212

Secondary Course

Science and Technology

Learner Guide

NATIONAL INSTITUTE OF OPEN SCHOOLING

Learner Guide

212 - Science and Technology

Secondary Course

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Message from Director

Dear Learner,

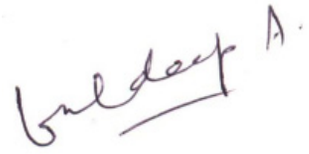
Greetings!

It has been our motto to help the self learners attain their educational goals. The Learner Guide has been designed for the first time to help you learn better. The important points of the study materials have been highlighted in this guide and would give you a glimpse of the whole course at one go. It would assist you in revising the study material in a short time.

I feel this study guide, apart from deepening your understanding of the subject, will also help you in enhancing your performance in the examination.

I hope you will refer to it for revision and find it useful.

Best wishes for a bright future and prosperous life!



(Dr. Kuldeep Agarwal)
Director (Academic)

Message from Assistant Director

Dear Learner,

Now your problems will be solved in a click,
As NIOS brings the knowledge, at your finger tip!

Appreciating your need for more support NIOS brings the magic of technology to your door step!! "Mukta Vidya Vani" our web based live PCPs supplement and complement the Self Learning Materials. It gives you an opportunity to interact with the experts of your subjects. You can clear your queries and doubts by calling on our TOLL Free Number ***1800 180 2543.*** *You can also call on* ***0120- 4626949****. The time schedule of the live programmes is given below for reference. If due to any reason you miss the live PCPs you can hear the recorded versions in repeat cycle or at Audio on Demand.*

We hope that you will access these ICT options for better understanding of content, concepts and clarification of your doubts. For listening to live or recorded PCPs on Mukta Vidya Vani, you can directly log on to www.nios.ac.in and click on Mukta Vidya Vani. You can also log on to http://www.nios.iradioindia.com/. NIOS also provides video programmes which are telecast through Doordarshan educational channel Gyandarshan and audio programme through Gyan Vani (FM) channel at 106.5 MHz.

ICT Options	***Time Slots***	
Mukta Vidya Vani	*2.30 PM – 5.00 PM* *Monday-Friday 10.30AM – 12.30AM* *Saturday and Sunday*	*Recorded 24X7*
DD 1	*5.02 AM – 5.25 AM Every Friday*	
Gyandarshan	*6.30 PM - & 7.00 PM Every day*	
Gyan Vani (FM)	*8.30 AM – 9.00 AM* *Every Friday, Saturday* *and Sunday*	*4.30 PM- 5.00 PM* *Repeat broadcast on* *Friday, Saturday and Sunday*

We look forward to your greater participation and interaction!

Dr. Rachna Bhatia
Assistant Director (Academic)

Contents

INTRODUCTION

Science not only prepares you for vocations, it also prepares you for life. It inculcates a habit of rational and logical thinking, gives an insight in the things and happenings around you, develops a wisdom to identify what is good and what is bad and provides a bent of mind for problem solving. By learning science you not only understand the world around you better, you learn to work for its betterment. There is no dearth of studies which tell us that there is a high position correlation because the development of a country and the number of scientists it produces. So the intension of NIOS is to help you learn and understand science in a better way, so that, you may score good marks in examinations and be motivated to excel in the field of science by demonstrating your worth in this competitive world. The learner guide will help you revise all major concepts of your science and technology curriculum in a short time. In addition it will make you aware about the intricacies of some concepts and will create interest to motivate you for further studies.

Objective of the Learner Guide

- to facilitate the learner's to understand and revise the study material in shorter time.
- to strengthen the learning of the content material.
- to help and support the learner's to enhance their performance in examination
- to enable the learner's to corelate the content with real life situations.
- to motivate the learner's to seek more information from other sources.
- to highlight the important concepts and points of information.

Tutor Marked Assignments (TMA)

1. Significance of Tutor Marked Assignments (TMAs) for you (learner)

Needless to say that there is great significance of Tutor Marked Assignments (TMAs) in open learning system. In fact, TMAs are an essential and integral part of open learning system. The learner gets an opportunity to come into contact with his/her Tutor or Teacher through Tutor Marked Assignments (TMAs). It provides an opportunity to the learner to correct his/her answers and improve his/her knowledge content-wise. The suggestions/directions of the Tutor help the learner to make the required improvement in the assignments submitted by him/her.

2. How to prepare a Good Assignment

While preparing his/her assignments, a learner should focus on the contents of his/her lesson and should also give required weightage to all units/ lessons. He/she is supposed to write the assignments giving headings and sub-headings and the same should not eclipse any important information. The assignments should be in conformity with the prescribed format. It should not be neither too lengthly nor too small in size.

3. Responding to Learning from the comments of Tutors

The learner should invariably respond to the comments of the tutors. This will enable the learners to improve and update his/her knowledge of the subject and correct/rectify his/her mistakes or lapses. The comments of the Tutors will also help the learner to prepare himself/herself for better performance in his/her examinations. It is, therefore, imperative and in the interest of the learner that he/she responds to the comments of Tutors on his/her Assignments.

Preparing for Examination

1. Positive side of the Examination

The positive side of Examination is that it provides the examinee (the learner) an opportunity to

assess his/her knowledge of the concerned subject and also the level of his competence and capability.

2. Myth about Examinations

The myth about the Examinations is that Examination is the only and sole yardstick to measure, assess and judge the ability, calibre and competency level of examinee. The truth or reality is that out of many other techniques, examinations are only one such technique.

3. What to Avoid

While preparing for Examinations, the learner should avoid putting unnecessary stress on his/her mind and should not suffer what is generally known as 'Examination Fear'. He/she should not waste much time in cramming all the details and should concentrate on the main points of each lesson or the study material.

4. Revising for Examinations

Revising all that the learner has studied, is a must while preparing for examination. It provides an opportunity to the learner to recall all that he/she has studied so far. It also enables him/her to recollect at least the main points of each lesson or the study material.

5. Working out Tactics for Examinations and getting geared up Just Before Examinations

The learner must understand that the time before Examinations is the most crucial time for every learner some tactics for Examinations are

- Do revise your lesson/study material.
- Maintain the required level of self confidence.
- Do not allow yourself to suffer from Examination Fear.
- Do reach your Examination Centre well in time.
- The learner must keep in mind that he/she has to complete the answers of all the questions well before the alloted time so that he/she may be able to have a final look at his/her answer book and ensure that all the questions have been answered.

6. Attention Learners'

To know in detail please go through your social science book-1 & 2.

SCHEDULE FOR SUBMISSION OF THE TMA

For appearing in the Public Examination to be held in April/May

No. of Assignments	By Learners to study centres	Feedback by the Subject Teacher to the Learner
	Sec. & Sr. Sec. Level	Sec. & Sr. Sec. Level
TMA-I	5th December	15th December
TMA-II	5th January	15th January
TMA-III	5th February	15th February

For appearing in the Public Examination to be held in October/November

No. of Assignments	By Learners to study centres	Feedback by the Subject Teacher to the Learner
	Sec. & Sr. Sec. Level	Sec. & Sr. Sec. Level
TMA-I	5th June	15th June
TMA-II	5th July	15th July
TMA-III	5th August	15th August

1. Measurement in Science and Technology

- Measurement is a process of comparing a physical quantity with a standard quantity.
- The standard quantity used to compare a physical quantity for its measurement is called unit.
- The internationally accepted modern system of units used in science is known as SI units.
- If a physical quantity P is "n" times the standard quantity (unit) u, then

$$P = nu$$

- In SI units there are 7 basic units. These are metre for length, kilogram for mass, second for time, Kelvin for temperature, ampere for electric current, candela for luminous intensity and mole for amount of substances.
- The units obtained in terms of basic units are called derived units.
- In international system of units known as SI the basic units are defined as under:

(i) **Kilogram:** One kilogram is the mass of a particular cylinder made of Platinum Iridium alloy kept at the International Bureau of Weight and Measures in France.

(ii) **Metre:** one metre is the distnace travelled by light in vacuum in a time interval of 1/299792458 second.

(iii) **Second:** One second is the time required for cesium-133 atom to undergo 9192631770 vibrations.

(iv) **Kelvin:** One kelvin is equal to 1/273.15 of the thermodynamic temperature of tiple point of water.

(v) **Ampere:** One ampere is the current that when flowing through two long parallel wires, each of length equal to one metre, separated by one metre in free space, results in a force of 2×10^7 N between the two wires.

(vi) **Candela:** One candela is the luminous intensity, in a given direction of a source that emits monochromatic radiation of frequency 540×10^{12} Hz and that has a radiant intensity of 1/683 watt per steradian in that direction.

(vii) **Mole:** One mole is the amount of any substance, which contains, as may elementary units, as there are atoms in exactly 0.012 kg of C-12 isotops of carbon.

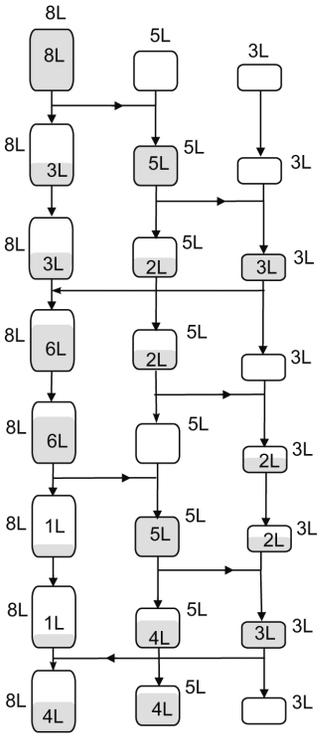
Build Your Understanding

- Classify the followings as basic units and derived units newton, kilogram, ms^{-2}, joule, kelvin, watt, kilo watt hour, second, metre.
- Which can be taken as standard; hand span, pace, light year, ton, dhanurmusti, maund.
- Express the following in basic units (i) newton (ii) joule (iii) pascal
- How will you measure the density of a solid block?
- Arrange the following in increasing order of their values. seer, ratti, chhantak, masha.
- Write the numeral value of the following SI prefixs: yotta, mega, micro, femto, yoco.
- Cite one example which shows that the power to which a unit with a prefix is raised applies to the whole unit, including the prefix.

Measurement and distribution

A milkman has only threee containers of capacity 8L, 5L and 3L. He has 8L of milk. Now he decides to divide the milk into two equal halves. How will he do it?

Let 8L milk be taken in the container of 8L capacity. Now he has to poure the milk as the process given below:



✔ Maximise Your Marks

- "Measurement is an essential part of our day to day activities" justify.
- In the ancient times parts of 'human body' were used for measurement. Give some examples of the same.
- Why were the ancient measurements replaced by SI units?
- Write three charactristics of Unit.
- In the statement p = nu, what do the symbols stand for?
- For measurement of which quantities are the followings units used:
  (i) Gaz (ii) Prahar (iii) quantal (iv) KVAH

★ Stretch Yourself

1. Rules while using SI prefixes

(i) No space is required between the prefix and the symbol of the unit.
(ii) The prefixes are used only with the units and not alone.
(iii) Use only one prefix at a time.
(iv) SI prefix is not used with the unit °C.

2. Rules for Representing SI units

(i) While writing the value of physical quantity, the number and the unit are separated by a space.
(ii) No space is given between number and °C, degree, minute and second of plane angle.
(iii) The symbols of the unit are not changed while writing them in plural.
(iv) The symbols of the units are not followed by a full stop except at the end of a sentence.
(v) In writing the SI unit obtained as a combination of unit a space is given between the symbols.
(vi) When using powers with a unit name the modifier is used after the unit name.

? Test Yourself

1. Convert the followings into respective SI units
   (i) metric tone (ii) light year (iii) year
2. In what unit the following are measured (i) potatoes (ii) milk (iii) silk-ribbon (iv) land area.
3. Can a weighing machine with each division at 5 kg weigh 2 kilo mango?
4. Represent the following measurements by using suitable SI prefixes.
   (i) 2×10^{-8} s (ii) 1.54×10^{-10} m (iii) 1.98×10^{-6} mol
5. Convert the following into SI unit.
   (i) 1 litre (ii) 10000 cm^2 (iii) 100 decigram
   (iv) 760 cm of Hg coloumn

2. Matter in our Surroundings

- Anything that has mass and occupies space is matter.
- There are three different physical states of matter in which a substance can exist namely solid, liquid and gas.
- A particular state of matter can be changed into other states by changing the temperature and/or pressure.
- A solid has a definite size and shape which do not change on their own.
- A liquid has a definite size or volume and it takes shape of the container in which it is kept.
- A gas has no shape or size of its own. It occupies entire volume of the container in which it is kept.
- Matter can be classified on the basis of its composition as element, compound or mixture.
- An element is a basic form of matter that cannot be chemically broken down into simpler substances.
- A compound is a pure substance made from two or more than two elements chemically combined together in a definite proportion by mass.
- A homogeneous mixture is a mixture where the substances are completely mixed together and are indistinguishable. A homogeneous mixture is called a solution.
- A heterogeneous mixture is a mixture where the substances remain separate and the composition is not uniform.
- A suspension is a heterogeneous mixture where the dispersed particles are large enough to settle out eventually.

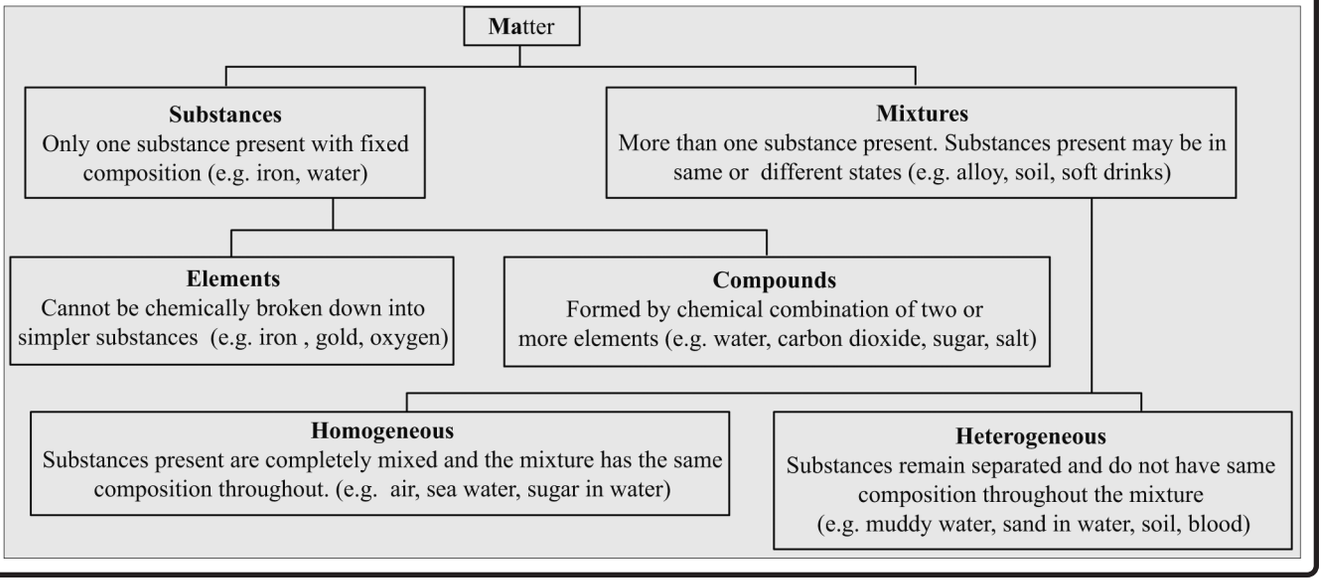
Build Your Understanding

Classification of matter

Matter can be classified as:

(i) by the physical state of matter as a solid, liquid and gas

(ii) by the chemical composition of matter as an element, compound and mixture



Solution and its concentration

The substance which is present in bigger quantity is normally taken as solvent and substance which is present in smaller quantity is normally taken as solute.

Concentration of a solution

It is defined as the mass of solute present in a definite volume of the solution. It may also be expressed in terms of percent by mass of solute in gram.

$$\% \text{ of solute} = \frac{\text{Mass of Solute}}{\text{Mass of Solution}} \times 100$$

A solution of 5% sugar by mass means that 100 gram of the solution contains 5 gram of sugar.

Suspensions

Materials of smaller particle size, insoluble in a solvent but visible to naked eyes form suspension. The size of particles in suspension is over 1000 nanometers.

Separation of mixtures

1. Separation by using separating funnel

The mixture of two immisible liquids like oil and water can be separated by this method

2. Separation by evaporation

This method is used to separate solvent and solid from a solution by heating or by solar evaporation.

3. Separation by filtration

This method is used to separate solids from liquids in heterogeneous mixtures. In filtration, the solid material is collected as a residue on filter paper and the liquid phase is obtained as filtrate.

4. Separation by crystallization

Crystallization is a process of formation of solid crystals from a solution. The process begins by evaporating the liquid allowed to cool slowly to form crystals which can be separated by filtration.

5. Separation by distillation

This method is used to separate a liquid from a solution of a homogeneous mixture. In this process the mixture is boiled in a distillation flask and the vapours are condensed as liquid.

6. Separation based on Magnetic properties

This method is used to separate magnetic and non-magnetic substances from their mixture by using a magnet. For example, iron granules which are magnetic can be separated from non-magnetic substances like sand, sugar etc.

Stretch Yourself

1. How much amount of glucose will be used to prepare a 10% solution of glucose in water.
2. Which method will be used to separate salt from sea water.

Test Yourself

1. Explain the interconversion of states of matter with the variation of temperature.
2. Differentiate between homogeneous and heterogeneous mixture.
3. Name the method which is used in the separation of iron from sand.
4. What do you mean by suspension and also suggest the size of particles?

3. Atoms and molecules

- According to ***law of constant proportions***, a sample of a pure substance always consists of the same elements combined in the same proportion by mass.
- When an element combines with another element and forms more than one compound, then different masses of the one element that combine with the fixed mass of another element are in the ratio of simple whole number or integer. This is the ***law of multiple proportions***.
- A molecule is the smallest particle of an element or of a compound which shows all properties of that substance and can exist freely under ordinary conditions.
- A molecule can be represented in the form of a chemical formula using symbols of elements that constitute it.
- Atom of the isotope C-12 is assigned atomic mass unit of 12 and the relative atomic masses of all other atoms of elements are obtained by comparing them with it.
- **The mole is the amount of a substance which contains the same number of particles (atoms, ions or molecule)** as there are atoms in exactly 0.012 kg of carbon-12.
- Avogadro's number is defined as the number of atoms in exactly 0.012 kg (or 12 g) of C-12 and is equal to 6.02×10^{23}. Avogadro's constant is written as 6.02×10^{23} mol^{-1}.
- Mass of one mole atoms or one mole molecules or one mole of formula unit of a substance is its **molar mass**.
- The composition of any compound can be represented by its formula. For writing the formula of a compound, valence or valency of an element is used. This is normally done in case of covalent compounds.
- Valency is the combining capacity of an element.

Learner Guide

Build Your Understanding

Atoms and Molecules

An atom is the smallest particle of an element that retains the chemical properties of the element. An atom of one element is different in size and mass from the atoms of the other elements.

Atomic Mass

The masses of atoms are obtained by comparison with C-12 isotope which has been arbitrarily assigned a mass of exactly 12 atomic mass units.

Atomic Number

The number of protons in the nucleus is called atomic number and is denoted by Z.

Total number of protons and neutrons is called mass number and is denoted by A. An element X with atomic number Z and mass number A is denoted as ${}^{A}_{Z}X$.

Isotope

Atoms of an element that have the same atomic number (Z) but different mass number (A). For example: ${}^{16}_{8}O$, ${}^{17}_{8}O$ and ${}^{18}_{8}O$.

Molecule

A molecule is an aggregate of two or more than two atoms of the same or different elements in a definite arrangement. A molecule of a substance shows all chemical properties of that substance. Examples : H_2O, NH_3, C_2H_5OH.

Molecular formula

A molecule is represented in the form of a formula known as molecular formula. For example CO_2, H_2O, CH_4 etc.

Molecular mass

It is the sum of atomic masses of all the atoms present in that molecule.

Mole Concept

A mole is the amount of a substance that contains as many elementary entities (atoms, molecules, formula units or other fundamental particles) as there are atoms in exactly 0.012 kg (12 grams) of carbon-12 isotope.

The number of atoms in 12 gram of C-12 is 6.022×10^{23}. This number is called Avogadro's number.

Molar Mass

Mass of one mole of a substance is called its molar mass. It is expressed in the unit of $g\ mol^{-1}$.

Laws of chemical combination

1. Law of conservation of mass

In every chemical reaction, total masses of all the reactants is equal to the masses of all the products.

2. Law of definite or constant proportion

In a given chemical compound, the proportions by mass of the elements that compose it are fixed.

3. Law of multiple proportions

When two elements form more than one compound, the masses of one element in these compound for a fixed mass of the other element are in the ratio of small whole numbers.

Chemical Formula of Compounds

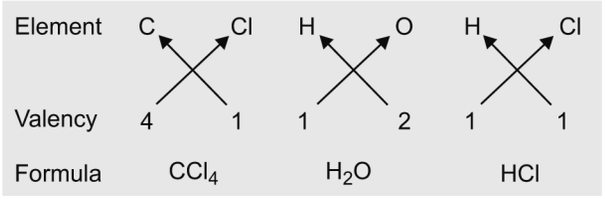
A compound is represented by a shorthand notation known as chemical formula. In this, the atoms of elements constituting a compound are indicated by their symbols and their number is indicated as a subscript on the right hand bottom of the symbol.

Valency and Formulation

The combining capacity of an element is called its valency.

Chemical Formula

For writing chemical formula, we have to write valencies on the symbol of the element and then cross over the valencies of the combining atoms. For example, CCl_4, H_2O, HCl.



Stretch Yourself

1. Define atom and molecule.
2. Write down the postulates of Dalton's atomic theory
3. If valency of an element 'X' is 2 and another element 'Y' is 3, then what is the formula of compound formed by combination of X and Y?

Test Yourself

1. The atomic number of an element is 20 and its atomic mass is 40. Calculate number of electrons, protons and neutrons in it.
2. What is an isotope? Chlorine is obtained as a mixture of two isotopes $^{35}_{17}Cl$ and $^{37}_{17}Cl$. These isotopes are present in the ratio of 3 : 1. What will be the average atomic mass of chlorine?
3. Calculate the molecular mass of calcium chloride.
4. Define mole and find out the molar mass of the molecule S_8 and O_3.

4. Chemical Reactions and Equations

- A chemical equation is a shorthand description of a reaction. It symbolically represents the reactants, products and their physical states.
- In a balanced chemical equation, number of atoms of each type involved in the chemical reaction is equal on the reactants and products sides of the equation.
- If charged species are involved, the sum of the charges on reactants should be equal to sum of charges on the products.
- During balancing of a chemical equation, no change in the formula of reactant(s) and product(s) is allowed.
- A balanced chemical equation obeys the law of conservation of mass and the law of constant proportions.
- In a combination reaction two or more substances combine to form a new single substance.
- In a decomposition reaction, a single substance decomposes to give two or more substances. Thus decomposition reactions are opposite to combination reactions.
- Reactions in which heat is given out during product formation are called **exothermic reactions** and reactions in which heat is absorbed during product formation are called **endothermic reactions**.
- A displacement reaction is one in which an element displaces another element from its compound.
- When two different ions are exchanged between two reactants double displacement reaction occurs.
- Precipitation reactions are the result of ion exchange between two substances, producing insoluble salts.
- Oxidation is the gain of oxygen or loss of hydrogen and reduction is loss of oxygen or gain of hydrogen. Oxidation and reduction reactions occur simultaneously and are jointly called ***redox reactions***.
- Redox reactions can broadly be defined in terms of loss and gain of electrons. Gain of electron(s) is reduction and loss of electrons is oxidation.

Learner Guide

Build Your Understanding

Chemical Equations

Chemical reactions are conveniently represented with the help of a chemical equation using chemical formulae of reactants and products as shown below

Reactants $\longrightarrow$ Products

Types of Chemical Reactions

Chemical reactions are classified into the following categories:

1. **Combination Reactions** are the ones in which a single product is formed from two or more reactants. Example:

   $C(s) + O_2(g) \longrightarrow CO_2(g)$

2. **Decomposition Reactions** are those in which a compound decomposes into two or more substances (elements or compounds).

Types of decomposition reactions

(i) **Thermal Decomposition Reaction** is the one in which the decomposition occurs with the help of heat Example:

$$CaCO_3\ (s) \xrightarrow{\text{heat}} CaO(s) + CO_2\ (g)$$

(ii) **Electrolytic Decomposition Reaction** is the one in which the decomposition occurs with the help of electrical energy. The process is called **electrolysis**. Example:

$$2H_2O(l) \xrightarrow{\text{electrolysis}} 2H_2\ (g) + O_2\ (g)$$

3. **Displacement Reactions** are those in which one element displaces another element from its compounds. Example:

$$Zn\ (s) + CuSO_4\ (aq) \longrightarrow ZnSO_4\ (aq) + Cu\ (s)$$

4. **Double Displacement Reactions** are those in which there is an exchange of ions between the reactants. Example:

$$Na_2SO_4\ (aq) + BaCl_2\ (aq) \longrightarrow BaSO_4\ (s)\downarrow + 2NaCl\ (aq)$$

Exothermic and Endothermic Reactions

Exothermic Reactions are those in which heat is given out. Example:

$$CaO(s) + H_2O\ (l) \longrightarrow Ca(OH)_2\ (aq) + \text{heat}$$

Endothermic reactions are those in which heat is absorbed. Example :

$$2Pb(NO_3)_2(s) \xrightarrow{\text{heat}} 2PbO(s) + 4NO_2(g) + O_2(g)$$

Oxidation and Reduction (Redox) Reactions

(i) **In terms of loss or gain of oxygen:** When a substance gains oxygen during a reaction, it is said to be **oxidized** (process is called oxidation) and when a substance loses oxygen during a reaction, it is said to be reduced (the process is called reduction) and the reaction is called a **redox** reaction.

(ii) **In term of loss or gain of electrons:** The species which loses electrons is said to be oxidized and the process is called oxidation and the species which gains electrons is said to be reduced and the process is called reduction.

Oxidizing and Reducing Agents

Oxidizing agent is the substance which oxidizes another substance. It itself gets reduced in the reaction.

Reducing agent is the substance which reduces another substance. It itself gets oxidized in the reaction.

Effects of Redox Reactions in Everyday Life

Two commonly observed effects are (i) corrosion and (ii) rancidity

(i) Corrosion

It is a destructive chemical process in which metals are oxidized in presence of air and moisture.

Examples (i) Rusting of iron (ii) tarnishing of silver (iii) formation of green coating on copper, brass and bronze items

Prevention of corrosion

(i) Applying a protective coating such as oil or paint

(ii) Plating the metal (iron) with a layer of less reactive or less easily oxidizable metal such as nickel

(iii) Connecting or coating of a more reactive or more easily oxidizable metal such as connecting with magnesium or coating a layer of zinc (galvanization)

(ii) Rancidity

Rancidity is the process of oxidation of fats and oils resulting in the formation of acids. This process changes the smell and taste of stale fats and oil. Prevention :

(i) Keeping food items in air tight containers

(ii) Addition of antioxidants to food items which prevent the oxidation process.

Stretch Yourself

1. Balancing of chemical equations is often a tedious task. Why can't we use unbalanced equation?
2. A balanced chemical equation can provide a lot of information involving moles, masses and volumes of substances taking part in a reaction. Which one of the following equations provides less information and why?

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

   (b) $H_2 + I_2 \longrightarrow 2HI$

Test Yourself

1. Balance the following equation

   $Fe_2O_3\,(s) + CO\,(g) \longrightarrow Fe(s) + CO_2\,(g)$

2. Identify what types of reaction is this?

   $Zn\,(s) + CuSO_4\,(aq) \longrightarrow ZnSO_4(aq) + Cu(s)$

3. In the reaction

   $2Na(s) + Cl_2\,(g) \longrightarrow 2NaCl(s)$

   Identify the substance that

   (i) loses electrons

   (ii) gains electrons

   (iii) is oxidising agent

   (iv) is reducing agent

4. What are antioxidants and what is their use?

5. Atomic Structure

- According to Dalton's atomic theory, the atom is considered to be the smallest indivisible constituent of all matter. This theory could explain the law of conservation of mass, law of constant composition and law of multiple proportions.
- Sir J.J.Thomson discovered that when very high voltage was passed across the electrodes in the cathode ray tube, the cathode produced rays that travel from cathode to anode and were called **cathode rays**.
- Eugen **Goldstein** discovered anode rays by using a perforated cathode (a cathode having holes in it) in the discharge tube filled with air at a very low pressure. The discovery of anode rays established the presence of positively charged proton in the atom.
- According to Thomson's plum-pudding model, atoms can be considered as a large sphere of uniform positive charge with a number of small negatively charged electrons scattered throughout it.
- The α-ray scattering experiment performed by Geiger and Marsden led to the failure of Thomson's model of atom.
- The results of α-ray scattering experiment were explained in terms of Rutherford's model. According to which the atom contains a dense and positively charged region called **nucleus** at its centre and the negatively charged electrons move around it. All the positive charge and most of the mass of atom is contained in the nucleus.
- In 1932, James Chadwick discovered an electrically neutral particle in atom and named it as **neutron**.
- The number of protons in an atom is called the atomic number and is denoted as 'Z'. On the other hand the number of nucleons(protons plus neutrons) in the nucleus of an atom is called its mass number and is denoted as 'A'
- The electrons are distributed in different shells in the order of increasing energy. The distribution is called electronic configuration. The maximum number of electrons present in a shell is given by the formula $2n^2$, where 'n' is the number of the orbit or the shell.
- The valence is the number of chemical bonds that an atom can form with univalent atoms. If the number of valence electrons is four or less, then the valency is equal to the number of the valence electrons. On the other hand, if the number of valence electrons is more than four, then generally the valency is equal to 8 minus the number of valence electrons.

