Topic 1: Chemical Reactions & Equations

Summary

Knowing your Chapter at Glance:

- Universe is recognised by two major changes:- chemical changes and physical changes.

Types of Changes

Physical Changes (No new substance is formed)	Chemical Changes (A new substance is formed)
e.g. Melting of ice, boiling of water, breaking of a glass tumbler.	e.g. Souring of milk in summers, Rusting of iron articles, Burning of any substance, Digestion of food in our body.

- **Chemical reaction** is the process of breaking and making of bonds between different atoms to produce new substances.

Examples

Rutherford observed the deflection of alpha particles after passing through metal sheet and proposed his atomic model

Digestion of food

The burning of magnesium in air to form magnesium oxide

The two main components of the chemical reaction are

Reactants which are the substances that take part in a chemical reaction.

Product(s) that are formed as a result of chemical reaction between the reactants.

$$\underset{\text{Reactants}}{Zn + H_2SO_4} \longrightarrow \underset{\text{Products}}{ZnSO_4 + H_2}$$

A chemical reaction is accompanied by the following chemical change that is observed as:

- Change in state
- Change in colour
- Evolution of gas
- Change in temperature
- Formation of precipitate

- Chemical equation is the representation of chemical reactions in the form of formulae.

  While writing a chemical reaction the following steps must be employed
- The symbols and formulae of the reacting substances are written on the LHS with a plus sign(+) between them.
- The symbols and the formulae of the product formed are written on the RHS with a plus sign(+) between them.
- The LHS and RHS are connected by an arrow sign(→).
- To make the equation more informative, states of the reactants and the products are also mentioned.

Example

$$2CO(g) + O_2(g) \longrightarrow 2CO_2(g)$$

- Balanced equation is the one which has same number of atoms of each element on the LHS and RHS of the equation.

  Balancing is done in accordance with the **law of conservation of mass** which states that "the total mass of the elements present in the products of the chemical reaction is equal to the total mass of the elements present in the reactants.

  Example of Balancing a Chemical Equation (? means coefficient missing)

  $$? CH_4 + ? O_2 \longrightarrow ? CO_2 + ? H_2O$$
- Identify the elements in the equation: C, H, O

- Identify the net charge: no net charge, which makes this one easy!
- H is found in CH_4 and H_2O, so it's a good starting element.

  You have 4 'H' in CH_4 yet only 2 'H' in H_2O, so you need to double the coefficient of H_2O to balance H.

  $1CH_4 + ?\ O_2 \longrightarrow ?\ CO_2 + 2H_2O_2$
- Looking at carbon, you can see that CH_4 and CO_2 must have the same coefficient.

  $1CH_4 + ?\ O_2\ ? \longrightarrow 1CO_2 + 2H_2O$
- Finally, determine the 'O' coefficient. You can see you need to double the O_2 coefficient in order to get 4 'O' seen on the product side of the reaction.

  $1CH_4 + 2O_2 \longrightarrow 1CO_2 + 2H_2O$

  So the final balanced equation would be written:

  $CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$

PREVIOUS YEARS' EXAMINATION QUESTIONS

TOPIC 1

1 Mark Questions

1. Which one is a chemical change – rusting of iron or melting of iron?

[TERM 1, 2011]

2. Why do silver articles become black after some time when exposed to air?

[TERM 1, 2011]

3. The aqueous solutions of copper sulphate and zinc sulphate appear
(a) Blue and green respectively
(b) Green and colourless respectively
(c) Blue and brown respectively
(d) Blue and colourless respectively

[TERM 1, 2012]

4. When crystals of $FeSO_4$ are strongly heated the residue obtained is
(a) reddish brown in colour.
(b) blue in colour.
(c) green in colour.
(d) colourless.

[TERM 1, 2013]

5. A student took solid quicklime in a china dish and added a small amount of water to it. He would hear:
(a) A pop sound
(b) A crackling sound
(c) A hissing sound
(d) No sound at all

[TERM 1, 2015]

6. The chemical reaction between barium chloride and sodium sulphate is an example of
(a) combination reaction
(b) decomposition reaction
(c) displacement reaction
(d) double displacement reaction

[TERM 1, 2016]

7. Which gas is evolved in the reaction of Zinc metal and $NaOH$
(a) Cl_2
(b) H_2O
(c) O_2
(d) H_2

[TERM 1, 2016]

8. Barium Sulphate is:
(a) White
(b) Yellow
(c) Green
(d) Red

[TERM 1, 2016]

9. When sodium sulphate solution and barium chloride solution are mixed together, the colour of precipitate formed is:
(a) Yellow
(b) Green
(c) White
(d) Red

[TERM 1, 2017]

10. While doing an experiment a student observed that the blue colour of the aqueous copper sulphate was changed to pale green by immersing a metal rod in it. The metal of the rod used by the student is:
(a) iron
(b) zinc
(c) silver
(d) aluminium

[TERM 1, 2017]

2 Marks Questions

11. Reddish brown deposit observed on iron nails, when these are kept in aqueous solution of copper sulphate solution is that of
(a) Cu_2O
(b) CuO
(c) Cu
(d) CuS

[TERM 1, 2013, 2017]

Topic 2: Types of Chemical Reactions, Corrosion and Rancidity

The chemical reactions are of the following types-

- In combination reactions, two or more than two elements combine to give one single product.

  $NH_3(g)$ + $HCl(g)$ $\longrightarrow$ $NH_4Cl(s)$

  Ammonia Hydrogen chloride Ammonium chloride

  $2CO(g)$ + $O_{2(}g)$ $\longrightarrow$ $2CO_2$ (g)

  Carbon monoxide Oxygen Carbon dioxide

  This reaction is a combination reaction, as ammonia and hydrogen chloride combine together to form ammonium chloride as a single product.

- Decomposition is splitting of a compound into two or more simpler products.

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

  Lead nitrate (Colourless) → Lead oxide (yellow) + Nitrogen dioxide (Brown fumes) + Oxygen

  Decomposition reaction can be accomplished by supplying energy in the form of heat,electricity or light.

- **Thermal decomposition** reaction is the one where energy is supplied as heat.

  $2\ KClO_3(s) \xrightarrow[(MnO_2)]{Heat} 2KCl(s) + 3O_2(g)$

  Potassium Chlorate → Potassium Chloride + Oxygen

- **Photo decomposition** reaction is the one where energy is supplied as light.

  $2H_2O_2(l) \xrightarrow{Light} 2H_2O(l) + O_2(g)$

  Hydrogen peroxide → Water + Oxygen

- **Electrolytic decomposition** reaction is the one where energy is supplied as electricity.

  $2H_2O(l) \xrightarrow[current]{electric} 2H_2(g) + O_2(g)$

  Water → hydrogen (2 Volume) + oxygen (1 volume)

- In **displacement reaction**, the more reactive metal displaces the less reactive metal from a compound.

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

  Zinc + Copper sulphate (Blue) → Zinc sulphate (Colourless) + Copper (Reddish brown)

  $Cu(s) + 2\ AgNO_3(aq) \rightarrow Cu(NO_3)_2(aq) + 2\ Ag(s)$

  Copper + Silver nitrate (Colourless) → Copper nitrate (Blue) + Silver

- The reactions in which the different atoms or group of atoms are displaced by other atoms or group of atoms, i.e two compounds exchange their ions and one of the products formed is insoluble are said to be **double displacement reactions**.

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

  Sodium sulphate Sol. + Barium chloride Sol. → Barium sulphate (white ppt) + Sodium chloride

- **Redox reactions**

  In the term 'redox', 'red' stands for reduction and 'ox' stands for oxidation.

  Thus the reactions in which oxidation and reduction take place simultaneously are called Redox reactions, i.e. in redox reactions one substance is oxidized and other is reduced.

  $CuO(s) + H_2(g) \rightarrow Cu(s) + H_2O(g)$

  Copper (II) oxide (black) + hydrogen → Copper (brown)

IMPORTANT TERMS IN REDOX REACTION

Oxidation: Reaction that involves the gain of oxygen or loss of hydrogen.

Reduction: Reaction that shows the loss of oxygen or gain of hydrogen.

Oxidising agent: It is a substance which itself gets reduced but oxidizes the other substance.

Reducing agent: It is a substance which itself gets oxidized but reduces the other substance.

$$\underset{\text{Copper (II) oxide (black)}}{CuO(s)} + \underset{\text{hydrogen}}{H_2(g)} \rightarrow \underset{\text{Copper (brown)}}{Cu(s)} + H_2O(g)$$

In the above equation CuO is undergoing reduction and H_2 is undergoing oxidation. Hence CuO acts as oxidising agent and H_2 acts as reducing agent.

- **Corrosion:** The surface of the reactive metals are attacked by air, water and the other substances around it, and corrodes while the process is called corrosion. It is a redox reaction where metal gets oxidised to metal oxide and oxygen gets reduced to oxide ions.

Oxidation

$$\underset{\text{iron}}{4Fe(s)} + 3O_2(g) + 2xH_2O(l) \rightarrow \underset{\text{Hydrated ferric oxide (Rust)}}{2Fe_2O_3.xH_2O(s)}$$

from moist ari

This reaction is called corrosion of iron or rusting.

Prevention of rusting

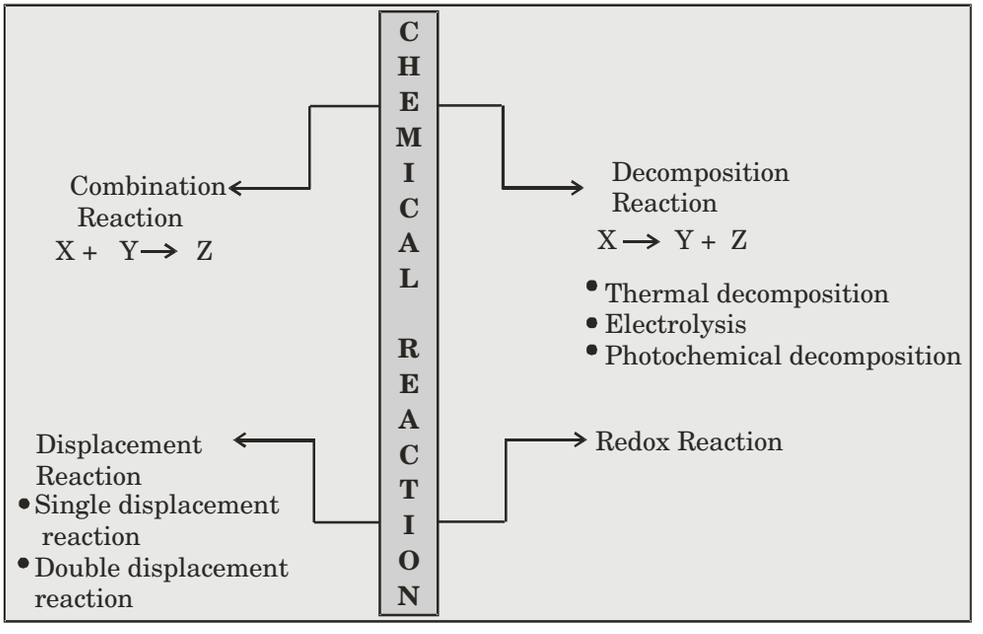
- By painting
- By lubricating it with oil or grease
- By galvanising (coating with active metals like zinc)
- By alloying
- **Rancidity:** Oils and fats when get oxidized on exposure to air results in the production of foul odour and taste in them.

Methods to prevent Rancidity

Packing of food materials in air tight containers flushed with inert gases like nitrogen.

Refrigeration of cooked food at low temperature.

Chapter in Brief:



Summary

Knowing your Chapter at Glance:

Acid

- The term 'acid' has been derived from the Latin word 'acidus' which means sour.

  Characteristics of acids

  * They are sour in taste.
  * They give H^+ ions in aqueous solution.
  * They turn blue litmus red.
  * The aqueous solution of acid conducts electricity.
  * Most acids are corrosive in nature. They produce a burning sensation on the skin and make holes on surfaces on which they fall.
- Acids produce H^+ ions when dissolved in water. H^+ ions cannot exist alone. They combine with water molecule to form H_3O^+.Acids when dissolved in water release a large amount of heat. Hence it is advised to add acid to water drop by drop with constant stirring.

Acids are of 2 types

* Strong acids
* Weak acids
* Strong acids dissociate completely in water and thus produces a large amount of H^+, while weak acids do not dissociate completely and thus produces small amount of H^+ (aq) ions.

Example of strong acids

HCl, H_2SO_4

Example of weak acids

CH_3COOH, HNO_3

- The acids obtained from minerals are called **mineral acids**. Those acids which are obtained from plants and animals are called **organic acids**. Those acids which contain minimum amount of water are called **concentrated.**

  Reaction involving acids

  Reaction with metals

  Acid + Metal → Salt + Hydrogen gas

  e.g., $2HCl + Zn \rightarrow ZnCl_2 + H_2$

Reaction with metal carbonates

Acid + Metal carbonate → Salt + CO_2 + H_2O

e.g., $2HCl + Na_2CO_3 \rightarrow 2NaCl + CO_2 + H_2O$

Reaction with metal hydrogen carbonates

Acid + Metal hydrogen carbonate Salt + CO_2 + H_2O

e.g. $HCl + NaHCO_3 \rightarrow NaCl + H_2O + CO_2$

Reaction with metallic oxide

Acid + Metal oxide → Salt + Water

e.g. $2HCl + CuO \rightarrow CuCl_2 + H_2O$

Strength of an acid ∝ Degree of ionization

Bases

Characteristics of base

- Bases are substances that, in aqueous solution, release hydroxide (OH^-) ions
- They are slippery to the touch
- They taste bitter
- They turn red litmus paper blue

Types of bases

- **Strong base**

  Strong base is a base that is completely dissociated in an aqueous solution.

  These compounds ionize in water to yield one or more hydroxide ion (OH^-) per molecule of base.

  Eg:- NaOH, KOH
- **Weak base**

  a weak base is a base that does not ionize fully in an aqueous solution.

  Eg:- NH_3, NH_4OH

Reaction involving base

Reaction with metal

Base + Metal → Salt + H_2 gas

e.g., $2NaOH + Zn \rightarrow Na_2ZnO_2 + H_2$

Reaction with non metallic oxide

Base + Non-metallic oxide → Salt + H_2O

- **Salt:** The ionic compound consisting of two parts, one containing a positive charge (cation) and the other carrying a negative charge (anion)
- Salt of strong acid and strong base: NaCl, KCl

- Salt of strong acid and weak base: NH_4Cl.
- Salt of weak acid and strong base: CH_3COONa.
- Salt of weak acid and weak base: CH_2COONH_4.
- **Indicators**

  Indicators are those substances which change their colour (or odour) in acidic or basic solutions.
- Natural indicator: Litmus solution, turmeric
- Synthetic indicator: Phenolphthalein, methyl orange
- Olfactory indicator: Onion, clove oil, vanilla extract.

