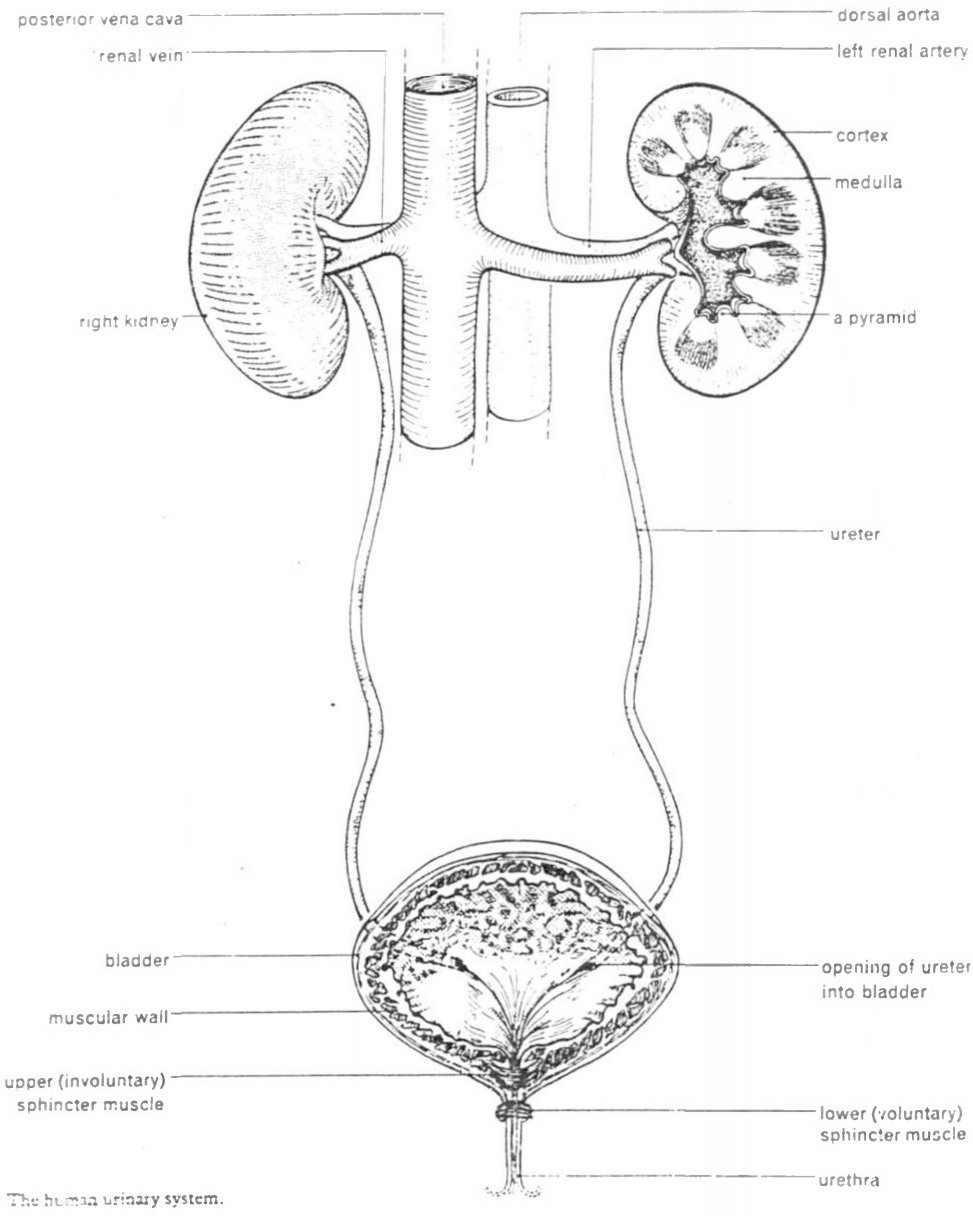
Venues : Capillaries eventually unite into larger blood vessels called **venules** which carry blood out of the organ.

Veins : Venules unite to form veins and more of these unit as blood is brought back to the heart.