Build Your Understanding

Constituent Particles of Atom

Electron, proton and neutron are the three constituent particles of atom and their properties are given in the following table.

Particle	Symbol	Mass (in kg)	Actual Charge (in Coulombs)	Relative charge
Electron	e	$9.109\ 389 \times 10^{-31}$	$1.602\ 177 \times 10^{-19}$	–1
Proton	p	$1.672\ 623 \times 10^{-27}$	$1.602\ 177 \times 10^{-19}$	1
Neutron	n	$1.674\ 928 \times 10^{-27}$	0	0

Earlier Models of Atom

Thomson Model: The atom can be considered as a sphere of uniform positive charge in which negatively charged electrons are scattered throughout.
Drawback could not explain the results of α-ray scattering experiment:

α-ray Scattering Experiment

A stream of α-particles from a radioactive source was directed on a very thin gold foil and their scattering was observed.

Actual observations

Most of the α-particles passed straight through the gold foil. Some of these were deflected by small angles and very few were deflected by large angles and rarely rebounded back (See figure)

Rutherford's Atomic Model

An atom consists of very small nucleus at the centre which contains all the positive charge and most of its mass. In rest of the space electrons revolve around the nucleus. Results of a-ray scattering could be explained by this model as shown the following figure.

Drawbacks of Rutherfords model

1. Accending to Maxwell's electromagnetic theory, if a charge particle like electron accelerates (revolves) around nucleus it would continuously lose energy and fall into nucleus.
   However, atoms are stable and such a collapse does not occur.
2. This model does not say anything about the way the electrons are distributed around the nucleus.
3. This model is not able to explain the relationship between the atomic mass and atomic number.

Bohr's Model of Atom

This model is based on two postulates

Postulate 1: The electrons move in definite circular paths of fixed energy around a central nucleus. These paths are called **orbits** or **energy level or shells**.

Later on, the concept of circular orbits was modified to energy shells. While a circular orbit is two dimensional, a shell is a three dimensional region. These shells are represented by letters K, L, M, N etc. or by positive integers 1, 2, 3 ... etc. (Fig. ...) The energies of the shells increase with these integers, (represented by n). Shell with n = 1, is of the lowest energy.

Postulate 2: The electron can change its shells or energy level by absorbing or releasing energy. An electron at a lower state of energy E_i can go to final higher state of energy E_f by absorbing a single photon of energy is given by $E = h\nu = E_i - E_f$. Similarly, when an electron changes its shell from a higher initial level of energy E_i to a lower final level of energy, E_f a single photon of energy $h\nu$ is released.

Atomic Number and Mass Number

Atomic number Z = number of protons = number of electrons (in neutral atom)

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

Atomic notation

An atom X with atomic number Z and mass number A is denoted as

$$^{A}_{Z}X$$

Distribution of electrons in different orbits

The maximum number of electrons present in a shell is given by the formula $2n^2$ as given in the table below.

Value of n	Shell name	Maximum capacity
1	K-Shell	$2 \times 1^2 = 2$
2	L- Shell	$2 \times 2^2 = 8$
3	M- Shell	$2 \times 3^2 = 18$
4	N- Shell	$2 \times 4^2 = 32$

Valency

It is the number of chemical bonds that an atom can form with univalent atoms. The electrons in the outermost shell are known as, valence electrons valency of an atom is determined by the number of it valence electrons.

- If the number of valence electrons is four or less then the valency is equal to the number of the valence electrons.
- If the number of valence electrons is more than four, then generally the valency is equal to 8 minus the number of valence electrons.

Stretch Yourself

1. We observe that matter present around us in various forms is quite stable which atomic model was rejected on the basis of this observation?
2. Valency of an element is 4 and electron are present in K, L and M shells of its atom. What is the number of protons present in its nucleus.

Test Yourself

1. Name the two constituent particles of atom in each case that have
   (a) equal charges (with opposite signs)
   (b) nearly equal masses
   (c) are present in the nucleus of the atom
2. How does an orbit differ from a shell?
3. Which atomic model could not explain the results of α-ray scattering experiment/
4. What is the maximum number of electrons that can be present in N shell?
5. Find out the number of electrons, protons and neutrons present in an atom $^{17}_{8}X$

6. Periodic Classification of Elements

- The first classification of elements was as metals and non-metals.
- After the discovery of atomic mass (old term, atomic weight) it was thought to be the fundamental property of elements and attempts were made to correlate it to their other properties.
- John Dobereiner grouped elements into triads. The atomic mass and properties of the middle element were mean of the other two. He could group only a few elements into triads. For example (i) Li, Na and K (ii) Ca, Sr and Ba (iii) Cl, Br and I.
- Newlands tried to see the periodicity of properties and stated his law of octaves as "*When elements are arranged in the increasing order of their atomic weights every eighth element has properties similar to the first*". He could arrange elements up to calcium only out of more than sixty elements then known.
- Mendeleev observed the correlation between atomic weight and other properties and stated his periodic law as, "*The chemical and physical properties of elements are a periodic function of their atomic weights*".
- Mendeleev gave the first periodic table which is named after him which included all the known elements. It consists of seven horizontal rows called **periods** and numbered them from 1 to 7. It has eight vertical columns called **groups** and numbered them from I to VIII.
- Main achievements of Mendeleev's periodic table were (i) inclusion of all the known elements and (ii) prediction of new elements.
- Main defects of Mendeleev's periodic table were (i) position of isotopes, (ii) anomalous pairs of elements like Ar and K and (iii) grouping of dissimilar elements and separation of similar elements.
- Moseley discovered that atomic number and not atomic mass is the fundamental property of elements. In the light of this the periodic law was modified to "The *chemical and physical properties of elements are periodic functions of their atomic numbers*". This is the Modern Periodic Law.
- Modern Periodic Table is based upon atomic number. Its long form has been accepted by IUPAC. It has seven periods (1 to 7) and 18 groups (1 to 18). It is free of main defects of Mendeleev's periodic table. Elements belonging to same group have same number of valence electrons and thus show same valency and similar chemical properties.
- Arrangement of elements in the periodic table shows periodicity. Atomic radii and metallic character increase in a group from top to bottom and in a period decrease from left to right.

Build Your Understanding

Classification of Elements

Major attempts were made for classification of elements

1. Dobereiner's Triads
2. Newlands' Law of Octaves
3. Mendeleev's Periodic Law & Periodic Tables
4. Modern Periodic Table

Mendeleevs Periodic law

We will start with the Mendleev's periodic classification. ***The chemical and physical properties of elements are a periodic function of their atomic masses.***

Merits of Mendeleev's Periodic Classification

Classification of elements (all 63 elements known at that time classify.)

Correction of atomic masses, atomic masses of Be, Au (Gold) corrected

Prediction of new elements: Germanium, Gallium

Defects

- Position of Hydrogen could not be explain.
- Position of isotopes could not explain.
- Anomalous pairs of elements
- Grouping of chemically dissimilar elements
- Separation of chemically similar elements

Modern periodic Law

Chemical and physical properties of elements are periodic functions of their atomic number. If the elements are arranged in the order of their increasing atomic numbers the elements with similar properties are separated after certain regular intervals.

Merits of the Modern Periodic Table

- Position of isotopes can be explain.
- Anomalous pairs are corrected.
- Electronic configuration can be explain
- Separation of metals and non-metals
- position of transition element

Variation in Periodical Properties

1. Atomic Size

- Increases in groups from top to bottom due to increase in the number of shells
- Decreases in the periods from left to right due to increase in attraction between nucleus and valence electron

2. Metallic character

- Increase in the group from top to bottom due to the tendency to loose the electron increases
- Decreases in the periods from left to right because tendency to loose the electron is decreaases.

Stretch Yourself

1. How many groups and periods are available in modern period table?
2. How is the position of isotopes justified in modern periodic table?
3. Carbon is non-metal but lead is a metal why?

Test Yourself

1. Mendeleev's could not explain the position of isotopes in the periodic table why?
2. Potassium is more metallic in nature as compared to Lithium.
3. Carbon is less metallic in nature as compared to Lithium
4. Atomic size decrease in the periodic table from left to right but increases in the groups from top to bottom explain
5. What do you mean metalloids? Give few examples of metalloids

7. Chemical Bonding

- The basic cause of chemical bonding is to attain noble gas configuration either by transfer of electron from a metal to non- metal or by sharing of electrons between two non-metal atoms.
- All the atoms have a tendency to acquire stable state or noble gas configuration and is called **Octet Rule.**
- Atoms of elements in a molecule are held together by **Chemical Bonding.** The formation of chemical bonds result in the lowering of energy which is less than the energy of the individual atoms. The resulting compound is lower in energy and hence more stable.
- There are two types of chemical bonding : ionic bonding and covalent bonding.
- Ionic Bonding: The chemical bond formed by transfer of electrons from a metal to a non-metal is known as Ionic Bond or Electrovalent bond.
- Ionic compounds are solid, hard, have high melting and boiling points. They are soluble in water but insoluble in organic solvents .They are good conductor of electricity in molten state and in aqueous solution.
- Covalent Bonding: The chemical bond formed by mutual sharing of equal no. of electrons between two atoms.
- On the basis of sharing of number of electrons by each atom, covalent compounds are classified as single bonded, double bonded and triple bonded. When sharing of one electron takes place from both the atoms , single bond is formed. Like Cl-Cl or Cl_2 and H-H or H_2.
- Double bond is formed when two similar atoms share two pair of electrons e.g. O=O or O_2 and triple bond is formed when there is sharing of three electrons from each atom. e.g. N≡N or N_2.
- Covalent compounds mostly have liquid or gaseous state. Some are solid also. They have low melting point, low boiling point. They are insoluble in water but soluble in organic compounds. They are non- conductor of electricity.

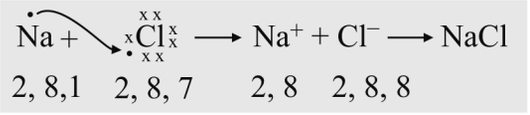
Build Your Understanding

Types of chemical bonds and their properties

Ionic bonding or electrovalent bond

The chemical bond formed by transfer of electron from a metal to non-metal is known as ionic bond

$$Na\ (s) + Cl_2\ (g) \longrightarrow 2NaCl$$



Condition for Ionic Bonding

- Tendency to loose the electron of donor atom should be high.
- Tendency to gain the electron by acceptor should be high
- Electrostatic force of attraction should be strong

Properties of Ionic Compounds

- Solids, hard and brittle in nature
- High M.P and B.P (strong electrostatic forces)

Learner Guide

- Good conductor of electric in molten state or in aqueous solution (see ions)
- Soluble in ionic solvent such as H_2O

Covalent bond

A bond which is formed by sharing of electron between the atoms is called covalent bond

Sharing of one pair of electrons represented by a single bon Cl–Cl

Sharing of two pairs electrons represented by a double bond O = O

Sharing of three pairs electrons represented by a triple bond N≡N

The covalent bond forms when the forces of attraction and repulsion balance each other and the potential energy is minimum.

Properties of covalent compounds

- exist as liquid or gases state
- Low M.P. and B.P.
- do not conduct electricity
- Soluble in non-ionic solvents such as ethanol

Stretch Yourself

1. Write down the conditions for the formation of ionic bond.
2. Name the type of bonds formed by
   (i) Sharing of electron between the atoms.
   (ii) Transfer of electron from one atom to another atom.

Test Yourself

1. What type of bond exist in the following
   (i) MgO (ii) $CaCl_2$
   (iii) H_2 (iv) O_2
2. Solid sodium chloride is a conductor of electricity or not. Explain.
3. Is CCl_4 soluble in water or not? Explain.

8. Acids, Bases and Salts

- Acids are the substances which taste sour, change **blue litmus red**, are corrosive to metals and furnish H^+ ions in their aqueous solutions.
- Bases are the substances which taste bitter, change **red litmus blue**, feel slippery and furnish OH^- ions in their aqueous solutions.
- Indicators are the substances that show one colour in an acidic medium and another colour in a basic medium. Litmus, phenolphthalein and methyl orange are commonly used indicators.
- Acids are presents in many unripe fruits, vinegar, lemon, sour milk etc., while bases are present in lime water, window pane cleaners, many drain cleaners etc.
- Aqueous solutions of acids and bases both conduct electricity as they dissociate on dissolving in water and liberate cations and anions which help in conducting electricity.
- Strong acids and bases dissociate completely in water.
- Weak acids and bases dissociate partially in water.
- Acids and bases react with each other to produce salt and water. Such reactions are called **neutralization** reactions.
- Water itself undergoes dissociation and furnishes H^+ and OH^- ions in equal numbers. This is called self dissociation of water.
- Concentrations of H^+ and OH^- ion formed by the self dissociation of water are 1.0×10^{-7} molar each at 25°C.
- In pure water or in any aqueous solution pH + pOH = pKw = 14 at 25°C.
- In pure water $[H^+] = [OH^-]$. It is also true in any neutral aqueous solution. In terms of pH, pH = pOH = 7 in water and any neutral solution.
- In acidic solution $[H^+] > [OH^-]$ and pH < pOH. Also pH < 7 at 25°C.
- In basic solutions $[H^+] < [OH^-]$ and pH > pOH. Also pH > 7 at 25°C.
- If pH of rain water falls below 5.6, it is called acid rain and is quite harmful.

Learner Guide

Build Your Understanding

Characteristics of Acids and Base

The term acid comes from Latin term 'accre' which mean sour. We can characterise the acids and bases as

Acids	Bases
• taste sour	• taste bitter
• corrosive metals	• feel slippery or soapy
• change blue litmus red	• change red litmus blue

- An acid is a substance which furnishes hydrogen ion (H^+) when dissolved in water

  $HCl\ (aq) \longrightarrow H^+(aq) + Cl^-(aq)$

- A base is a substance which furnishes hydroxide ions (OH^-) when dissolved in water.

  $NaOH\ (aq) \longrightarrow Na^+(aq) + OH^-(aq)$

  The term '**alkali**' is often used for water soluble bases.

- A salt is the product of neutralization process when acid is added into base or vice versa salt and water are formed.

$$\underset{\text{Acid}}{HCl\ (aq)} + \underset{\text{Base}}{NaOH\ (aq)} \longrightarrow \underset{\text{Salt}}{NaCl} + \underset{\text{Water}}{H_2O\ (l)}$$

Indicator

There are many substances that show one colour in an acidic medium and another colour in a basic medium. Such substances are called acid-base indicators.

The colour of these indicator in acidic, neutral and basic solutions are given below

Indicator	Colour in acidic solutions		Colour in neutral solutions		Colour in basic solutions	
Litmus		red		purple		blue
Phenolphthalein		colourless		colourless		pink
Methyl orange		red		orange		yellow

Chemical Properties of Acids and Bases

Corrosive nature of acids

- Acids attack various substances such as metals, metal oxide, metal hydroxides called as corrosive nature of acids.
- Not related to strength of acids but depends on negatively charged part of acid

  HF is a weak acid but reacts with glass

$$\underset{\text{glass}}{SiO_2} + 4HF \longrightarrow SiF_4 + 2H_2O$$

Neutral, acidic and basic solution and pH

Ionic product of water

$$Kw = [H^+]\ [OH^-]$$

$$Kw = (1.0 \times 10^{-7}) \times (1.0 \times 10^{-7})$$

$$= 1.0 \times 10^{-14}$$

Nature of solution	concentration of H^+ ion at 298 K
Neutal	$[H^+] = 1.0 \times 10^{-7}$ mol L^{-1}
Acidic	$[H^+] > 1.0 \times 10^{-7}$ mol L^{-1}
Basic	$[H^+] < 1.0 \times 10^{-7}$ mol L^{-1}

pH

The pH is the logarithm of the reciprocal of the hydorgen ion concentration. It is written as

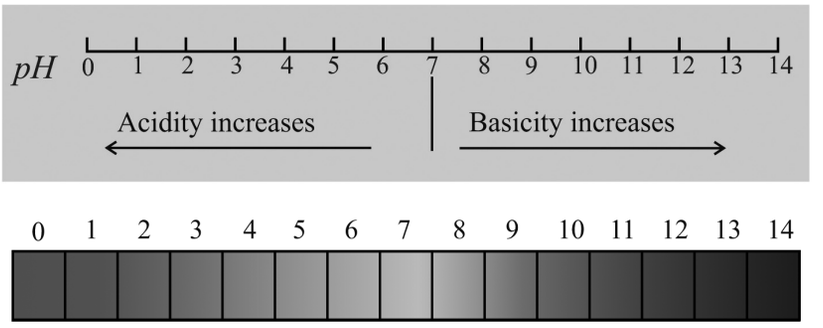
$$pH = \log \frac{1}{[H^+]}$$

or $pH = -\log [H^+]$.

Because of the negative sign in the expression, if $[H^+]$ increases, pH would decrease and if it decreases, pH would increase.

pH Scale

The pH scale ranges from 0 to 14 on this scale.



Important Compounds

Baking Soda ($NaHCO_3$)

Raw materials

- Lime stone ($CaCO_3$)
- Concentrated NaCl Solution (brine)
- Ammonia (NH_3)

Solvey's process

$$CaCO_3 \xrightarrow{\text{heat}} CaO + CO_2$$

$$NaCl + CO_2 + NH_3 + H_2O \longrightarrow NaHCO_3 + NH_4Cl(aq)$$

Use

(i) Cooking (baking powder)
(ii) in medicine
(iii) Fir extinguisher

Washing soda ($Na_2CO_3.10H_2O$)

$$2NaHCO_3 \xrightarrow{\text{heat}} Na_2CO_3 + H_2O + CO_2$$

$$Na_2CO_3 + 10H_2O \longrightarrow Na_2CO_3.10H_2O$$

sodium carbonate — washing soda

Uses

- removing permanent hardness of water.
- domestic purpose (cleaning)
- Manufacture of NaOH, glass borax etc.

Plaster of Paris $2CaSO_4.H_2O$ or $CaSO_4.½H_2O$

$$CaSO_4.2H_2O \xrightarrow[100°C(373\ K)]{\text{heat}} CaSO_4.1/2H_2O + 3/2H_2O$$

gypsum — plaster of paris

or $2CaSO_4.H_2O$

Uses

- For making toys and statues.
- Fire proof materials.
- Chalk, in medicine
- Homes (design)

Bleaching Powder ($CaOCl_2$)

- Slaked lime, $Ca(OH)_2$
- Chlorine gas, Cl_2

$$Ca(OH)_2 + Cl_2 \longrightarrow CaOCl_2 + H_2O$$

Uses

1. bleaching of cotton and linen.
2. Manufacture $CHCl_3$
3. germicide
4. oxidising agent

Stretch Yourself

1. Lemon and orange juices changes the colour of blue litmus paper to red but the aqueous solution of ammonia and sodium hydroxide changes red litmus paper to blue. Explain the nature of all.
2. How will you differentiate between acids and bases on the basis of pH?
3. Write down the chemical composition of baking powder.
4. What will happen if a dry litmus paper come in contact with dry HCl gas?
5. Why HF is not stored in glass bottle?

Test Yourself

1. What happens when H_2SO_4(aq) and KOH(aq) are mixed
2. Corrosive nature of acid is dependent on the strength of acid or not
3. Classify the following into strong and weak acids and bases

   $RbOH, HClO_4, HNO_3, HCOOH, HF, NH_4OH$
4. Choose acidic, basic and neutral from the following

   Solution A — pH < pOH
   Solution B — pH = pOH
   Solution C — pH > pOH

9. Motion and its Description

Motion: A continuous change in the position of the object with respect to time is called motion.

Rectinear motion: If an object moving in a straight line changes its position with respect to time.

Circular motion: When an object moves at a constant distance from a fixed point, its motion is called circular motion.

Periodic motion: A motion which repeats itself after certain fixed interval of time is called periodic motion

Oscillatory motion: A motion which is repeated about its mean position periodically is called oscillatory motion e.g. motion of simple pendulum.

Distance: The length of the path fallowed by a body is called distance.

Displacement: The shortest distance between initial and final position of the object is called displacement. It is vector quantity.

Speed: Distance travelled by a body in unit time is called speed i.e.

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$

Average speed: $\dfrac{\text{Total distance travelled}}{\text{Total time taken}}$

Velocity: Displacement of a body in unit time is called velocity i.e. $\dfrac{\text{Displacement}}{\text{Time taken}}$

The unit of velocity in SI system is m/s. Other commonly used unit is km/h. It is a vector quanity.

The SI unit of distance and displacement is metre (m), of speed, velocity, average speed and averge velocity is ms^{-1}.

Acceleration: The rate of change of velocity is called accelertion. i.e.

$$\text{Acceleration} = \frac{\text{Final velocity} - \text{initial velocity}}{\text{Time}}$$

$$a = \frac{v-u}{t}$$

The unit of acceleration in SI unit is ms^{-2}. It is a vector quantity.

Equations for uniformly accelerated motion:

$$v = u + at \quad \text{(i)}$$

$$s = ut + \frac{1}{2}at^2 \quad \text{(ii)}$$

$$v^2 = u^2 + 2as \quad \text{(iii)}$$

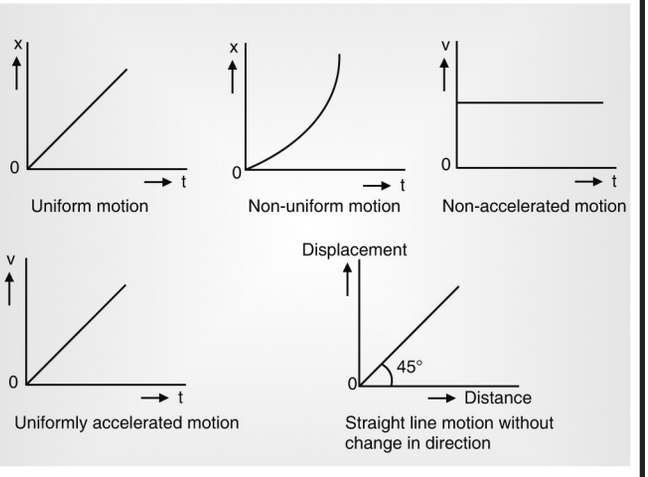
where u = initial velocity
v = final velocity
a = acceleration
s = distance
t = time

Distancwe travelled by a body in n^{th} second:

$$s = u + \frac{a}{2}(2n-1)$$

Here $n = n^{th}$ second

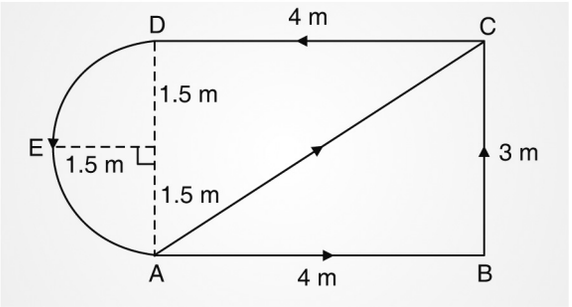
Graphical representation of motion



Build Your Understanding

- A person starts from point A and moves following path (i) ABC (ii) AC (iii) ACDE and takes 12 min, 14 min and 20 min in all these cases respectively.

  Find (a) distance and displacement (b) speed and velocity in all these cases.



Sol:

(a) (i) 7 m, 5 m (ii) 5 m, 5m

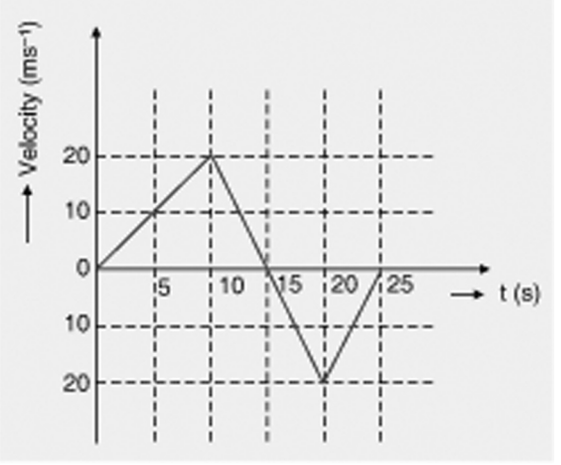
(iii) 11.93 m, $1.5\sqrt{2}$ m

(b) (i) $\frac{7}{720}\text{ms}^{-1}, \frac{5}{720}\text{ms}^{-1}$

(ii) $\frac{5}{840}\text{ms}^{-1}, \frac{5}{840}\text{ms}^{-1}$

(iii) $\frac{11.93}{1200}\text{ms}^{-1}, \frac{1.5\sqrt{2}}{1200}\text{ms}^{-1}$

- Find distance, displacement and maximum acceleration from the given graph.



Sol:

Distance = $\frac{1}{2}\times 20(15)+\frac{1}{2}\times 20(10) = 250$ m

Displacement = 150 – 100 = 50 m

Maximum acceleration = $\frac{20-0}{25-20} = 4\ \text{ms}^{-2}$

Plan Your Jorney

If Nimish covers x_1 distance in time t_1 with speed v_1 and x_2 distance in time t_2 with speed v_2, then Average speed

$$= \frac{x_1 + x_2}{t_1 + t_2}$$

$$= \frac{v_1 t_1 + v_2 t_2}{t_1 + t_2}$$

$$= \frac{(x_1 + x_2) v_1 v_2}{x_1 v_2 + x_2 v_2}$$

✔ Maximise Your Marks

There is a smooth pole of height 18 m. A monkey climbs up 3m and slips down 2 m over the pole again and again. If time of each climb and slip is 6 min and 2 min respectively, then find (i) number of climbs to reach at the top of the pole (ii) average velocity, (iii) average speed (iv) distance travelled and (v) displacement of monkey.

Sol. (i) 16 (ii) $\frac{18}{126\times 60}$ ms–1

(iii) $\frac{48+30}{126\times 60}\ \text{ms}^{-1}$ (iv) 78 m

(v) 18 m

Stretch Yourself

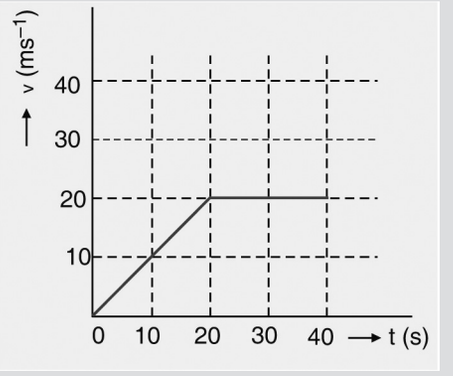
1. If a body does not move in the same direction its displacement is less than the distance.
2. Distance is path dependent while displacement is position dependent.
3. Displacement can be zero but distance can not be zero.
4. Instantaneous speed is the magnitude of instantaneous velocity but average speed is not the magnitude of average velocity.
5. Average velocity is less than or equal to the aveage speed.
6. Average velocity can be zero but not average speed.

Test Yourself

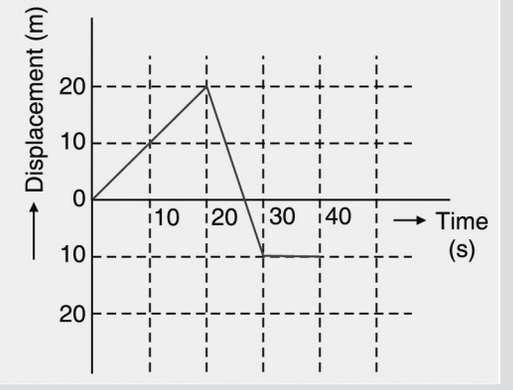
1 An object is dropped from a height of 19.6 m. Find the time taken and the velocity of the object when it reaches the ground.

2. Krishna goes from her house to Kalpna's house with the speed of 40 kmh^{-1}. When she just reaches her house she came to know that the gift given to Kalpna is left at home and returns the home immediately with speed of 60 kmh^{-1}. Find the average speed of Krishna.

3. Find the acceleration and displacement of an object from the given velocity-time graph.



4. Find the distance and displacement for the entire motion of an object shown in graph.



5. An object is dropped from the height of 78.4 m at the same time another object is thrown vertically up with the speed of 39.2 ms^{-1}. When and where will they meet?

10. Force and Motion

Inertia: The property of a body which tends to keep the body in its state of rest or of uniform motion is called inertia.