	Indicator	Acids	Bases
1.	Red litmus	remains red	turns blue
2.	Blue litmus	turns red	remains blue
3.	Phenolphthalein	colourless	pink
4.	Methyl orange	red	yellow

- A **universal indicator** with the mixture of many different indicators which show graduate but well marks series of colour changes over a very wide range of change in concentration of H^+ ion.
- pH is the scale for measuring hydrogen ion concentration. The concentration of H^+ are generally small. The concentration of H^+ are expressed in terms of pH. pH is defined as negative logarithm of H^+ concentration

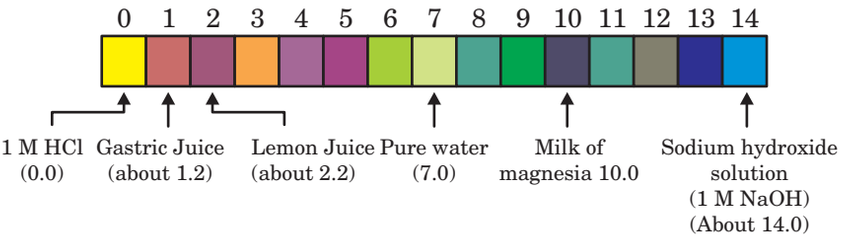
  or H_3O^+ concentration.

  $pH = -\log[H^+]$ or $pH = -\log[H_3O^+]$
- For a neutral solution

  $[H^+] = [OH^-] = 10\text{-}7$ mol/L; pH = 7
- For an acidic solution

  $[H^+] > [OH^-]$; pH < 7
- For a basic solution

  $[H^+] < [OH^-]$; pH > 7



PREVIOUS YEARS' EXAMINATION QUESTIONS

1 Mark Questions

1. A student tested the pH of distilled water using pH paper and observed green colour. After adding a few drops of dilute NaOH solution, the pH was tested again. The colour change now observed would be:
(a) Blue
(b) Green
(c) red
(d) orange **[TERM 1, 2011, 2015]**

2. Four solutions I, II III and IV were given to a student to test their acidic or basic nature by using pH papers. He observed that the colour of pH paper turned to red, blue, green and orange respectively when dipped in four solutions. The correct conclusion made by the student would be
(a) I, II and III are acidic
(b) I and IV are acidic
(c) II, III, and IV are acidic
(d) II and IV are acidic **[TERM 1, 2011]**

3. A metal powder was added to dil. HCl and dil. NaOH solutions taken in separate test tubes. On mixing the contents react in both the test tubes. Hydrogen gas was formed in both the cases. The metal used will be:
(a) Cu
(b) Zn
(c) Fe
(d) Pb **[TERM 1, 2011]**

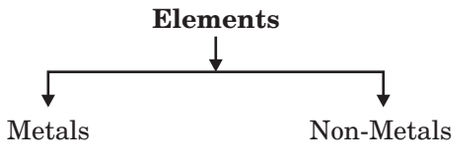
4. Acetic acid reacts with solid sodium hydrogen carbonate
(a) Slowly forming no gas.
(b) Vigorously with effervescence.
(c) Slowly without effervescence.
(d) Vigorously without gas formation.
[TERM 1, 2011, 2012, 2017]

5. Which one of the following are the correct observations about acetic acid?
(a) It turns blue litmus red and smells like vinegar
(b) It turns blue litmus red and smells like burning sulphur
(c) It turns red litmus blue and smells like vinegar
(d) It turns red litmus blue and has a fruity smell
[TERM 1, 2012]

Topic 1: Metal, Non-metals & Their Properties

Summary

Knowing your Chapter at Glance:



Physical properties

Metal	Non-metal
Mostly Solid	Solid, liquid and gas.
Lustrous and sonorous	Non-lustrous.
Malleable and ductile	Non-malleable and non ductile.
Hard and have high density	Varying hardness and have low density.
Good conductors of heat and electricity	Poor conductors of heat and electricity.
High melting and boiling point	Low melting and boiling points.

- Substances that can be beaten into thin sheets are called malleable.
- Substances that can be drawn into thin wires are called ductile.

Exception in physical properties

- Graphite a non metal is a good conductor of electricity
- Iodine is a lustrous non metal
- Diamond is allotrope of carbon which is a non metal is the hardest substance while Sodium and potassium being metal are soft enough to be cut by knife
- Mercury is the metal, is liquid at room temperature while rest are solids.
- Sodium, Potassium, mercury, caesium and gallium are metals with low melting and boiling point
- Diamond is a non metal with the high melting and boiling point
- Sodium, Potassium and lithium are metals with low density.

Chemical properties of metals

- React with dilute acids to liberate hydrogen gas.

  Metal + Dilute acid $\longrightarrow$ Salt + Hydrogen

  $2Na + 2HCl \longrightarrow 2NaCl + H_2$

  $Mg + 2HCl \longrightarrow MgCl_2 + H_2$

  $2Al + 6HCl \longrightarrow 2AlCl_3 + 3H_2$

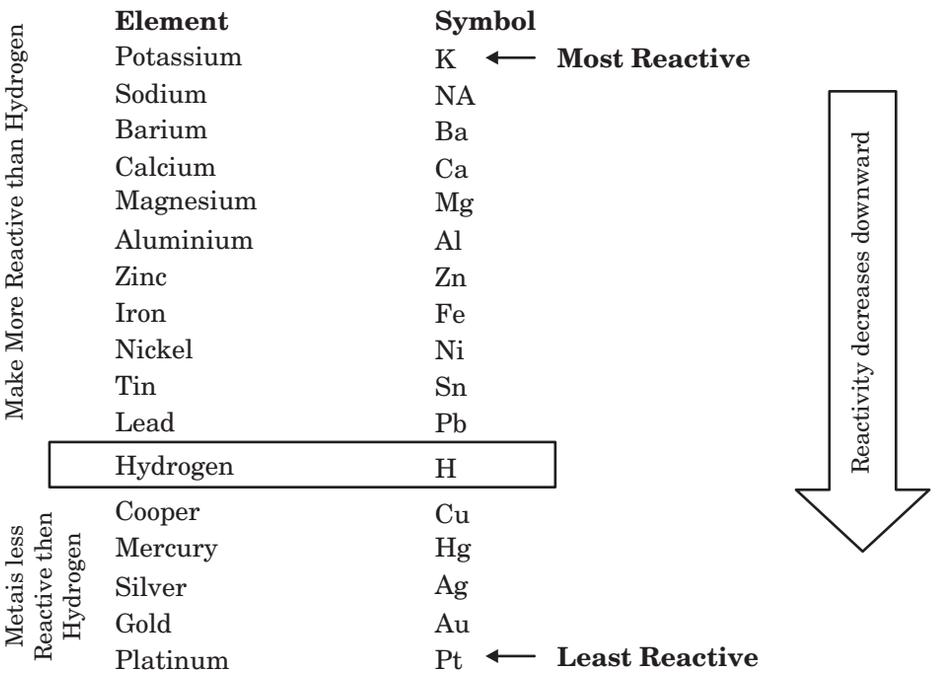
  $2Na(s) + H_2SO_4\,(aq) \longrightarrow Na_2SO_4(aq) + H_2(g)$

  $Mg(s) + H_2SO_4(aq) \longrightarrow MgSO_4(aq) + H_2(g)$

  $2Al(s) + 3H_2SO_4(aq) \longrightarrow Al_2(SO_4)_3(aq) + 3H_2(g)$

- Those metals which are more reactive than hydrogen, displace hydrogen from dilute acids to produce hydrogen gas. This is due to the fact that the more reactive metals give electrons easily and those electrons reduce hydrogen ions of acids to hydrogen gas.

  The metals like copper and silver which are less reactive than hydrogen, do not displace hydrogen from dilute acids. Only high reactive metals displace the least reactive metals in accordance to the following series:



Activity series of metals

- **Aqua regia, (Latin for 'royal water') is a freshly prepared mixture of concentrated hydrochloric acid and concentrated nitric acid in the ratio of 3 : 1. It can dissolve gold, even though neither of these acids can do so alone. Aqua regia is a highly corrosive, fuming liquid. It is one of the few reagents that is able to dissolve gold and platinum.**
- Reacts with oxygen to form basic oxides.

  Metal + Oxygen $\longrightarrow$ Metal oxide

  Metal oxides are basic in nature.

  Sodium and potassium react with oxygen at room temperature to form basic oxides.

  $4Na + O_2 \longrightarrow 2Na_2O$

  $4K + O_2 \longrightarrow 2K_2O$
- Most of the metals do not react with hydrogen. A few reactive metals such as sodium, potassium and calcium react with hydrogen to form ionic hydride.

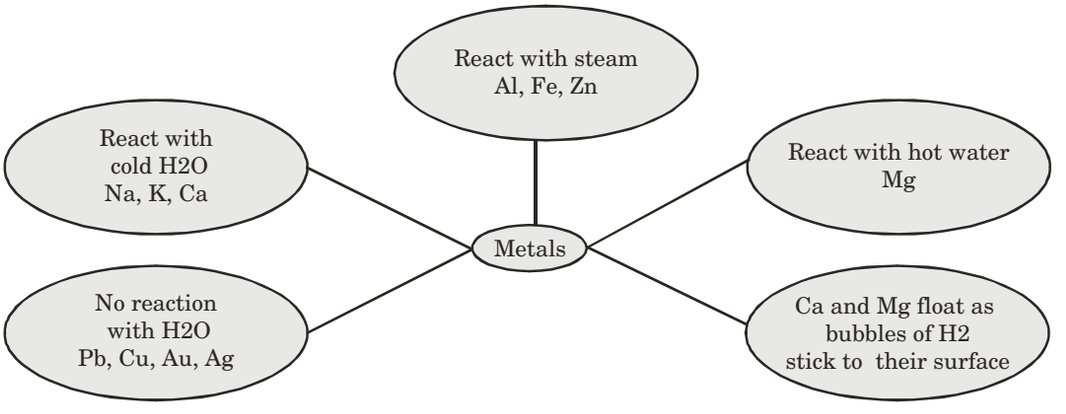
  $2Na + H_2 \longrightarrow 2NaH$

  $2K + H_2 \longrightarrow 2KH$

  $Ca + H_2 \longrightarrow CaH_2$
- React with water to form metal oxides or metal hydroxides.

  Metal + Water $\longrightarrow$ Metal oxide + Hydrogen

  Metal oxide + Water $\longrightarrow$ Metal hydroxide



- Electropositive i.e. form positive ions by losing electrons.

$$M \longrightarrow Mn^{+} + ne^{-}$$

For example:

$$Na \longrightarrow Na^{+} + e^{-}$$

$$Mg \longrightarrow Mg^{2+} + 2e^{-}$$

The characteristic chemical properties of metals are due to their electropositive character.

- Reducing agents.

Chemical properties of non-metal

- Do not displace hydrogen on reaction with dilute acids. For the liberation of hydrogen the non-metals should be able to reduce H^{+} ions to H_2 gas by supplying electrons. However, non-metals are electronegative elements and hence have more tendency to accept electrons rather than donating. Hence, non-metals do not produce hydrogen gas on reaction with acids.
- React with oxygen to form acidic or neutral oxides.

$$S + O_2 \longrightarrow SO_2$$

$$P_4 + 5O_2 \longrightarrow 2P_2O_5$$

On the other hand, certain oxides of non-metals are neutral. Some examples are nitrous oxide (N_2O), carbon monoxide (CO), etc. These oxides do not have any effect on litmus paper.

- Combine with hydrogen to form stable hydrides.
- Do not react with water .
- Electronegative i.e. form negative ions by gaining electrons.

$$\frac{1}{2}Cl_2 + e^{-} \rightarrow Cl^{-}$$

- Oxidising agents.

PREVIOUS YEARS' EXAMINATION QUESTIONS

TOPIC 1

1 Mark Questions

1. Iron nails were dipped in an aqueous solution of copper sulphate. After about 30 minutes, it was observed that the colour of the solution changed from
(a) Colourless to light green
(b) Blue to light green
(c) Blue to colourless
(d) Green to blue

[TERM 1, 2011, 2014]

2. A cleaned aluminium foil was placed in an aqueous solution of zinc sulphate. When the aluminium foil was taken out of the zinc sulphate solution after 15 minutes, its surface was found to be coated with a silvery grey deposit. From the above observation it can be concluded that
(a) Aluminium is more reactive than zinc
(b) Zinc is more reactive than aluminium
(c) Zinc and aluminium both are equally reactive
(d) Zinc and aluminium both are non-reactive

[TERM 1, 2011]

3. Solutions of copper sulphate, iron sulphate and zinc sulphate are prepared and marked I, II and III respectively. Few pieces of aluminium are added to each solution. After some time a change will be observed in
(a) I and II
(b) II and III
(c) III and I
(d) All the three

[TERM 1, 2012]

2 Marks Questions

4. (a) If an iron nail is immersed in the aqueous solution of copper sulphate, what are the changes happening to the nail and to the solution?
(b) Write the balanced chemical equation for the reaction between iron metal and aqueous copper sulphate solution.

[TERM 1, 2011]

5. Write the balance chemical equation for the chemical reaction between Manganese dioxide and Aluminum powder. What happens if Manganese powder is heated with Aluminum oxide?

[TERM 1, 2013]

and the reaction between a metal oxide and aluminum is highly exothermic. Such highly exothermic reaction is called a thermite reaction. For example:- [1]

$Fe_2O_3 + 2Al \rightarrow 2Fe + Al_2O_3$

It is used in joining railway tracks and filling gaps of machineries. [1]

12. (a) The amphoteric oxides are those metal oxides which behave as both the acidic as well as basic oxides. For example, aluminium oxide (Al_2O_3) and zinc oxide (ZnO). [1]

(b) Sodium and potassium both are the highly reactive metals. They can easily react with oxygen and catch fire if kept out in air. Therefore they are kept immersed in kerosene so that this type of destruction can be avoided. [1]

(c) The balanced chemical equation for the reaction between Al and steam is given below:

$2Al\ (s) + 3H_2O\ (g) \rightarrow Al_2O_3(s) + 3H_2(g)$ [1]

(d) (i) Bromine (Br) is a non-metal which is liquid at room temperature. [1]

(ii) Iodine (I) is a non-metal which is lustrous. [1]

Topic 2: Ionic Compound & Metallurgy

Summary

Formation of ionic compound

In chemistry, an ionic compound is a chemical compound composed of ions held together by electrostatic forces termed ionic bonding.

Properties of ionic compound

- **Physical nature**

  Ionic compounds are hard and brittle. The ions are held by the strong electrostatic forces.
- **Melting and Boiling points**

  The ionic compounds have high melting and boiling points due to the strong inter-ionic attraction.
- **Solubility**

  Electrovalent compounds are generally soluble in water and insoluble in solvents such as kerosene and petrol.
- **Conduction of electricity**

  It conducts electricity due to the movement of ions in molten state or in aqueous solution but behaves as insulator in solid state as there are no free ions for movement to conduct electricity.

Occurrence of metals

- Minerals : Most of the elements occur in nature as in combined states as minerals. The chemical composition of minerals is fixed.
- Ore : Minerals from which metals can be extracted profitably are known as ores.
- Gangue : The impurities like sands,salt,soil etc present in the ore are called gangue.

  Metals can be divided into 3 categories
  - * Metals of low reactivity
  - * Metals of medium reactivity
  - * Metals with high reactivity

Extraction of low reactivity metals

These metals are generally unreactive and these can be reduced to metals by heating alone.

$$2HgS(s) + 3O_2(g) \longrightarrow 2HgO(s) + 2SO_2(g)$$

Extraction of middle reactivity metals

- Roasting is a process of converting suphide ores into oxides by heating strongly in the presence of excess of air reaction.