Unit 28, Page No. 349, Excretory system

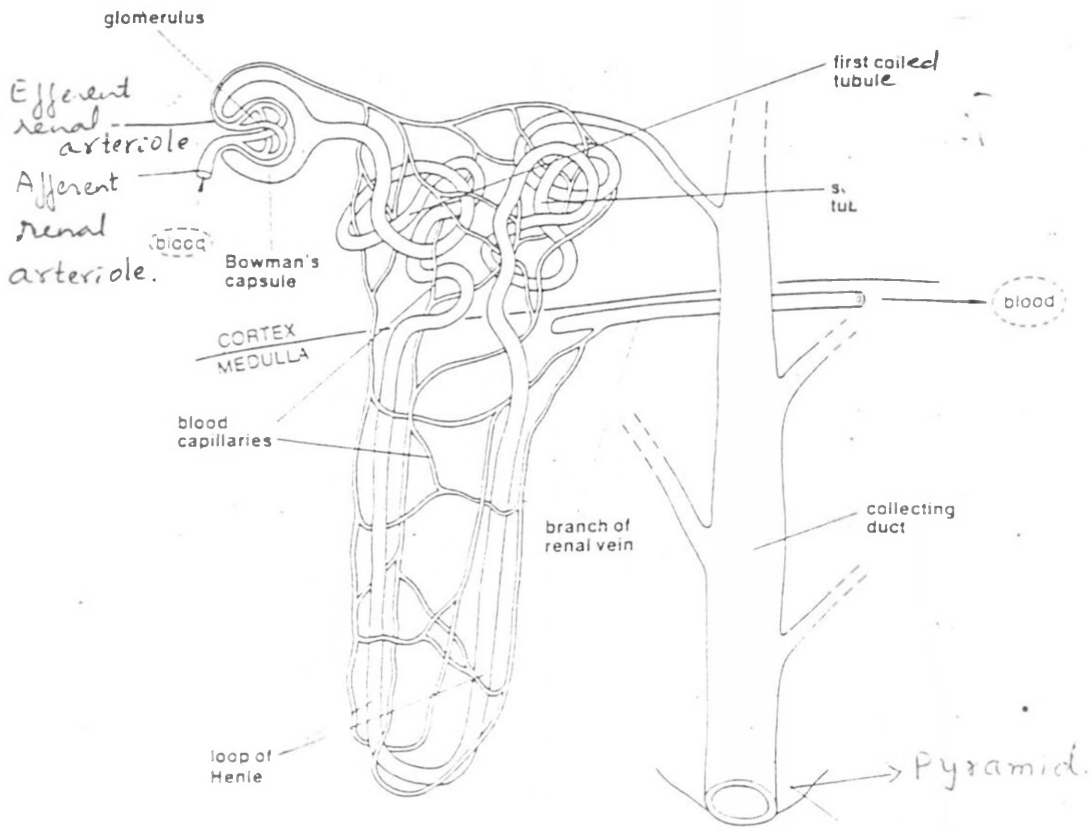
Introductory additional information :

Many chemical reactions take place inside the cells of an organism in order to keep it alive. Some products of these reactions are poisonous and must be removed from them. The phenomenon of removal of metabolic wastes or nitrogenous wastes from the body is called Excretion.



The human urinary system.

Unit 28, Page No. 251, Labelled Diagram of Nephron



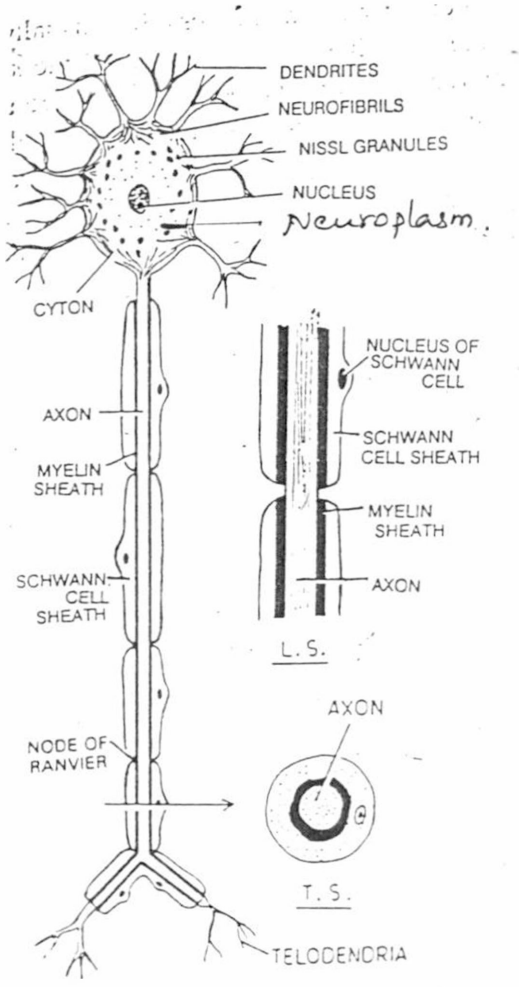
Unit 28, Page No. 352, Correction regarding Renal Vein

This sentence should be read as, "Renal artery branches into number of capillaries" instead of "Renal vein branches into number of capillaries" - correction to be incorporated.