Momentum: Measure of motion is called momentum i.e. momentum = mass × velocity

$$p = mv$$

Laws of motion

First law: whenever a body is at rest or uniform motion it will continue in rest or in uniform motion until or unless an external unbalanced force is applied on the body.

Second Law: The rate of change of momentum of a body is directly proportional to the force acting on it and takes place in the same direction as the force i.e.

$$F \propto \frac{dp}{dt}$$

$$F = k\frac{dp}{dt}$$

$$F = \frac{dmv}{dt} \quad (\because \ p = mv \text{ and } k = 1)$$

$$= m\frac{dv}{dt}$$

$$F = ma \qquad \left(\because \ a = \frac{dv}{dt}\right)$$

The S.I. unit of force is Newton.

Third Law: To every action there is an equal and opposite reaction but they act on different objects.

Law of Conservation of Momentum: It states that the momentum of a system remains unchanged (conserved/constant) if no external force is acting on the system i.e.

$$F = \frac{p_2 - p_1}{t} \qquad \text{(From Newton's second law)}$$

When $F = 0$ i.e. external force is not applied

Then $$0 = \frac{p_2 - p_1}{t}$$

i.e. $p_1 = p_2$ i.e. no change in its momentum

Friction: Whenever a body slides over the surface of another body, an oppositing force comes into play which resists the motion of the body and is called force of friciton.

Static friciton: The resistive force before the body starts moving over the surface of an other body is called static friciton

Disadvantages of Friction

(i) Force of friction causes lot of wear and tear in the moving parts of machine.

(ii) Eficiency of machine decreases due to presence of force of friction

(iii) Force of friction restricts the speed of moving vehicles.

Advantages of Friction

(i) The force of friciton between chalk and blackboard helps to write on the board.

(ii) Moving belt remain on the rim of a wheel because of friction.

(iii) Force of friciton helps us to move on the surface of the earth.

Methods of reducing friction

(i) Polishing of surfaces (ii) Lubrication

(iii) Use of ball bearings and roller bearings.

Thrust: The force acting upon the surface of a body perpendicular to it is called thrust.

Pressure: Thrust per unit area is called pressure i.e. $\text{pressure} = \frac{\text{Thrust}}{\text{Area}} \Rightarrow \frac{F}{A}$. The unit of pressure is $\frac{\text{N}}{\text{m}^2}$ or (pascal)

Build Your Understanding

- Inertia is measure of mass.
- A person gets hurt when he falls on a cemented floor because the momentum of person becomes zero within very short time. As the rate of change of momentum is very high, so very large force is exerted on the person.
- The force of reaction appears so long as the force of action acts.
- Action and reaction act on two different bodies.
- Friction depends upon normal reaction i.e.

$$f \propto R$$

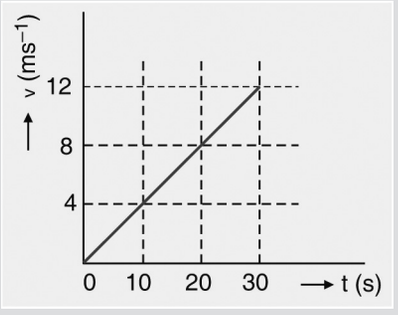
- Friction does not depend on surface area of given bodies which are in contact with each other.

Stretch Yourself

1. Can unbalanced forces acting on the body change its state of rest or motion?
2. Can balanced forces change the state of rest or motion?
3. Why do massive objects resist more than lighter ones?
4. A bullet when fired from a gun can kill person. while same bullet thrown with hand hardly do any harm. Explain.
5. Why do porters caryying heavy load, wear turbans on their heads?

Test Yourself

1. Velocity-time graph of a body of mass 2 kg is shown in figure. Find the rate of change in momentum of the body.



2. A block of mass 5 kg is resting on an inclined plane at angle of 30° with the horizontal. What are the forces acting on the body.
3. The velocity of a 2 kg object changes from 4 ms^{-1} to 12 ms^{-1} in 6s. Find the acceleration of the body and force acting on the body.
4. The body of mass 5 kg gets acceleration of $2ms^{-2}$ under the influence of a certain force. If same force is applied on a body of mass 2 kg. What acceleration will it acquire?
5. A force of 5 N is required to keep a body in motion with constant velocity. What is the force of kinetic friciton acting on it?
6. Can force of action and reaction act on the same body? Write its consequences with examples.

11. Gravitation

Gravity: The gravitational force due to earth is called gravity.

Newton's law of gravitation: In this universe all things attract each other. The force of attraction acting between two bodes of masses m_1 and m_2 separated by a distance r is directly proportional to product of their masses and inversely proportional to square of the separation between them.

i.e. $$F \propto \frac{m_1 m_2}{r^2}$$

$$F = \frac{G m_1 m_2}{r^2}$$

Here G is proportionality constant is called Gravitation constant i.e. $G = 6.67 \times 10^{-11}$ $Nm^2 \times kg^{-2}$

Relation between g (Acceleration due to gravity) and G (gravitation constant)

$$F = \frac{GMm}{r^2} \quad \text{(i)}$$

(From Newton's law of gravitation)

$$F = mg \quad \text{(ii)}$$

(From Newton's second law)

From (i) and (ii)

$$mg = \frac{GMm}{r^2}$$

$$g = \frac{GM}{r^2}$$

The value of g near the surface of the earth is taken as 9.8 ms^{-2}

Motion of object under gravity:

When a body is falling down then a is replaced by g

(i) $v = u + gt$ (ii) $s = ut + \frac{1}{2} gt^2$ (iii) $v^2 = u^2 + 2gs$

when a body is thrown up then a is replaed by (–g)

(i) $v = u - gt$ (ii) $s = ut - \frac{1}{2} gt^2$ (iii) $v^2 = u^2 - 2gs$

Buoyancy: Whenever a body is immersed in a fluid, an upward force is exerted by the fluid on the body, called force of buoyancy or buoyant force. This is also known as upthrust.

Archimedes Principle

When a body is immersed fully or partially in a fluid, it experiences an upward force that is equal to weight of the fluid displaced by it.

Build Your Understanding

- A weighing machine measures the reaction R which is equal to the weight of the body.
- Astronaut in space experiences weightlessness because normal reaciton R is zero. Therefore astronaut appears to be floating weightlessly.

Mass	*Weight*
(i) Matter contained by a body is called mass of the body.	(i) The gravitational force acting on a body is called weight.
(ii) It is represented by m.	(ii) It is represented by W.
(iii) It is measured by physical balance.	(iii) It is measured by spring balance.
(iv) It is scalar quantity.	(iv) It is a vector quantity.
(v) The unit of mass is kg.	(v) The unit of weight is Newton.
(vi) Mass of a body remains constant	(vi) Weight of body may change from place to place in accordance wtih g.

✔ Maximise Your Marks

- The value of acceleration due to gravity (g) is maximum at poles and minimum at equator.
- The gravitational force is always attractive in nature.
- The magnitude of the buoyant force acting on a body at a given place depends on the density of the liquid and volume of the body immersed in the fluid.
- A body inside a freely fallig laboratory under gravity is weightless.
- Gravitational forces are very weak forces.
- Acceleration produced due to force of attraction by the earth is known as acceleration due to gravity.
- Acceleration due to gravity of the moon is 1/6 of the acceleration due to gravity of the earth.

★ Stretch Yourself

1. Why do two objects of different masses fall at same rate, when dropped from the same height?
2. Why do two students sitting close to each other not feel force of gravitational force of attraction between them?
3. Does the buoyant force act on a body when it is kept in vacuum?
4. Does a body experience same bouyant force when it is immersed in different liquids separately?

? Test Yourself

1. A ball is thrown upwards and rises to a height of 19.6 m. Calculate –
   (a) The velocity with which the ball was thrown.
   (b) The time taken by the ball to reach the highest point.
2. State two factors on which weight of an object depends.
3. A body weights 3.5 N in air and 2 N in water. How much buoyant force acts on the body?
4. What is the mass of the object whose weight is 90 N? (given $g = 9.8\ ms^{-2}$)
5. Why does a caped empty bottle released under water bounces back to the surface of water?

12. Sources of Energy

- Energy is the ability to do work. It exists in different forms.
- Some of the energy sources can be replenished in a short period of time such sources are called "renewable sources" of energy.
- The sources of energy that can not be regenerated in a short period of time are called "non-renewable sources" of energy.
- Fossil fuels like coal, petroleum and natural gas are the examples of non-renewable sources of energy and Sun, windmill, hydroelectric generator, etc. are the example of renewable sources of energy.
- Energy can be obtained from atom (nuclear energy) and biomass as well.
- In addition to the renewability, there are other reasons why we should look to switching over to such sources, such as:
  - (a) To reduce pollutants, green house gases and toxins that are byproducts of non-renewable sources of energy.
  - (b) The use of alternative energy sources can help preserve the delicate ecological balance of the earth, and help conserve the non-renewable energy sources like fossil fuels; and
  - (c) Renewable sources are inexhaustible.
- All plants and animals get their energy from the Sun.
- Some of the advantages of using solar energy are:
  - (a) Use of solar energy causes no environmental pollution, because no chemical waste or toxic gases get released while using solar energy.
  - (b) solar energy can be used for practical purpose such as heating and lighting.
  - (c) The sun is an ever lasting source of energy which is freely available, and can be converted into electrical energy and put to many uses.
- Using the Sun as a source of energy has certain limitations. Solar power plants can not produce energy if the sun is not shining. During night time and cloudy days it is not possible to produce energy from Sun. Establishment of solar power stations is very expensive. Solar panels need to be regularly maintained and cleaned to continue generating electricity.
- Nuclear energy is non-renewable as the fuels are consumed in the fission reaction and hence are not replenishable. But it has many uses such as:
  - (i) Energy produced in a nuclear reactor can be harnessed to produce electricity.
  - (ii) Nuclear energy is also being used to power submarines and ship. Vessels driven by nuclear energy can sail for long periods without having to refuel.
  - (iii) Radio isotopes obtained as by products in nuclear reactions are used in medicine, agriculture and research.
- Geothermal energy is used for heating homes and for generating electricity without producing any harmful emissions. It has following advantages:
  - (i) Unlike most power stations, a geothermal power plant does not create any pollution. Harnessed correctly, it leads to no harmful byproducts.

(ii) Geothermal power plants have very low running costs. Because they require energy to run a water pump. There is also no cost for purchasing, transporting, or cleaning up of fuels.

(iii) Geothermal power plants are an excellent source of clean and inexpensive renewable energy.

(iv) Geothermal energy can be used to produce electricity 24 hours a day.

(v) Geothermal power plants are generally small and have little effect on the natural landscape, or the near environment.

Build your Understanding

- Classify the following as renewable and non-renewable sources of energy. Sun, ocean, wind, coal, natural gas, wood.

  Sun, ocean and wind are the renewable sources of energy.

  Coal, natural gas and wood are the non-renewable source of energy.

- Sun is the ultimate source of energy. Justify.

  Every energy source gets energy from Sun directly or indirectly. Therefore, Sun is the ultimate source of energy.

- Where should a wind mill be establish? What are advantages of wind energy?

  Wind mill should be established at a place where flow of wind is very strong like coastal areas.

  (i) Wind energy is free of cost and reliable.

  (ii) Wind energy is clean and produces no environmental pollution.

  (iii) In wind power generation no harmful by-products are left over.

  (iv) Farming and grazing can still take place on land occupied by wind which can help in the production of bio-fuels.

- Hydroelectric energy is clean energy. Write some disadvantage of it.

  Few disadvantage of hydroelectricity are:

  (i) The hydroelectric power plants can not be sited at a place of our choice. There must be a strong current or considerable height to make the production worthwhile, as the capital cost of setting up production is relatively quite high.

  (ii) Dams can be very expensive to build.

- How will you use tidal power of ocean to generate energy?

  The tidal energy of ocean can be harnessed by trapping water at high tide and then capturing its energy as it rushes out and drops to low tide. When tides come into the shore, they can be trapped in reservoirs behind dams. And when the tide drops, the water behind the dam can be let out just like in a regular hydroelectric power plant.

✔ Maximise Your Marks

- There are different types of energy sources. The sources of energy which can be used again and again are called renewable sources and those which can not be used again are called non-renewable source of energy.
- Any one form of energy can be converted into another form of energy.
- The energy sources which do not pollute the environment are called clean energy sources.
- Some common source of energy are:
  - (i) Coal,
  - (ii) Natural gas,
  - (iii) Nuclear energy,
  - (iv) Solar energy,
  - (v) Wind
  - (v) Hydroelectric,
  - (vii) Geothermal,
  - (viii) Ocean,
  - (ix) Biomass.
- For future we should make use of renewable source of energy as much as possible. We should not depend upon the non-renewable source of energy.

★ Stretch Yourself

1. The coal based power plants first burns the coal in large furnaces creating tremendous amounts of heat. The heat is used to boil water in boilers so as to convert it into steam. The steam expands, causing pressure to increase in boiler. A steam turbine is placed at the exit of the boiler so that the moving steam rotates the turbine to produce electricity.
2. The particles formed on burning of fossil fuels are very dangerous. These small particles can exist in air for indefinite periods of time, upto several weeks and can travel two miles. The particle, sometime smaller than 10 microns in diameter, can reach deep within the lungs. The particles smaller than this can enter the blood stream, irritating the lungs and carry with them toxic substances such as heavy metals pollutants. Those affected by these particles could become affected with fatal asthma and other serious pulmonary diseases.
3. If the nuclear chain reaction is uncontrolled, all the nuclei in the piece of uranium split in a fraction of a second and this may cause a devasting explosion – such as those of the atom bombs.
4. The pressure and temperature increase as one move closer to the centre of earth. As one moves outwards from the inner core, he/she encounters the outer core and then mantle followed by the crust. The mantle is a layer that is below the crest of the earth. This is said to go down 2900 km, its temperature is about 870ºC. The outer core has a very high temperature which ranges from 4400ºC to 6100ºC. The outer core begins where the mantle ends and it extends further down to the centre 2250 km. The inner core is about 6400 km below the earth surface. The temperature of the inner core of the earth is at high of about 7000ºC.

? Test Yourself

1. Write the advantages of renewable source of energy over non-renewable source of energy.
2. Write the disadvantages of renewable source of energy over non-renewable source of energy.
3. Mention the limitation of (i) Wind energy, (ii) solar energy, and (iii) biomass energy.
4. How best use of solar energy can be made?
5. Explain the formation of electrical energy from coal energy.
6. Explain a conventional source of energy.
7. Reason out the energy crisis in our country.
8. Explain few methods of mitigating energy crisis.

13. Work and Energy

Work: The product of displacement and force in the direction of displacement of a body is called work. i.e. work = Displacement × Force in the direction of displacement.

The unit of work is Joule in m.k.s. system and erg in C.G..S. system.

$$1 \text{ Joule} = 10^7 \text{ erg}$$

Energy: The capacity of a body to do work is called energy. i.e. Energy possessed by a body = Total work that the body can do

The m.k.s. unit of energy is Joule.

Joule: When a body moves through a distance of 1 m under the force of 1 N in the direction of force, then work done by the body is said to be 1J.

Different forms of energy:

(i) **Kinetic energy:** The energy possessed by a body due to its motion is called kinetic energy. i.e. KE = ½ mv^2. Here m is mass and v is velocity of the body.

(ii) **Potential energy:** The energy possessed by a body due to its position is called P.E. Potential energy = mgh

(iii) **Mechanical energy:** The energy possessed by a body due to position or motion is called mechanical energy. i.e. Mechanical energy = PE + KE

(iv) **Thermal energy:** The energy which gives us sensation of warmth is called thermal energy.

(v) **Light energy:** The energy which helps us see things is called light energy.

(vi) **Electrical energy:** The energy due to moving charges is called electrical energy.

(vii) **Nuclear energy:** The energy released in nuclear reactions by conversion of mass into energy is called nuclear energy.

Power: The time rate of doing work is called power. i.e. power = work done/time

The SI unit of power is **Watt**. It is also measured in horse power, 1 HP = 746 watt

Watt: If one Jule of work is done by a body in one second, then power of a body is said to be one watt.

Build your understanding

- When you try to push a wall you do not do any work as distance moved by the body is zero.
- When no force is applied on the body and the body is either at rest or moving with constant velocity then no work is done.
- If force and displacement are perpendicular to each other then work done by force is zero. e.g. A person carrying a load on his head and moving on level road does no work against gravity.

Since no component of force is there in the direction of force of gravity.

- Energy can neither be created nor destroyed but it can be converted from one form to another form.

✔ Maximise Your Marks

- Remember that Kilowatt hour is a unit of energy. Power is measured in watt or kilo watt.
- 1 k watt = 1000 watt, 1 kwh = 3.6×10^6 Joule
- Calculate the energy spent in converting 100 g of ice into water at 0ºC.

$$Q = mL$$
$$m = 100 \text{ g}$$
$$= 100 \times 80 \text{ cal}$$
$\{\because L$ = Latent heat of ice
$$= 80 \text{ cal/g}\}$$
$$= 100 \times 80 \times 4.18 \text{ J}$$
$(\because 1 \text{ cal} = 4.18 \text{ Joule})$
$$= 33440 \text{ Joule.}$$

★ Stretch Yourself

1. Does work done depend on the path?
2. A ball of mass 0.5 kg has 100 J of kinetic energy. What is the velocity of the ball?
3. State law of conservation of energy.
4. Why road accidents at high speed are worse than accidents at low speed?
5. In which of the following situations work is done?
   (a) A person is climbing up a staircase.
   (b) A satellite revolving around the earth in closed circular orbit.
   (c) Two teams play a tug of war and both pull with equal force.
   (d) A person is standing with heavy load on his head.

? Test Yourself

1. What type of energy is possessed by water stored in a dam?
2. Vishrut is moving with speed 10 m/s in circular path of radius 10 m. What work is doen by vishrut to complete one revolution?
3. What will be the percentage increase in kinetic energy of a body if its velocity is doubled?
4. Alok climbs up a staircase in 5 minutes, Vishrut takes only 3 minutes in going up the same staircase. The weight of Alok and vishrut is equal, which one will spend more power?
5. Calculate the work done in lifting a 5 kg mass through a height of 2 m from the ground. ($g = 9.8 \text{ ms}^{-2}$)

14. Thermal Energy

- Thermal energy, also called heat, is a form of energy which gives us sensation of hotness. Like other forms of energy its SI unit is Joule (J)
- Temperature is a measure of hotness of a body. It is measured in, ºF, ºC or K, with the help of a device called thermometer.
- The three scales of temperature are related as:

$$\frac{C}{100} = \frac{F-32}{180} = \frac{K-273}{100}$$

- Different types of thermometer are designed for different purposes for measuring human body temperature doctors use a clinical thermometer, for measurement of temperature of bodies in laboratory, laboratory thermometers are used, for measuring the highest and lower value of atmospheric temperature meteorologists use maximum and minimum thermometer.
- When heat is supplied to a substance and its state does not change, the temperature of the substance rises. The heat gained or lost by a substance is given by

$$Q = mc\theta$$

where m = mass, c = specific thermal capacity and θ = rise or fall in temperature.

- Specific thermal capacity of a substance (also called its specific heat) is defined as heat per unit mass per degree change in temperature. Its SI unit $Jkg^{-1}K^{-1}$.
- When heat is supplied to a substance and it changes from solid to liquid or liquid to gaseous state (or vice-versa) there is no change in its temperature. The heat supplied during change of state is called Latent heat of the substance. The Latent heat of a substance is defined as heat required to change a unit mass of substance from one state to another without change in its temperature, i.e., $L = Q/m$
- There are two types of latent heats of a substance: Latent heat of fusion and latent heat of vaporization. SI unit of latent heat is $J\ kg^{-1}$.
- The constant temperature at which a solid changes to its liquid state is called melting point and the constant temperature at which a body changes from liquid to gaseous state is called boiling point.

  Melting point and boiling point are characteristic properties of the substance. Thus the substance which melt at 0ºC and boils at 100ºC is H_2O.
- All the substances expand on heating. Expansivity of different materials is different. However, the expansivity of liquids is more than solids, where as, the expansivity of gases is very much more than even liquids.
- Solids may increase in length, in breadth, as well as, in height, on heating. Therefore we define linear expansivity of a solid as the increase in length per unit original length per degree Celsius rise in temperature i.e. $\alpha = \frac{l_2 - l_1}{l_1(\theta_2 - \theta_1)}$. Also the volume expansivity of a substance is defined as $\gamma = \frac{\nu_2 - \nu_1}{\nu_1(\theta_2 - \theta_1)}$.

  The SI unit of expansivity is per Kelvin.
- A bimetallic strip bands on heating due to difference in expansivities of the two metals it is made of. Bimetallic strips are used in temperature control devices, called thermostats.
- While laying our structures we have to make provisions for thermal expansions or otherwise our structures will be damaged or get deformed to damage other things.

Build your Understanding

- A piece of metal and a piece of wood are lying in open. On a winter morning you measure temperatures. Will you find any difference in temperature? Obviously not, because, they both might have attained the temperature of the atmosphere.

  Now, you touch the two one by one. Which of the two you feel colder? Metal piece why so? Because, metal piece conducts heat and so more heat flows from your body to piece of metal.

- How much heat is required to convert 20 g of ice at –10ºC into steam at 100ºC. Given: Specific heat of ice = 0.5 cal g^{-1} $ºC^{-1}$, Specific Heat of water = 1 cal g^{-1} $ºC^{-1}$, Latent heat of fusion of ice = 80 cal/g. Latent heat of vapourization of water = 540 cal/g. Express the result in S.I. unit.

  Ans: For this conversion heat is absorbed in the following steps:

  (i) For converting –10ºC ice into 0ºC ice,

  $$Q_1 = mc\theta = 20\text{g} \times \frac{0.5 \text{ cal}}{0°\text{C}} \times 10°\text{C}$$

  $= 100$ cal.

  (ii) for converting 0ºC ice into 0ºC water

  $Q_2 = mL = 20 \times 80 = 1600$ cal

  (iii) for converting 0ºC water in 100ºC water

  $Q_3 = mC'\theta' = 20 \times 1 \times 100 = 200$ cal

  (iv) For converting 100ºC water in 100ºC steam,

  $Q_4 = mL' = 20 \times 540 = 10800$ cal

  $\therefore$ Total heat required $= Q_1 + Q_2 + Q_3 + Q_4$

  $= 100 + 1600 + 2000 + 10800$ cal

  $= 14500$ Cal

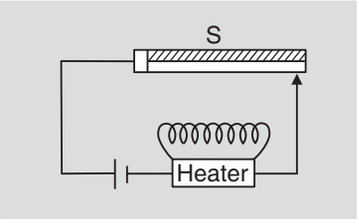
  1 Cal $= 4.18$ J

  $\therefore$ $Q = 14500 \times 4.18$ J

  $= 60610$ J

✔ Maximise Your Marks

1. The bimetallic strip in the diagram is made of iron and aluminum. Which side is iron if the circuit is broken on heating? Explain.



2. Why do liquids have two types but gases only are type of volume expansivity.

3. You have same amount of water and mercury at the same temperature. When equal size ice piece are placed in the two liquids which of them will supply more heat to ice? Explain.

★ Stretch Yourself

1. Why is the use of mercury preferred in most thermometers?
2. Give one example where we supply heat to a substance but its temperature does not rise and one example where we do not supply heat but temperature rises.
3. Why do you not use ice cold water in place of ice to cool your drinks?

? Test Yourself

1. What will be the value of 20ºC on Fahrenheit scale and Kelvin scale?
2. What will be the length of a rod of steel at 100ºC if it has a length of 1m at 0ºC. Expansivity of steel is 8×10^{-6} $ºC^{-1}$.
3. Describe an activity to show that real expansion of a liquid is greater than apparent expansion.

15. Light Energy

- Light is the form of energy which makes the objects visible to us. When light reaches from object to our eyes, it becomes visible to us.
- Reflection, refraction and dispersion are the important properties of light.
- In reflection the angle of incidence is equal to the angle of reflection and the frequency, speed and wavelength of light remain unchanged.
- In refraction, the ratio of the speed of light in one medium to another medium remains constant and called refractive index. Refractive index of medium 2 with respect to medium 1,

$$n_{12} = \frac{\text{speed of light in medium 1}}{\text{speed of light in medium 2}}$$

- The refractive index is also measured as the ratio of sine of angle of incidence to sine of angle of refraction, i.e., $n = \frac{\sin i}{\sin r}$
- For spherical mirror, the focal length of the mirror is half of the radius of curvature. The focal length (f), object distance (u) and image distance (v) for the mirror are related as

$$\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$$

This relation is called mirror formula.

- The distances referred to here are always measured from the pole. The distances measure in the direction of incident ray are taken as positive and in opposite direction of incident ray are taken as negative.
- In plane mirror virtual image of same size as object is formed behind the mirror at a distance equal to the distance of the object from the mirror.
- The number of images of an object placed between two plane mirrors inclined at an angle θ,

$$n = \left(\frac{360°}{\theta} - 1\right), \text{if } \left(\frac{360°}{\theta}\right) \text{ is even integer}$$

and $\quad n = \left(\frac{360°}{\theta}\right), \text{if } \left(\frac{360°}{\theta}\right)$ is odd integer

- Due to reflection in plane mirror left handedness is changed into right handedness and vice-versa. This is known as lateral inversion. However, the mirror does not invert vertically up and down.
- In refraction the image formed appears little closer as compared to the distance of real object such that

$$\text{apparent depth} = \frac{\text{Real depth}}{\text{Refractive index}}.$$

- The focal length of lens (f), the distance of object (u) and distance of image (v) from the lens are related as:

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$

This relation is called lens formula.

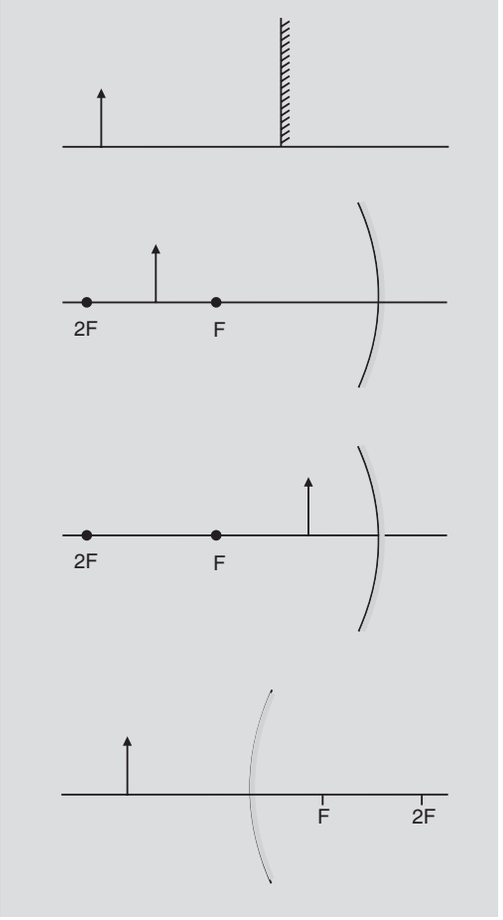
- When light passes through a prim it splits into its constituents colours. This phenomenon is called dispersion of light.
- The rainbow is the consequence of dispersion of light.
- A person who can see distant objects and not able to see the nearby objects is suffering from hyper metropia or long-sightedness. This defect of vision can be corrected by using convex lens.
- A person who can see the nearby objects and not able to see the distant objects is suffering from myopia or short-sightedness. This defect of vision can be removed by using concave lens.
- The least distance of distinct vision for normal human eye is 25 cm and far distance is infinity.

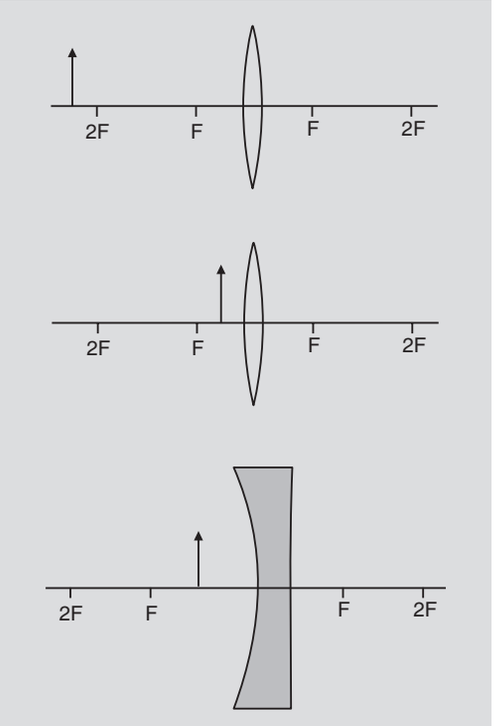
- The nature and position of image formed is given in the table.

	u	*v*	*nature*
For concave mirror/ Convex lens	$= f$ $> f < 2f$ $= 2f$ $> 2f$ ∞	∞ $> 2f$ $2f$ $< 2f > f$ f	Highly enlarged, real, inverted enlarged, real, inverted same size, real, inverted smaller, real, inverted highly diminished, real, inverted.
Convex mirror	Any value $< f$	Behind the mirror	Smaller, virtual and erect
Concave lens	Any value $< f$	On same side	Virtual, smaller and erect
Convex lens/ Concave miroor	$< f$	On same side/ Behind the mirror	Virtual, larger and erect

Build your Understanding

- Complete the ray diagrams for the formation of image.