- Calcination is the process of converting carbonte ore into oxides by heating strongly in presence of air.

$$\underset{\substack{\text{Zinc sulphide}\\(\text{Zinc blende-ore of Zn})}}{2\,ZnS(s)} + \underset{\text{From air}}{3O_2(g)} \xrightarrow[\substack{\text{Presence of}\\\text{excess of air}}]{\text{Heat}} \underset{\text{Zinc oxide}}{2ZnO(s)} + \underset{\text{Sulphur dioxide}}{2SO_2(g)}$$

Thermit reaction

The reaction of iron oxide with aluminium used to join railway tracks or damaged machine parts.

$$\underset{\text{Iron (III) oxide}}{Fe_2O_3(s)} + \underset{\text{Aluminium}}{2\,Al(s)} \xrightarrow{\text{Ignited}} \underset{\text{Iron (melt)}}{2\,Fe\,(l)} + \underset{\text{Aluminium oxide}}{Al_2O_3\,(s)}$$

Extraction of high reactivity metals

These metals are obtained by electrolytic refining as they are quite reactive. They are obtained by electrolysis of their molten chlorides.

During electrolysis, the metal ions, being positive are liberated at the cathode (the negatively charged electrode), whereas the chlorine is liberated at the anode (the positively charged electrode).

The reactions taking place are as follows :

At Cathode :
$$\underset{\text{Sodium ion}}{Na^+(l)} + \underset{\text{Electron}}{e^-} \xrightarrow{\text{Reduction}} \underset{\text{Sodium metal}}{Na(s)}$$

At Anode :
$$\underset{\text{Chloride ion}}{Cl^-(l)} \xrightarrow{\text{Oxidation}} \underset{\text{Chlorine atom}}{Cl(g)} + e^-$$

$$\underset{\text{Chloride atoms}}{Cl\,(g)} + Cl(g) \longrightarrow \underset{\text{Chlorine gas}}{Cl_2\,(g)}$$

Thus, sodium metal is obtained at the cathode whereas chlorine gas is liberated at the anode.

Refining of metals

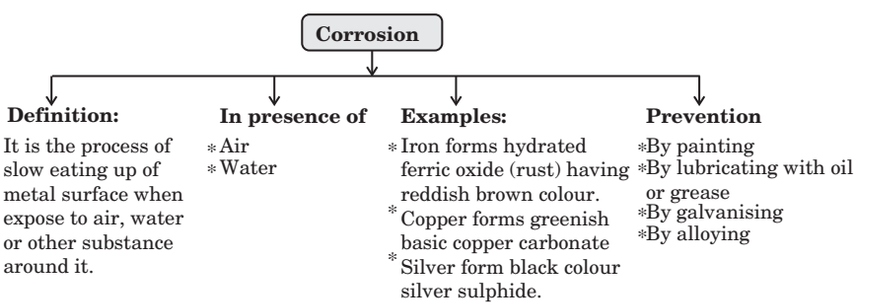
Electrolytic Refining

This is the most widely used method for refining impure metals. Many metals, such as copper, zinc, tin, nickel, silver, gold, etc., are refined electrolytically. In this process, the impure metal is made as anode and a thin strip of pure metal is made as cathode. A solution of the metal salt is used as an electrolyte. On passing the current through the electrolyte, the pure metal from the anode dissolves into the electrolyte. An equivalent amount of pure metal from the electrolyte is deposited on the cathode

The following reactions take place :

At Anode :
$$\underset{\text{Copper atom}}{Cu(s)} \xrightarrow{\text{oxidation}} \underset{\text{Copper ions}}{Cu^{2+}(aq)} + 2e^-$$

At Cathode :
$$\underset{\substack{\text{Copper ions}\\\text{(from solution)}}}{Cu^{2+}(aq) + 2e^-} \xrightarrow{\text{reduction}} \underset{\text{Copper atom}}{Cu}$$



An alloy is a homogeneous mixture of two or more metals or a metal and a non-metal.

An alloy containing mercury as one of the metals is known as an amalgam.

Some examples of common alloys are :

(a) Brass containing copper and zinc metals.

(b) Bronze containing copper and tin metals.

(c) Stainless steel containing iron, carbon and chromium.

Topic 1: Carbon and Its Properties

Summary

Knowing your Chapter at Glance:

Characteristics of Carbon

Carbon is a non-metallic element.

Symbolic Representation : $^{12}_{6}C$ where, atomic number is 6 and atomic mass is 12

- Always forms covalent bonds
- Tetravalent
- 3 all otropes - diamond, graphite and fullerenes
- Catenation - Unique property of self-linking of carbon atoms
- Steps for writing the Lewis Dot Structures of a Covalent Compound

(a) Write the electronic configuration of all the atoms present in the molecule.

(b) Identify how many electrons are needed by each atom to attain noble gas configuration.

(c) Share the electrons between atoms in such a way that all the atoms in a molecule have noble gas configuration.

(d) Keep in mind that the shared electrons are counted in the valence shell of both the atoms sharing it.

Types of chemical bonding

1. Ionic bond
2. Covalent bond

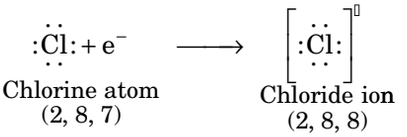
Ionic bond

The chemical bond formed by the transfer of electrons from one atom to another is known as an ionic bond. The ionic bond is called so because it is a chemical bond between oppositely charged ions i.e. one positive and one negative ion.

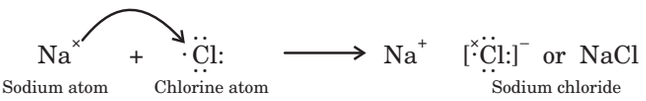
Sodium (with electronic configuration 2, 8, 1) has only one electron in the valence shell. It loses this electron to acquire the stable electronic configuration 2, 8 (similar to that of neon) and form sodium ion (Na^+).

$$\underset{\text{Sodium atom}}{\underset{(2,8,1)}{Na}} \longrightarrow \underset{\text{Sodium ion}}{\underset{(2,8)}{Na^+}} + e^-$$

Chlorine(with electronic configuration (2, 8, 7) has seven electrons in the valence shell. It gains one electron to acquire the stable electronic configuration 2, 8, 8 (similar to that of argon) and form chloride ion (Cl^-)



Sodium loses one electron to form Na^+ ion and chlorine gains that electron to form Cl^- ion. As a result, both acquire the stable nearest noble gas configuration. These oppositely charged ions are then held together by electrostatic forces of attraction forming the compound Na^+Cl^- or simply written as NaCl. The transfer of electron may be represented in one step as follows:



Covalent bonds

The chemical bond formed by the sharing of electrons between two atoms is known as a covalent bond.

Covalent bonds are of three types :

(i) Single covalent bond

(ii) Double covalent bond

(iii) Triple covalent bond

(i) Single covalent Bond

A single covalent bond is formed by the sharing of two electrons between the atoms, each atom contributing one electron for sharing.

For example, a hydrogen molecule H_2

(ii) Double covalent Bond

A double covalent bond is formed by the sharing of four electrons between two atoms, each atom contributing two electrons for sharing. It is represented by putting two short line (=) between the two atoms. For example, oxygen molecule, O_2, contains a double bond between two atoms and it can be written as O = O.

(iii) Triple covalent Bond

A triple bond is formed by the sharing of six electrons between two atoms, each atom contributing three electrons for sharing. It is represented by putting three short line () between the two atoms. Nitrogen molecule, N_2, contains a triple bond, so it can be written as NN.

Properties of covalent bond

(a) Physical states: They are generally liquid or gases. Some covalent compounds may exist as solid.

(b) Solubility: They are generally insoluble in water and other polar solvents but soluble in organic solvents such as benzene, toluene etc.

(c) Melting and boiling points: They do not conduct electrical current.

(d) Electrical conductivity: They do not conduct electrical current.

Versatile nature of carbon

- Carbon is tetravalent, it does not form ionic bond by either losing four electrons (C^{4+}) or gaining four electrons (C^{4-}). It is because it is difficult to hold four extra electrons and would require large amount of energy to remove four electrons. So, carbon can form bond by sharing of its electron with the electrons of other carbon atom or with other element and attain gas configuration.
- Carbon atoms have a unique ability to combine with one another to form chains. This property is called catenation.
- Due to small size, carbon also forms multiple (double and triple) bonds with other carbon atoms, oxygen, and nitrogen.

Hydrocarbons

- Carbon and Hydrogen combine in different proportions to form a large number of compounds called hydrocarbons.
- There are two types of hydrocarbons : saturated and unsaturated.

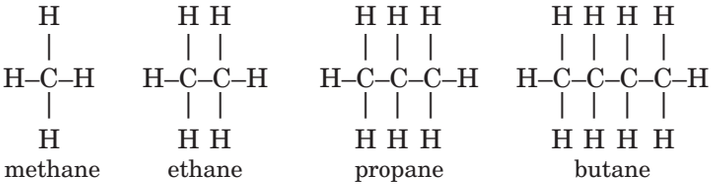
(a) Saturated Hydrocarbons (Alkanes)

Saturated hydrocarbons are also called paraffins or alkanes. They are represented by the general formula

C_nH_{2n+2}, where n = number of carbon atoms in a molecule of the alkane.

When n = 1, the alkane is methane (CH_4).

When n = 2, the alkane is ethane (C_2H_6) and so on.

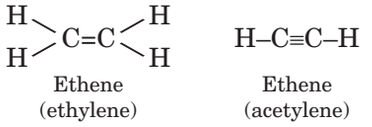


(b) Unsaturated hydrocarbons

(i) Alkenes

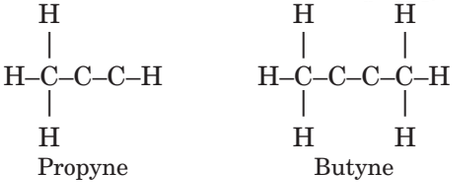
Hydrocarbons in which two carbon atoms in the molecule are joined by a double (=) or triple () bond, are called unsaturated hydrocarbons. For example,

Alkenes are represented by the general formula, C_nH_{2n}, where n = number of carbon atoms in a molecule. When n = 2, the alkene is ethene or ethylene (C_2H_4), when n = 3, the alkene is propene or propylene (C_3H_6), and so on.



(ii) Alkynes

The molecules of hydrocarbons containing a triple bond between two carbon atoms are called alkynes. They are represented by general formula C_nH_{2n-2}.



Topic 2: Carbon Compounds, Soaps & Detergents

Summary

Rules for naming a compound

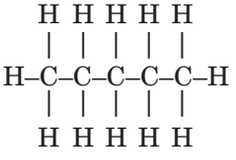
- Select the longest possible chain containing C atoms.
- Numbering of chain is done from the end from which the substituent is closer.
- If there are substituents that have the same number of carbons from either end, start numbering from the end nearest the next substituent.
- The hydrocarbon groups attached to the parent chain are called alkyl groups such as methyl ethyl propyl etc.
- Name the substituent as an alkyl group based on the number of carbon atoms in the chain
- Place the name of the branch substituent preceded by a number indicating the carbon of the parent chain carbon to which it joins.

Types of formula for writing hydrocarbons

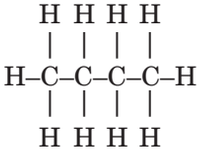
1. Molecular formula - it involves the actual number of each type of atom present in the compound.
2. Structural formula- the actual arrangement of atom is written in structural formula.
3. Condensed formula- it is the shortest form of the structural formula.

Isomerism

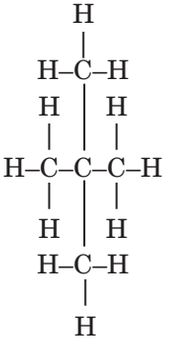
- Organic compounds with the same molecular formula but different structural formulae are known as isomers. This phenomenon is called Isomerism.
- Isomers of pentane : The molecular formula of pentane is C_5H_{12}. Three isomers corresponding to this formula are possible.



Common Name : n-pentane
IUPAC Name : pentane



Common Name : iso pentane
IUPAC Name : 2-methyl butane



Common Name : neo pentane
IUPAC Name : 2,2-dimethyl propane

Functional groups

In hydrocarbon chain one or more hydrogen atom is replaced by other atoms in accordance with their valencies these are called heteroatom.

These heteroatom or group of atoms which make carbon compound reactive and decide its properties are called functional groups.

Various functional groups are given as follows

S. No.	Hetero atom	Functional Group	Formula of a Functional Group	Class of Compounds
1.	O	Hydroxyl	–OH–	Alcohols, R–OH
2.	O	Aldehydic	–CHO or $-\overset{\overset{O}{\|\|}}{C}-H$	Aldehydes, R–CHO

3.	O	Keto	$-\overset{\overset{O}{\|\|}}{C}-$ or –CO–	Ketones, R–CO–R
4.	O	Carboxyl	$-\overset{\overset{O}{\|\|}}{C}-OH$ or –COOH	Carboxylic acids, R–COOH
5.	Cl, Br	Halo (chloro, bromo)	–Cl, –Br	Haloalkanes, R–Cl, R–Br

- **Homologous series**

A homologous series is a group of organic compounds having same general formula, similar structures and similar chemical properties in which the successive compounds differ by CH_2 group. The various organic compounds of a homologous series are called homologues.

Chemical properties of a carbon compounds

- **Combination**

The process of burning of a carbon compound in air to give carbon dioxide, water, heat and light, is known as combustion.

For example,

When methane (natural gas) burns in a sufficient supply of air, then carbon dioxide and water vapour are formed, and a lot of heat is also produced :

$$\underset{\text{Methane (Naturalgas)}}{CH_4} + \underset{\text{Oxygen (from air)}}{2O_2} \xrightarrow{\text{Combustion}} \underset{\text{Carbon dioxide}}{CO_2} + \underset{\text{Water}}{2H_2O} + \text{Heat} + \text{Light}$$

Other example of combustion are

$$\underset{\text{Carbon}}{C} + \underset{\text{Oxygen}}{O_2} \longrightarrow \underset{\text{Carbondioxide}}{CO_2} + \text{Heat and light}$$

$$\underset{\text{Ethanol}}{CH_3CH_2OH} + \underset{\text{Oxygen}}{3O_2} \longrightarrow \underset{\text{Carbondioxide}}{CO_2} + \underset{\text{Water}}{3H_2O} \text{ Heat and light}$$

- **Oxidation**

Addition of oxygen to any substance is called oxidation and the substances which are capable of adding oxygen to other substances are called oxidizing agents.

Alkaline potassium permanganate and acidified potassium dichromate are good oxidizing agents. These can easily oxidize alcohols to carboxylic acids. For example,

$$\underset{\text{Potassium dichromate}}{K_2Cr_2O_7} + \underset{\text{Sulphuric acid}}{4H_2SO_4} \longrightarrow \underset{\text{Potassium sulphate}}{K_2SO_4} + \underset{\text{Chromium sulphate}}{Cr_2(SO_4)_3} + 4H_2O + 3[O]$$

- **Substitution reaction**

Reactions which involve the direct replacement (displacement or substitution) of an atom or a group of atoms in an organic molecule by another atom or group of atoms without any change in the rest of the molecule are called substitution reactions.

$$\underset{\text{Methane}}{CH_4} + \underset{\text{Chlorine}}{Cl} \xrightarrow[\text{or 520–670 K}]{\text{Sunlight}} \underset{\text{Chloromethane (Substitution product)}}{CH_3Cl} + \underset{\text{Hydrogen chloride}}{HCl}$$

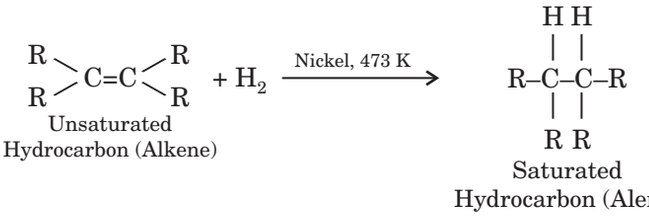
$$\underset{\text{Chloromethane (Methyl chloride)}}{CH_3Cl} + Cl_2 \xrightarrow[\text{or 520 – 670 K}]{\text{Sunlight}} \underset{\text{Dichloromethane (Methylene chloride)}}{CH_2Cl_2} + HCl$$

$$\underset{\text{Dichloromethane (Methylene chloride)}}{CH_2Cl_2} + Cl_2 \xrightarrow[\text{or 520–670 K}]{\text{Sunlight}} \underset{\text{Trichloromethane (Chloroform)}}{CHCl_2} + HCl$$

$$\underset{\text{Trichloromet hane}}{CHCl_2} + Cl_2 \xrightarrow[\text{or 520–670 K}]{\text{Sunlight}} \underset{\substack{\text{Tetrachloro methane}\\ \text{(Carbon tetra chloride)}}}{CCl_4} + HCl$$

- **Addition**

  Reactions which involve addition of two reactants to form a single product are called addition reactions.