Unit 28, Page No. 354, Note on Nervous System

Nervous system controls and coordinates the activities of various body parts. It receives information from all body parts and also about the changes in Environment.

Unit 28 (3a) Page No. 354, Neuron



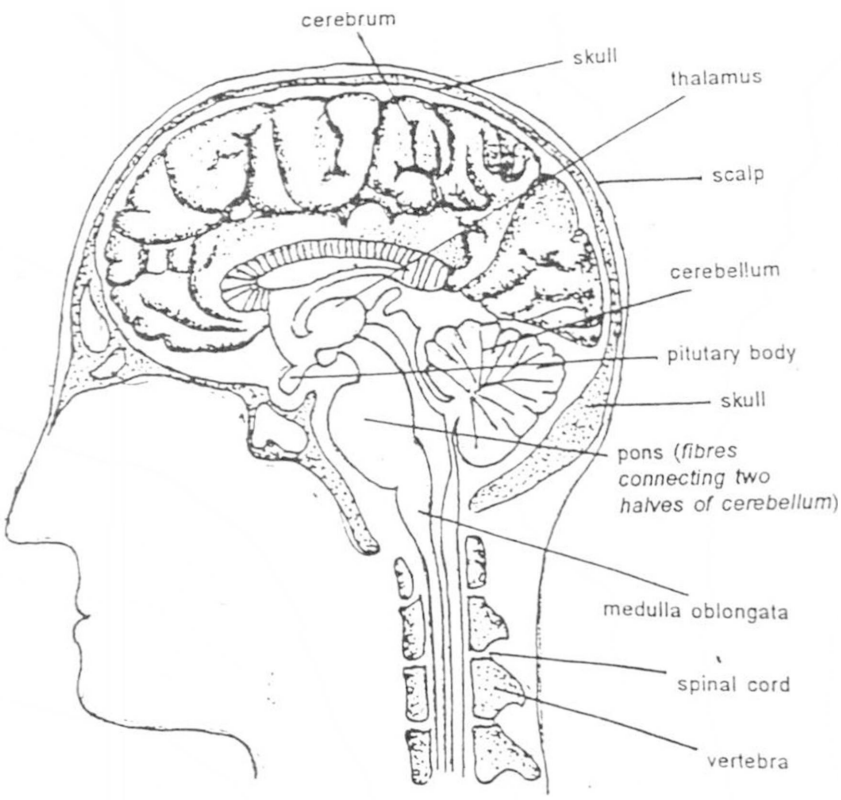
Structure of a nerve cell. The cyton and the nerve fibres are its parts. At right the nerve fibre is shown in a vertical and transverse section to show myelin and Schwann cell sheath.

Neuron or Nerve cell is the structural and functional unit of nervous system. It consists of a cell body and two types of processes namely Axon and Dendrites.

The cell body consists of Nucleus surrounded by cytoplasm which extends to form number of branches called Dendrites. Axon is a long slender branch arising from the cell body. It ends with Telodendria. It conducts impulses from one part of the body to other part.

Unit 28, Page no. 355, Human Brain

A neat labelled diagram of the sagittal section of Human Brain.



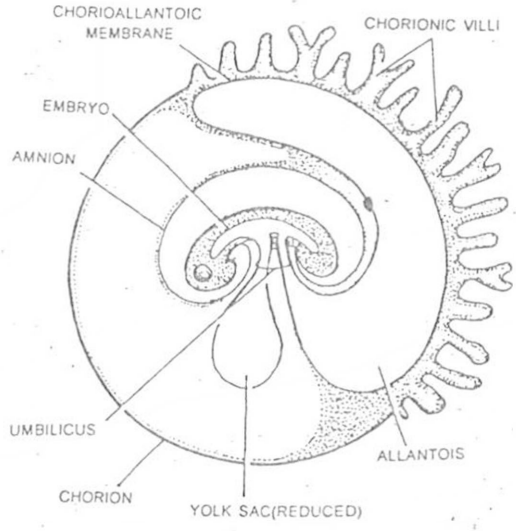
Sagittal Section through head to show brain

Unit 29, Page No. 364, Human Reproductive Biology, Para 2

[An additional explanation regarding Female gamete (ovum).]

Ovum is spherical single celled non-motile female Gamete. It is surrounded by non-cellular layer zona pellucida. Outside this layer, there are radially arranged follicle cells which make corona radiata.