- An object is placed at a distance of 30 cm from a convex lens of focal length 20 cm. Find the position and nature of the image.

Sol. For convex lens,

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$

$$\frac{1}{20}=\frac{1}{v}-\frac{1}{-30}$$

or $$\frac{1}{v}=\frac{1}{20}-\frac{1}{30}=\frac{3-2}{60}=\frac{1}{60}$$

or $v = 60$ cm.

Image will be enlarged, real and erect.

- The size of the image formed by a concave mirror of focal length 12 cm is double of the size of the object. Find the position of the object.

For concave mirror,

$$\frac{1}{f}=\frac{1}{v}+\frac{1}{u}$$

$$\frac{I}{O}=-\frac{v}{u}$$

$$\Rightarrow \quad -\frac{v}{u}=2$$

$$v=-2u$$

For real image v is negative

$\therefore \quad v = -(-2u) = 2u$

applying mirror formula

$$\frac{1}{f}=\frac{1}{v}+\frac{1}{u}$$

$$\frac{1}{-12}=\frac{1}{2u}+\frac{1}{u}=\frac{3}{2u}$$

$$\Rightarrow \quad u=-\frac{12\times 3}{2}=-18 \text{ cm}$$

(in front of the mirror)

For virtual image

v is positive

$\therefore \quad v = +(-2u)$

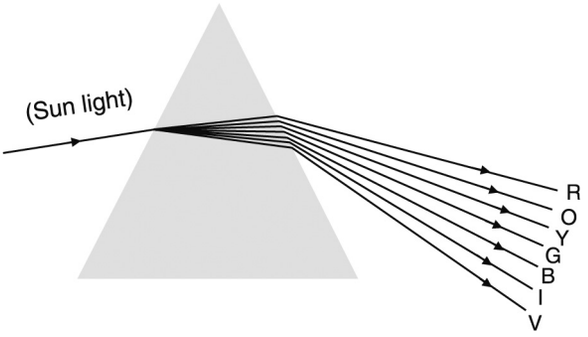
$$\therefore \quad \frac{1}{-12}=\frac{1}{-2u}+\frac{1}{u}$$

or, $$\frac{1}{-12}=\frac{+1-2}{-2u}=+\frac{1}{2u}$$

$$\Rightarrow \quad u = -6 \text{ cm} \quad \text{(in front of the mirror)}$$

- A fine beam of Sun light is incidents on one face of the prism. Draw the emergent rays and name the colours in the emergent beam in sequence.

Sol:



Changes During Refraction

- When light goes from rarer medium to denser medium its speed decreases due to which its wavelength decreases but the frequency remains constant, hence there is no change in colour. Colour is the function of frequency not of wavelength.

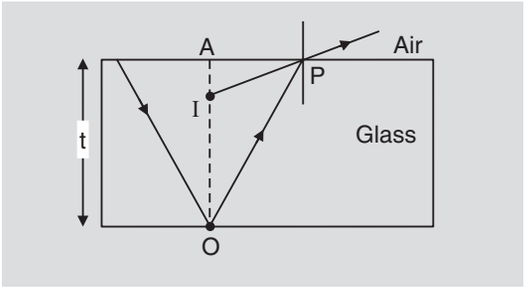
  For normal incidence, $i = r = 0$ but $n \neq 0$,

$$n=\frac{C_1}{C_2}=\frac{\lambda_1}{\lambda_2}$$

- Refractive index of glass

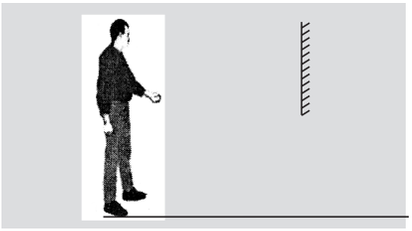
$$n=\frac{t}{AI}$$

or the apparent depth, $AI=\frac{t}{n}=\frac{\text{Real depth}}{\text{refractive index}}$

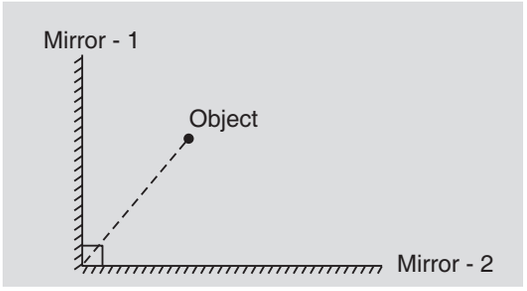


✔ Maximise Your Marks

- Draw the ray diagram for compete image formation and write the relation between the height of the object and mirror reqired.



- Draw ray diagram to show the formation of maximum number of images from the following arrangemtns of the mirrors.



★ Stretch Yourself

1. A plane mirror moves with velocity v toward a stationary object. What is the velocity of the image with respect to the object.
2. The distance between object and image is 40 cm. What is the position of the convex lens so that the size of the image and object are equal. Also write the value of focal length of the lens.
3. Does the colour of the image formed by convex lens depend upon the refractive index of the material of the lens?
4. Name the lens in which larger virtual image is formed.
5. Name the lens in which small and virtual image is formed.
6. Can a concave mirror form a virtual image? Mention the condition.

? Test Yourself

1. Find the value of v and write the nature of image in the given table

	u	*v*	*Nature of the image*
Convex lens of focal length 24 cm	16 cm	.....	.....
	36 cm	.....	.....
Convex mirror of focal length 12 cm	18 cm	.....	.....
	24 cm	.....	.....
	8 cm	.....	.....
Concave lens of focal length 20 cm	40 cm	.....	.....
	10 cm	.....	.....
Concave mirror of focal length 20 cm	15 cm	.....	.....
	40 cm	.....	.....
	60 cm	.....	.....

2. Mention the conditions of regular and diffused reflection.
3. Why does light split into its constituents colours when passed through a prism.
4. Explain:
   (i) In refraction of lenses if sides of the lens changes, there is no change in the focal length of the lens.
   (ii) When lens is placed in medium of refractive index greater than its material, it will behave as if it is of opposite nature, compared to what it behaves as when placed in a medium of lesser refractive index.
   (iii) In convex mirror and concave lens image formed is always virtual.
5. Can we take a photograph of virtual image?
6. In prism red colour light deviate least and violet colour light deviates most. Why?
7. Long-sightedness can be removed using convex lens and short-sightedness can be corrected removed by using concave lens. How?

16. Electrical Energy

- There are two types of charges: positive charge, i.e., the charge that a glass rod acquires when rubbed with silk and negative charge, i.e., the charge which an ebonite rod acquires when rubbed with flannel.
- Like charges repel each other while opposite charges attract each other.
- The force of attraction (or repulsion) between two charged particle is given by Coulomb's law, according to which the interaction force between two charged particles is directly proportional to the product of charges and inversely proportional to the square of the distance separating them, i.e., $F = \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{r^2}$, where $\frac{1}{4\pi\varepsilon_0}$ is a constant of proportionality and its value for charges placed in vacuum (or air) is 9×10^9 Nm^2C^{-2}.
- If we try to bring a small charge 'q' close to an already exiting similar charge, Q, called source charge, it experiences a force of repulsion. Hence work is to be done to bring it to any point at a distance from the source charge which is stored up as electrostatic potential energy. The electrostatic potential energy of the system of these two charges is given by:

$$U = \frac{1}{4\pi\varepsilon_0}\frac{Qq}{r}$$

- Potential energy per Coulomb of charge is called potential. Thus potential $\phi = \frac{U}{q} = \frac{1}{4\pi\varepsilon_0}\frac{Q}{r}$ is a function of position. Potential difference between two points in the surroundings of a source charge is given by:

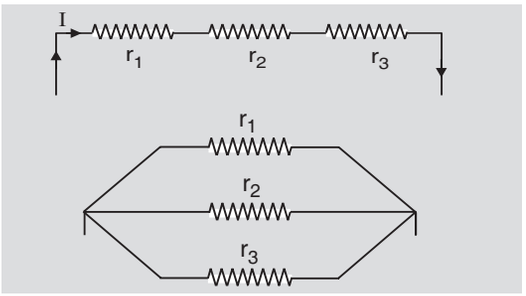
$$V = \phi_B - \phi_A = \frac{1}{4\pi\varepsilon_0}\left(\frac{Q}{r_B} - \frac{Q}{r_A}\right) = +\frac{U}{q} = +\frac{w}{q}$$

- The SI unit of potential difference is JC^{-1}, the other name for which is volt (V). Chemical cell, such as dry cell is a source of potential difference and voltmeter is a device which is used for measuring potential difference between two points.
- Charge is basically inherent in matter which is composed of atoms. Atoms, which themselves are neutral, are infact composed of a positively charged massive nucleus. and negatively charged electrons around it to fulfill the conditions of neutrality and stability.
- Electrically, materials are of two types: conductors which can conduct charges through them due to presence of large number of free electrons and insulators which do not conduct charge due to lack of sufficient number of free electrons.
- When a cell in connected across a conductor the free electrons move from lower to higher potential in external circuit. The flow of electrons from lower to higher potential in the conductor constitutes what is called electric current. Electric current is defined as the rate of flow of charge i.e., $I = \frac{Q}{t} = \frac{n|e|}{t}$.

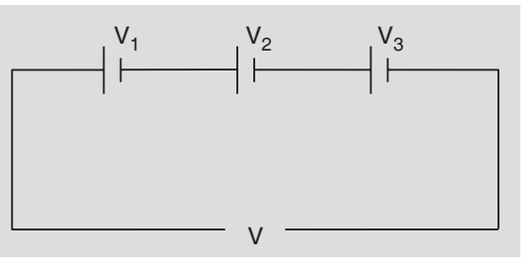
  Conventionally the direction of current is taken as the direction of flow of positive charge, that is, opposite to the direction of flow of electrons. Thus conventional current flows from positive to negative terminal of the cell in external circuit.
- Current is measured in amperes (A) with the help of a device called ammeter.
- When potential difference across a conductor is increased, the current through the conductor also increases such that the ratio $\frac{V}{I}$ remains constant. The relation $\frac{V}{I} = R$ is called Ohm's

law and the constant R is called resistance of the conductor. SI unit of resistance is ohm (Ω) and it is measured with the help of a device called Ohm-meter.

- Resistance of a given conductor is constant at a constant temperature and is given by $R = \rho\frac{l}{A}$, where ρ is called resistivity of its material, l = length and A = area of cross section.
- Resistance may be combined in two different ways: in series and in parallel. In series combination resistors are connected end to end in such a way that same current flows through all the resistors. In parallel combination one end of all the resistors is connected to the positive terminal of the battery and the other end to its negative terminal.



- The resistance of series combination is given by $R = r_1 + r_2 + r_3$. The resistance of parallel combination is given by $\frac{1}{R} = \frac{1}{r_1} + \frac{1}{r_2} + \frac{1}{r_3} + ...$
- A combination of cells is called battery. Normally we use series batteries, where in the total potential difference of the combination is given by the sum of the potential differences of individual cells. i.e., $v = v_1 + v_2 + v_3$



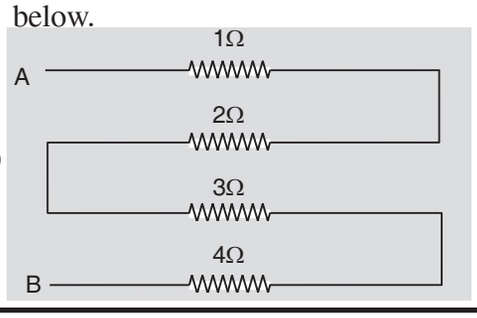
- There are three effects of electric current: heating effect, magnetic effect and chemical effect.
- When current is passed through a conductor, work is done in over coming the resistance, which manifests itself in the form of heat. This effect is called heating effect of electric current and is the basic principle behind electrical appliances like electric stove, electric iron, electric geyser, room heater, soldering iron and electric bulb etc.
- $Q = W = qV = VIt = \frac{V^2}{R}t = I^2Rt = Pt.$

  These relations help us to calculate heat produced in different situations.
- The electric energy is measured in kilowatt hour (kWh), 1 kWh = 3.6×10^6 J.

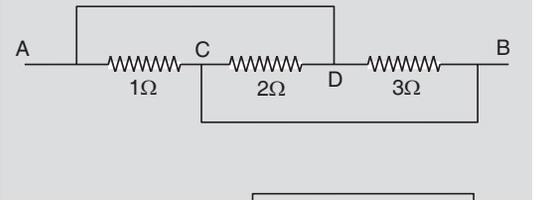
Build Your Understanding

1. Find the equivalent resistance between points A and B of the resistance combinations given below.

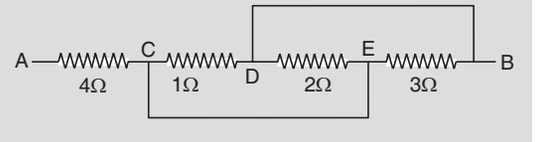
(i)



(ii)



(iii)

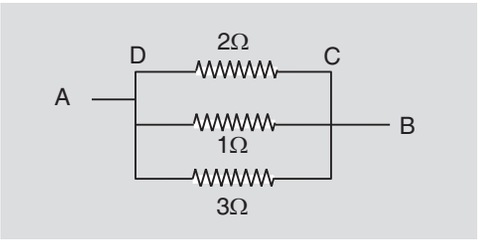


Sol:

(i) The resistances are connected in series:

$$R_{eq} = 1 + 2 + 3 + 4 = 10\ \Omega$$

(ii) As shown in the equivalent circuit the 3 resistors are connected in parallel

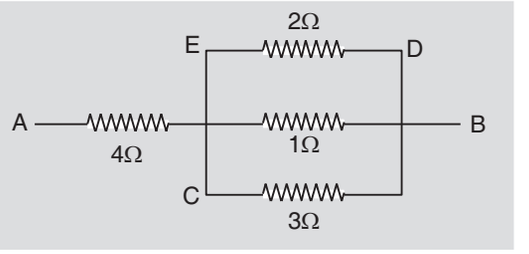


$$\therefore \quad \frac{1}{R_{eq}} = \frac{1}{2} + \frac{1}{1} + \frac{1}{3} = \frac{3+6+2}{6} = \frac{11}{6}$$

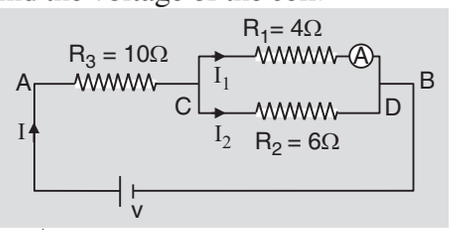
$$\Rightarrow R_{eq} = \frac{6}{11}\Omega$$

(iii) As shown in the equivalent circuit the four resistors are connected in mixed combination: A parallel combination of 1, 2, 3, Ω in series with 4Ω resistor. Therefore the equivalent resistance is

$$R_{eq} = 4 + \frac{6}{11} = \frac{50}{11}\Omega$$



2. In the adjoining circuit if ammeter reads 3A find the voltage of the cell.



Sol: $V_{CD} = I_1 R_1 = 3 \times 4 = 12\ \text{V}$

$$I_2 = \frac{V_{CD}}{R_2} = \frac{12}{6} = 2\ \text{A}$$

$$I = I_1 + I_2 = 3 + 2 = 5\ \text{A}$$

Total resistance $R = R_3 + \dfrac{R_1 R_2}{R_1 + R_2}$

$$= 10 + \frac{4 \times 6}{4+6} = 10 + 2.4 = 12.4\ \text{V}$$

$\therefore \quad V = IR = 5 \times 12.4 = 62\ \text{V}$

✔ Maximise Your Marks

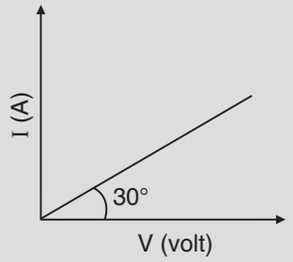
- kwh is the commercial unit of electrical energy. It is the unit in which your electric meter reads your electric energy consumption.
- Commercial unit of electric power is horse power (H.P.)

  1 H.P. = 746 W
- Because, energy E = P. t, take *t* in *s* if E is in J and take *t* in *h* if E is in kilowatt hour.
- You should know the electric consumption by various household appliances. Switch on the high power devices like geyser, electric iron, heater etc. for the time they are needed. Your geyser may consume 2 units in one hour.

★ Stretch Yourself

1. The power rating of a microwave oven is 1 kw. Calculate
   (i) current it draws from a 200 V mains.
   (ii) Cost of energy it consumes in 30 minutes at the rate of Rs 4/unit.
2. A carbon resistor has strips of different colours on its body as shown. What is the purpose of these colour strips.

3. Draw a circuit diagram for the experimental set up to verify Ohm's Law. I-V graph for a conductor is shown in fig. calculate its resistance.



Test Yourself

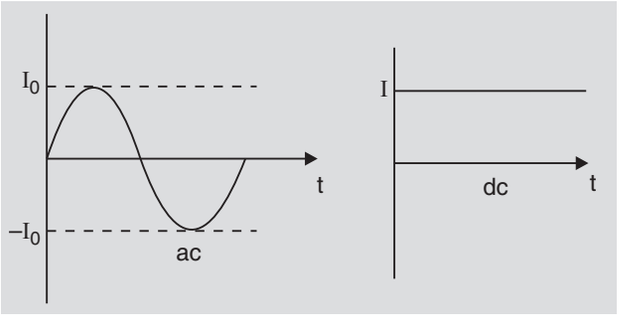
1. A wire of resistance R is stretched to double its length. How will its resistance change? (Assume no change in temperature). Will there be any change in its resistivity?
2. 3 cells of 2 V each are connected in series. What will be the voltage of the combination?
3. A 100 watt lamp is lighted 5 h a day for thirty days. Calculate the cost of energy consumed at the rate of Rs 4 per unit.

17. Magnetic Effect of Electric Current

- Magnet is a naturally occurring or artificially designed material which has a peculiar property of attracting some materials like iron, nickel and cobalt, called magnetic materials.
- Magnets also have a directional property due to which a magnetic bar when suspended freely always stays in north-south direction. In this situation the end of the magnet which points towards geographical north is called north pole and the one which points towards south is called south pole. The directional property of a magnet is explained by visualizing a large magnet inside the earth with its north pole near the geographical south pole of the earth and vice versa.
- Directional property of magnet is being utilized by navigators for finding direction using a magnetic device called magnetic compass.
- The two poles of a magnet are inseparable and like poles repel each other while unlike poles attract each other.
- Electricity and magnetism were considered two separate phenomena, until, in 1820 Dutch Scientist HC Oersted found that when current is passed through a conductor a magnetic needle lying alongside shows a deflection. Thus magnetism is now seen as a magnetic effect of electric current.
- When direct current is passed through a cylindrical coil of wire (called solenoid), it behaves like a magnet. The strength of the electromagnet depends on: the number of turns per unit length in the coil, the strength of current and material of the core inside it. Again, if the core is of soft iron the magnetism goes as soon as the current is switched off, however, if the core is of material like carbonized steel magnetism stays even when the current is switched off.
- Electromagnets are used in many electrical devices like electric bell, telegraph, magnetic cranes etc.
- A current carrying conductor placed in a magnetic field (i.e., near a magnet) experiences a force, the magnitude of the force is given by $F = BIl \sin\theta$, where B = strength of the field, I = current, l = length of the conductor and θ the angle that the conductor makes with the direction of the field (which is always taken from north to south pole of the source magnet).
- The direction of force experienced by a current carrying conductor placed in a magnetic field is given by 'Fleming's Left Hand Rule', according to which if we stretch the fore finger, the central finger and the thumb of our left hand at right angles to each other and hold it in such a way that central finder points in the direction of current, fore finger in the direction of magnetic field, then the thumb will point in the direction of force.
- A coil of wire when placed in a magnetic field experiences several forces due to which it tends to rotate. The tendency of rotation in the coil is measured in terms of a physical quantity called torque. Due to this torque the current carrying coil may be set into continuous rotatory motion. This is the principle of electric motor–the device which converts electrical energy into mechanical energy and is basic unit used in electric fans, irrigation pumps etc.
- Faraday discovered the phenomenon of electromagnetic induction, according to which a current is induced in a coil when the strength of magnetic field associated with the coil is changed. The current remains in the coil till the change in magnetic field is continued.

Electromagnetic induction is the principle behind electric generators.

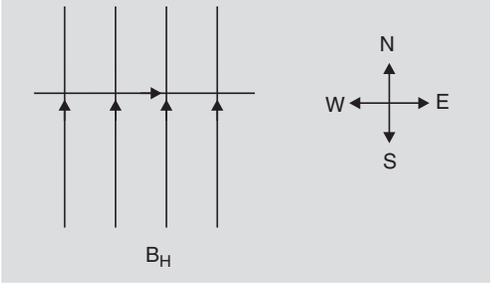
- Depending on the way the energy is tapped out of a generator, the current output that we get may be of two types: ac and dc. ac or alternating current reverses its direction periodically while dc or direct current is unidirectional.



- ac has many advantages over dc, specially the generation, distribution and consumption of ac is much cheaper than dc. True, in some applications like electrolysis and solid state devices we have to use dc but then ac can be easily converted into dc using rectifiers.
- Transformers are devices through which we can increase or decrease the level of ac voltage as required. When voltage is stepped up current is reduced in the same proportion and vice versa. Thus when we step up voltage we reduce current and hence the low current can be sent at lower costs to distant places without much power loss and there using a step down transformer it can be regained and utilized at required level.
- Fuse is a weak link in electric circuits, made of a wire of comparatively higher resistance and lower melting point (such as lead-tin alloy), used to protect the installation. If due to overloading, leakage, or short circuiting excessive current is to flow through the circuit the fuse blows off and saves the installation from the risks of this excessive current. These days we use MCB in place of fuse.
- Earthing in electrical installations is done to protect the operator from getting shock due to leakage of current.

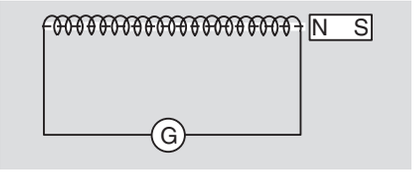
Build Your Understanding

1. At a certain place where the horizontal component of earth's magnetic field is B, a high tension wire lies in E-W direction. Find the direction of current which will correct the sag in the wire due to its own weight.
Sol: The direction of field is south to north. The force on the wire due to interaction of magnetic field and current is required in upward direciton to counter balance the weight of the wire causing sagging. Applying fleming's left hand rule we determine the direction of current to be west to east.



2. On a 10 cm long cylindrical tube of Cardboard you first wind 100 turns, then 150 turns of insulated copper wire, and then you insert a soft iron rod inside the tube. If same current is passed and you measure the magnetic field each time, in which of the three cases you will have maximum magnetic field and in which case minimum? Explain.
Sol: Minimum in case 100 turns are wound and core is air. Maximum in case soft iron core is introduced in solenoid of 150 turns. Because more the number of turns per unit length stronger the field and core of magnetic material also increases the strength of the field of an electromagnet.
3. A magnet is moved with respect to a solenoid carrying a galvanometer across it, at a constant speed as shown in Fig. Will there be a deflection in the galvanometer as it moves (i) towards the solenoid, (ii) inside the solenoid, (iii) away

from the solenoid? Will there be any change in the deflection as the speed of the magnet is increased?



Sol: The galvanometer shows deflection when the magnet moves towards or away from the coil due to induced current. If does not show any deflection when the magnet moves inside the coil. When the magnet moves with a greater speed the deflection will be more.

✔ Maximise Your Marks

- Force on a magnetic pole is a redundant concept, because an isolated magnetic pole can never be obtained. We always talk in terms of force due to magnetic field on a current carrying conductor or on a charged particle.
- Any plot of magnetic field lines is always a composite field of the magnet as well as that of the earth. Magnetic field due to earth at a place may always be considered as uniform, pointing south to north.
- Step up transformer build up ac voltage, they do not work on dc, because, for induced voltages changing magnetic field is required. But this does not mean that transformers build up energy. What they gain in voltage they lose in current. In whatever ratio voltage increases in the same ratio current in the output decreases.

  i.e., $\frac{V_{output}}{V_{input}} = \frac{I_{input}}{I_{output}}$
- In Indian standards the ac that we get in our households is at 220 volts, 50 hertz frequency. But the ac that they get in USA is at 110 volt, 60 hertz. Generators in these countries are constructed accordingly.
- Many of the appliances in our houses which are based on heating effect can be safely used on ac as well as on dc. But the appliances that are based on magnetic effect have different construction for ac and dc and dc appliance can not be used on dc or vice versa.
- Fuse are rated for current. Take care to use proper fuse always. A 15 A fuse should not be used on a 5 A line or conversely 5 A fuse should not be used on a 15 A line. Can you explain, why?

★ Stretch Yourself

1. Write four precautions you will use in laboratory while working on electric line and electrical applicances.
2. Why should you always put your fuse and switch on phase wire only?
3. What can you do to save electrical energy?

? Test Yourself

1. How will you check whether iron bar is a magnet or not? You can do whatever you like with the bar but cannot use anything else for your activity.
2. Why can't two magnetic field lines interest each other.
3. Draw a diagram to show the relative position of earth's geographic axis and magnetic axis.
4. A wire is stretched over a magnetic needle parallel to its magnetic axis. A variable frequency ac source is connected across the wire. How will the deflection of magnetic needle change as we pass current keeping current constant and increasing the frequency gradually.
5. Distinguish between: (i)ac and dc, (ii) Electromagnet and permanent magent.
6. Describe the construction and working of an electric bell with the help of a neat lablled diagram.

18. Sound and Communication

- Sound is the form of energy which gives the sensation of hearing. It travels in the form of waves.
- The wave which can travel without medium is called non mechanical or electromagnetic wave. The wave which requires medium for its propagation is called mechanical wave. Mechanical waves are of two types: (i) longitudinal waves and (ii) transverse waves.
- The wave in which vibrations are along the direction of wave propagation are longitudinal waves. They travel in the form of rarefactions and compressions. These types of waves are sound waves. Vibrations produce sound and the sound of frequency 20 Hz to 20000 Hz is audible to humans. The sound of frequency greater than 20000 Hz is called ultrasonic and less than 20 Hz is called infrasonic.
- The transverse wave travels in the form of crest and trough.
- The minimum distance between two successive crest or troughs is called wavelength.
- The minimum distance between two rarefactions or compressions is also the wavelength of the wave.
- The time of one oscillation or one vibration is called time period. The number of oscillations or vibrations in one second is called frequency.
- The velocity of the wave (v) is product of wavelength (λ) and frequency (ν).

$$v = \nu\lambda$$

Also, $v = \frac{\lambda}{T}$, T is time period

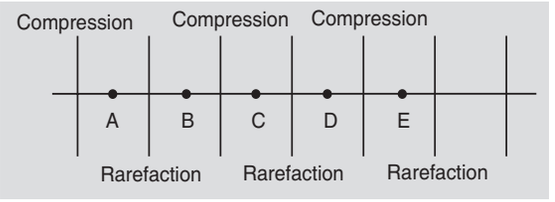
- Sound is a longitudinal mechanical wave which travels in air with the speed of 333 ms^{-1} at N.T.P. The velocity of sound in solids is more than in liquids. In steel it travels with the speed of 5200 ms^{-1} while in water with 1520 ms^{-1}.
- Sound level is measured in unit of decibel (dB). Here deci means one-tenth and bel is the level of sound. It is a unit which compares the levels of power of two sources. Two power levels P_1 and P_2 are known to differ by n decibels if $n = 10\log_{10}\left(\frac{P_2}{P_1}\right)$.
- For average human ears, the whisper is about 30 decibel. The normal conservation is about 65 decibels while jet plane taking off makes a noise of about 150 decibels. Beyond 85 decibels, sound is damaging and can lead to temporary loss of hearing.
- We can not have sound communication on moon, because moon has negligible atmosphere. In such cases the effective communication is done by electromagnetic waves. They do not require medium for their propagation. Radio, micro, IR and X-rays are examples of electromagnetic waves. They travel in free space with speed of light i.e., 3×10^8 ms^{-1}.
- Now a days satellite communication is very common. The satellite has to be launched using a rocket, lifted into the correct orbit and given suitable energy and momentum in the right direction so that it keeps moving. A satellite having time period equal to the time period of earth's rotation is called geostationary. It appears stationary with respect to earth. The satellite which appears at the same place at same time every day is called sunsynchronous satellite.
- Computer and internet are inevitable in daily life. Even at home, majority of the gadgets, whether television, automatic washing machine

or microwave oven, one can find applications of computers.

- In the form of application to internet, computers have emerged as very strong communication link. Using e-mail, one can send a message, chat live and even talk instantly which has revolutionized communication.