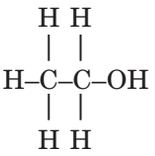


  The addition of hydrogen to an unsaturated hydrocarbon to obtain a saturated hydrocarbon is called hydrogenation. It is used to prepare vegetable ghee from vegetable oils.

  Some important compounds of carbon-

1. Ethanol

The structural formula of ethanol is



Formula : CH_3CH_2OH

IUPAC Name : Ethanol

Common Name : Ethyl alcohol

Ethanol is a colourless liquid at room temperature. Its freezing point is 156 K while its boiling point is 351K.

Ethanol is commonly called alcohol. It is an active ingredient of all alcoholic drinks such as beer, rum, whisky, brandy, etc. Consumption of small quantities of dilute ethanol causes drunkenness. However, intake of even a small quantity of pure alcohol (absolute alcohol) can be lethal.

Ethanol reacts with sodium in the cold to form sodium ethoxide with the evolution of hydrogen gas

$$\underset{\text{Ethanol}}{2\,CH_3CH_2OH} + \underset{\text{Sodium}}{2Na} \xrightarrow{\text{Cold}} \underset{\text{Sodium ethoxide}}{2\,CH_3CH_2ONa} + H_2$$

When ethanol is heated with excess of concentrated sulphuric acid at 170°C (443 K), it gets dehydrated to form ethene (which is an unsaturated hydrocarbon) :

$$\underset{\substack{\text{Ethanol}\\ \text{(Ethyl alcohol)}}}{CH_3 — CH_2OH} \xrightarrow[\text{(Dehydration)}]{\text{Conc. } H_2SO_4 \text{ ; } 170°C} \underset{\text{Ethene}}{CH_2 = CH_2} + \underset{\text{Water}}{H_2O}$$

Ethanoic acid is the second member of homologous series of carboxylic acids

Formula : CH_3COOH

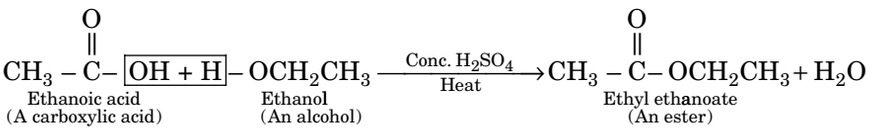
IUPAC Name : Ethanoic Acid

Common Name : Acetic Acid

Ethanoic acid is a colourless, pungent smelling liquid. When pure ethanoic acid is cooled, it freezes (m.p. 290 K) forming glacier like crystals. Therefore, 100% acetic acid, obtained by melting these crystals, is called glacial acetic acid

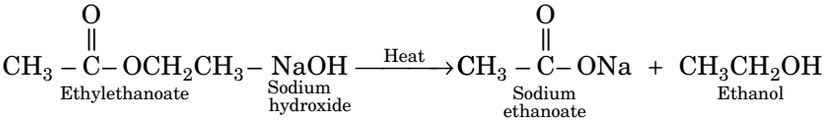
Esterification

Carboxylic acids react with alcohols to form esters For example, when ethanoic acid is warmed with ethnol in presence of a few drops of concentrated sulphuric acid as catalyst, an ester (ethyl ethanoate, commonly called ethyl acetate) and water are formed



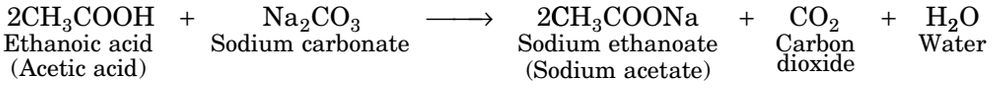
Saponification

Alkaline hydrolysis of an ester to give the salt of the corresponding carboxylic acid and the alcohol is called saponification. It is reverse of esterification, therefore also called as De-esterification.



Reaction with Sodium Carbonate

Ethanoic acid reacts with sodium carbonate to form sodium ethanoate and carbon dioxide gas.



When sodium carbonate is added to a solution of ethanoic acid, brisk effervescence of carbon dioxide is given off.

Soaps

These are sodium or potassium salt of long chain fatty acids. These work well in soft water but in hard water it form scum.

Detergents are ammonium salt of long chain carboxylic acid. It works well in soft as well as hard water.

Cleansing Action of soap

The long hydrocarbon chain is hydrophobic i.e. water repelling, so the hydrocarbon part of soap molecule is insoluble in water but soluble in oil and grease, so it can attach to the oil and grease particles present on dirty clothes.

The ionic portion of soap molecule is hydrophilic i.e. water attracting due to the polar nature of water molecules. So it can attach to the water particles.

When the surface of the cloth is mechanically scrubbed or beaten or agitated in a washing machine, the loosened oily dirt particles are removed from the dirty surface and the cloth is cleaned. Since detergents lower the surface tension of water to a greater extent than soaps, therefore, the cleansing power of detergents is much higher than those of soaps.

A spherical aggregate of soap molecule in soap solution in the water is called 'micelle'.

PREVIOUS YEARS' EXAMINATION QUESTIONS TOPIC 2

1 Mark Questions

1. The correct general equation for saponification reaction is:
(a) Easter of fatty acid + alkali → soap + glycol
(b) Easter of fatty acid + alkali → soap glycol
(c) Easter of fatty acid + acid → soap + glycerol
(d) Easter of fatty acid + acid → soap glycol
[TERM 2, 2015, 2016]

2. Water containing magnesium ion is called:
(a) polluted water
(b) soft water
(c) heavy water
(d) hard water **[TERM 2, 2015]**

3. While studying the saponification reaction, what do you observe when you mix an equal amount of colourless vegetable oil with aqueous solution of in a beaker?
(a) The colour of the mixture has become dark brown.
(b) A brisk effervescence is taking place in the beaker.
(c) The outer surface of the beaker has become hot.
(d) The outer surface of the beaker has become cold. **[TERM 2, 2017]**

Summary

Knowing your Chapter at Glance:

Necessity for classification of elements

- For easy study of elements, elements were classified into certain groups in such a way that they share common properties.
- Dobereiner was first to classify elements with similar properties together in increasing order in such a way that the atomic mass of the middle element of the triad was roughly the average of the atomic masses of the other two elements.

Element	Symbol	Atomic Mass	
Lithium	Li	6.9 u	$\frac{6.9+39.0}{2} = 22.950$ u
Sodium	Na	23.0 u	
Potassium	K	39.0 u	

The major drawback of the dobereiner triad was that it was applicable to only few elements.

There were only three triads known they are:

Li	Na	K
Ca	Sr	Ba
Cl	Br	I

- Dobereiner's attempt encouraged other scientists to correlate the atomic masses of the elements with their properties.
- In 1866, Newlands arranged the elements in order of increasing atomic masses in such a way that the properties of every 8th element was similar to the 1st one.

Therefore, he called it as "Newlands' law of octaves"

sa (do)	**re (re)**	**ga (mi)**	**ma (fa)**	**pa (so)**	**da (la)**	**ni (ti)**
H	Li	Be	B	C	N	O
F	Na	Mg	Al	Si	P	S
Cl	K	Ca	Cr	Ti	Mn	Fe
Co and Ni	Cu	Zn	Y	In	As	Se
Br	Rb	Sr	Ce and La	Zr	–	–

Limitaion:

- It was found that the law of octaves was applicable only upto Ca or only for the lighter elements.
- It was assumed by Newland that only 56 elements existed in nature and no more elements would be discovered in the future. But later on many more elements were discovered whose properties did not fit into the law of octaves.
- In order to fit elements into his table, Newlands not only adjusted two elements into the same slot, but also put some unlike elements under the same note.

- Mendeleev was the most successful in developing the peroidic table where he arranged elements on the basis of atomic mass and chemical properties.

  Mendeleev's periodic law states that the physical and chemical properties of elements are the periodic functions of atomic masses.

Characteristics of mendeleev's periodic table

- He arranged the elements in the increasing order of atomic masses in horizontal rows known as periods and vertical columns known as groups.
- There were 8 groups designated as I, II, III, IV, V, VI, VII, and VIII and 7 periods. The group I to VII are subdivided into subgroups A and B. Group VIII don't have any subgroup.
- In some cases Mendeleev had to place an element with a slightly greater atomic mass before an element which has slightly lower atomic mass. Example, cobalt (atomic mass 58.9 u) appeared before Nickel (atomic mass = 58.71 u) and tellurium (atomic mass 127.6 u) was placed before Iodine (126.9 u).
- Mendeleev also left some gaps in his periodic table for those elements which were not known or discovered at that time. Example, scandium, gallium and germanium discovered later have properties similar to Eka-boron, Eka-aluminium and Eka-silicon.

Limitations

Anomalous position of hydrogen

Hydrogen resembles in its electronic configuration with alkali metals as it has only one electron in its valence shell.On the other hand hydrogen has many properties similar to that of halogens like both have one electron less than the nearest noble gas. For example, like halogens (F_2, Cl_2, Br_2, I_2) hydrogen (H_2) also exist as diatomic molecules. Also it combines with alkali metals to form covalent compounds like halogens.

Position of isotopes

Isotopes are the atoms of the same atomic number but having different atomic masses.

Since in the Mendeleev's periodic table elements are arranged in order of their increasing atomic masses so isotopes should be placed at different positions in the periodic table. As there is no provision for them in Mendeleev's periodic table, so these can not be placed at separate positions.

Uncertainty in prediction of new elements

As in Mendeleev's periodic table atomic mass does not increase in a regular manner in going from one element to another, so it was not possible to predict new elements.

Modern periodic table

Henry Moseley gas a new property of elements,'atomic numbers' and this was adopted as the basis of modern periodic table.

Periodic table

Modern periodic law states that the physical and the chemical properties of elements are the periodic function of atomic number.

Characteristics of modern periodic table

It has 7 periods and 18 groups.

Elements in the same group shares common chemical properties due to the same number of valence electrons.

Elements present in the same period contains same number of shells.

Atomic Number

Atomic number is defined as the total number of protons present in the nucleus of an atom. It is denoted by 'Z'.

Atoms of two different elements will always have different number of protons.

Electron Distribution in Orbits

It is arrangement of electrons in atomic orbitals.

Diagram

Rules:

1. An orbit can have a maximum of $2n^2$ electrons table
2. Orbits are filled from inside to outside. First, n = 1 shell is filled, then n = 2 shell, and so on...
3. The outermost shell of an atom cannot accommodate more than 8 electrons.

This is a very important rule is also called the Octet rule. The presence of 8 electrons in the outermost shell makes the atom very stable.

Valency:

Valence Electrons: Valence electrons are the electrons in the outermost orbit of an atom. Outermost orbit is also called valence shell.

Trends in modern periodic table:

1. Valence electron and valence shell
   (a) Across a period:
   • Valence electrons increases from left to right.
   • Valence shell is constant.
   (b) Down the group:
   • Valence electrons remains constant.
   • Valence shell increase.
2. Valency
   (a) Across the period:
   • Valence increases till group 14 and decreases till 18.
   (b) Down the group:
   • Valency remains constant.
3. Size of atom:
   (a) Across period:

- As we move to right, positive charge on nucleus increases, so attraction of outer electron increases. Therefore, electron comes close to nucleus. Thus size of atom decreases from left to right.

   (b) Down the group:

- As we go down, number of shells increases, so size of atom also increases.

4. Metallic character
   (a) Across the period:
   • Decreases from left to right.
   (b) Down the group:
   • Increases down the group.
5. Electro positivity
   It is ability of an atom to lose electron.
   • If electropositivity is high, it is easy to lose electron.

- If electropositivity is low, it is difficult to lose electron.

   (a) Across the period:

- As we move to right, size of atom decreases and therefore more attraction on electrons. So it is difficult to take electron. Thus electropositivity decreases from left to right.

   (b) Down the group:

- As we move down in a group, size of atom increase so less attraction on electrons. So it is easy to take electron. Thus electropositivity increases down the group.

6. Chemical reactivity
   (a) Across the period:

- First decreases as it is more difficult to loose more electron and then increases from left to right as it is easier to gain lesser number of electron.

   (b) Down the group:

- As we move down in a group, chemical reactivity increases for metals and increases for non-metals.

   Metallic and non-metallic character: Group 1 to 12 are metals. Group 13 to 18 comprises non-metals, metalloids and metals.

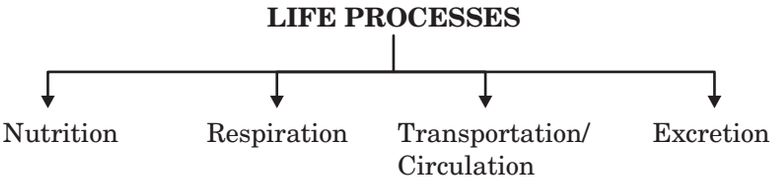
Metal	**Non-metal**
Mostly Solid	Solid, liquid and gas.
Lustrous and sonorous	Non-lustrous.
They have generally 1 to 3 valence electrons	They have generally 4 to 8 valence electrons
Malleable and ductile	Non-malleable and non ductile.
Hard and have high density	Varying hardness and have low density.
Good conductors of heat and electricity	Poor conductors of heat and electricity.
High melting and boiling point	Low melting and boiling points.

Topic 1: Nutrition

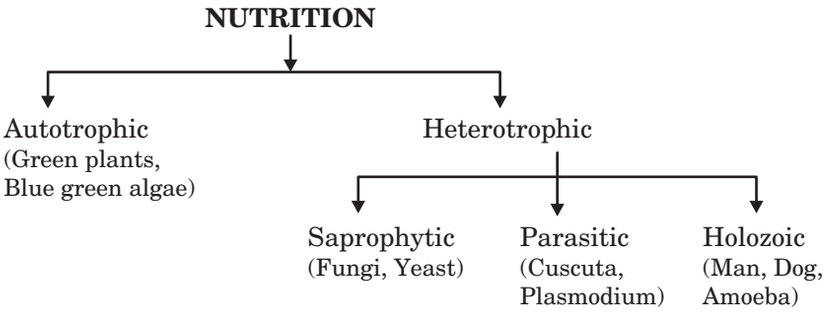
Summary

Knowing your Chapter at Glance:

- The various basic functions performed by living organisms to maintain their life on this earth are called life processes.