Unit 29, Page 365, (29.1.4) Foetal Development



The extraembryonic membranes of a mammal. The chorionic villi associate themselves with maternal tissues to form the placenta.

Reference Books

1. Life – Form and Function by C.V. Brewer and C.D. Burrow, published by MacMillan 1974.
2. Essential Science Biology by P.G. Dutta, Oxford University Press, 1997.
3. Biological Drawings by Maud Jepson, John Murray publishers, 1978.
4. Modern Practical Botany by B.P. Pandey, Vol.1, Published by Shandan and Company, Delhi, 1994.
5. A class book of Botany, VI Edition, Oxford University Press by A.C.Dutta.
6. Biology – by Mary Jones and Geoffjones, Cambridge University Press, 2002.

APPENDICES

WORKSHOP ON IDENTIFICATION OF HARD SPOTS

X Standard (Science)
(15th to 17th September 2003)

PROFORMA FOR IDENTIFICATION OF HARD SPOTS

Text Book Aspects	Reference to text Chapter No./Sec.No./Line No./Fig.No.	Descrip-tion of Hardness	Hard w.r.t.			Reasons for hardness	Suggest-ions for overcoming hardness
			Tr	St.	Both		

WORKSHOP ON DEVELOPMENT OF TRAINING PACKAGE ON HARD SPOTS IN X STANDARD (SCIENCE) OF TAMIL NADU (II PHASE)

13th October 2003 to 17th October 2003

PROFORMA FOR ITEM WISE ANALYSIS OF HARD SPORTS

Sl. No.	Identified Hard spots	Ref. To Text page/ Chapter/ Sec/ Para/Fig.No.	Experts' Advice for Remedy			Reference to Additional Resource (Page No.)
			Additional Resource Prepared	Additional Resource not required	Suggested Remedial Measures	

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REGIONAL INSTITUTE OF EDUCATION, MYSORE

Workshop for Identification of Hard spots X Std (Science)

(15-9-03 to 17-9-03)

(I Phase)

MON 15-9-03	9-10-03 Registration	10-30 – 11-15 Inauguration	11-20 – 1-00 Orientation about hard spots and planning a proforma	2-00 3-30 Finalization of draft proforma	3-45 – 5-30 Common Session about how to fill the proforma
TUE 16-9-03	Group Work (Identification of Hard spots)		Group Work	Group work	General session about day's work
WED 17-9-03	Group Work		Group work	Finalization of Report and completion of work	TA/DA and valedictory

(N.R.NAGARAJA RAO)
ACADEMIC CO-ORDINATOR

WORKSHOP ON DEVELOPMENT OF TRAINING PACKAGE ON HARDSPOTS IN X STD (SCIENCE) OF TAMIL NADU (II PHASE)

13th October 2003 to 17th October 2003
TIME-TABLE

Day/Date	9-11.15 am	11.30-1.00pm	2-3.30 pm	3.45-5.30 pm
Monday 13.10.2003	Registration Inauguration	Itemwise analysis of Hardspots	Discussion on various Remedial strategies	Proforma for Training package
Tuesday 14.10.2003	Development of Material (Groupwork- subjectwise)	Contd.	Contd.	General Discussion on DRAFT material prepared (Groupwise)
Wednesday 15.10.2003	Development of material (Group work-subjectwise)	Group work (Contd)	Group work (Contd)	Reporting on day's work
Thursday 16.10.2003	GROUP WORK (Laboratory-Tryout if any)		Group work	Discussion of final refinement
Friday 17.10.2003	Refinement of the material	Refinement	Refinement and Conclusion (2 – 4.30 pm)	Valedictory (4.30-5.30 pm)

N.R.Nagaraja Rao
Academic Coordinator

WORKSHOP TO TRY TRAINING PACKAGE ON HARDSPOTS IN X STD. SCIENCE (TAMIL NADU) (PAC-18-27 III PHASE)

8th December 2003 to 12th December 2003
TIME-TABLE

Day/Date	9-11.15 am	11.30-1.00pm	2-3.30 pm	3.45-5.30 pm
Monday 8.12.2003	Registration Inauguration	The Training Package –an Introduction	←Group study & discussion→ (subjectwise)	
Tuesday 9.12.2003	←Group study / discussion→ (subjectwise)		←Contd→	
Wednesday 10.12.2003	←Group study / discussion→ (subjectwise)		←Contd→	
Thursday 11.12.2003	Refinement of the material (Group work)		Refinement of the material (Group work)	
Friday 12.12.2003	Recording opinions about the package (Group work- subject wise)		←Contd→	Valedictory TA / DA

N.R.Nagaraja Rao
Academic Coordinator