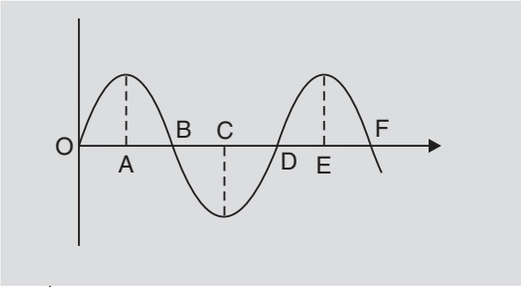
Built Your understanding

1. Express the separation AB, AC and CE in terms of wavelength (λ) for the given wave.



Sol: $AB = \frac{\lambda}{2}$, $AC = \lambda$, $CE = \lambda$

2. Express the separation AB, BD and AE in terms of wavelength (λ) for the wave shown in the figure.



Sol: $AB = \frac{\lambda}{4}$, $BD = \frac{\lambda}{2}$, $AE = \lambda$

3. A wave sends 100 wavelengths in 4s and travels a distance of 50 m. Find its speed, frequency and wavelength.

Sol: speed, $v = \frac{\text{distance}}{\text{time}} = \frac{50}{4} = 12.5 \text{ ms}^{-1}$

Frequency, $v = \frac{100}{4} = 25 \text{ Hz}$

wavelength, $\lambda = \frac{v}{\nu} = \frac{12.5}{25} = 0.5 \text{ m}.$

4. A wave travels a distance of 20m in 5 oscillations. Find its wavelength.

Sol: $\lambda = \frac{20}{5} = 4 \text{ m}$

5. The frequency of an electromagnetic wave is 10^{14} Hz. Find its wavelength in free space.

Sol: $\lambda = \frac{v}{\nu} = \frac{3\times10^{8}}{10^{14}} = 3\times10^{-6} \text{ m}$

6. Write a function of microphone and speaker each.
Sol: Microphone converts sound signals into electrical signal.
Speaker converts electrical signals into sound signals.

✔ Maximise Your Marks

- Wave is a periodic disturbance which carries energy from one place to another.
- The maximum displacement of the oscillation is called amplitude.
- Sound is a mechanical longitudinal wave whose speed depend upon medium and temperature. It increases with increase in temperature and decreases with the increase in the density of the medium. It also increases with increase in humidity in the air.
- For communication new techniques are evolved e.g. computer, internet and satellite.

Stretch Yourself

1. Considering the effect of sound on human health it become necessary to develop an instrument to measure loudness of sound. The loudness depends upon the maximum displacement from the mean position called amplitude. The Decibel meter makes use of a special crystal called piezo electric crystal. It generates electrical signal due to difference of pressure.
2. The shrill sound has high pitch i.e., higher frequency. The sound of same pitch and loudness can be distinguish by quality of sound. Quality of sound depends upon the number of harmonics.
3. In communication, telephone is very common. A basic telephone has three parts:
   (i) Cradle with a hook switch.
   (ii) A mouth piece which houses a microphone.
   (iii) A hearing piece which houses a speaker (usually an 8W speaker).

Test Yourself

1. Distinguish between mechanical and electromagnetic waves.
2. How do the longitudinal and transverse waves travel in a medium?
3. Establish the relation between frequency, wavelength and speed of the wave.
4. Write the relation between frequency and time period.
5. How has the computer revolutionised the world of communication? Explain.

19. Classification of Living Organisms

The earth came into existence 4-5 billion years ago and life originated around 3.4 billion years ago. In these many years, approximately 15 million different kinds of organisms have evolved. The wide variety of organisms is termed "**biodiversity.**" Various kinds of organisms differ from each other structurally. R. Whittaker classified all the organisms into five major groups, called *five kingdom classification*. All living organisms are further classified on the basis of their similarities and differences into different categories such as:

kingdom → phylum → class → order → family genus → species

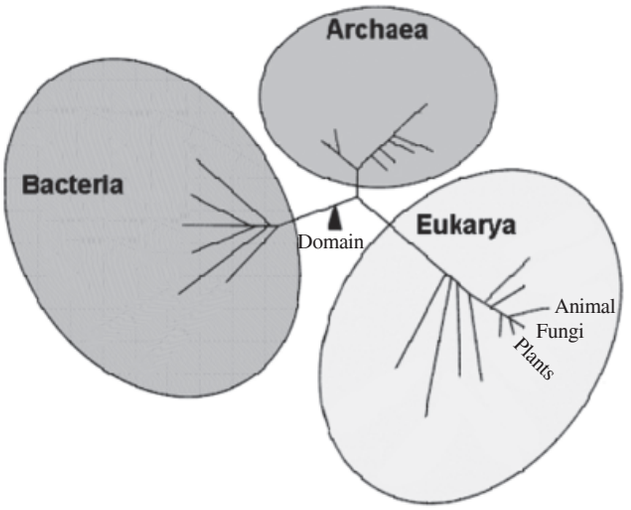
Classification shows evolutionary relationships between organisms and is also termed *Systematics*. The science of classification or systematics is termed **Taxonomy.**

Common names are confusing and variable, so each kind of organism has been given a scientific name. A scientific name includes the names of the genus and species

Build Your Understanding

- All living organisms are classified into three major domains:
  1. Archaebacteria: Primitive bacteria (prokaryotes) living in hot water bodies
  2. Eubacteria: All other bacteria found on earth, and devoid of a well-developed nucleus.
  3. Eukarya: All organsims other than bacteria and possessing a well formed nucleus.

In 1969, "Whittaker" arranged all kinds of organisms into five kingdoms:



Five Kingdoms of life

1. MONERA: All bacteria, are the only prokaryotes, i.e. their hereditary material is not enclosed in a nucleus.
2. PROTOCTISTA (PROTISTA): Single celled nucleated plant-like algae and animal like protozoans
3. FUNGI: Multicellular nucleated organisms which are saprotrophs.
4. PLANTAE: Includes plants which are autotrophs and manufacture food by photosynthesis. Their cells possess a cell wall.
5. ANIMALIA: Includes animals which are heterotrophs and are made of cells without a cell wall.

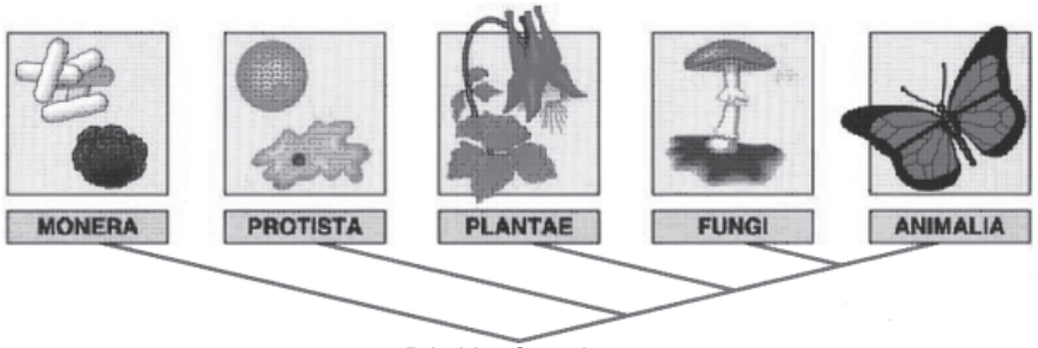


Fig. 1. Five kingdoms of life

Binomial Classification: Every kind of organism has a scientific name made of two parts: (i) name of the genus and (ii) name of the species. The initial letter of the genus is written with a capital letter and species with a small letter. The scientific name is written in italics or underlined.

Biodiversity has three levels namely:

(i) Genetic diversity

(ii) Species diversity

(iii) Ecosystem diversity

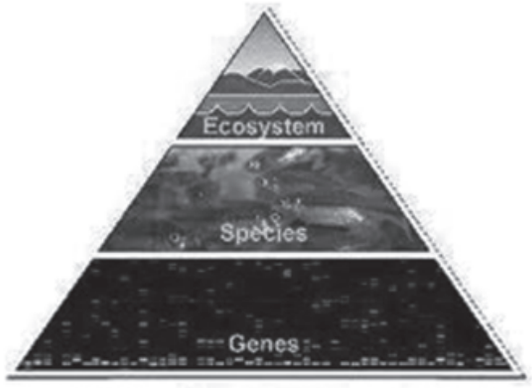


Fig. 2. Three levels of biodiversity

Stretch Yourself

1. The common name of rice is simpler than its scientific name *Oryza sativa*. Why is the scientific name then given?
2. Which out of the following categories are used for naming an organism?

   Phylum, Family, Genus, Species, Order, Class

Test Yourself

1. Given below are scientific names of some organisms, encircle the ones which are wrongly written and write them correctly:
   i. *Mangifera indica*
   ii. *Cajanus Cajan*
   iii. *Felis Domesticus*
   iv. *Ficus religiosa*
2. *Corvus splendens* (house crow) and *Corvus macrorhynchos* (jungle crow) are names of two crows. Do they belong to the same species? Give reasons in support of your answer.
3. Match the items in column I with as many as possible of the items given in column II.

Column I	*Column II*
Pine	Fungi
Earthworm	Monera
Bread mould	Prokaryote
Amoeba	Gymnosperm
Moss	Plantae
Bacteria	Animalia
	Protoctista
	Bryophyta

4. Why are ***Octopus*** and ***Oyster*** placed in the same phylum? Name the phylum to which they belong.
5. Make a taxonomic key of the following:

   cow, parrot, starfish, cobra, rohu

20. History of Life on Earth

Earth is the only planet in our solar system which sustains life. But earth was not the same as it is today. It was a ball of gases when it was first formed about 4.5 billion years ago. Earth cooled and chemicals of life were synthesized in water – **chemical evolution**.

Biodiversity came to exist through **biological evolution** for which a valid mechanism termed **Natural Selection** was provided by **Charles Darwin** (Father of Modern Evolution) which was later modified in the light of progress in various fields of biology and called **Neodarwinism**.

Fossils

Fossil Plant *Ammonite* *Dinosaur* *Archaeopteryx*

Fig. 1. Fossils are an evidence for Biological Evolution

Fossils are remains of plants and animals that have been preserved in rocks or oil or amber. A study of fossils tells us how life on earth has changed or evolved. Fossils form evidence for Biological evolution.

Build Your Understanding

- How did chemical evolution occur?
  - Primitive atmosphere had gases like CH_4, NH_3, H_2 and CO_2 and water vapour.
  - Temperature was extremely high.
  - Earth cooled, water vapours condensed and there were torrential rains.
  - Water collected on earth's crust into which were washed down these gases.
  - They combined to yield biomolecules like nitrogenous bases, glucose and amino acids which further formed proteins and nucleic acids.
- All kinds of organisms came into existence through **Organic Evolution**

Evolution and Darwin

  - Charles Darwin emphasized that all (i) kinds of organisms are related through ancestry and (ii) that **Natural Selection** is the force which causes evolution.
  - It is not the individual which evolves but the entire population of that area evolves. **So, the unit of evolution is a population.**
  - It has its own gene pool (gene pool: all kinds of genes found in a population/ species).

– Variation arises in the gene pool through mutation and recombination
– Natural selection causes greater reproduction of beneficial variant genes.

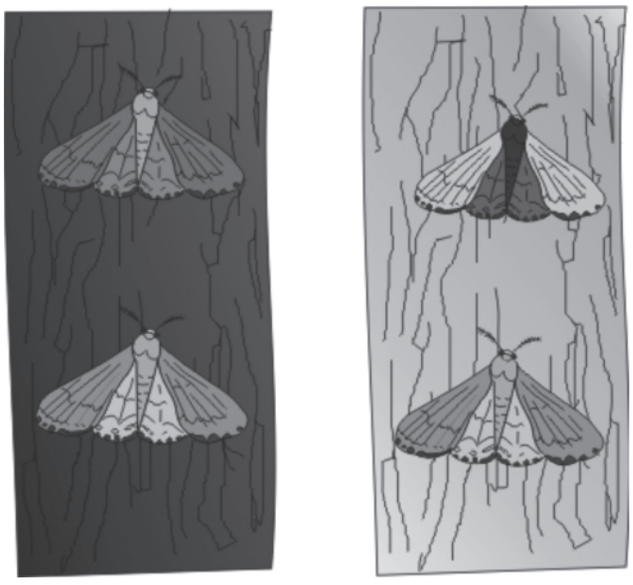


Fig. 2. Natural Selection in Action

- Levels of evolution:
  – Micro evolution–Evolutionary changes in the gene pool at the level of population.
  – Macro evolution – also called adaptive radiation, leads to formation of new species and genera.
- Stages in Human evolution:

  The two trends in human evolution are (i) larger brain and (ii) bipedal gait (walking on two legs)

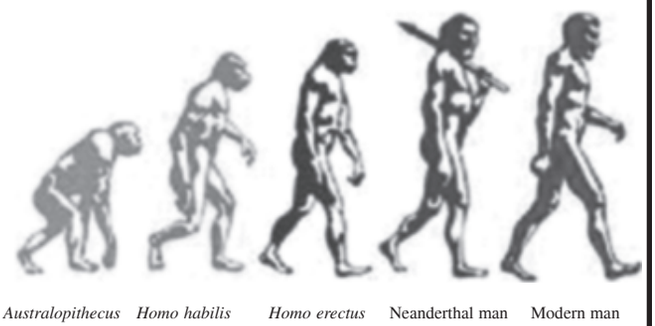


Fig. 3. Stages of Human evolution

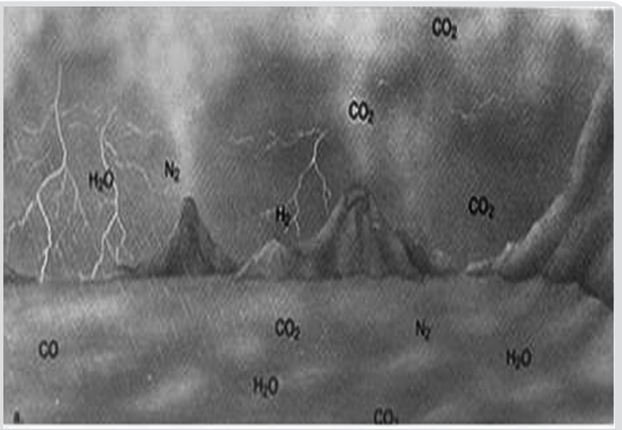
Stretch Yourself

1. Arrange in the proper sequence, the stages of human evolution mentioned below.

   Homo sapiens neanderthalensis, Australopithecus, Homo sapiens sapiens, Homo erectus.
2. Differentiate between chemical and biological evolution.
3. Natural selection is still considered as a valid and reliable mechanism for evolution. How does it operate? Also cite an example.

Test Yourself

1. Here is a picture of primordial atmosphere. Name the missing gases.



2. How did Oparin and Haldane explain the origin of life? Who experimentally proved it and how?
3. What do you understand by 'Biological Evolution'? What was its outcome? How does it operate in Nature?
4. Who is considered the father of evolution? State briefly his contribution in this field.
5. Give a brief account of human evolution.
6. How does micro evolution differ from macro evolution?

21. Building Blocks of Life-Cells and Tissues

- **Cell** is the structural and functional unit of life.
- A typical cell includes a cell membrane, cytoplasm and genetic material either within the nucleus or in the cytoplasm.
- The cytoplasm contains cell organelles such as mitochondria, endoplasmic reticulum lysosomes, vacuoles, ribosomes, golgi bodies.
- Cell wall and chloroplasts are present only in plant cells while centrosome is present in animal cells.
- Each organelle performs a specific function in the cell.

Prokaryotic cell	Eukaryotic cell
(i) Well organised nucleus absent and genetic material lies in the cytoplasm.	1. Genetic material enclosed within a nuclear membrane forming the nucleus.
(ii) Membrane bound organelles absent.	2. Organelles like Mitochondria chloroplasts, E.R. etc are present.
(iii) Examples: Bacteria, blue green algae.	3. Examples: Cells of fungi, plants, animals.

Build Your Understanding

- **Tissue:** a group of similar cells performing the same function and having a common origin.

Plant Tissues

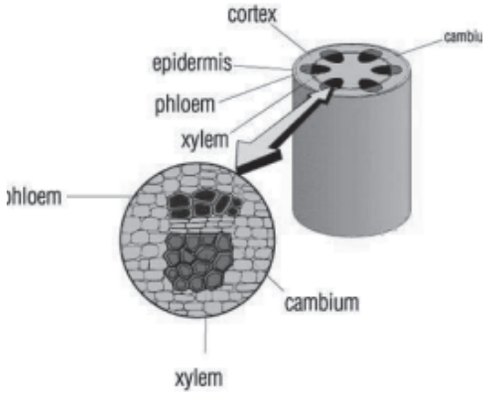
Meristematic Tissue
- Capable of cell division to add new cells to the plant
- Thin walled with large nucleus

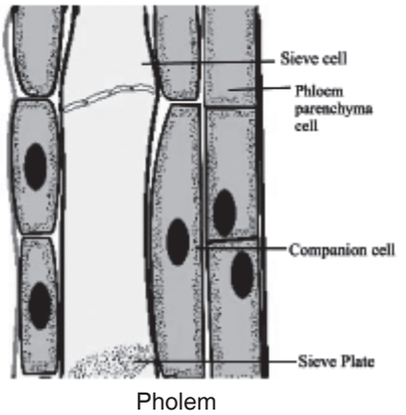
Permanent tissue
- These tissues do not divide

Protective tissue
- Occur on the outer surface of leaves, stem and root
- e.g. Epidermis

Supporting tissue
- Occurs in the leaf stalk, fills up the interior of plant parts
- e.g. Parenchyma

Conducting tissue
- Provide passage for the fluids to move up and down
- e.g. Xylem and phloem





Pholem

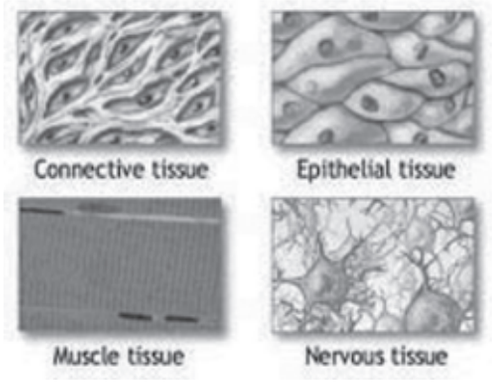
Animal Tissues

Epithelial tissue
- Have thin, irregular surface
- Present on the outermost part of skin
- Function; Provide protection to the underlying parts, secretion, absorption

Muscular tissue
- Consist of long narrow fibres
- Capable of contraction
- Bring about movement of body parts
- Are of three types: striated, unstriated and cardiac

Connective tissue
- has matrix, cells and fibres
- binds/connects different parts; form supportive frame work
- Example: Bones, blood, adipose tissue

Nervous tissue
- Consist of neurons
- receive and transmit nerve impulse



Four types of Animal Tissue

Stem cells

Stem cells are undifferentiated cells in our body which can divide by mitosis and differentiate into specialised cell types and also produce more stem cells. Stem cell therapy is useful in treating blood cancer, in testing new drugs and providing cells for gene therapy.

Cell Division

- New cells are formed by cell division
- Cell division replaces worn out cells, repairs injuries, helps in growth and in reproduction.
- There are two types of cell divisions:

  mitosis and **meiosis.** Prior to all divisions the chromosomes duplicate or replicate themselves and then enter cell division.
- During mitosis, the two chromatids of the duplicated chromosome separate. Each chromatid is now a chromosome. One each of these two chromosomes moves into the two daugher cells.
- Meiosis involves two successive divisions:

In meiosis I, the chromosomes of the same (matching/homologous) pair move to two daughter cells. Thus two cells with half the number of chromosomes are fomed at the end of phase I. This is reduction division. However, each chromosome still has the duplicated copies with them.

In meiosis II, like mitosis the duplicated copies that is the chromatids of each chromosome separate and move to two new daughter cells. Thus, four haploid cells are formed.

These daughter cells ultimately give rise to reproductive cells such as pollen grain, ovule, sperm and ovum.

✔ Maximise Your Marks

- To revise the structure and functions of different parts of a cell, **draw large enough diagrams** of one plant cell and an animal cell. Label their parts and write the functions against each part.

- **Cell organelles:**

S. No.	Name of the cell part/organelle	Key feature	Function
1	Cell membrane	Thin delicate membrane enclosing the cell	Selectively permeable
2	Cytoplasm	Homogenous, colloidal semifluid in which cell organelles are present	Helps in manufacture and exchange of materials between different cell organelles
3	Nucleus	Small rounded structure bounded by nuclear membrane and containing chromatin material and nucleolus (or nucleoli)	Coordinates the cellular activities and contains the DNA
4	Endoplasmic Reticulum (E.R.)	Irregular network of double membranes in the cytoplasm. Ribosome may be present on E.R.	Helps in synthesis and transport of proteins and fats within the cell
5	Ribosome	Granules in the cytoplasm or on E.R.	Site for protein synthesis
6	Mitochondria	Sausage or rod shaped double membranous structures in the cytoplasm	Carry out cellular respiration
7	Golgi bodies/golgi complex	Stacks of flattened sacs and small vesicles called dictyosomes in plants	Help in secretion and storage of substances like enzymes, hormones
8	Plastids	Of three types, leucoplast, chromoplast and chloroplast. Chloroplast contains chlorophyll pigment and carotenoids	Chloroplast helps in photosynthesis
9	Cell wall	Outer, rigid, protective covering of plant cells; made of cellulose	Provides shape and rigidity; protects the inner parts
10	Centrosome	Consists of two small granules called centrioles, lying anteriror to the nucleus	Helps in spindle formation during cell division

Stretch Yourself

- What would happen if meosis did not occur in the reproductive organs?
- Why do multicellular organisms develop tissues performing different functions?

Ans: In multicellular organisms, there are many tissues for division of labour so that different tissues perform different functions. All the tissues work in coordination and the organism functions more efficiently.

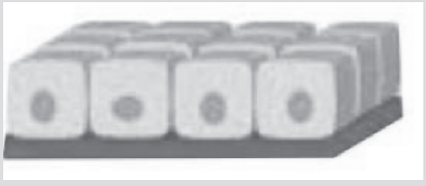
Test Yourself

1. Complete the table

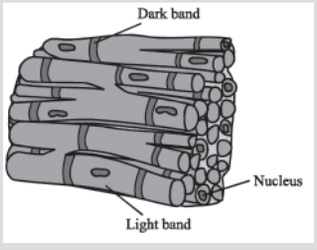
Plant or Animal Cell	Name of Organelle	Function
(i) Animal Cell	_____	_____
(ii) _____	Chloroplast	_____
(iii) Plant Cell	_____	_____
(iv) _____	_____	Controller of the cell

2. Identify the animal tissues shown below and state how our body would be affected in the absence of each of these tissues

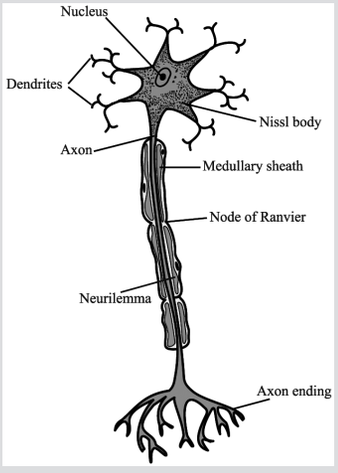
(a)



(b)



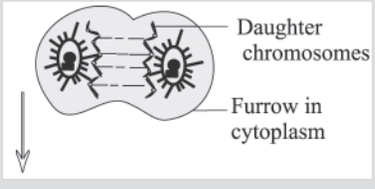
(c)



3. Identify the stage of cell division in each of the diagrams shown below and mention one characteristic feature of each stage.

(a)

(b)



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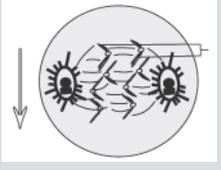


4. Draw a typical plant and an animal cell and label only the parts that are not common between the two.

22. Life Processes– I: Nutrition, Transportation, Respiration and Excretion

- Life Processes such as Nutrition, Respiration, Circulation and Excretion are necessary for the survival of living beings.
- Energy is needed for running life processes.
- Solar energy is trapped by plants to produce sugar (glucose) from CO_2 and H_2O in the presence of chlorophyll. This is called **photosynthesis**. Water is picked up by roots and reaches leaves through xylem where photosynthesis occurs. CO_2 reaches leaves from atmosphere through stomata. Plants are **autotrophs**. Sugar reaches other parts of the plant from leaves through phloem
- Animals feed on plants and other animals to get energy. They are **heterotrophs**. Animal nutrition involves ingestion, digestion, absorption, assimilation and egestion. Digested food is transported to cells by blood.
- Oxygen also reaches cells through blood.
- Oxygen obtained through respiration helps to get energy from food. Carbon dioxide is produced after food is oxidised by oxygen. It is removed from body during respiration
- Ammonia, uric acid and urea are produced when proteins are broken down for utilisation by the body. These substances reach the kidney for removal as harmful wastes from the body by means of blood. This is called **excretion.**

Build Your Understanding

NUTRITION

Food is an essential requirement for obtaining energy needed for performing vital activities. Food also helps in growth, maintenance, repair and protection from various diseases.

• Types of food

Type of food	Nutrients	Food items
(a) Energy yielding foods	carbohydrates, oils and fats	sugar, starch, rice, potato, sweets, oils, butter, ghee, gur, nuts
(b) Growth and tissue forming food	proteins	milk, egg, beans, pulses, meat, fish, chicken, mutton
(c) Protective and regulatory food	vitamins and minerals	fruits, green vegetables, lemon, orange, apple, tomato, carrot

• Plant Nutrition

Plants prepare their own food in the presence of sunlight hence they are **autotrophs**. Solar energy is trapped by green plants to produce organic food such as sugar (glucose) with the help of atmospheric carbondioxide (CO_2) and water (H_2O) from soil. This process is called **Photosynthesis** in which water is absorbed by roots and CO_2 diffuses into leaves through stomata.

$$6CO_2 + 6H_2O \xrightarrow[\text{Sunlight}]{\text{chlorophyll}} C_6H_{12}O_6 + O_2\uparrow + \text{energy}$$

(Atmospheric carbondioxide) (soil water) (glucose) gets stored as starch (oxygen gas)

Leaves of plants are the organs which undertake photosynthesis as they have chloroplasts.

- **Animal Nutrition**

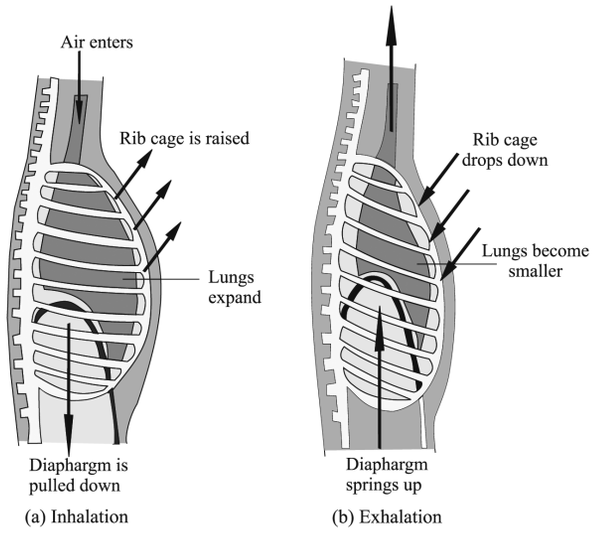
Most animals feed on green plants and other small animals to get energy because animals are incapable of preparing their own food. Animals are thus called **Heterotrophs** and such mode of nutrition is heterotrophic nutrition.

Animal nutrition involves processes given below in the table:

Process	**Organs where it occurs**
Ingestion (Intake of food)	Mouth, tongue, teeth
Digestion (Breakdown of food)	Mouth, stomach, duodenum, small intestine
Absorption	Small intestine – blood absorbs products of digestion and carries them to different parts of the body
Assimilation	Tissues of different organs use them to build parts and get energy
Egestion	Rectum stores, anus and removes undigested food

RESPIRATION

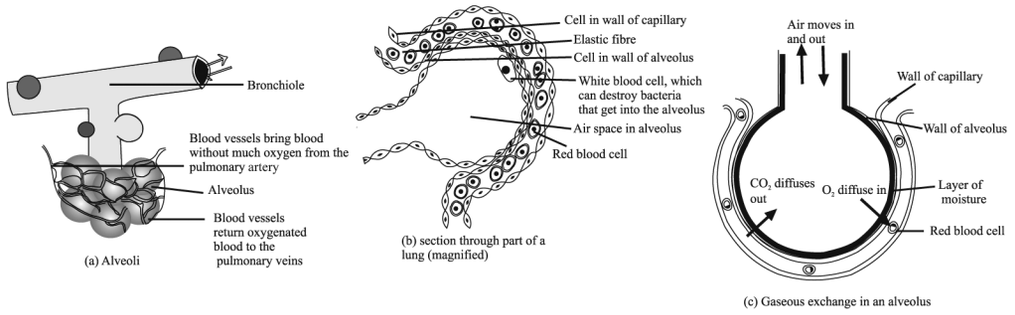
- Provides O_2 to cells for energy production and removes CO_2 from cells.
- In animals, Respiration involves:
  - (i) **breathing or ventilation** which happens in lungs, and
  - (ii) **cellular respiration** which occurs in cells and produces energy from oxidation of food.
- Organs of respiration in fish are gills. In humans – nostrils, trachea, bronchi, lungs.
- Breathing happens by change in position of ribs and diaphragm



- Air moves from region of its high pressure to its low pressure

	At inspiration	At expiration
O_2 in air	20%	16%
CO_2 in air	04%	4%

- O_2 enters blood and reaches cells
- CO_2 produced by cells goes out into blood and from lungs out of body.