The process of obtaining food from the surroundings and using it for various metabolic activities by an organism is called nutrition.



Autotrophic Nutrition

Green plants are capable of manufacturing their own food in the form of carbohydrate in presence of light by using water and carbon-dioxide, this process is called photosynthesis.

Heterotrophic Nutrition

The type of nutrition in which organisms derive their food (nutrients) from other living organism is called heterotrophic nutrition. Heterotrophic mode of nutrition is of different types :

(a) **Saprotrophic Nutrition** : It refers to the mode of nutrition in which organisms obtain nutrients from the dead and decaying organic matter e.g. fungi (yeast) and some bacteria. These organisms are called saprophytes.

(b) **Parasitic Nutrition** : It refers to the mode of obtaining food synthesized by other animals. The organism which obtains food is called the parasite and the organism from which the food is obtained is called 'host'. This nutrition is observed in fungi, bacteria, few plants like Cuscuta, orchids and some animals like Plasmodium, roundworm, ticks, lick, leeches etc.

(c) **Holozoic Nutrition** : it refers to the mode of nutrition in which the complex organic matter in the form of solid food is ingested, digested and then absorbed into the cells and utilized e.g. Amoeba, frog, human being etc. In single-celled organisms, the food may be taken in by the entire surface.

Photosynthesis: It is the process by which green parts of the plant synthesise organic food in the form of carbohydrates from CO_2 and water in the presence of sunlight.

$$6CO_2 + 6H_2O \xrightarrow[\text{Chlorophyll}]{\text{Light}} \underset{\text{(Glucose)}}{C_6H_{12}O_6} + 6O_2$$

Steps of photosynthesis

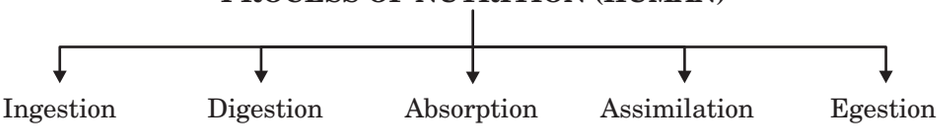
- Absorption of light energy by chlorophyll.
- Conversion of light energy to chemical energy and splitting of water molecules into hydrogen and oxygen.
- Reduction of carbon-dioxide to carbohydrates. This is also known as dark reaction as it does not require light.

- Plants carry out gaseous exchange with surrounding through stomata.
- The mode of nutrition in Amoeba is holozoic and it is omnivorous.

Nutrition in Amoeba

- When Amoeba comes in contact with food particles, it sends out temporary finger-like extensions of the cell surface called pseudopodia which engulf the prey by forming a food cup. This process is ingestion.
- When the tips of encircling pseudopodia touch each other, the food is encaptured into a bag called food vacuole. This step is digestion.
- The food vacuole serves as a temporary stomach secreting digestive juice.
- The digested food gets absorbed and diffuses into the cytoplasm and then assimilated.
- The process of elimination of undigested food is called egestion. Egestion of undigested food takes place at any point on the surface of the body .
- However in Paramoecium, which is also a unicellular organism the cell has a definite shape and food in taken in at a specific spot. Food is moved to this spot by the movement of cilia which covers the entire surface of the cell.

PROCESS OF NUTRITION (HUMAN)

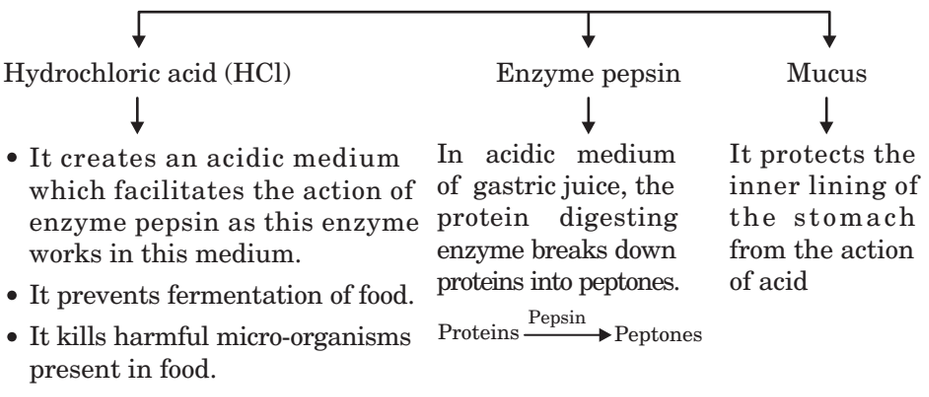


- In humans, digestion of food takes place in alimentary canal.

  The various organs of human alimentary canal in sequence are: Mouth ⟶ Buccal Cavity ⟶ Pharynx ⟶ Oesophagus ⟶ Stomach ⟶ Small Intestine ⟶ Large Intestine ⟶ Anus

1. **Mouth**: It is bound by two soft, movable lips, the upper lips and lower lip. Mouth opens into a chamber or cavity called buccal cavity. This cavity contains:
   (a) Teeth: In man, there are 16 teeth in each jaw (upper and lower). These are used for the purpose of chewing and grinding of food.
   (b) Tongue: It is a muscular, sensory organ, which forms the floor of buccal cavity. It bears taste buds and hence helps in tasting the food.
   (c) Salivary glands: The buccal cavity receives the secretion (saliva) of three pairs of salivary glands through their ducts. Saliva contains water, salts and an enzyme ptyalin or salivary amylase, which breaks starch into maltose. Thus, the digestion of carbohydrate begins in mouth itself.
2. **Pharynx**: The buccal cavity opens into a funnel shaped vertical canal. It is the common passage for food and air. It opens into oesophagus.
3. **Oesophagus**: It is muscular tube about 10 inches long and carries the food from pharynx to the stomach. No digestion occurs here. The lining of the food pipe has muscles that contract rhythmically in order to push the food forward. These movements are called peristaltic movements.
4. **Stomach**: The stomach has branched and tubular glands present on its wall (gastric glands). The secretions of these glands are collectively called gastric juice.

LIFE PROCESSES



- The small intestine is the site of complete digestion of carbohydrates, proteins and fats. It is distinctly divided into three regions - duodenum, jejunum and ileum.
- Duodenum, the first part of small intestine is U-shaped. It receives the secretions of liver and pancreas. Liver secretes bile, which contains bile pigments and bile salts.

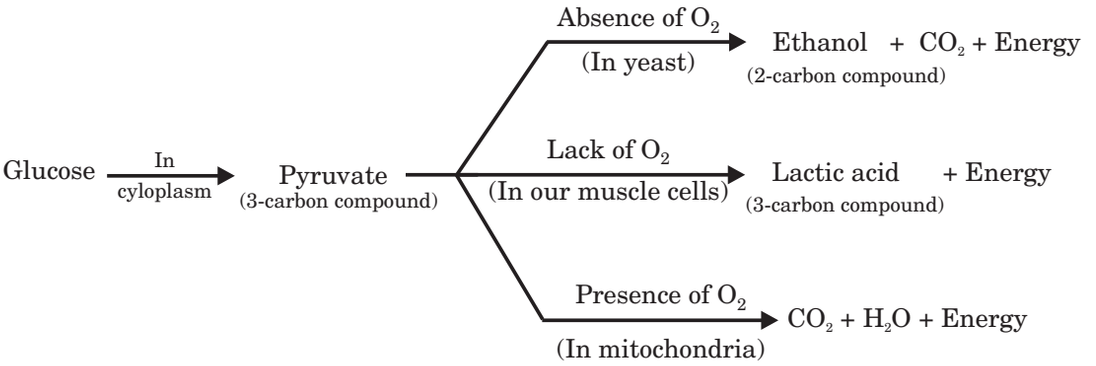
  The following steps of digestion takes place in the duodenum :

  1. Bile juice makes the medium alkaline in small intestine as the food coming from the stomach is acidic.
  2. Bile emulsifies fat present in the food. Emulsification means breaking of fat molecules into small globules increasing the efficiency of enzyme action.
  3. Pancreatic juice contains :
     - Trypsin for digesting proteins,
     - Pancreatic amylase for breakdown of starch and
     - Pancreatic lipase for breaking down emulsified fats.

     The partially digested proteins, carbohydrates and emulsified fats enter jejunum and ileum, where intestinal juice called succus entericus completes the digestion of proteins into amino acid, carbohydrates into glucose, and fats into fatty acids and glycerol.

     Internally, the wall of the small intestine is provided with numerous long finger-like projections called villi, which increase the surface area of the inner lining of intestine.
- Large intestine: The undigested and unabsorbed food is sent to the large intestine. It is about 1.5 - 1.8m long and about 6.5 cm in diameter. It consists of three parts - caecum, colon and rectum. The walls of large intestine absorb most of the water from this undigested food making the contents in semi-solid form.
- Anus: The undigested waste is passed out through the anus. This is called egestion or defecation. The exit of this waste material is regulated by anal sphincter.

  Break-down of food in cells to release energy is called cellular-respiration.



Topic 2: Respiration, Circulation & Excretion

Summary

TYPES OF RESPIRATION

Aerobic Respiration

Anaerobic Respiration

S. No.	Aerobic Respiration	Anaerobic Respiration
1	Takes place in presence of oxygen	Takes place in absence of oxygen
2	Complete breakdown of food takes place	Partial breakdown of food takes place
3	Food gets converted into CO_2 and water.	Food can be converted into either ethanol and CO_2 (as in yeast) or in lactic acid (as in animal muscles)
4	38 molecules of ATP are produced	2 molecules of ATP are produced.

RESPIRATION IN PLANTS

Exchange of gases CO_2 and O_2 in Plants:

At Night ⟶ No Photosynthesis only Respiration ⟶ CO_2 is given out

At Daytime ⟶ Photosynthesis and Respiration ⟶ O_2 is given out

↓

CO_2 is used up in photosynthesis.

RESPIRATION IN ANIMALS

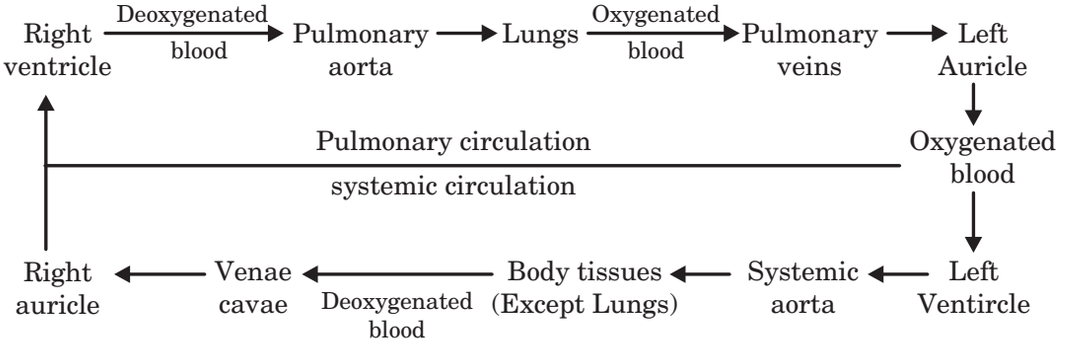
Respiratory system

The various parts of the respiratory system are :

$$\underbrace{\text{Nasal Passage} \rightarrow \text{Pharynx} \rightarrow \text{Larynx} \rightarrow \text{Trachea}}_{\text{Respiratory tract}} \rightarrow \underbrace{\text{Bronchi} \rightarrow \text{Bronchioles} \rightarrow \text{Terminal Bronchioles} \rightarrow \text{Alveoli}}_{\text{Respiratory organ}}$$

Breathing : It is a physical process in which there is intake of fresh air from the environment and removal of foul air (having more CO_2) from the body.

- In humans, the respiratory pigment haemoglobin, carry oxygen from lungs to different tissues of the body.
- Human heart has 4 chambers-2 atria(right and left) and 2 ventricles(right and left).Right half of the heart receives deoxygenated blood whereas the left half receives oxygenated blood.
- Blood travels twice through the heart in one complete cycle of the body.



- Blood vessels

S. No.	Arteries	Veins
1	Always carry blood away from the heart.	Always bring back blood to the heart.
2	They carry oxygenated blood except pulmonary artery.	They carry deoxygenated blood except pulmonary vein.
3	Blood flows under high pressure.	Blood flows at lower pressure.
4	More thick and elastic.	Thin walled.
5	Have no valves.	Have valves to ensure unidirectional flow of blood.

Capillaries: Each artery divides into smaller and smaller vessels on reaching organ or tissue to bring the blood in contact with all the individual cells. These smallest vessels are known as capillaries. Capillaries have walls which are one-cell thick to allow exchange of material between the blood and surrounding cells.

The transport system in highly organized plants consists of -

(a) Xylem - Transports water. Consists of tracheids and vessels

(b) Phloem - Transports food. Consists of sieve tubes and companion cells.

Transpiration is the process of loss of water as vapour from aerial parts of the body.'

Excretion

It is the biological process of elimination of harmful metabolic waste products from the body of an organism.

During excretion, the harmful metabolic nitrogenous wastes generated are removed from the body.

Formation of Urine

1. The waste material is brought to kidneys by the renal arteries.
2. Blood is filtered, from the blood capillaries into Bowman's capsule.
3. As this filtrate passes through the tubular parts of nephron, some useful products, such as glucose, amino acids, salts and major amount of water are selectively reabsorbed by blood capillaries surrounding the nephron.
4. The nephrons drain the remaining liquid waste (urine) into the collecting duct which eventually enters a long tube, the ureter. Human urine contains water and nitrogenous substances, most of which is urea.

- From the ureter, urine passes into the urinary bladder. Urine is stored in the urinary bladder until the pressure of the expanded bladder leads to the urge to pass it out through the urethra. The bladder is muscular, so it is under nervous control. As a result, we can usually control the urge to urinate.
- Dialysis is the procedure used in artificial kidney to do the work of a non-functional or damaged kidney. In the process blood of the patient is allowed to pass through the long cellulose tubes dipped in a tank containing dialysing solution having same ionic concentration as plasma. The waste substances diffuse out of blood into the tank and the cleansed blood is returned back into the patient through a vein. This procedure is also known as haemodialysis.
- Blood pressure: It is the force that blood exerts against the wall of a vessel. This pressure is much greater in arteries than in veins.
- The normal systolic blood pressure is about 120 mm of Hg and diastolic blood pressure is 80 mm of Hg.
- Blood pressure is measured using an instrument called sphygmomanometer.
- Abnormally high blood pressure is called hypertension and it can lead to rupture of an artery.

Lymph

It is another type of fluid which also helps in transportation.

The major functions of lymph are:

1. It carries digested and absorbed fat from intestine into blood.
2. It drains excess fluid from extra cellular space back into the blood.
3. It provides immunity to the body.

Topic 1: Plant Hormones and Movement

Summary

PLANT HORMONES (PHYTOHORMONES)

S. No.	Hormone	Functions
1.	Auxin	• Promotes cell enlargement and cell differentiation (e.g. growth of stem). • Promotes fruit growth.
2.	Gibberellins	• Promotes cell enlargement and cell differentiation in presence of auxin.
3.	Cytokinin	• Promotes cell division i.e. cytokinesis (e.g. in fruits and seeds). • Helps in breaking the dormancy of seeds and buds. • Promotes opening of stomata.
4.	Abscisic Acid (A growth inhibitor)	• Promotes the dormancy in seeds and buds. • Promotes the closing of stomata. • Promotes the wilting and falling of leaves.