Exchange of O_2 and CO_2 between alveoli and blood.

In the cells, energy production by oxidation of glucose occurs in mitochondria

Gas Exchange between alveoli and blood capillaries

- Air with more O_2 breathed in
- Reaches alveoli
- High concentration of O_2 in alveoli
- High concentration of CO_2 in tissues
- The two gases exchanged between blood brought from tissues and alveoli
- In plants, oxygen enters through stomata of leaves by diffusion. CO_2 diffuses out of cells, also through stomata.

TRANSPORTATION (BLOOD CIRCULATION)

- Blood transports food and oxygen to all the cells of the body. It is made of fluid plasma and cells.
- Plasma which transports glucose, enzymes and hormones to cells, carries waste material from liver to kidneys for removal.
- Blood cells are (1) RBC (Red blood cells or **Erythrocytes**) for transport of O_2 to cells by combining with haemoglobin. RBCs are red as they contain the red pigment **Haemoglobin**. They have no nuclei. In lungs, haemoglobin of RBC combines with oxygen and forms a compound known as oxy-haemoglobin. Blood carrying oxygen reaches all the cells of body where gas exhnage takes place. Oxygen goes into cells and CO_2 comes into it from cells.

1. WBC (White blood cells or **Leucocytes**) are nucleated cells and eat up bacteria and foreign bodies or fight them by producing antibodies
2. Blood Platelets (Thrombocytes) are small fragments of cells without nuclei and help in the clotting of blood

• Blood vessels

Blood flows in arteries and veins whch are joined by thinner blood vessels called **capillaries**. Arteries carry away blood from heart to parts of body and veins bring blood to heart from other parts of the body.

Heart and Blood circulation

- Heart is made of cardiac muscle fibres which rhythmically contract and relax all the time throughout life.
- One cycle of contraction and relaxation of muscles in wall of ventricle constitutes a **heart beat**.
- In one minute heart beats 72 times which can be felt as a pulse on the writst or neck.
- Heart is four chambered: with two atria and two ventricles.
- Heart receives blood from all parts of the body and also pumps blood to all parts.
- **Vena cava** (largest vein) brings CO_2 laden blood to heart. Pulmonary artery carries it to lungs. In the lungs, capillaries on alveoli exchange CO_2 laden blood for O_2 laden blood which goes again to heart via pulmonary vein. **Aorta** (largest artery) takes oxygenated blood to all parts of the body.
- Since blood crosses the heart twice in one round the circulation is called double **circulation**.

EXCRETION

• Excretion is the removal of harmful wastes like urea by kidneys, sweat from skin and CO_2 by Lungs.

Excretory organ	What it excretes	Purpose
Skin	Sweat	Cools the body
Kidneys	Urine	Controls the water content of the body. Removes harmful urea
Lungs	Carbon dioxide + Water	These waste substances are produced by respiring cells.

Functions of kidneys

- The two kidneys remove urea from blood with the help of tubular structures called **nephrons.** Kidneys are made of nephrons.
- In excretion, waste substances are filtered by uriniferous tubules or nephrons.
- The useful substances (like water, glucose, etc.) are reabsorbed back into blood.
- Kidneys also control the amount of water in blood.
- When water needs to be conserved, concentrated urine is expelled out of the body.
- Such controlled removal of water in urine is called **osmoregulation.**
- In case of kidney failure, dialysis is done in which blood is taken out and filtered in an artificial kidney or dialysis fluid and then pumped back into the body.
- Urine is made in kidneys from waste like urea present in blood. Blood reabsorbs all the useful substances like glucose and amino acids from the blood filtered in the kidneys.
- Urinary bladder stores urine till it is removed from the body.

✔ Maximise Your Marks

NUTRITION

1. How does photosynthesis prove to be beneficial to both plants and animmals, including humans? Explain.
2. Explain how small intestine plays a very important role in animal nutrition.

★ Stretch Yourself

NUTRITION

- Only green plants have the capacity to utilise solar energy to synthesise their own food. On the other hand, animals are dependent on plants and other animals for food. The Tapeworm is an endoparasite. It derives nutrition from the host, the human beings in whose intestine it lives and feeds on digested food of the host.

RESPIRATION

- Blood vessels carry oxygen from alveoli to tissues. Cells of tissues take up the oxygen. In the mitochondria of the cells, oxygen acts upon glucose to yield energy and release carbon dioxide. This is called **'cellular respiration'**.
- **Harms of smoking**

  Smoking causes lung cancer. The tar in it may accumulate in the respiratory organs. Chronic smokers feel difficulty in breathing and suffer from emphysema.

TRANSPORTATION (BLOOD CIRCULATION)

- The heart also needs oxygen and food and coronary arteries supply them. The heart is approximately of the size of closed fist.

Part of heart	Kind of blood	Pressure	Transporated from heart
Right Ventricle	less O_2	Lower	Lungs
Left Ventricle	more O_2	Higher	Body

EXCRETION

- The renal vein and renal artery are blood vessels of the kidney.
- Renal artery brings blood to kidneys

Blood entering the kidneys contains

- Lots of oxygen, glucose, H_2O, Salts from food and urea
- Renal vein takes blood from kidneys

Blood leaving the kidneys contains:

- Less oxygen, glucose and urea (removed in urine)
- Right amount of water and salts (their excess is removed in the urine)

Learner Guide

? Test Yourself

NUTRITION

1. Point out the odd one (mismatch) in the statement.

   Energy yielding food includes carbohydrates, proteins, oils and fats.

2. Find out the missing step in animal nutrition and write them all in the proper sequence

   1. Ingestion 2. Egestion
   3. Digestion 4. Assimilation

3. Mention whether true or false. Tick T or F for your answer

   (a) Milk, egg, beans, meat and fish are energy yielding food. (T)/(F)

   (b) Vitamins and minerals are disease protecting foods. (T)/(F)

   (c) Plants are capable of producing organic food and release oxygen gas. (T)/(F)

   (d) Most of the animals are heterotrophs with regard to nutrition. (T)/(F)

   (e) Digestion of food is breaking down of complex food into simple constituents. (T)/(F)

4. Match the items in the column (A) with those of column (B)

Column A	Column B
(i) Producing organic food by photosynthesis	(a) Proteins
(ii) Food which provides protection	(b) Digestion
(iii) Breaking of complex food	(c) Autotrophs
(iv) The food constituent responsible for growth, repair and maintenance	(d) Water
(v) Highest percentage found in food	(e) Vitamins and minerals

5. Name the diseases caused by deficiency of (i) Protein and (ii) Vitamin A and (iii) due to Liver infection.

RESPIRATION

6. From where do (i) dogs and (ii) fish obtain oxygen for respiration?
7. What role does diaphragm play in ventilation?
8. What are alveoli or air sacs?
9. Why is respiration mentioned as a process of gas exchange?

TRANSPORTATION (BLOOD CIRCULATION)

10. Which chamber of the heart has the thickest muscle and why?
11. Why is blood circulaiton in humans and other mammals called double circulation?
12. Why is pulmonary vein called so even though it carries oxygenated blood unlike other veins?
13. Why are heart and lungs called vital organs?

EXCRETION

14. Name the two functions carried out by kidneys
15. What are the functions of ureter, urethra and urinary aperture?
16. Name excretory organs other than kidney
17. Name the fluid tissue which brings waste from all body parts and gets them removed by kidneys.

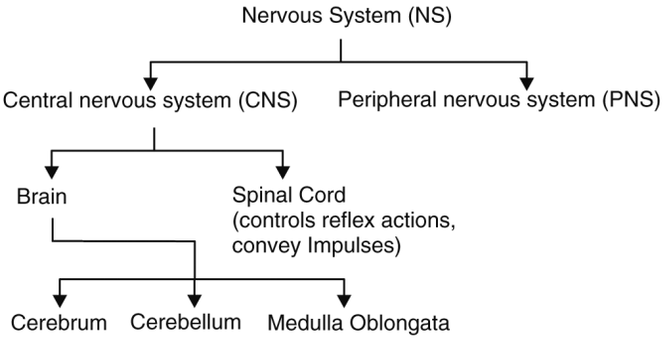
23. Life Processes – II
Control & Coordination

Nervous system (NS) & endocrine system together ensure that all the parts of the body work in a controlled and coordinated manner.

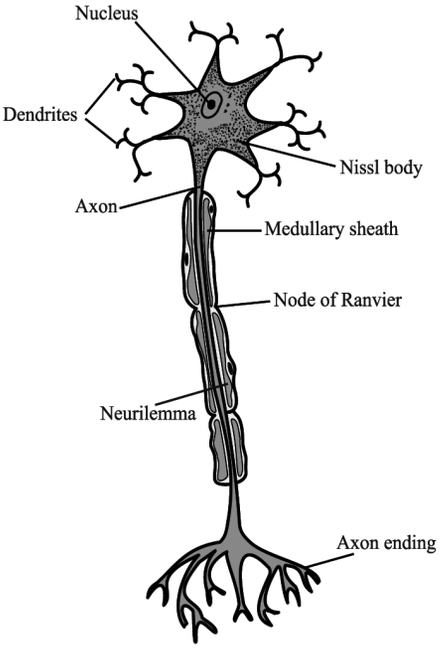
- NS includes brain, spinal cord, sense organs and nerves
- Endocrine glands secrete hormones directly into the blood
- Pituitary, thyroid & pancreas are some important endocrine glands that influence our growth and development

Build your Understanding

- Nervous system is made of nerve cells or neurons
- It is divided into parts shown below.



- Brain is responsible for thoughts, imagination, motor movements, balance and controls all functions of body.
- Neurons have the capacity to respond to a stimulus and conduct it to another neuron/ effector organ.
- Dendrites receive an impulse, set off a chemical reaction that creates an electrical impulse.
- This electrical impulse travels down the cell body, the axon and reaches the end bulbs
- Neurotransmitter stored in the end bulb is released in the synaptic cleft.
- The chemical crosses the synapse and initiate a similar electrical impulse in the next neuron.
- Finally, the impulse is delivered from neuron to other cells/effector organ such as muscles/ gland to elicit the desired action.



- Reflex action is a spontaneous, autonomic and mechanical response to a stimulus controlled by the spinal cord and without the involvement of the brain. It can be of two types.

• **Reflex action**

Inborn reflex	Conditioned reflex
(a) No previous experience required.	(a) Develop during the life time due to learning or experience.
(b) No reinforcement required or is not unlearnt.	(b) Need reinforcement periodically, otherwise they are unlearnt.
(c) Eg. Closing the eyelids when strong light falls on the eye.	(c) E.g – salivation on smelling a good flavoured food or thinking of 'good food'.

• **Endocrine Glands**

- Our body has a number of endocrine glands which produce chemical secretions called hormones.
- These hormones are carried by blood to the target organs situated elsewhere in the body to stimulate a specific action.
- Pituitary gland regulates growth of the child from puberty to reproductive maturity. It also secretes growth hormone and gonad stimulating hormones.
- Undersecretion of thyroid causes cretinism and goitre.
- Insulin and glucagon are the two hormones secreted by pancreas. These regulate glucose metabolism in the body.

Stretch Yourself

1. What role do the two different parts of the Central Nervous System play? Explain.
2. Why is a neuro transmitter needed for transmission of nerve impulse across a synapse?
3. An impulse is conducted as an electrical activity along a neuron but not across a synaptic cleft. Why?
4. Name the two parts of the CNS that consists of white matter. Mention their sites.

Test Yourself

1. When you hear a blast you run away from it instantly. Which part of nervous system gets involved in this response.
2. Name two parts of the CNS which are made of white matter.

3. Match the items of column I with those of column II.

Column I	Column II
1. Meninges	a) Maintain the balance of the body.
2. Cerebellum	b) Controls breathing and heart beat.
3. Medulla oblongata	c) Protective membrane over the brain and spinal cord.
4. Cerebrum	d) Is a small central canal filled with cerebrospinal fluid.
	e) Seat of intelligence, will power & consciousness.

4. You see a lion you run. Which part of the nervous system is involved?
5. State the symptoms of cretinism.
6. Name the hormone that stimulates the secretion of testosterone in males.
7. Why is intake of iodised salt recommended?
8. Why is insulin given to patients of diabetes mellitus? Explain.

24. Life Processes III – Reproduction

- Giving rise to offspring of one's own kind is called **Reproduction.**
- Reproduction is a means for continuance of species.
- It is a characteristic of all living beings.

Build Your Understanding

Reproduction may happen in two ways, from a single parent – **Asexual,** and through male and female sexes involving mostly two parents – **Sexual**.

Difference between Asexual and Sexual Reproduction

Asexual	Sexual
• Single parent	• Two parents – a male and a female. (rarely, the male and female sexes are found only in one parent, as in earthworm)
• Offspring similar to the parent and each other	• Offspring different from each other and parents in looks and other respects. Similar in some respects.
• Comparatively simpler and faster.	• Complex and occurs in several steps.

- **Examples of Asexual Reproduction**

Vegetative propagation in plants:

New plants arise from stem or leaf or roots e.g. grass, potato, ginger. Vegetative propagation may be done aritificially by humans through different methods like layering, cutting, gootee, etc.

- **Sexual Reproduction**

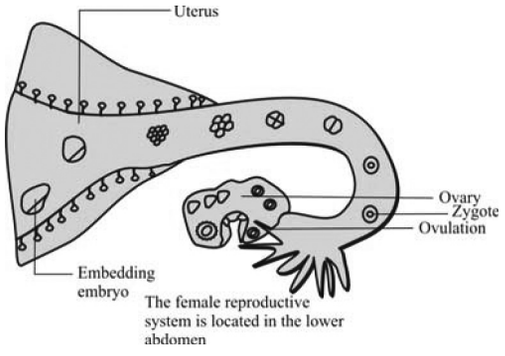
In Plants

- Flower is the reproductive organ of plants.
- The male gamete is the pollen grain which develops in anther of the stamen.
- The female gamete is the ovule that develops in the ovary of the pistil.
- **Pollination** is the transfer of pollen to the stigma of same flower (**self pollination**) or another flower of same species (**cross pollination**). Pollination occurs by means of wind, water or insects
- **Fertilisation** takes place when nucleus of pollen grain fuses with that of ovule.
- Ovules develop into seeds and flower into fruit.
- Seeds germinate into a new plant.
- **In Animals**

Mostly, the animals reproduce by sexual reproduction. Asexual reproduction occurs only in primitive animals like sponges and hydra. They also have sexual reproduction.

Human reproduction

Male and Female reproductive organs are found in separate individuals



Observe the diagrams. Sperms made in testes reach the fallopian tube as shown in the figure.

Fertilisation occurs there. Development of the zygote (fertilised egg) begins and then reaches the uterus, attaches to its wall and is ready to be delivered in 280 days and begin life as a human being!

What a pregnant mother should not do

- Do not prediagnose the sex of your foetus.
- Do not smoke. It deprives the baby of oxygen leading to low birth weight and premature birth.
- Do not be an HIV infected mother.

Puberty and Adolescence

- The period of childhood to adulthood when sexual organs mature, is long in human beings.
- Puberty and adolescence sets in due to hormones from pituitary gland situated in the brain which cause sexual organs to mature and secrete sex hormones– testosterone in male and estrogen in female.
- The sex hormones trigger
  - Physical changes
  - Psychological changes, and
  - Social changes during adolescence.
- One of the physical changes caused by hormones is the 28 day cycle called **menstrual cycle** in females. It begins during puberty and ends at the age of 45 years to 50 years (**menopause**).

  Menstruation does not occur during pregnancy. Explain.

Caution

- Exhibit responsible sexual behaviour during adolescence.
- Make informed choices regarding child birth and number of children.
- Observe menstrual hygiene.

Population Issues and Contraception

A large population becomes a liability of a country unless turned into an asset. Population can be checked and informed choice of a child by a couple maintained by **contraception**, using condoms, IUCDS, pills, vasectomy, tubectomy etc.

RTI, STD, HIV and AIDS

- Poor genital hygiene can lead to infections of genital tract (RTI)
- Gonorrhea, Syphilis, Chancroid, Chlamydia infections are passed on from an infected sexual partner during sexual act.
- AIDS is a viral disease that saps the immunity of the patient making him/her fatally prone to infections.
- HIV (AIDS causing virus) passes from the infected person
  - through sexual contact.
  - injecting infected blood through infected syringes during blood transfusion or substance abuse through infected needles.
  - from infected mother to foetus or through breast milk.

Stretch Yourself

1. What is **micropropagation**?

   Micropropagation or tissue culture helps to grow many plants from single cell extricated from any part of plant. Every cell has all the genes and equal potential for development (totipotent) into a new plant. The cell or few cells from an undifferentiated mass of cells (callus) can differentiate into different parts and form a whole plant.

2. **Cloning**

   An exact copy of the parent, having identical genes is a **clone**. A clone can be produced by removing nucleus from a body cell and introducing it into the egg whose nucleus is removed. It is then allowed to develop.

Test Yourself

1.

→ Female Male ↓	X	X
X	XX	XX
Y	XY	XY

(i) What does this table depict?

(ii) Who is responsible for sex of the child-mother or father? Give reasons.

1. Wheat plant may be multiplied by micropropagation for its desired characters. How can this be possible? State an advantage and disadvantage of this method.
2. Dolly, the cloned sheep was created from the mother's udder cell and Snuppy the dog, cloned from his father's skin cell. What is a clone and how can a 'cloned organism' be created?
3. Embryo, foetus, gametes, zygote, new born infant are stages in human reproduction. Place these stages in the correct sequence in which they occur.
4. The table given below shows structures involved in reproduciton

	Plants		Animals	
	♂	♀	♂	♀
1.	Sperm	eggs	pollen	ovules
2.	ovules	sperm	eggs	pollen
3.	eggs	pollen	ovules	sperm
4.	pollen	ovules	sperms	egg

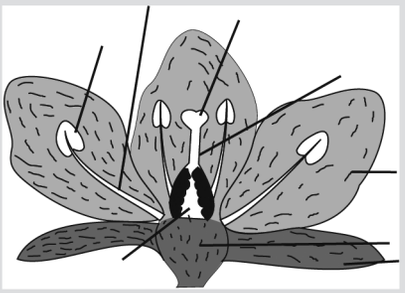
(i) Which row is correct

(ii) Identify and point the mistakes in the other rows.

5. The diagram shows a section of the flower.

(i) Label A B C and D

(ii) State one function of B,A, and D



(iii) Indicate by the label line, the male and female parts.

(iv) What happens when structures received on part C from another flower reach the interior of part B of the flower?

6. Give two examples of organisms, one which was born of a single parent and one which was born by the combination of gametes from male and female parents. Also explain the two processes of reproduction.
7. What is the menstrual cycle? Approximately at which age does it begin in girls and approximately at which age does it end?
8. Without pollination, there would be no seed formation. Justify the statement.

25. Heredity

- Features passed down from one generation to the other is **Heredity** or **Inheritance**. Genes control heredity.
- Differences in features of individuals of the same species is **variation**.
- An Austrian monk, **Gregor Johann Mendel** experimented with peas to find out how the various features get inherited. He postulated laws of inheritance.

Build Your Understanding

- **Heredity and Variation**

When your eyes are like those of your mother and your brother's eyes like those of your father, it is due to **heredity.** The noticeable difference in the colour of eyes is termed **variation**.

- **Mendel's Laws**

Mendel explained heredity and variation through laws called Mendel's laws of inheritance.

1st Law: Law of segregation of characters

Every feature is controlled by a pair of genes (factors) which segregate during gamete formation and go to different cells (gametes, sperm or egg)

2nd Law: Law of Dominance

A gene of a pair which may express even in the presence of the other – is called **dominant.** The other gene termed **recessive** expresses only when two recessive genes are present, one each received from either parent.

The different forms of a gene are termed **alleles.**

Dominant alleles are shown by capital letter and recessive by small letter e.g. Bb; B = Brown eyes, b = blue eyes

What will be the eye colour of a person whose genetic composition is indicated as bb?

Chromosomes and Genes

- **Sutton** (1902) saw thread like structures in the dividing cells of grasshopper's testis. These were the chromosomes. Soon it was evident that **genes** are present on chromosomes.
- **chromosomes** seen only in dividing cells. Jumbled up as **chromatin network** in the nucleus of non-dividing cells
- Number of chromosomes fixed in a species, present in **homologous pairs** (both chromosomes of a pair bearing same genes, but not necessarily same alleles). Hence, the fixed member is termed **diploid** and designated as 2n (n = **haploid**). In humans 2n = 46. Of these 44 are termed autosomes and X and Y as sex chromosomes. Male has a long X and a short Y chromosome and female has two X chromosomes.
- A chromosome is made of one molecule of DNA or Deoxyribonucleic acid and proteins.
- Segments of this DNA molecule are **genes.**
- Bacteria have only one circular chromosome.

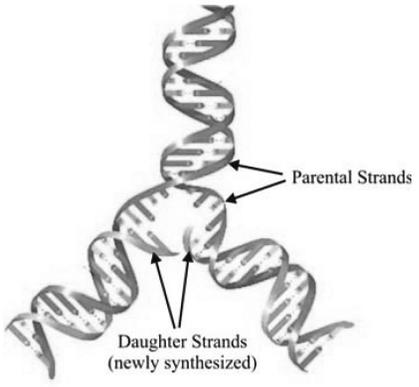
DNA – Deoxyribonucleic Acid

- Is a polynucleotide made of many units of deoxyribonucleotides.
- Each deoxyribonucleotide has
  - – A nitrogenous base
  - – A deoxyribose sugar
  - – A phosphate
- The nitrogenous bases are Adenine (A),Guanine (G), Thymine (T), Cytosine (C).
- A DNA molecule is made of two strands of DNA helically coiled around each other.

DNA Replication

- For genes to be inherited, DNA needs copies of itself. This is called DNA **replication**. The steps are aided by enzymes, DNA unwinds into its two strands.
- New daughter strands are formed such that their base pairing is correct with the two parental DNA strands.
- So upon DNA replication, two identical molecules of DNA are formed. These are termed **chromatids** and remain joined by a **centromere**.

DNA Replication



- Parent DNA ® DNA unzips
- Two new daugher strands helically coil against the two unzipped parental strands.
- So two identical daughter DNA molecules formed giving rise to two chromatids.
- A chromosome after replication

Blood Groups

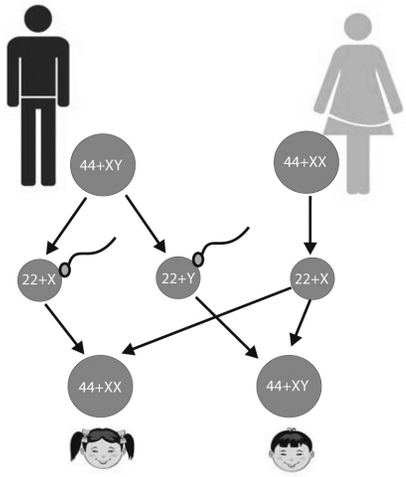
Every human belongs to one of the four blood groups A, B, AB, O controlled by genes I^A, I^B, or i and Rh^+ or Rh^-

I^AI^A or I^Ai	Blood group A	Can donate blood to A or AB
I^BI^B or I^Bi	Blood group B	Can donate blood to B or AB
I^AI^B	Blood group AB	Universal Recipient
I^AI^B	Blood group O	Universal donor
Safest blood group for transfusion O Rh^-		

• Heredity and Variation

Variations caused by environment such as sun burn, powerful muscles of body builder, scars due to accident are **not hereditary**. Only genetic variations like hair color, height, tongue rolling etc. are inherited. Intelligence, musical and sports ability are due to both effect of genes and environment.

• Sex determination in humans



Slogan: Say **No** to testing foetus for its sex.

• Hereditary disorders in human and Genetic Counselling

A change in a gene is called mutation. A mutated gene may cause hereditary diseases such as:

- **Thallasemia**, a genetic disorder when Hb is not synthesised in bone marrow and frequent blood transfusion is required
- **Haemophilia**, where a gene for clotting is absent.

Colour blindness, when the recessive gene for colour distinction present on X-chromosome interferes with distinguishing colours.

When marriages take place between relatives, there is a chance of inheritence of two recessive genes from either parents who are related. Hence, it makes sense to meet a **genetic counsellor** beforehand if there are defective genes in the family.

• Human Genome

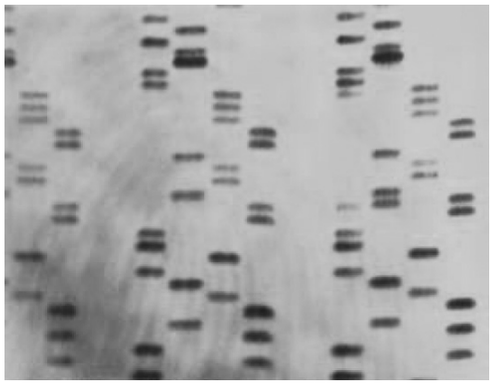
Genome means all the genes and their location on various chromosomes. Human genome has been mapped and gene therapy for curing hereditary diseases is underway.

DNA Fingerprinting: Method to identify unique DNA of an individual and gentic relathionships.

- Source of DNA of the suspect such as hair, blood, skin is obtain.

- Extract DNA is extracted and increase its quantity.
- Cut and separated DNA fragments according to size are used to get '**genetic fingerprint**'.
- Compared and the suspect identified.

Use of genetic fingerprinting as criminal evidence



This shows that the suspect I was at the crime scene as the DNA fragments match up.

Genetic Engineering or Recombinant DNA Technique

- Genes may be altered for making a useful product e.g. insulin for diabeties.

★ Stretch Yourself

1. How does variation arise?

   Variation arises at gamete formation or through **mutation.**

2. How is it that normal couple may have a child with a genetic disorder?

   When a gene in a gamete mutates either naturally or due to exposure to radiation or other causes, it may lose its normal function. The expression of a defective gene is usually masked by the normal gene with which it pairs. But if both parents possess the defective gene, then the child may inherit both the defective genes and is likely have the disorder.

? Test Yourself

1. Why are 'heredity' and 'variation' studied together?
2. 'Law of segregation of characters' is Mendel's first and universal law of inheritance.How does the segregation take place? Explain.
3. What is the chemical nature of a chromosome and a gene and what is the difference between a chromosome and gene?
4. What is needed to be collected from the side of crime for finding the real criminal through DNA finger printing and why is just a bit of the tissue from criminal site enough?
5. What is DNA made of? Describe.
6. Which is the safest blood group for transfusion in an emergency and why?
7. Why should parents not be blamed for the sex and gender of their child?
8. What is genetic engineering?
9. Why should marriages betwen relatives be discouraged?
10. How does DNA make identical copies?

26. Air and Water

- Air is a mixture of different gases. It contains oxygen, Nitrogen, Argon, Carbon dioxide and traces of some inert gases. It also contains water vapour.
- O_2, N_2 and CO_2 are directly or indirectly useful to all living organisms.
- Air above the earth exerts a force on earth's surface which is called atmospheric pressure. It plays an important role in working of common devices like syringe, water pump, etc.
- Water is the next abundant natural resource available to us. Although sea water is the largest natural source of water, it is unfit for domestic use and drinking.
- Decantation, filtration, chlorination and boiling are some of the steps that convert non potable water into potable water.
- Properties of water make it suitable for use in everyday life for domestic purposes, in agriculture, in industries as coolant and for steam production) and in power generation.
- Water resources are managed by constructing dams, canals, reservoirs, walls etc.
- Rain water harvesting can recharge ground water.
- Human activities are responsible for air and water pollution.

Build Your understanding

- **Air**

Importance of various components of air

Component	Importance
Oxygen O_2	• Necessary for respiration of almost all living organisms. • Supports combustion. Finds use in cutting and welding torches in the form of hydrogen or acetylene torches. • Mixture of oxygen and nitrous oxide is used as anesthesia in surgical operations. • Rusting of metals occurs in presence of oxygen and water.
Nitrogen N_2	• Main constituent of amino acids, proteins and enzymes. • Subdues the activities of oxygen such as metabolism, combustion and corrosion.
Carbon dioxide CO_2	• During pototsynthesis green plants absorb CO_2 and H_2O and convert them into sugars. • Used for food preservation. • Solid CO_2 is called dry ice which is used as refrigerant. • used in soft drinks and in fire extinguishers. • It also acts as a green house gas.
Water vapour	• causes heating or cooling of atmosphere and day to day change in weather. • Water evaporates from water bodies due to heat of sun, forms clouds and then falls as rain.
Air pressure	• Air exerts pressure. • Atmospheric pressure decreases with altitude

- **Air Pollution**

Air pollution is caused by harmful chemicals, biological wastes and particulate matter introduced in the atmosphere through human activities. Air pollution has harmful effects on all living organisms.

Air pollutants	
Primary pollutants	**Secondary pollutants**
CO, CO_2 Volatile organic compounds CFCs Particulate matter	Photochemical smog Ground level ozone

- **Water** – the precious natural resource

Water is essential for survival of all living beings.

Non potable water can be treated to make it potable. The methods are:

(i) Decantation, (ii) Filtration,

(iii) Boiling, (iv) Chlorination.

Soft Water	Hard Water
1. Forms lather with soap	1. Does not produce lather with soap
2. Contains less amount of salt	2. contain salts of calcium and magnisium.

Properties of water Importance/Significance

1. Polar nature – makes it an excellant solvent
2. Capillarity – Water moves up from soil through roots and enters the branches and leaves of the plants
3. Strong surface tension – Upper layer of water acts like a tight sheet and small insects can crawl over and move on the water surface
4. Density of water is highest at 4°C. – This explains why aquatic animals living in water bodies of very cold regions do not die in severe winter.

Increasing population, growth in industries, expanding agriculture and demand for water in thermal and nuclear power plants have pushed up the demand for water.

Water conservation by way of rain water harvesting, making dams and reservoirs, recycling of used water and desalination of water has become the need of the hour.

✔ Maximise Your Marks

1. How does each one of the pollutants cause harm to humans?
2. Atmospheric pressure plays an important role in the working of a syringe, water pumps etc. How does it help in their working?
3. What role does atmospheric pressure play in the process of breathing?

★ Stretch Yourself

Terrestrial animals take O_2 directly from the air, O_2 dissolved in water is the source of oxygen for aquatic animals. However, Dolphin, Whales etc breathe in air. Can you explain how?

? Test Yourself

1. A person will die in an atmosphere of either carbon mono-oxide or carbon dioxide but due to different reasons. Explain.
2. Why are we advised to minimise the use of CFCs?
3. Water has highest density at 4°C. How is this unusual property helpful to aquatic animals in very cold regions? Explain.
4. 'Without CO_2 in the air, no food will be available for any organism and yet it is considered a menace when its level reaches beyond a certain level.' Discuss the statement.
5. In what ways can you recycle waste water at home? Mention any three ways.

27. Metals and Non-metals

- Elements are broadly classified as metals non-metals.
- Metals can be distinguished from non-metal on the basis of their physical properties like malleability ductility, lusture etc.
- Metals have tendency to lose electrons whereas non-metal have tendency to gain electrons. Thus metals show electropositive character whereas non-metals show electronegative character.
- An ore is a mineral from which a metal can be profitably extracted from it.
- Metallurgy is the branch of science which deals with extraction of metals from its ores.
- Some of the non-metals are also found in free state in nature for example sulphur and carbon (as coal, graphite, diamond).
- Chemical properties of metals and non-metal are different. Metal and non-metal both react with oxygen (air), water and acids.
- Certain oxides of metals show both the properties acidic as well as basic e.g. ZnO and Al_2O_3.

Build Your Understanding

Physical Properties of metals and non-metals

Physical Properties	Metals	Non-Metals
Malleability and Ductilily	Metals are malleable. They can be beaten into thin sheets. They are also ductile and can be drawn into wire	Non-metals are neither malleable nor ductile. For e.g. coal, (carbon) and sulphur
Metallic Lusture	show metallic lusture.	Do not show any metallic lusture except I_2.
Hardness	Hard except Hg, Na	Soft except diamond
Physical state	solid and liquid states	Solid, liquid and gas
Sonorous	Sonorous (produce sound)	Non-sonorous
Density	High	Low
Electrical conductivity	Good conductor	Bad conductor

Chemical Properties of Metals

1. **Reaction with Oxygen:** Form oxides which are basic in nature
   Oxides of aluminium (Al_2O_3), zinc (ZnO), tin (SnO) and iron (Fe_2O_3) are amphoteric. React with acids as well as with bases.
2. **Reaction with acids:** Generally metals react with acids to form salts and evolved H_2

$$Mg + 2HCl \longrightarrow MgCl_2 + H_2$$

3. **Reaction with water to form base**

$$2Na + 2H_2O \longrightarrow 2NaOH + H_2$$

Al or Fe react with steam to form oxides

$$3Fe + 4H_2O \longrightarrow Fe_3O_4 + 4H_2$$

4. Reaction with bases

Al, Sn and Zn react with common base

$$Sn + 2NaOH + H_2O \longrightarrow Na_2SnO_3 + 2H_2$$

Corrosion: Oxygen reacts with metals to form oxides. Oxidation of metals is known corrosion for example rusting of iron.

$$4Fe + xH_2O + O_2 \longrightarrow 2Fe_2O_3.xH_2O$$

Presence of moisture and oxygen is necessary for corrosion. Corrosion can be prevented by (i) Painting (ii) oiling and greasing (iii) Galvanization (iv) Alloying

Uses of Metals

- To make utensils (iron, aluminium)
- To make electrical wire (copper, aluminium)
- to make machines
- uses in cells and batteries
- to make Jewellery
- To make sheets Al and iron are used to make sheet due to malleable nature (Malleability)

Uses of Non-metals

- For the manufacture of fertilizer
- Silicon is used for making transistor, chips etc
- White phosphorous is used in match industry
- Sulphur is used to control fungus pests. It is also used for the manufacture of H_2SO_4 and gun powder.

Stretch Yourself

1. Why is it better to use copper than carbon in electrical wires.
2. Aluminium metals is used as utensils in houses why?
3. Left copper coin in open air and observed. After one month a green layer is developed on the coin. Why it is so?

Test Yourself

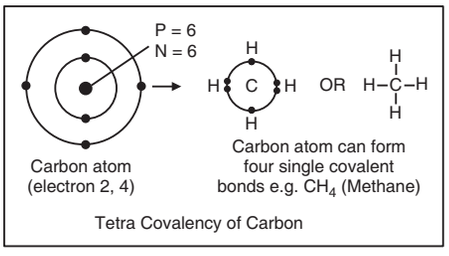
1. Metals are good conductor of electricity but non-metal are not why?
2. What are the main conditions for the corrosion? How will you prevent it?
3. How will you prove that metal oxides are basic but non-metal oxides are acidic in nature?
4. Sn is soluble in excess NaOH why? Explain with equation.

28. Carbon and its Compounds

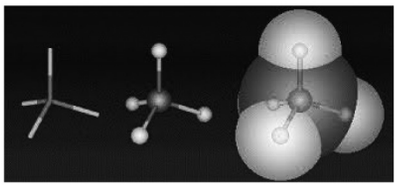
- Diamond has a three-dimensional network of covalently bonded carbon atom. It is hard and colourless. It has high melting and boiling point and is a good conductor of heat but poor conductor of electricity.
- Graphite is soft, black, and slippery in nature and has a layered structure. It is a good conductor of electricity.
- Fullerenes contain carbon atoms arranged in closed structures similar to football.
- Charcoal, coke and carbon black are micro-crystalline forms of carbon.
- The compounds of carbon can be classified as organic and inorganic.
- Carbon monoxide and carbon dioxide are two important inorganic compounds of carbon.
- Organic compounds of carbon are hydrocarbons and their derivatives.
- Hydrocarbons are classified as saturated and unsaturated. The saturated hydrocarbons contain carbon-carbon single bonds whereas the unsaturated hydrocarbons contain carbon-carbon multiple bonds.
- Isomers have same molecular formula but different structure.
- Some simple functional groups include halo-, hydroxyl-, carbonyl, carboxylic acid etc.
- Compounds containing the above functional groups exhibit characteristic properties and have important uses in our daily life.

Build Your Understanding

Tetravalency of carbon



Tetra Covalency of Carbon



Carbon can form long chains of carbon atoms. This unique property of forming long chains is known as **catenation**

Allotrops of carbon

Carbon show three allotropic forms

- Diamond
- Graphite
- Fullerens

Diamond

- High density 3.51 gcm^{-3}
- M.P. 3500°C
- Do not conduct electricity but good conductor of heat

Uses

- For cutting and grinding hard material (glass)
- For making Jewellery
- Rock drilling

Graphite

- Density 2.2 gcm–3
- M.P. 3700°C (in vacuum)
- Good conductor of electricity

$$\text{Graphite} \xrightarrow[\text{High Temperature}]{\text{High atm Pressure}} \text{Diamond}$$

Uses

- used as lubricant in machines
- making electrodes in dry cells and electric arcs
- making pencil lead

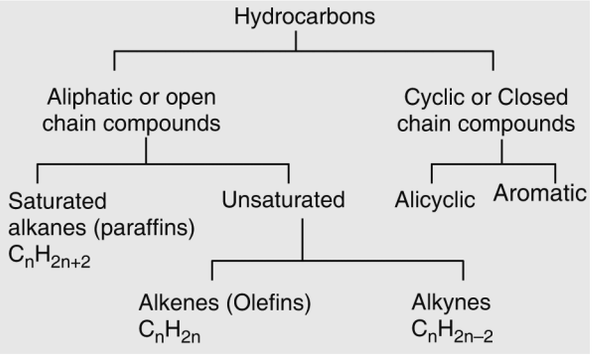
Fullerens

Fullerens have closed structure like foodball so it is also known as Buckminister fullerens C_{60}

$$\text{Vapourized carbon} \xrightarrow{\text{Condensed}} \text{Fullerences}$$

Hydrocarbons

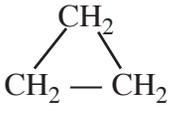
Contain carbon and hydrogen only



Aliphatic hydrocarbons: Derived from the Greek word aleiphar meaning fat. They are derived from fat.

Acyclic: strairght chain

Cyclic: form rings of carbon atoms



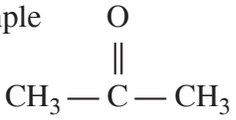
Aliphatic can be divided into: saturated and unsaturated hydrocarbons: Saturated hydrocarbon single bond in unsaturated multiple bonds (double and triple bonds)

IUPAC Nomenclature

For IUPAC naming, we must have idea about word root of carbon skeleton

No. of Carbon atom	Word root	No. of Carbon atom	Word root
1	meth	5	pent
2	eth	6	hex
3	prop	7	hept
4	but	8	oct

Rules

1. Alkane (CH_4)
   Word root + ane ⟶ meth + ane ⟶ Methane
2. Alkene (C_2H_4)
   Word root + ene ⟶ eth + ene ⟶ ethene
3. Alkyne (C_2H_2)
   Word root + yne ⟶ eth + yne ⟶ ethyne
   CH_3OH → Methane → replace 'e' by ol → Methanol
   C_2H_5OH → Ethane → replace 'e' by ol → Ethanol
   Alcohols: Synthesis of acetic acid, additive petrol, spirit
   Aldehyde and ketones: As solvent, polish removes
   Carboxylic acid: Ascorbic acid vitamin C citrus fruits.
4. Ketone
   For example
   
   Propane → replace 'e' by one → propanone
5. Carboxylic Acid.
   For example CH_3COOH
   Ethane → replace 'e' by oic acid → ethanoic acid

Functional groups

Functional groups is an atom or a group of atoms which is responsible for characteristic properties of a compound.

Functional group	Class	General formula	Example	IUPAC Name
$-C=C-$	alkene	C_nH_{2n}	$H_2C=CH_2$	Ethene
$-C\equiv C-$	alkyne	C_nH_{2n-2}	$HC\equiv CH$	Ethyne
$-OH$	alcohols	$R-OH$	CH_3OH	Methanol
$-\overset{\overset{O}{\|}}{C}-H$	aldehydes	$R-\overset{\overset{O}{\|}}{C}-H$	CH_3CHO	Ethanal
$-\overset{\overset{O}{\|}}{C}-$	ketones	$R-\overset{\overset{O}{\|}}{C}-R$	$CH_3-\overset{\overset{O}{\|}}{C}-CH_3$	Propanone
$-\overset{\overset{O}{\|}}{C}-OH$	carboxylic acids	$R-\overset{\overset{O}{\|}}{C}-OH$	CH_3COOH	Ethanoic Acid
$-\overset{\overset{O}{\|}}{C}-O-$	esters	$R-\overset{\overset{O}{\|}}{C}-OR$	$CH_3COOC_2H_5$	Ethyl ethanoate

Stretch Yourself

1. Methyl alcohol to harmful but ethylalcohol is not why?
2. Name the property of diamond which makes it brilliant when cut and polished.
3. Suppose in nature tetravalent of carbon is lost. What will happen then?

Test Yourself

1. Why diamond is used for cutting glass?
2. Explain the tetracovalency of carbon.
3. Carbon has a tendency to form long chain compounds. Why?
4. Write down possible isomers of C_4H_{10}.
5. Write down the IUPAC names of the following

(i) $CH_3 - CH = CH_2$

(ii)
$$\begin{array}{l} \quad\quad CH_3 \\ \quad\quad | \\ CH_3 - CH - CH_3 \end{array}$$

(iii)
$$\begin{array}{l} \quad\quad O \\ \quad\quad \| \\ CH_3 - C - CH_3 \end{array}$$

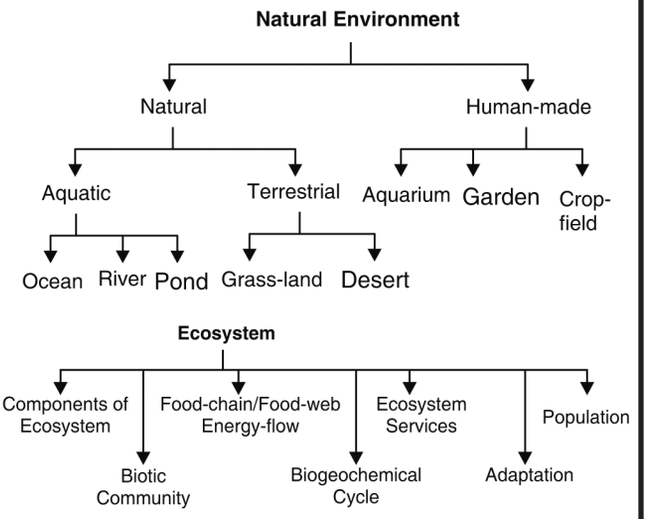
(iv) $HCHO$

(v) $CH_3 - C \equiv C - H$

29. Natural Environment

In an ecosystem, living organisms interact among themselves and also with the surroundings continously and yet maintain a balance. Ecosystem is very complex and to make its study easy, it is divided into two basic categories namely terrestrial and aquatic. Humans can also make ecosystems. For example, aquarium, gardens and agricultural fields are examples of man-made ecosystem.

The various components of an ecosystem function as a complete unit and have definite relationships with each other. The living organisms are directly or indirectly dependent on each other and use various natural resources for their survival. However, because of the growing human population there is a tremendous pressure on natural resources. The need of the hour, thus, is to check the overuse of our natural resources.



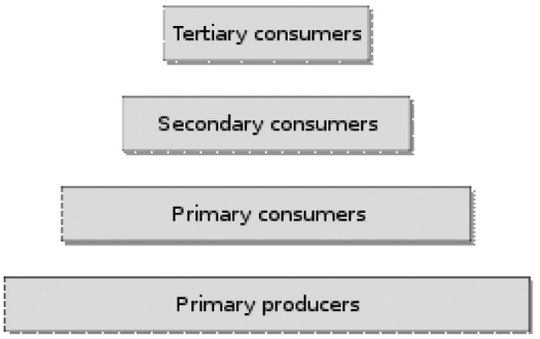
Build Your Understanding

Ecosystem = Non-living Component (Abiotic) + Living Component (Biotic)

e.g. sunlight, air (write two more abiotic components yourself)

(List the biotic components

- All components of a biotic community are connected through food (see figure), and energy available. They also form a web of inter-relationships



Components of any Food Chain

- A number of controlled processes occur in an ecosystem. Plants use nutrients from the soil. Their availability is largely dependent upon decomposition and mineralization of organic detritus. Animals found in an ecosystem are delicately balanced by the number of herbivores and the degree to which they are being eaten.
- Nutrients like carbon, nitrogen, water, sulphur and phosphorus are present in definite amounts in the ecosystem.
- Saprophytes help in recycling the nutrients back into the atmosphere by feeding on the dead and decaying organic matter and in the process also help in cleaning the environment.
- Energy flow is unidirectional. Only part of the energy is transferred to the next trophic level.
- Ecosystem provides us free service but we are overexploiting its resources.
- The **three important functions** of an ecosystem are:

1. Productivity and energy flow
2. Nutrient cycling
3. Development and stabilization

When two species use the same resource at the same time, the result is **Competition** and neither species does as well as it would in the absence of the other species. **Mutualism** is a relationship between two different species which benefits both species. **Commensalism** is when a species benefits by living in or on another species but has no effect on its host. A close interaction between two or more different organisms of different species living in close physical association is **symbiosis**.

An understanding of how populations interact is important for **Conservation** and **Management** because this information can be used to:

1. Monitor changes in structure of a biological community.
2. Understand how human activities that affect one species may also have indirect effects on other species.
3. Determine the impact of introduced species on populations.

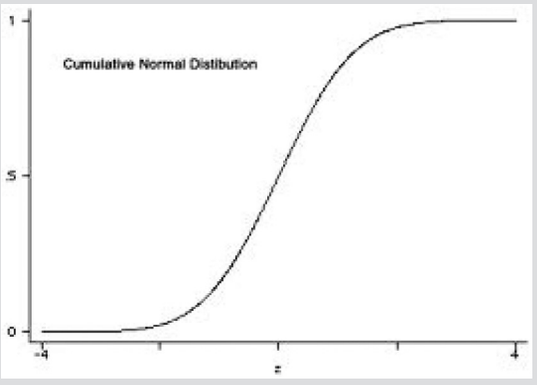
Stretch Yourself

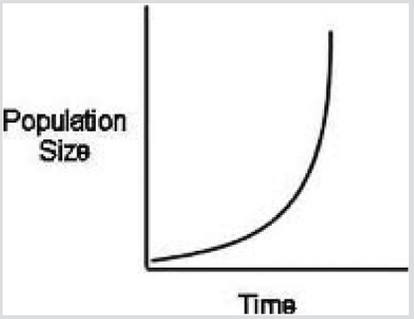
1. Difference between acclimatisation and adaptation?
2. Acclimatisation is a process of becoming accustomed to different environments over short periods. The changes which take place during acclimatisation are temporary and can be reversed.
3. Adaptation is the adjustment or change in behaviour, physiology and structure of an organism to become more suited to an environment. The changes that take place are permanent and cannot be reversed.
4. Draw arrows to connect the blocks and explain the two concepts you understand from this figure.

Autotrophs	Herbivores	Primary Carnivorous	Secondary Carnivorous
10,000 k cal	1000 k cal	100 k cal	10 k cal

Test Yourself

1. An animal has a round body with small ears. The body is covered by fur. It also has a thick layer of fat beneath its skin.
   a. Name the habitat of this animal
   b. What is the advantage of having a thick layer of fat beneath its skin?
   c. How is the round body and small ear advantageous to the animal?
2. Maithi is eating curd. Michael tells Githa that Maithi is eating curd and thus he occupies the second trophic level. Do you think Githa is correct? Give reasons in support of your answer.
3. Given below are two graphs. What can you conclude from the two graphs? Explain





Learner Guide

4. Which one is the correctly depicted food chain?
   a. eagle → snake → grasshopper → grass → frog
   b. frog → snake → eagle → grasshopper → grass
   c. grasshopper → grass → frog → eagle → snake
   d. grass → grasshopper → frog → snake → eagle
5. Importance of ecosystem lies in:
   a. Flow of energy
   b. Recycling of nutrients
   c. Both a and b
   d. Neither a nor b
6. A young crocodile has eaten a lamb. A hawk attacks the crocodile and eats it. In ecological terms, hawk is:
   a. Producer
   b. Primary consumer
   c. Secondary consumer
   d. Tertiary consumer
7. Role of bacteria in carbon cycle is
   a. Photosynthesis
   b. Breakdown of organic compounds
   c. Assimilation of nitrogen compounds
   d. Chemosynthesis
8. How does the nutrient content of an ecosystem increase?
9. With the help of suitable examples distinguish between the grazing food chain and detritus food chain. How is the detritus food chain ecologically important?
10. There are two plants. One of them (a) is a tall tree with needle like leaves, the other plant (b) is medium sized whose leaves have thorns, has long deep roots and the stem is covered with cuticle
    a. What is the most likely habitat of a and b?
    b. What is the advantage for the tree in "a" in having needle shaped leaves?
    c. How is the plant "b" benefitted by having long deep roots?
11. In an ecosystem the movement of nutrients is called cycling and the term flow is used for energy. Why?

30. Human Impact on Environment

Environmental problems may arise due to natural disasters or due to human activities.

Environmental Problems

Natural Disaster	Human-made Disaster
• Floods	1. Deforestation and Loss of Ecosystem
• Cyclone	2. Air, Water, Soil and Noise Pollution
• Earthquake	3. Depletion of Fossil Fuel
• Forest Fire	4. Biomagnification
• Tsunami	5. Depletion of Ozone Layer
• Landslide	6. Global Warming
• Cloud Burst	7. Waste Generation
	8. Eutrophication

Build Your Understanding

- Prevention of natural disasters like earthquake, cyclone, tsunami, cloud-burst is not within human control, but an early warning system could help in saving lives and property.
- Constructing flood proof and earthquake proof buildings can help in minimizing loss to lives and property due to floods and earthquakes.
- Forest fires are a major cause of forest degradation and has an adverse ecological, social and economic impact. Natural forest fire caused by lightning striking dry trees or by the heat generated in the litter and other biomass in the dry summer months is not in our control but definitely forest fire caused by human negligence can be avoided.
- Lighting a matchstick or cigarette should be completely banned in a forest. Deforestation by humans has contributed towards soil erosion and global warming.
- Increased population, mindless over-exploitation of resources and human negligence has adversely affected our environment.
- Over exploitation of resources has resulted in loss of ecosystem, depletion of fossil fuel, pollution, global warming, ozone layer depletion and photochemical smog.
- The excessive use of fertilizers and pesticides to increase agricultural yield has led to **eutrophication** and **biomagnification**.

- Pollution–Causes and Effects

Type of pollution	Causes	Effects
1. Air	Gases from Vehicle or factories exhaust, Forest fires, volcanic erruption, dry soil erosion other natural sources. Building construction and demolition	Pollutants in the air make it hard for poeple breathe causing long diseases. When it rains the chemicals in the air cause acid rain killing aquatic the animals and plants, and momument.
2. Water	– Increased sediment from Soil erosion – Improper waste disposal and littering Oganic Material decay in water supplies	Decreasing the quantity of available drinking water – Toxic waste and Oil spills cause many animals and plants to die
3. Land	– Thousands of waste and sewage fills – Non Sustainbale farming practices, such as the heavy use of inorganic pesticides – Strip mining, deforestation – Household dumping and littering	lead to poor growth and reduce crop yields, loss of wildlife habitats, soil erosion

✔ Maximise Your Marks

1. Do you think disposable paper cups are better than disposable plastic cups or earthen cups for having tea in trains? Give reasons in support of your answer.
2. If we are able to generate waste which is all biodegradable, then do you think there will be no adverse effect on the environment? Give reasons in support of your answer.

★ Stretch Yourself

- **Biomagnification:** Harmful chemicals used as pesticides enter food chain and accumulate in larger quantities as you go up the food chain.
- **Eutrophication:** Chemical fertilizers washed from fields into a water body promote growth of algae which deplete the water body of its oxygen. Other animals in the water body die, as a result.
- Agricultural and animal wastes like leaves, twigs, hay, dung etc. are **biodegradable wastes** which can be recycled into useful products and thus help in the conservation of our natural resources.
- **Non-biodegradable** waste like plastics, glass, electronic wastes etc. cannot be easily degraded and should be carefully disposed off to avoid causing serious environmental problems
- **Global warming** is caused by high concentration of carbon dioxide accumulated in the environment, which traps heat and increases atmosphere temperature.
- Ozone provides a protective layer against the ultra-violet rays coming from the sun. The excessive use of chemicals like CFCs have resulted in the **depletion of the ozone layer**.

? Test Yourself

1. Which of the following can you do to save energy and also reduce your impact on global warming?
   a. Walk or ride a bicycle if you are travelling short distances.
   b. Set your computer to an energy saving mode that reduces its electricity use while you are not using it.
   c. Turn the lights off when you leave a room.
   d. All of the above.

2. What are the materials that do not decay and remain in the environment called?
   a. Biodegradable wastes
   b. Garbage
   c. Non-biodegradable wastes
   d. Solid wastes
3. Given here are pictures (*a*, *b* and *c*) of some of the natural and human-made disasters. Name the disaster below each picture and write what disaster management steps will you take in each case.

a. .....
.....
.....

b. .....

.....

.....

c. .....

.....

.....

31. Food Production and Animal Husbandry

India has always been an Agrobased country and because of continuous agricultural research and sustainable farming, today it is among the top major agricultural nations. The credit for 'Green Revolution' goes to Dr. M.S. Swaminathan. An integrated approach for controlling the pests that damage our agricultural crops is being followed. Methods like crop rotation, mixed cropping, organic farming, using good manure and fertilizers, etc. together with the judicious use of pesticides is being practised by farmers to increase crop production. Also, "**a grain saved is a grain produced**" and thus scientific and safe storage of the agricultural produce is being adopted both by the farmers and the government. However, our food requirement cannot be fulfilled by agriculture alone and thus need of the hour is to strengthen our animal husbandry as well. We need to enhance our scientific approach for increasing the production of eggs, milk, honey, wool, meat etc. The field of biotechnology can be exploited both in the field of agriculture and animal husbandry to make our country self sufficient in food production.

Build Your Understanding

- In order to cultivate a crop successfully and profitably for food production, a farmer must adopt a large number of agricultural practices in a sequential order.
- Crop rotation, mixed farming, multiple cropping and organic farming are some of the methods of crop production.
- Peas, beans and pulses help in retaining the fertility of the soil after they are harvested as nitrogen fixing bacteria in their roots are left behind in the soil.
- Sowing of wheat with peas or groundnut with sunflower is advantageous to the farmers because they get two crops simultaneously from the same field. Can you recollect the name of the method?
- Organic farming enables the farmer to increase his agricultural produce without affecting the health of soil, ecosystem and people.
- The loosening of the soil by ploughing is beneficial to the farmers. Try to reason out as to why?
- Growing of crops repeatedly in the same field removes the important minerals, organic matter and other materials from the soil, making the soil infertile. Manure and fertilizers are added to the soil to remove the deficiency of plant materials and organic matter in the soil.
- Growth of weeds along with cultivated crops in the field reduces the crop production because ..... (fill in the blank).
- It is necessary to reduce the moisture content of grains before storing to prevent its spoilage during storage. Grains are stored in storage structures like Pusa bin or Silos which are moisture and rodent proof.
- Proper feeding of animals, proper shelter for them, proper breeding of these animals and prevention and cure of animal diseases are some of the practices necessary for the better production of food items and procurement of better services from animals.
- Poultry farming and fisheries have a special place in our country.
- GM Potato is a transgenic plant produced by the technique of genetic engineering. Tissue culture is also an effective technique for conserving rare plant species.
- Ration shops are public distribution systems and distribute the grain to the poor section of the society. Ration shops are state controlled.

✔ Maximise Your Marks

1. Explain how the irrigation requirement depends on the nature of the crop and also on the nature of the soil in which the crop is grown.
2. How do you think will the common man be affected if the Government did not have any policy for food security?

★ Stretch Yourself

- **Green Revolution:** Indian Agricultural scenario between 1968 and 1988 has been termed as the golden age of agriculture and is referred to as green revolution
- **Agronomy:** The branch of agricultural science which is concerned with crop production and management of farms
- **Crop Rotation:** The successive planting of different crops on the same land to improve soil fertility and help control insects and diseases.
- **Mixed Cropping:** Mixed cropping is a system of sowing two or three crops together on the same land, one being the main crop and the others, the subsidiaries.
- **Multiple Cropping:** Practice of growing two or more crops in the same space during a single growing season.
- **Transplantation:** Process of shifting new plants where they were sown to the main field
- **Plant Growth Regulators:** Adding chemicals that control the rate of growth of plants
- **Animal Husbandry:** The branch of agriculture concerned with the care and breeding of domestic animals such as cattle, hogs, sheep, and horses for better production of food items.
- **Poultry Farming:** Raising of domesticated birds such as chickens, turkeys, ducks, and geese, for the purpose of farming meat or eggs for food.
- **Fisheries:** The industry or occupation devoted to the catching, processing, or selling of fish, shell fish, or other aquatic animals
- **Agricultural Biotechnology:** Also referred to as "genetic engineering" or"genetic modification" (GM) is a sophisticated and precise means of modifying combination of plant genes for use in the production or processing of agricultural products.
- **Buffer Stock:** A supply of inputs held as a reserve to safeguard against unforeseen shortages or demands.

? Test Yourself

1. Arrange the following agricultural practices in a sequential order:

   Sowing, irrigation, adding manure and fertilizer, preparation of soil, removal of weeds, harvesting, storage of food
2. Auxin and cytokinin are ..... and are important for the plants because .....
3. Match the items in column A with those in column B

Column A	*Column B*
fumigation	tomatoes
vermicompost	cows
milch animals	chemical treatment
transplantation	earthworm
oysters	roundworm
	pearls

4. Farmers in India growlegumes like peas in one season and wheat or rice in the other season on the same land. What is this practice known as and how does this practice help in the replenishment of soil?