PLANT MOVEMENT

Plant movement can be divided into two heads on the basis of direction :

1. Tropism or Tropic movement

   Tropic movement is the directional movement of the part of plant in response to external stimuli.

Similarly, the types of tropisms are

S. No.	Receptor	Types of Stimulus	Sense organ
1	Photo receptors	Detects light	Eye
2	Phono receptors	Detects sound	Ear
3	Olfactory receptors	Detects smell	Nose
4	Gustatory receptors	Detects taste	Tongue
5	Thermo receptors	Detects heat or cold	Skin

2. Nasties or Nastic movement

   The movement of plant part in response to an external stimuli in which the direction of response is not determined by the direction of stimulus

(a) Types of nastic movement

   (i) Thigmonasty: Thigmonasty is the nastic movement of a plant part in response to touch. For example - Mimosa pudica responds to touch by folding its leaves.

   (ii) Photonasty: Photonasty is the movement of plant part in response to light. In case of dandelion flower it opens in the morning with the rising sun and as the sun sets lower also closes The stimulus here is light.

Topic 2: Nervous System in Animals

Summary

Knowing your Chapter at Glance:

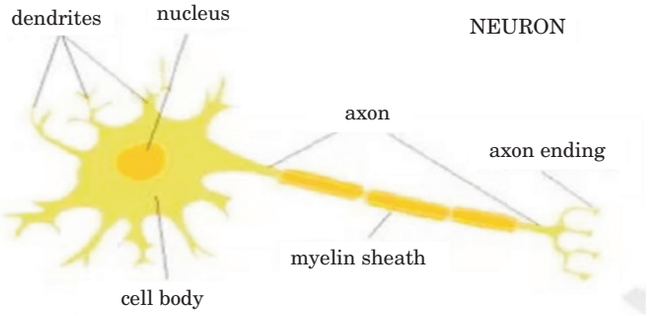
- Stimuli are the changes in the environment to which an organism reacts. For e.g. light, heat, cold, sound, smell, etc.
- The control and coordination in higher animals (Human) takes place through combination of nervous system and hormonal system, i.e. neuro-endocrine system.

NERVOUS SYSTEM IN ANIMALS

Nervous system is the system of conducting tissues the stimulus and transmits it to other parts of the body forming a network of nerves.

Nerve cells are the fundamental unit of nervous system.

Parts of Neuron



1. Dendrite: It receives information.
2. Cell body: The information acquired travels through it as an electrical impulse.
3. Axon: It is the longest fibre on the cell body is called axon. It transmits electrical impulse from cell body to dendrite of next neuron.

- Synapse is the gap between the nerve ending of one neuron and dendrite of the other neuron.

Functioning of neuron

- The information from receptors is acquired at the end of the dendritic tip of nerve cell as chemical reaction that creates an electrical impulse.
- This impulse travels from the dendrite to the cell body and at the end of axon.
- At the end of the axon, the electrical impulse sets off the release of the neurotransmitter which crosses the synapse and undergoes a chemical reaction resulting in initiation of a similar impulse in the next neuron.
- This impulse is again transmitted to the terminal endings of the next neuron and the process continues till it reaches the relay neuron in spinal cord and brain.
- From the brain and spinal cord arises a set of motor neurons which transmits electrical impulses in the similar way to the effectors like muscles and glands.

Receptor and Effector

- There are five sense organs in our body: eyes, ears, nose, tongue and skin. In a sense organ a receptor is present, which is a cell or group of cells sensitive to a particular type of stimulus (change in environment) such as light, heat, sound etc.

S. No.	Receptor	Types of Stimulus	Sense organ
1.	Photo receptors	Detects sound	Eye
2.	Phono receptors	Detects smell	Ear
3.	Olfactory receptors	Detects smell	Nose
4.	Gustatory receptors	Detects taste	Tongue
5.	Thermo receptors	Detects heat or cold	Skin

- The part of a body which can respond to stimulus according to the instruction sent from the nervous system is called effector. Effectors are mainly muscles and glands.
- Neuromuscular junction: It is the point where a muscle fibres comes in contact with the motor neuron carrying nerve impulses from the central nervous system.

Reflex Action

- It is a spontaneous, involuntary and unconscious (without will) response of the effectors to a stimulus.

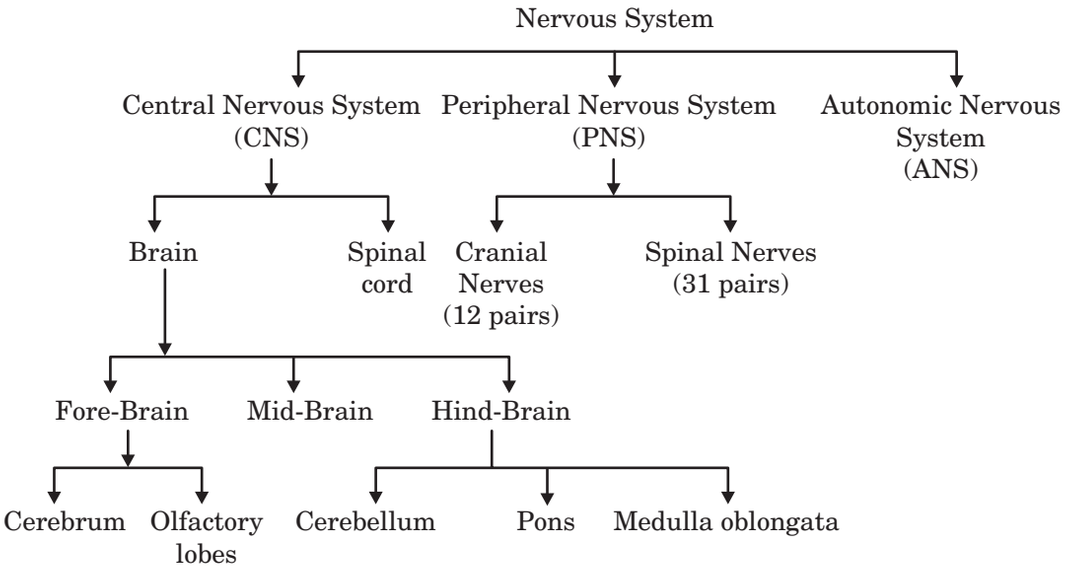
Reflex arc is the path taken by nerve impulses in a reflex action.

Responses are of three main types

1. Voluntary :Controlled by fore brain. E.g., talking, writing.
2. Involuntary: Controlled by mid and hind brain. E.g., vomiting, respiration.
3. Reflex action: Controlled by spinal cord. E.g., withdrawal of hand on touching a hot object.

How muscles work?

Muscles are made up of muscle cells which have special proteins. These proteins can change their arrangement on receiving message from brain due to which it can contract or expand. This contraction and expansion cause movement in body parts.



Human brain

The brain is broadly divided into three regions :

1. Fore Brain: It consists of Olfactory lobes: A pair of bodies covered by cerebrum. It is concerned with olfaction (smell).

   Cerebrum: It forms about two-third of the brain. Different areas of cerebrum perform different functions. Association areas control learning, reasoning, intelligence, personality, thinking, memory, etc. Sensory areas give us sensation by receiving information from eyes, ears, nose, tongue, skin. Motor areas give instructions to muscles for various voluntary actions.
2. Midbrain

   It controls reflex movements of the head, neck, eye muscles, etc. in response to visual or auditory stimuli.
3. Hind brain: It is further sub divided into :

Pons: It takes part in regulating respiration.

Cerebellum: It helps in maintaining posture and balance. It also coordinates smooth body movements like walking in a straight line, riding a bicycle, picking up a pencil etc.

Medulla Oblongata: It controls various involuntary actions such as heart beat, blood pressure, salivation, breathing, peristaltic movements, etc. Medulla also controls reflex actions like, swallowing, sneezing, vomiting, etc.

Spinal Cord is rod-like structure extending downwards in continuation with medulla. It is enclosed in a bony cage called vertebral column and is also surrounded by meninges.

- Glands are organs in our body which excrete a liquid substance having some different chemicals. This liquid is called secretion of the gland.
- Glands are of 2 types
  1. Exocrine Glands

     Glands that have ducts are called exocrine glands. Some examples of exocrine glands are sweat glands and salivary glands.
  2. Endocrine Glands

     The endocrine glands do not have ducts to carry their product to a surface. They are called ductless glands.

- Hormones are the chemical substances produced by endocrine glands.

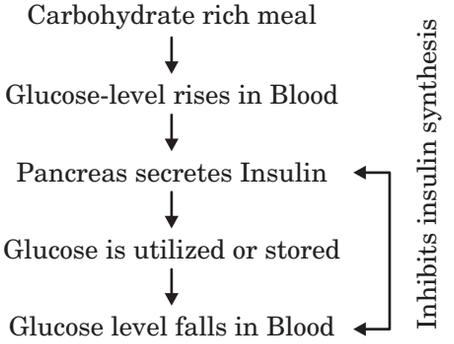
Endocrine gland	Hormones	Location	Function
Hypothalamus	Releasing Hormones	Below mid brain	Regulates the secretion of hormones from the pituitary.
Pituitary Gland	Growth Hormone	Below hypothal-amus in brain	Controls growth-dwarfism & gigantism
Thyroid Gland	Thyroxin (iodine is necessary for the secretion of thyroxine)	Around windpipe in neck	Regulates metabolism of carbohy-drates, fats & proteins
Adrenal Gland	Adrenaline	On top of kidneys	Regulates heart rate, breathing rate, blood pressure and carbohydrate metabolism.
Parathyroid	Parathormone	On the thyroid gland	Regulates calcium and phosphorus balance in the blood.
Pancreas	Insulin	Below stomach	Lowers the blood sugar level
	Glucagon		Increases the blood sugar level
Testes	Testosterone	In scortum	Regulates the development of male reproductive organs and accessory sexual characters like beard, moustache, etc.
Ovaries	Estrogen and Progesterone	In the pelvis	Regulates the development of female reproductive organs and accessory sexual characters like development of mammary gland. Maintenance of Pregnancy.

Feedback Mechanism

It is important that hormones should be secreted in precise quantities because both excess and deficiency of hormones has a harmful effect on the body. So, we need a mechanism through which this is to be done. The timing and amount of hormone released by various glands are controlled by 'Feedback mechanism' which is inbuilt in our body.

E.g. if the blood sugar level falls below normal, insulin secretion by pancreas decreases automatically.

FEEDBACK CONTROL OF BLOOD GLUCOSE LEVEL



Topic 1: Basics of Reproduction

Summary

Knowing your Chapter at Glance:

- Reproduction is defined as the production of new generation of individuals similar to themselves.

TYPES OF REPRODUCTION

There are two main types of Reproduction in living organisms :

(a) Asexual Reproduction

(b) Sexual Reproduction

Asexual Reproduction	Sexual reproduction
A single individual give rise to new individual	Two individuals i.e., one male and one female are needed to give rise to new individual
Gametes are not formed	Gametes are formed
New individual are identical to parent	New individual is genetically similar but not identical to parents.

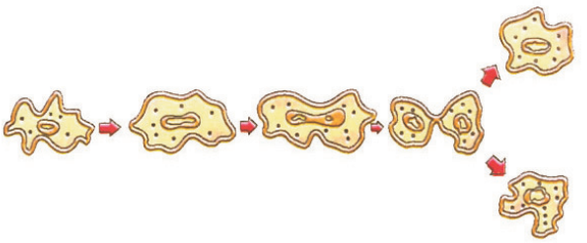
Types of asexual reproduction

Fission

It is defined as the splitting of a unicellular organism into two or more separate daughter cells.

(a) Binary fission: In binary fission, the parent organism splits to form two new organisms.

During binary fission, the DNA molecules replicate. The nuclear division is followed by the appearance of constriction in cell membrane. The membrane then grows centripetally from near the middle of dividing cell which separates the cytoplasm into two equal parts, each with one nucleus, e.g. Amoeba, Paramecium, Leishmania etc.



(b) Multiple fission: In multiple fission, the parent organism splits to form many new organisms at the same time. During multiple fission, the nucleus of parent cell divides several times into many daughter nuclei. The daughter nuclei then get arranged along the periphery of the parent cell followed by division of cytoplasm into as many pieces as the number of nuclei e.g. Plasmodium.

Budding in Hydra: A bulge appears on the body as a result of repeated mitotic division in the cells resulting in the formation of out-growth called bud. This bud enlarges in size by further division of cells and attains the shape of parent. It then separates from the parent body and starts behaving as new Hydra.

Spore formation

Spore formation takes place mostly in bacteria and fungi. Spores are formed in a sac-like structure called sporangium at the tips of fungal hyphae. The nucleus divides inside the sporangium and gets surrounded by a small mass of cytoplasm forming a spore. After attaining maturity, the sporangial wall ruptures releasing the spores. The spores are covered with thick walls that protect them until they come in contact with another moist surface and can begin to grow.

Regeneration

It is the ability of a fully differentiated organism to give rise to new individual organisms from its body parts. Small cut or broken parts of the organism's body grow or regenerate into separate individuals.

For example:Planaria and Hydra

Fragmentation

Spirogyra (algae) breaks up into smaller pieces upon maturation. These pieces (fragments) grow into new individuals.

Topic 2: Sexual Reproduction in Plants

Summary

Vegetative propagation in plants

Types of vegetative propagation

Natural vegetative propagation	**Artificial vegetative propagation**
1. Through leaf buds (Eg. Bryophyllum)	1. Stem cutting (Eg. rose)
2. Through stem (Eg. potato, onion, ginger)	2. Micro propagation (Eg. Orchids, Dahlia)
3. Through roots (Eg. guava, sweet potato)	3. Layering (Eg. rose, jasmine)
	4. Grafting (Eg. lemon, orange, mango)

- The production of plants from a small piece of plant tissue removed from the growing tips of a plant in a suitable growth medium (culture solution). It is called tissue culture. This technique is used for the production of ornamental plants like orchids, dahlia, etc.

Advantages of micropropagation (tissue culture)

- It is a fast technique producing many plantlets from a small plant tissue in few weeks and using very little space. In other words, it is quite economical.
- The plants produced by tissue culture are disease free.

Types of flower based on reproductive organs

(a) Unisexual: In such flower, only one reproductive part is present, either male (stamen) or female (pistil) e.g. cucurbits, mulberry, papaya, watermelon, etc.

(b) Bisexual: When stamens and carpel are found in the same flower, it is called bisexual, e.g. Hibiscus (chinarose), mustard, rose, pea, cotton, etc.

- Stamens and carpels are the reproductive parts of a flower which contain the germ cells. The male organ of a flower called 'stamen' makes the male gamete which are present in the pollen grain. The female organ of a female called 'carpel' or 'pistil' make the female gamete, which are present in ovules of the plant.
- A flower which bear only stamen is called staminate flower and one in which only carpel is present is called a pistillate flower.

Pollination : The transfer of pollen grain from the anther of a stamen to the stigma of a carpel.

Pollination (Transfer of pollens from anther to the stigma)

Self pollination	**Cross polination**
(Transfer of pollens from anther to stigm a of the same flower or different flower of the same plant) e.g. rice, pea, wheat, etc.	(Transfer of pollens from anther to stigma of another flower of same species e.g. rose, mango, etc.

Embryo is the stage of development between the zygote or fertilized egg and the newly formed offstring.

Fertilization: The fusion of male gamete with the female gamete to form a diploid zygote within the embryo sac is called fertilization.

- The part of the baby plant that develops into shoot is called plumule and the part which develops into root is called radicle.
- The part of the seed which contains stored food for the baby plant is called cotyledon.
- The baby plant inside the seed develops into a seedling under suitable conditions like water, air, temperature, etc. This is called germination.

Topic 3: Reproduction in Human Beings

Summary

(i) Puberty in males: It is attained at the age of 13 - 14 years. It is triggered by the secretion of testosterone from the testes which brings about the development of secondary sexual characters during puberty and maintains throughout life.

(ii) Puberty in females: It is attained at the age between 10 - 12 years. It is triggered by the hormone estrogen from the ovaries. This hormone causes growth, maturation of reproductive tracts and development of secondary sexual characters.

Changes at puberty

(i) In human males

- Enlargement of penis and scrotum.
- Broadening of shoulders.
- Growth of the body hair and facial hair.
- Deepening of the voice due to enlargement of larynx and thickening of vocal cords.
- Increase in the development of musculature and bones.
- Increase in height.

(ii) In human females

- Growth of breast and external genitalia.
- Growth of pubic hair and extra hair in the armpits.
- Broadening of pelvis.
- Initiation of menstruation and ovulation.
- Increase in fat particularly in thighs, shoulders, buttocks and face.

Male reproductive system

(a) Scrotum: The scrotum is a pouch of pigmented skin from the lower abdominal wall and hanging between the legs. The scrotum acts as a thermoregulator and maintains a temperature of 2 C less than the body and provides an optimal temperature for the formation of sperms. The life of the sperm is reduced if the temperature is higher.

(b) Testis : Testes are the primary sex organs lying in the scrotum outside the abdominal cavity. Testes are the sites where sperms are produced. It also produces sex hormone testosterone.

(c) Vas deferens : This is a straight tube about 40 cm long which carries the sperms to seminal vesicles. It temporarily stores the sperms.

(d) Urethra: It is 20 cm long tube that arises from urinary bladder to carry urine. It carries sperms from vasa deferentia through the penis. Thus urethra forms a common passage for both urine and sperms.

(e) Penis: It is a long and thick muscular organ made up of mostly erectile tissue. It opens outside the body. It passes the sperms from the man's body into the vagina of the women's body during mating.

Associated glands

Seminal vesicles and prostate glands add their secretion to the sperms. This fluid provides nourishment to sperms and make their transport easy.

Female reproductive system

It consists of a pair of ovaries, a pair of fallopian tubes, uterus and vagina.

(a) Ovaries: They are the primary sex organs located in the lower part of the abdominal cavity near kidney. Each ovary is connected by a ligament to the uterus. It produces gametes (eggs) and hormones like estrogen and progesterone.

When a girl is born, the ovaries already contain thousands of immature eggs. At puberty some of these eggs start maturing. One egg is produced every month by one of the ovaries. The release of egg from the ovary is called ovulation. The force of ejection carries the egg to the fallopian tube.

(b) Fallopian tube (oviducts): A fallopian tube is about 10 to 12 cm long muscular tube which carries egg from the ovary to the uterus and provides suitable environment for fertilization.

(c) Uterus: It is a large, elastic sac specialized for the development of embryo until birth. It is located between urinary bladder and rectum.

(d) Vagina: The vagina is a large, median elastic muscular tube. It is adapted to receive the male penis during copulation. The vagina is also called "birth canal". It allows the passage of baby at the time of child birth.

Fertilization is the fusion of sperm nucleus with the egg nucleus to form a diploid zygote.

- The sperm penetrates through penis into the vagina during copulation. The sperm moves to the uterus and then to the fallopian tube. The fallopian tube contains an ovum produced during ovulation. Only one sperm fuses with the ovum in the oviduct to form the zygote.
- The zygote divides and forms a hollow ball of hundred of cells called embryo which gets embedded in the thick lining of uterus. The lining thickens and is richly supplied with blood to nourish the growing embryo.
- A disc-like special tissue embedded in the uterine wall called placenta develops between the uterus wall and the embryo. The placenta contains villi on the embryo's side of the tissue. On the mother's side are blood spaces which surround the villi. It provides large surface area for exchange of oxygen, nutrients and waste products between the embryo and the mother.
- The complete development of the embryo (foetus) from the initial stage of conception till the birth of young ones is called gestation. It is also termed as pregnancy.

Sexual cycle in females

(a) Menstruation: When the egg released during ovulation is not fertilized by the sperm it lives for about one day, then the thick and soft uterus lining having lot of blood capillaries is not required. The unfertilized ovum dies and the uterus lining breaks down which produces blood along with other tissues. The blood and other tissues come out of vagina in the form of bleeding called menstruation.

(b) Menstrual cycle: The cycle of events taking place in female reproductive organs (ovaries and uterus) under the control of sex hormones, in every 28 days and marked by bleeding or menstrual flow is called menstrual cycle.

At puberty, the commencement of menstruation is termed menarche. Stoppage of menstrual cycle at the age of 45 - 55 is called menopause.

BIRTH CONTROL METHODS

The prevention of pregnancy in a woman is called contraception. Any device or chemical which prevents pregnancy is called a contraceptive. All the birth control methods are divided into:

- Barrier methods
- Chemical methods
- Intra uterine contraceptive device (IUCD)
- Surgical methods

Chemical methods

(a) Oral pills: They act by changing the hormonal balance of the body, so that eggs are not released & fertilization cannot occur. They are taken orally, therefore commonly called oral contraceptives (OC). These pills can cause side effects.

(b) Vaginal pills: They contain spermicides and therefore they kill the sperms.

Intra-uterine contraceptive device (IUCD)

They are contraceptives such as a loop or the copper-T placed in the uterus. They prevent implantation in the uterus. They can cause side effects due to irritation of the uterus.

Surgical methods

(a) Vasectomy: In males, a small portion of vas deferens (sperm duct) is cut and the cut ends are then ligated (tied). This prevents the sperms from coming out.

(b) Tubectomy: In females, a small portion of fallopian tubes is cut & the cut ends are then ligated (tied). This prevents the egg to enter the fallopian tube.

Surgical methods are the permanent methods of contraception.

There are some diseases which are spread by sexual contact with an infected person. Such diseases are called sexually transmitted diseases (STD).

For example:

- Gonorrhoea (bacterial disease)
- Syphilis (bacterial disease)
- Warts (viral infection)
- AIDS (viral infection)

Topic 1: Heredity & Mendel's Contribution

Summary

Knowing your Chapter at Glance:

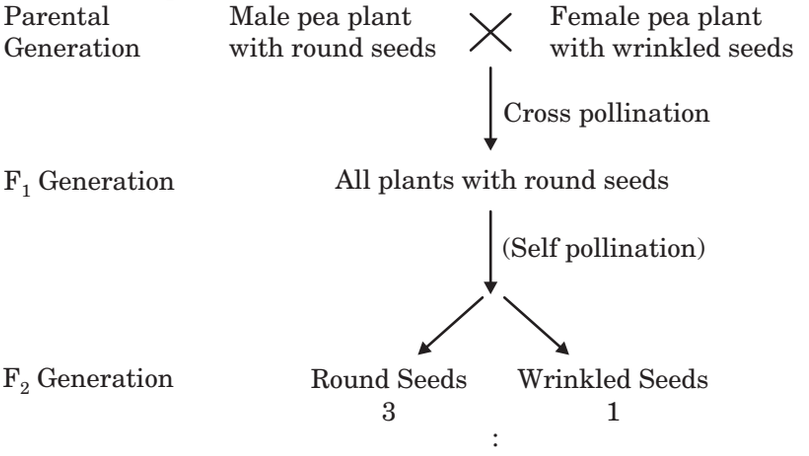
- **HEREDITY**
  Transmission of characters (resemblances as well as variations) from parents to the offsprings, i.e., from one generation to the next is called heredity.
- Trait is any characteristic that is transferred from parent to offspring. E.g. height and colour.
- Evolution is the process of development of new type of living organism from an old one due to gradual change.
- **VARIATION**
  The differences shown by the individuals of a species, and also by the offsprings (siblings) of the same parents are referred to as variations.
- Genetics is the study of heredity and variations. Genetics is to help our understanding of heredity by knowing how offspring inherit characteristics from their parents.
- Variation may occurs due to different combinations of genetic material or due to some positive gene mutations or due to interaction of genes with environmental changes.
- Importance of variations
  1. Different individuals would have different kinds of advantage.
  2. It forms the basis of heredity.
  3. Accumulation of variations forms the basis of evolution.
- Asexual reproduction involves single parent. When a single individual reproduces asexually, the resultant two individuals again after sometime reproduce to form four individuals. All these individuals would be exactly similar (carbon copies).
  On the other hand,Sexual reproduction, generates even greater diversity. This is so because sexual reproduction involves two parents (father and mother) and every offspring receive some characters of father and some characters of mother. Since, different offsprings receive different combination of characters of their parents, they show distinct differences (variations) among themselves as well as from their parents.
  Hence,Sexual mode of reproduction is considered better than asexual mode of reproduction.
- Gregor Johann Mendel carried out several experiments on pea plants. He carried out large number of monohydrid and dihydrid crosses using many constrasting characteristics and put forward several important conclusion.

MENDEL AND ITS CONTRIBUTION

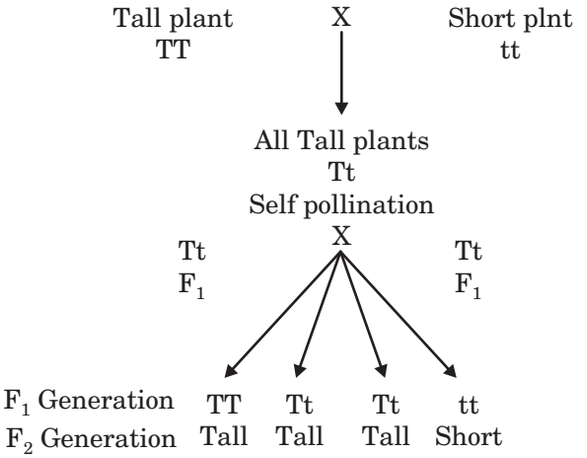
He studied the inheritance of contrasting characters (traits).Plant selected by Mnedel was Pisum sativum(pea plant)

Characters of pea plant studied by Mendel

- Plant height - Tall/short
- Flower colour - Violet/white
- Pod colour - Green/yellow
- Pod shape - Smooth/wrinkled
- Seed colour - Green/yellow
- Seed shape - Round/wrinkled
- Mendel was known as **Father of Genetics**
- In case of monohybrid cross with pure variety of plants, the phenotypic ratio obtained in F_2 generation is 3:1.
- In case of dihybrid cross involving two pairs of contrasting characters, the phenotypic ratio obtained in F_2 generation is 9:3:3:1.



Monohybrid cross : Cross between 2 pea plants with one pair of contrasting characters Tall/short (monohybrid cross)



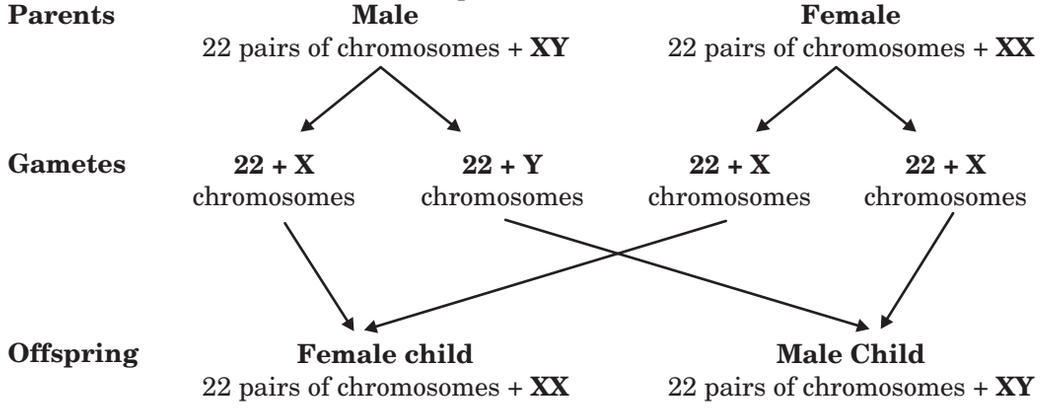
Mendel's Dihybrid Cross

A breeding experiment dealing with two characters at the same time is called a dihybrid cross.

	RY	Ry	rY	ry
RY	RRYY Round, yellow	RRYy Round, yellow	RrYY Round, yellow	RrYy Round, yellow
Ry	RRYy Round, yellow	RRyy Round, green	RrYy Round, yellow	Rryy Round, green
rY	RrYY Round, yellow	RrYy Round, yellow	rrYY Krinkled, yellow	rrYy Wrinkled, yellow
ry	RrYy Round, yellow	Rryy Round, green	rrYy Wrinkled, yellow	rryy Wrinkled, green

F_2 Generation	Plants with round and yellow coloured seeds		Plants with round and green coloured seeds		Plants with wrinkled and yellow coloured seeds		Plants with wrinkled and green coloured seeds
	9	:	3	:	3	:	1

- Genes carry information for producing proteins,which in turn control the various body characteristics.
- Phenotype is the appearance of an individual.
- Genotype is the genetic constitution of an organism which determines the character.
- The combination of male and female germ cells gives a diploid zygote.
- Sex is determined genetically in human beings by sex chromosomes. Male child has one pair of dissimilar sex chromosomes - XY. Female child has one pair of similar sex chromosomes - XX.



Topic 2: Evolution

Evolution

Evolution is the sequence of gradual changes which takes place in the primitive organisms,over millions of years,in which new species are produced.

Charles Darwin proposed that evolution of species occurred by natural selection, but he did not know the underlying mechanism.

Natural selection,genetic drift and geographical isolation can lead to speciation in sexually reproducing organisms.

Gene flow between the members of a population prevents speciation.

SPECIATION

Origin of new species from the existing one is called speciation.

KINDS OF TRAITS

(i) **Inherited traits** : These traits are controlled by specific genes and are passed on from one generation to another. Any alteration in the DNA will be passed on, through germ cells, to the progeny resulting in variations in them.

(ii) **Acquired traits** : Certain traits are acquired by organisms in their life time. For instance, decrease in the body weight of beetles due to starvation is an acquired trait by the beetles during their lifetime. It will not bring any change in the DNA. Therefore, even if some of the generations of beetles are low in weight because of starvation, this trait cannot be inherited by the progeny over generations.

Basis for classifying organisms are:

1. presence of prokaryotic or eukaryotic.
2. whether the organism is unicellular or multicellular
3. ability to perform photosynthesis
4. presence of endoskeleton or exoskeleton in heterotrophic organisms.

EVOLUTION AND CLASSIFICATION

Characteristics of organisms refer to the details of external and internal appearance or behaviour that distinguish them from one another. These characteristics of organisms also form the basis of the classification of organisms. The more characteristics two species have in common, the more closely they are related. Also, the more they are related, the more recently they will have had a common ancestor.

(a) Homologous organs

The organs, which perform different functions in different species but have similar basic structure, are called homologous organs.

Forelimbs of a frog, a lizard, a bird and human being are, therefore, homologous organs.

(b) Analogous organs

The organs, which are quite different in fundamental structure but perform same function are called analogous organs.

The wings of an insect and a bird are analogous organs.

It is so because both these organs in entirely different animals perform similar functions, i.e., they are used for flying in the air. However, they are very different in structure.

- Fossils are the remains or impressions of the dead animals and plants that lived in the remote past.

  How do we know the age of fossils?