32. Health and Hygiene

- Health is of importance to one and all, but constant efforts are required to maintain it.
- Health is physical, mental and social well being, not merely absence of a disease.
- Both personal and community health are important for well being of an individual as well as that of the community.

- **Health**

Personal health Includes	**Community health includes following activities and programmes**
• Balanced diet	• cleanliness of the locality through proper garbage disposal and effective drainage system
• Personal hygiene	• Prescribed standard in food stores
• Consuming clean food and water	• Health promotion and disease prevention activities e.g. national immunisation programmes for infants, pulse polio programme
• Regular exercise and sleep	• Awareness about diseases of national importance such as AIDS, T.B., Malaria, Polio, Leprosy
	• mid day meal in schools
	• ensuring access to hospitals and health centre
• abstaining from habit forming substances	

Health is enhanced by balanced diet, hygiene and exercise. Health is affected negatively by disease, substance abuse and certain environmental factors

- **Disease**

Type of Disease	*Cause*	*Examples*
(i) Communicable diseases	Pathogens	Cold, TB, Cholera
(ii) Non-communicable diseases	Nutritional deficiencies	Marasmus
	Hormonal disorders	Goitre
	Genetic defects	Down's syndrome

- Communicable diseases are spread in different ways
- Immunisation plays a very important role in control of communicable diseases
- Alcohol and drugs are harmful and addictive in nature
- Techniques like MRI, Ultrasound and X-rays help in early detection of the disease.
- First Aid is the immediate care given to the victims of an accident or sudden illness before medical help arrives.

Build Your Understanding

Communicable diseases are caused by entry of pathogens into the body and are contagious. Can be spread directly or indirectly.

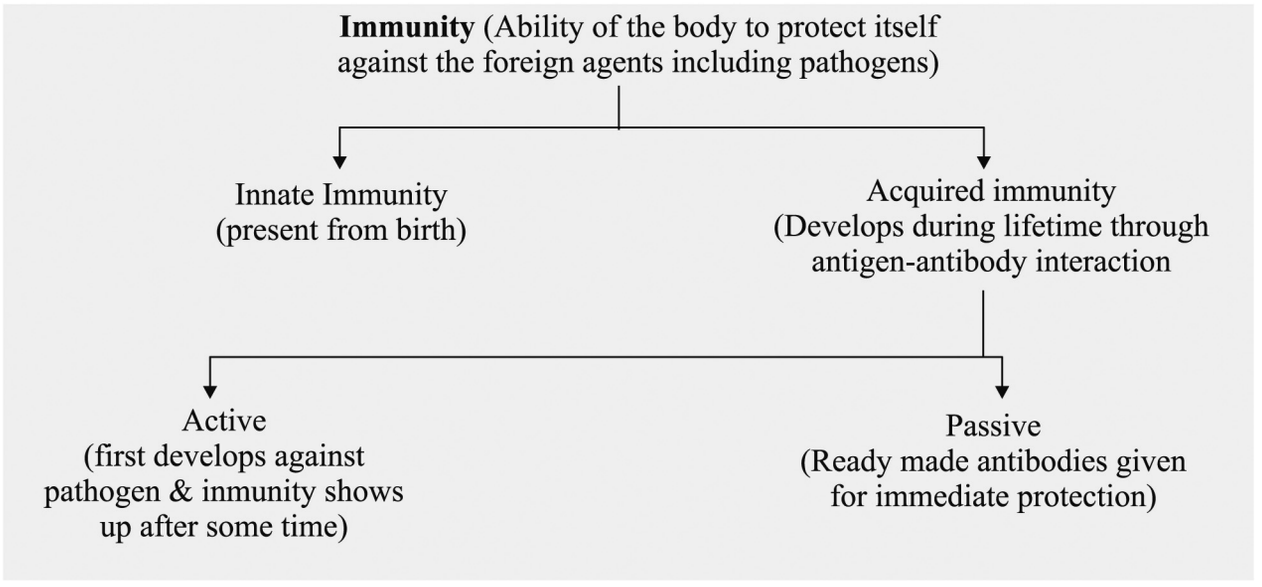
Direct method	Indirect method
• Contact with diseased person e.g. measles • Droplet infections e.g. tuberulosis • From infected mother to the new born e.g. HIV	• fomites, food, water • vectors eg mosquito • carriers like housefly • contaminated body fluids

- **Some common communicable diseases**

Name of the disease, causative agent, mode of transmission	Symptoms	Prevention and Treatment
(*i*) **Amoebiasis** caused by *Entamoeba histolytica*; indirect	Abnominal pain and cramps, constipation, stool containing mucous and blood	• Clean living conditions/ hygienic habits • Washing fruits and vegetables before eating
(*ii*) **Malaria** caused by *Plasmodium;* indirect	Fever with shivering followed by sweating and lowering of temperature	Eradication of mosquitoes treatment with antibiotics, prevent stagnation of water; use mosquito nets, door nets, mosquito repellents; Antimalarial drugs
(*iii*) **Influenza** (Flu) caused by virus; Direct transmission or indirectly through fomites	Fever, sore throat, cough, sneezing, running nose, headache, body pain, fatigue.	• Patients should cover their nose and mouth when sneezing avoid public places, vaccination. • Take plenty of fluids; medicines prescribed by the doctor.
(*iv*) **Tuberculosis** (T.B.) caused by *Mycobacterium tuberculi*; Transmitted directly by droplet infection, indirectly trhough formites.	Persistent low grade fever and cough and blood in sputum weight loss, chest pain, excessive fatigue.	B.C.G.. vaccination at birth; isolation of TB patient clothers and utensils used by T.B. patients should be regularly disinfected. • Regular course of antibiotics. • Treatment is for 6-8 months.

How human body fights back

- Human body fights a pathogens with W.B.C. engulfing them or by developing antibodies against the pathogens.
- For prevention, harmless version of pathogen is inoculated into human body which then produces antibodies against pathogen. This is called immunisation.
- Malnutrition and dietary disorders result in non-communicable diseases like diabetes, goitre, Marasmus, anemia, Scurvy etc.
- B.C.G., M.M.R and D.P.T are common vaccines given to children for immunity against Tuberculosis, Measles, Mumps and Rubella. Diptheria, Pertussis (Whooping Cough) and Tetanus; Oral Polio drops for polio



✔ Maximise Your Marks

- Viral diseases like common cold, measles, flu etc are spread very fast as they get transmitted both directly or through indirect means.
- Why are diseases like goitre, diabetes, anemia classified as non communicale diseases?
- Mothers' milk provides essential antibodies that provided immediate immunity to the new borns which type of immunity does it provide?

Table below gives examples of certain commonly abused drugs

Name of Drug	Purpose
Narcotics –opium, morphine	Kills pain
Cocaine and Amphetamines	Provides sense of euphoria and energy
Barbiturates	Acts as a Depressant–change perception
Hallucinogens like LSD, cannabinoids etc	Send into a make-believe world
Tobacco	Used for pleasure that becomes a habit.

Drugs are chemicals most of which are for medical use. Certain chemicals however, are addictive and harmful for mental and physical health upon prolonged use. Hence their consuumption is termed 'Drug abuse' rather than drug use.

Continuous abuse of drug leads to **addiction**, then **tolerance** of the drug by the body and ultimately **dependence** on it. It becomes difficult to give up the drug due to withdrawal symptoms which become unbearable. The drug abuser begins to steal, indulge in criminal acts to procure money to buy drugs. Physical health deteriorates. Students abusing drugs give up studies. Drug abuse is triggered by unhealthy and unhappy domestic environment, peer pressure and experimentation. Prevention is possible when there is awareness or availability of guidance and counselling. Cure is possible if medical and professional help is sought.

Stretch Yourself

1. Try to identify any two communicable and two non communicable diseases in your own locality and find out what causes them. Also, suggest remedial measures.

Test Yourself

1. Why is amoebiasis said to be transmitted by the indirect method and tuberculosis by both direct and indirect methods? Explain.
2. A child who has been given vaccine for polio will still be susceptible to tuberculosis. Give reasons and name the vaccine for preventing tuberculosis.
3. Given below are names of certain diseases, their symptoms, causative agents and preventive measures in a jumbled up manner. Using different coloured pencils / pens, connect the names of the disease with its causative agent, symptoms and preventive measure. You may use multiple lines.

I	II	III	IV
Malaria	Bacteria	Fever	Oral vaccine
TB	Virus	Watering of eyes	B.C.G.
Amoebiosis	Protistan	Shivered followed by sweating	Gambusia fish
Influenza	Protozoa	Sore throat	Use of door nets
	Worms	Abdominal pain with mucus in stool	Not sharing used towels
	Protozoa	Cough with blood in sputum	Antibiotics

4. Why are B.C.G.. and D.P.T. vaccines given to new borns?
5. (a) Mention the odd one out in the following diseases caused by protista.

   1. Malaria 2. Amoebiasis 3. Typhoid

5. (b) Encircle odd ones among following diseases caused by bacteria.

   1. Tuberculosis 2. Typhoid
   3. Cholera 4. Amoebiasis
   5. Dipheria 6. Leprosy
   7. Malaria

6. Differentiate between Pathogens and Vectors.
7. How does the polio virus enter the human body and paralyse organs.

Sample Question Paper

SCIENCE AND TECHNOLOGY

(212)

Roll No. ..... **Code No. 46/AS/3–A**

Day and Date of Examination

Signature of Invigilators 1. **.....**

2. **.....**

General Instructions

1. Candidate must write his/her Roll Number on the first page of the Question Paper.
2. Please check the Question Paper to verify that the total pages and total number of questions contained in the Question Paper are the same as those printed on the top of the first page. Also check to see that the questions are in sequential order.
3. For the objective type of questions, you have to choose any **one** of the four alternatives given in the question i.e. (A), (B), (C) or (D) and indicate your correct answer in the answer-book given to you.
4. All the questions including objective type questions are to be answered within the allotted time and no separate time limit is fixed for answering objective type questions.
5. Making any identification mark in the answer-book or writing roll number anywhere other than the specified places will lead to disqualification of the candidate.
6. Write your Question Paper code No. **46/AS/3-A** on the answer-book.
7. (a) The Question Paper is in English Hindi medium only. However, if you wish, you can answer in any one of the languages listed below :

   English, Hindi, Urdu, Punjabi. Bengali, Tamil, Malayalam, Kannada, Telugh, Marathi, Oriya, Gujarati, Konkani, Manipuri, Assamese, Nepali, Kashmiri, Sanskrit and Sindhi. You are required to indicate the language you have chosen to answer in the box provided in the answer-book.

   (b) If you choose to write the answer in the language other than Hindi and English, the responsibility for any errors/mistakes in understanding the question will be yours only.

Time 2½ Hours] [Maximum Marks **85**

Note (1) All questions are **compulsory.**

(2) Marks are given against each question.

1. A solution having pH = 4 is mixed with another solution having pH = 10, 1

The pH of the mixture can **not** be

(A) 3 (B) 5

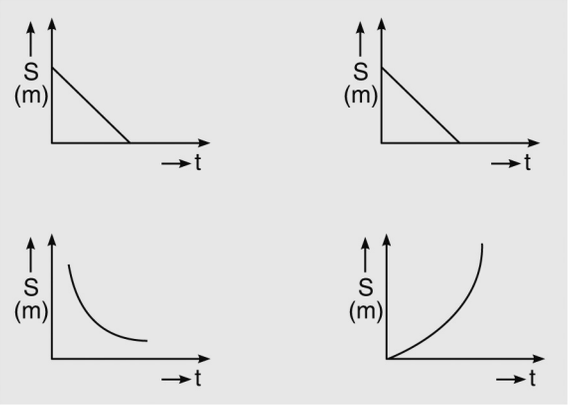
(C) 7 (D) 9

2. In sodium chloride crystal each sodium ion is surround by 1

(A) four chloride ions (B) six chloride ions

(C) eight chloride ions (D) Twelve chloride ions

3. Which of the following graphs represents the motion of a body falling freely under gravity ? 1



4. Which of the following is not a renewable source of energy ? 1

(A) Sun (B) Biomass

(C) Wind (D) Coal

5. Which of the following forms of energy is never produced in chemical reactions

(A) Light (B) Sound

(C) Heat (D) Nuclear energy

6. The linear expansivity of silver is $18 \times 10^{-6}\ ^{\circ}C^{-1}$. It volume expansivity will be 1

(A) $108 \times 10^{-6}\ ^{\circ}C^{-1}$ (B) $54 \times 10^{-6}\ ^{\circ}C^{-1}$

(C) $18 \times 10^{-6}\ ^{\circ}C^{-1}$ (D) $36 \times 10^{-6}\ ^{\circ}C^{-1}$

7. Person having which blood group can donate blood to any blood group person ? 1

(A) A (B) B

(C) AB (D) O

8. Formic acid is found in - 1

(A) Ants (B) Rancid batter

(C) Citrons fruits (D) Vitamin C

9. Which of the following is an aromatic hydro carbon ? 1

(A) Benzene (B) Butane

(C) Butene (D) Butyne

10. Name the physical quantities which have been assigned the following derived2 SI units and write the special names given to them

(i) $kg\ ms^{-2}$ (ii) $kg\ m^2s^{-3}$

11. Write each of the following quantities with proper prefix with symbol of units and also express it in terms of power of ten 2

(i) Charge of 4 Giga coulomb

(ii) Capacitance of 100 pico farad.

12. Oil got mixed with water. Draw a labelled diagram to show the method of separation of water and oil from the mixture. 2

13. Calculate the molecular mass of calcium chloride. 2

[Given: atomic mass: Calcium = 40 u; Chlorine = 35.5 u]

14. A car weighing 500 kg moves with a constant speed on a rough, levelled horizontal road under a force of 1000 N exerted by its engine. Calculate the acceleration of the car when the engine exerts a force of 1500 N. 2

15. Draw a neat labelled ray diagram to show the dispersion of light through an equiangular glass prism. 2

16. Give the full form of (i) RADAR (ii) SONAR write any two uses of RADAR. 2

17. Write a balanced chemical equation for the chemical reaction between sodium sulphate and barium chlorides solutions. Make it as informative as you can. Identify the type of reaction and define it. 4

18. A body of mass 40 kg placed on the surface of the earth is attracted by it with a force of 400 N. Find the values of G and g [radius of earth = 6.4×10^6 m mass of the earth = 6×10^{24} kg] 4

19. Calculate the time in which a 1.5 kw electric water heater may raise the temperature of 100 litre of water from 30°C to 60°C. 4

[Given mass of 1 L of water = 1 kg, specific heat of water = 4200 J/kg °C]

20. (a) What is an electric fuse ? What material is used for it? How does it work ? 4

(b) What is earthing ? How does it help us

21. Name four organs that remove wastes from our body. Describe the function of any two of these in brief 4

22. (Explain what is meant by the following terms 4

(i) Viviparous

(ii) Oviparous

Give two examples of each.

23 (a) Write (i) two general, (ii) two medical and (iii) two industrial uses of oxygen. 4

(b) Mention two harmful effects of it.

24. What is meant by activity series of metals ? Arrange Cu, Al and Fe in decreasing order of their activity. Justify the arrangement with the help of experiments giving chemical equations involved. 4

25. Draw a labelled block diagram showing energy flow in different trophic levels. Also explain the phenomenon of biomagnification and what are its adverse effects? 4

26. Classify the following diseases as communicable and non-communicable diseases AIDS, Diabetes, Influenza, Polio. Describe one cause and one symptom of any two of these. 4

27. Name four global environmental problems. Discuss the causes and essential measures to be taken to check any one of these. 4

28. (a) How many electrons, protons and neutrons are there in ${}^{35}_{17}X$. 6

(b) Write electronic configuration of X.

(c) Identify X and find its valency.

(d) Is it metallic or non metallic ? Explain.

(e) What type of bond will it form with (i) Carbon and (ii) Hydrogen ?

29. What are (i) Representative elements (ii) Transition elements and (iii) Rare earth elements. Give two examples of each. 6

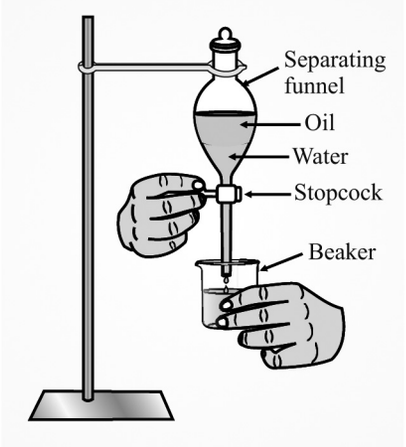
30. Differentiate between the following 6

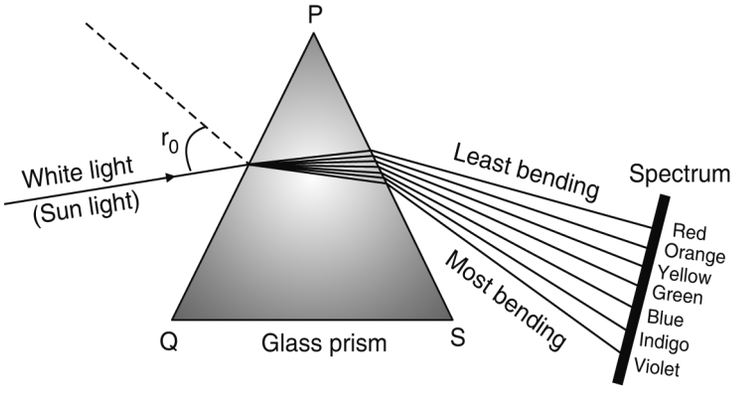
(i) Sensory nerve and motor nerve.

(ii) Cerebrum and cerebellum

(iii) Sympathetic and parasympathetic nervous system.

Secondary
April/May - 2013
Science & Technology (new Syllabus) (212)
Marking Scheme

Set		Distribution of marks	Total marks
A			
1	A	1	1
2	B	1	1
3	D	1	1
4	D	1	1
5	D	1	1
6	B	1	1
7	D	1	1
8	A	1	1
9	A	1	1
10	Name of Physical quantity (i) Force (ii) Power	½ + ½	2
	Special Name to the unit (i) newton (ii) watt	½ + ½	
11	(i) Q = 4 Giga Coulomb		2
	$= 4\times10^{9}$ C	½	
	= 4 GC	½	
	(ii) C = 100 Pico farad		
	$=100\times10^{-12}$ F	½	
	= 100 pF	½	
12		1	2
	Labelling	1	

13	Calcium Chloride is $CaCl_2$	½	2
	Molecular Mass $= 40\ u + 2 \times 35.5\ u$	½	
	$= 40\ u + 71\ u$	½	
	$= 111\ u$	½	
14	Car is moving with a constant velocity,		
	$\therefore$ net force on the car = 0		
	$\therefore$ frictional force = force by the engine		
	$= 1000\ N$	½	
	When driving force is 1500 N		
	Net force = 1500 – 1000 = 500 N	½	2
	According to Newton's second law of motion	½	
	$a = \frac{F}{m} = \frac{500}{500} = 1\ ms^{-2}$		
	The car will acceleration with	½	
15		1	2
	Correct Labeling	1	
16	(i) RADAR ⇒ Radio Detection And Ranging	½	2
	(ii) SONAR ⇒ Sound Navigation And Ranging	½	
	Uses : (any two)	½ + ½	
	(i) Observation of atmospheric objects		
	(ii) Air Traffic control		
	(iii) Ship navigation		
	(iv) In military use (early warning and fighter control radar)		
17	$Na_2SO_4\ (aq) + BaCl_2\ (aq) \rightarrow BaSO_4\ (s) + 2NaCl\ (aq)$	1	4
	Correct formula of reactants and products	1	
	Balancing	½	
	States	½ + ½	
	The reaction is double displacement reaction	½	

18 Given 4

$m_1 = 40\ kg$

$m_2 = 6\times10^{24} kg$

$R = 6.4\times10^{6}\ m$

$F = 400\ N$

According to Newton's law of gravitation $F = G\frac{m_1 m_2}{R^2}$ ½

$\Rightarrow G = \frac{F R^2}{m_1 m_2}$ ½

Substituting the values

$G = \frac{400\times\left(6.4\times10^{6}\right)^2}{40\times6\times10^{24}}$ 1

$= \frac{10\times6.4\times6.4}{6}\times10^{-12}\ \frac{Nm^2}{kg^2}$

$= \frac{409.6}{6}\times10^{-12}\ Nm^2\ kg^{-2}$

$= 6.83\times10^{-11} Nm^2\ kg^{-2}$ 1

$g = \frac{F}{m_1} = \frac{400}{40} = 10\ m\ s^{-2}$ 1

19 Let the time be t. 4

The electrical energy consumed by heater in t s = Pt = 1500 t J ½

Mass of 100 L of water = 100 kg ½

Amount of heat required to raise the temperature of water from 30°C to 60°C given by

$Q = m\ C\ \theta$ ½

$= 100\times4200\times30 J$

$= 12.6\times10^{6} J$ 1

Assuming that the entire electrical energy is converted into heat

$1500\ t = 12.6\times10^{6}\ J$ ½

$t = \frac{12.6}{15}\times10^{6} s$

$= 8.84\times10^{4} s$

= 8400 s 1

20	(i)	Fuse is a weak link in electric circuits which is deliberately placed on the phase wire of the circuit for the protection of the installation	½	4
		The fuse wire is made of a material which has a comparatively higher resistivity and lower melting point. Normally a copper-tin alloy is used for the purpose.	1	
		Whenever due to short-circuiting or overloading excessive current flows the fuse wire blows off and saves the installation from the damage (any two points)	½	
	(ii)	**Earthing** is an arrangement in electric circuit devised for the safety of the operators.	½	
		It connects the bodies of all high power appliances to the ground through a thick conducting wire	½	
		In case charge leaks to the body of the appliance, for any reason, it passes it to the ground leaving the body uncharged or else the charge will accumulate on the body of the device and may give severe shock to any person who touches it. (any two points)	1	
21	The organs which remove wastes from our body are : (i) kidneys (ii) lungs (iii) skin (iv) liver		½ × 4 = 2	4
	Sweat glands in our skin remove excess salts from our body when we perspire.		1	
	Lungs remove carbon dioxide from our blood stream when we respirate.(or any other correct answer)		1	
22	(i)	Viviparous animals are those animals in which the babies develop in their mother's wombs.	1	4
		All mammals such as cats, dogs etc. are examples of viviparous animals.	½ + ½	
	(ii)	Animals which lay eggs to be hatched out side the womb are called Oviparous animals, fish, frog etc. are examples of oviparous animals.	1 ½ + ½	
23	(a) (i)	General use : (1) Oxygen cylinders are carried by high mountain climbers, high altitude aviators and fireman for respiration. (2) Necessary for respiration or medical use (any other use)	½ × 2 = 1	4

(ii) (1) A mixture of oxygen and nitrous oxide is used as anesthesia in surgical operation. ½ × 2 = 1

(2) Used for artificial respiration in hospitals.

(iii) Industrial use :

(1) Oxygen mixed with hydrogen (hydrogen torch) or acetylene (oxyacetylene torch) is used for cutting and welding metals. ½ × 2 = 1

(2) Used for manufacture of sulphuric acid from sulphur and nitric acid from ammonia.
(or any other correct use)

(b) Harmful effects :

(i) Corrosion or rusting of iron ½ × 2 =1

(ii) Combine with almost all elements to form oxides.

24 The arrangement of metals in the decreasing of their activity is known as activity series of metals 1

Al > Fe > Cu 1

The following replacement reactions clearly show this order in reactivity.

(i) $2Al + Fe_2O_3 \rightarrow 2Fe + Al_2O_3$

Aluminum can replace iron in its salt solution

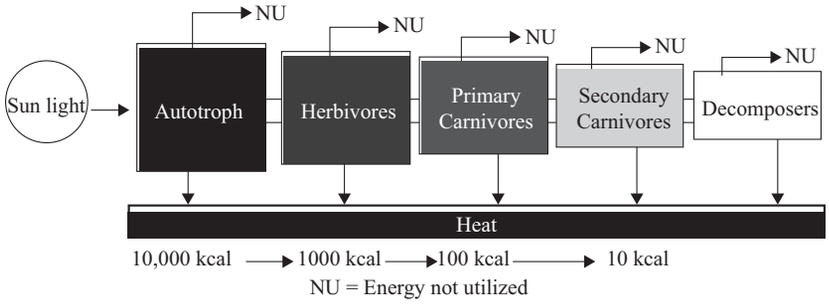
$\therefore$ Al is more reactive than Fe. 1 4

(ii) $Fe + CuSO_4 \rightarrow FeSO_4 + Cu$

Here Fe replaces Cu from its salt solution.

$\therefore$ Fe is more reaction than Cu. 1

25



2 4

The fertilizers, insecticides and pesticides etc used for increasing crop yield or for fighting disease vectors are normally non-biodegradable and hence as we advance in trophic levels the concentration of these chemicals increases in the bodies of higher organisms of higher trophic levels. This is called as biomagnification. 1

The chemicals as they enter the food chain may have adverse effect on the health and propagation of organisms of any trophic level and disturb the eco balance. 1

26	Communicable diseases, AIDS, Influenza, Polio	½×3 =1½	4
	Non-communicable diseases : Diabetes	½	
	AIDS : HIV infection through infected needles or syringes causes deterioration in immune system of body.**Influenza** : viral infection of respiratory tract causes fever, soar throat, cough, sneezing, body ache etc.**Polio Virus** : Polio virus caused deformation or haphazard, growth of long bones. **Diabetes** : malfunctioning of pancreas increases blood sugar and start affecting the function of vital organs.(any two)	1×2=2	
	(Other correct answers may also be acceptable)		
27	**Global problems :**		
	(i) Depletion of ozone layer	½ × 4 =2	4
	(ii) Global warming		
	(iii) Photochemical smog		
	(iv) Acid rain		
	At about 50 – 80 km height above the earth there is a thin layer of ozone (O_3) which absorbs UV radiations coming from the sun and saves us from the harmful effects of these radiations.	1	
	This layer is thinning above the arctic and antarctic over the years due to continuous use of CFCs in refrigeration systems, fire extinguishers, aerosols and cleansing solvents.	1	
	Thus depletion of O_3 layer has to be prevented by reducing the use of CFC (Or any other correct answer)		
28	(a) No. of electrons = No. of protons = atomic number = 17	½	6
	No. of neutrons = A – Z = 35 – 17 = 18	½	
	(b) Electronic configuration		
	= K L M 2 8 7	1	
	(c) X is element belonging to period 3, group 17, i.e. chlorine, its valency is (7 – 8) = –1 or 1.	1	
	(d) Being on the right extreme side of periodic table it is non-metallic.	1	
	(e) (i) The bond formed with carbon will be covalent bond	1	
	(ii) Bond formed with hydrogen will also be (polar) covalent bond		
29	(i) **Representative elements :** The elements of group 1-2 and 13-17 which have their outermost orbits incomplete are called representative or main group elements.	1	6
	e.g. Sodium, Magnesium		
	(or any other correct answer)	½ + ½	

	(ii)	**Transition elements :** Elements belonging to group 3 – 12 of the periodic table which have the outermost well as the penultimate orbit incomplete are called as transition elements, because, they exhibit a transition from the most electropositive to most electronegative elements and multiple valency. (example Cu, Fe or any other correct example)	1 ½ + ½	
	(iii)	**Rare earth elements :** Lanthanoids and Actinoids, two series of 14 elements each placed along with lanthenum (Z = 57) and Actinium (Z = 89) and shown separately below the main periodic table and having three outermost orbits incomplete are called rare earth elements. examples : Ce, Th or any other correct example	1 ½ + ½	
30	(1)	Sensory nerves consisting of sensory fibres carry impulse from sense organs to the brain or spinal cord whereas motor nerves consisting of motor nerve fibres carry impulse from brain or spinal cord to affector organ like muscle or glands.	1+1	6
	(2)	Cerebrum is the largest portion of brain considered to be the seat of intelligence, consciousness and will power. The cerebellum is much smaller portion of brain located below the cerebrum. It maintains the balance of the body and coordinates muscular activities.	1 1	
	(3)	Sympathetic nervous system is that part of autonomic nervous system which prepares the body for action during stress. The parasympathetic nervous system executes actions. That do not require immediate response. e.g. producing saliva, tears or digestive secretions.	1 1	

Mind Without Fear

Where the mind is without fear and the head is held high;
Where knowledge is free;
Where the world has not been broken up
into fragments by narrow domestic walls;
Where words come out from the depth of truth;
Where tireless striving stretches its arms towards perfection;
Where the clear stream of reason
has not lost its way into the dreary desert sand of dead habit;
Where the mind is led forward by thee
into ever-widening thought and action
Into that heaven of freedom, my Father, let my country awake.

— *Gurudev Rabindranath Tagore*

विद्याधनम् सर्वधनं प्रधानम्

NATIONAL INSTITUTE OF OPEN SCHOOLING