  1. First way is relative. If we dig the earth to locate fossils, the fossils we find closer to the surface are more recent than the fossils we find in deeper layers.
  2. Second way is to date the rocks or fossils. Dating the rocks or fossils is done by working out the ratio of uranium to lead in a rock or fossil.

- Artificial selection is the process by which man selects trait(s) useful to him for improving the qualities of domesticated plants and animals.

  Humans have carried out artificial selection for various features of cabbage and produced different vegetables.

  1. Cabbage : with short distances between leaves.
  2. Broccoli : with arrested flower development.
  3. Cauliflower : with sterile flowers.
  4. Kohlrabi : with swollen parts.
  5. Kale : with larger leaves.

- Molecular phylogeny is the branch of science, which is used to trace the changes in DNA.
- **Human evolution**

  Tools for studying human evolution are:

  1. Excavating.
  2. Time dating.
  3. Studying fossils.
  4. Determining DNA sequences.
- All human beings,whether fair skinned or dark skinned,belong to the same species i.e., Homosapiens that originated in Africa.
- The human ancestors gradually migrated from Africa to various parts of the world such as Asia,Europe,Australia and America. Thus they spread to different parts of the earth.

PREVIOUS YEARS' EXAMINATION QUESTIONS

TOPIC 2

1 Mark Questions

1. What is a gene? **[TERM 2, 2014]**

2 Marks Questions

2. Describe any three ways in which individuals with a particular trait may increase in population. **[TERM 2, 2011]**

3. State the evidence we have for the origin of life from inanimate matter. **[TERM 2, 2011]**

4. What are fossils? What do they tell us about the process of evolution? **[TERM 2, 2011]**

5. List in tabular form two distinguishing features between acquired traits and inherited traits, with one example of each. **[TERM 2, 2012, 2013]**

6. How are fossils formed? Describe, in brief, two methods of determining the age of fossils. **[TERM 2, 2012]**

7. With the help of suitable examples, explain why certain traits cannot be passed on to the next generation. What are such traits called? **[TERM 2, 2014]**

8. "A trait may be inherited, but may not be expressed." Justify this statement with the help of a suitable example. **[TERM 2, 2014]**

9. An organ like a wing in birds is an advantage to the organism. Did they appear in different stages or were formed due to a single sudden change in them? **[TERM 2, 2015]**

10. "Evolution and classification of organisms are interlinked". Give reasons to justify the statement. **[TERM 2, 2017]**

5 Mark Questions

11. An angiosperm plant having red coloured flowers when crossed with the other having the same colour produced 40 progenies, out of which 30 plants were with red coloured flowers, 10 plants were with white coloured flowers. Find out:

(a) What is the possible genotype of parent plants?

(b) Which trait is dominant and recessive?

(c) What is this cross called as and what is its phenotypic ratio? **[TERM 2, 2015]**

12. Define evolution. How does it occur? Describe how fossils provide us evidences in support of evolution. **[TERM 2, 2016]**

13. With the help of one example each, distinguish between the acquired traits and the inherited traits. Why are the traits/experiences acquired during the entire lifetime of an individual not inherited in the next generation? Explain the reason of this fact with an example. **[TERM 2, 2017]**

Solutions

1. The basic functional and physical unit of heredity is called a gene. There are two copies of gene in every person, one inherited from each parent.[1]

2. The ways in which particular trait may increase in population are as follows:

(i) **Genetic Drift:** When there is some accident or disaster with some part of the population with some trait. The remaining population undergoes a genetic drift in which accumulation of particular trait of the remaining population takes place. It does not give any survival advantage but brings variation. [1]

(ii) **Natural Selection:** Organisms with certain traits are selected by nature on basis of their traits which they possess. The selection is done naturally for traits which give natural advantage for that particular species to increase its population. [1]

Topic 1: Reflection of Light, Image formed by Spherical Mirrors

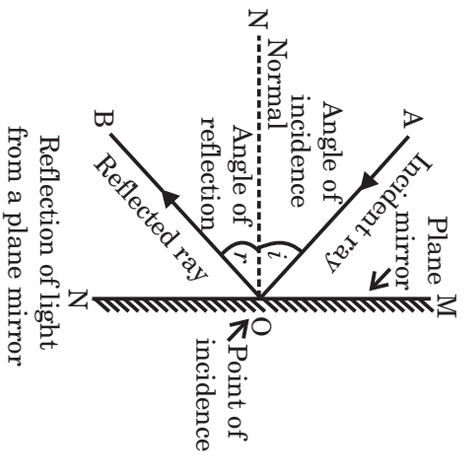
Summary

Knowing your Chapter at Glance:

- Light is a form of energy that produces in us the sensation of sight.

Properties of light

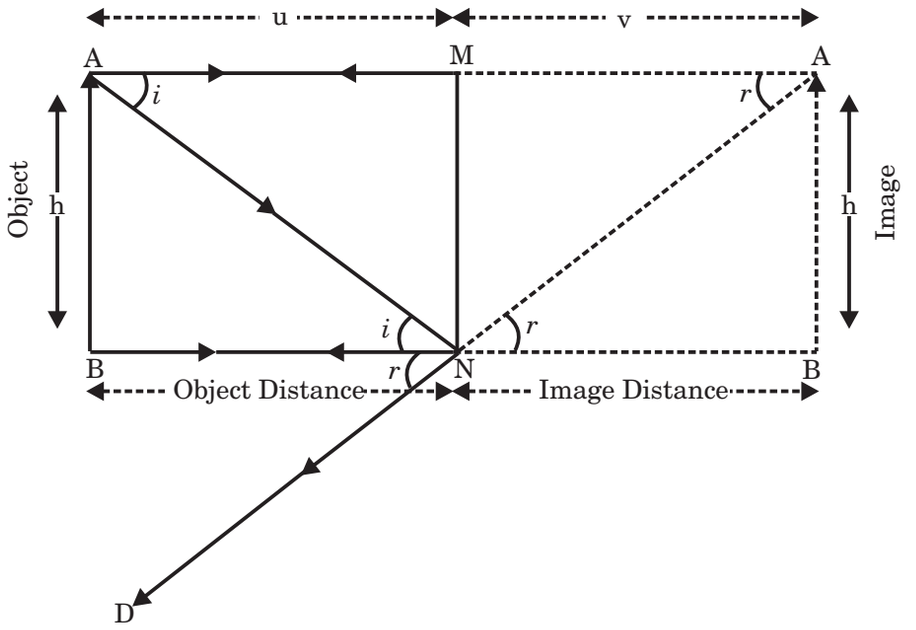
- It's an electromagnetic wave, so does not require any medium to travel.
- Light tends to travel in straight line.
- Light has dual nature: Wave and Particle nature.
- Light casts a shadow.
- Speed of light is maximum in vacuum and its vacuum is 3×10^8.
- When light falls on a surface, following may happen
  1. Reflection
  2. Refraction
  3. Absorption
- A ray of light is the straight line path along which light travels. It is represented by an arrow head, on a straight line ($\underset{\text{(Ray)}}{\longrightarrow}$).
- A group of parallel rays is called a beam of light.
- Reflection of light is the phenomenon of bouncing back of light in the same medium on striking the surface of any object.
- The two laws of reflection are :
  (i) the incident ray, the reflected ray and the normal (at the point of incidence), all lie in the same plane.
  (ii) the angle of reflection (r) is always equal to the angle of incidence (i) $\angle r = \angle i$



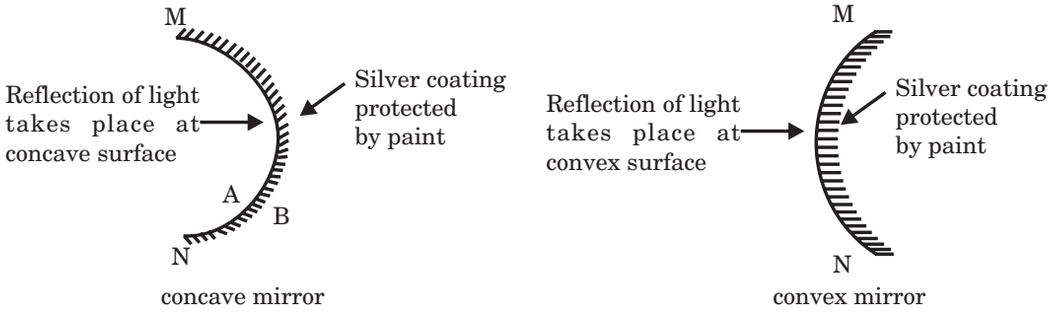
Real image	Virtual image
The real image is formed due to real intersection of reflected or refracted rays.	The virtual image is formed due to apparent intersection of reflected or refracted light rays.
Real images can be obtained on screen.	Virtual images can't be obtained on screen.
Inverted	Erect
e.g. the images formed on a cinema screen are real images.	e.g. The image of our face in a plane mirror is a virtual image

CHARACTERISTICS OF IMAGE FORMED BY PLANE MIRRORS

- Virtual and erect
- Size of image is equal to the size of object
- The image distance is equal to the object distance.
- Laterally inverted.



- A spherical mirror whose reflecting surface is curved inwards and polished on the outer spherical surface is called concave mirror.
- A spherical mirror whose refletcting surface is curved outwards and polished on the inner spherical surface is convex mirror.



DIFFERENTIATING BETWEEN PLANE, CONVEX AND CONCAVE MIRROR

1. If the image formed is erect and of the same size then it is a plane mirror.
2. If the image formed is erect but smaller in size then it is a convex mirror.
3. If the image is erect but magnified when mirror is close to the object then it is a convex mirror.

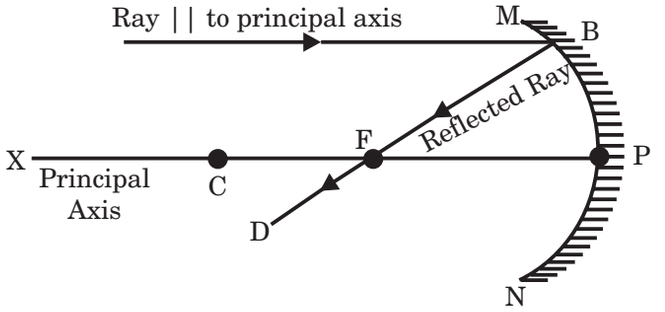
The important terms related to spherical mirrors are -

- The centre of curvature of a spherical mirror is the centre of the imaginary hollow sphere of glass, of which the spherical mirror is a part. It is denoted by 'C'.
- The radius of curvature of a spherical mirror is the radius of the imaginary hollow sphere of glass, of which the spherical mirror is a part. It is denoted by the letter 'R'.
- The centre of the reflecting surface of a spherical mirror is called its pole. It is usually denoted by the letter 'P' .
- The principal axis of a spherical mirror is the straight line passing through the centre of curvature C and pole P of a spherical mirror, produced on both sides.
- The aperture of a spherical mirror is denoted by the diameter of its reflecting surface.

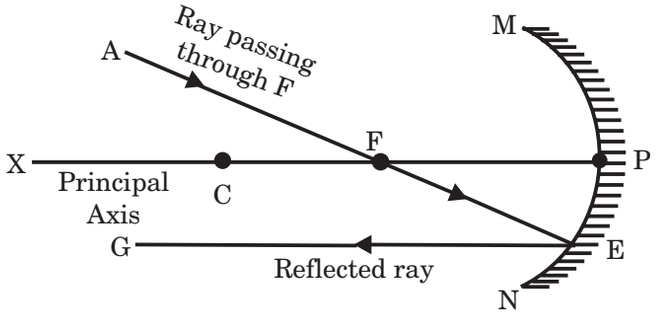
$$f = \frac{R}{2} \Rightarrow R = 2f$$

RULES FOR TRACING IMAGES FORMED BY CONCAVE MIRRORS

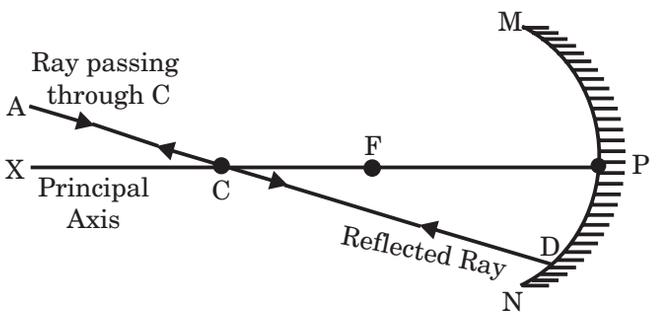
1. A ray parallel to the principal axis will pass through the principal focus,after reflection.



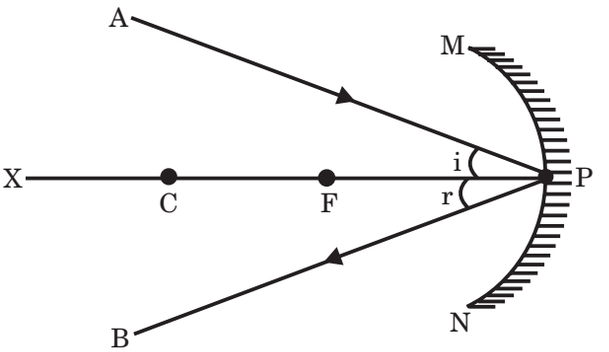
2. A ray passing through the principal focus of concave mirror will emerge parallel to principal axis after reflection.



3. A ray of light passing through the centre of curvature of a concave mirror is reflected back along the same path.



4. A ray incident obliquely to the principal axis of a concave mirror is reflected obliquely making equal angles.



According to New Cartesian Sign Convention, for spherical mirror.

(i) All distances are measured from the pole of the spherical mirror.

(ii) The distances measured in the direction of incidence of light are taken as positive and vice-versa.

(iii) The heights above the principal axis of the mirror are taken as positive and vice-versa.

Images formed by concave and convex mirror at different positions of the object

Lens	Object position	Image position	Image size	Nature of image
CONVEX	At infinity	At focus F	Highly diminished, point sized	Real and inverted
	Beyond C	Between F and C	Diminished	Real and inverted
	At C	At C	Same size	Real and inverted
	Between F and C	Beyond C	Enlarged	Real and inverted
	At focus F	At infinity	Highly enlarged	Real and inverted
	Between focus F and optical centre O	On the same side of the lens as the object	Enlarged	Virtual and erect
CONCAVE	At infinity	At focus F	Highly diminished, point sized	Virtual and erect
	Between infinity and optical centre O of the lens	Between focus F and optical centre O	Diminished	Virtual and erect

- **Mirror Formula**

  The relationship between the image distance (v), object distance (u) and focal length (f) of a spherical mirror is known as the mirror formula.

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

- **Linear Magnification**

  It is the ratio of the height of image to the height of the object

$$\text{linear magnification (m)} = \frac{\text{height of the image (h')}}{\text{height of the object (h)}}$$

$$\boxed{m=\frac{h'}{h}=-\frac{v}{u}}$$

- In case of a concave mirror, for the real and inverted images the magnification is always -ve. and for the virtual and erect images the magnification is always +ve.
- In case of a convex mirror, which always forms virtual and erect image, the magnification is always +ve.
- Magnification of plane mirror is always +1.

FOR SPHERICAL MIRRORS IF THE

(i) Linear magnification, $m > 1$, the image is enlarged

(ii) Linear magnification, $m = 1$, the image is of the same size as the object.

(iii) Linear magnification, $m < 1$, the image is diminished

Given magnification, $m = \frac{1}{3}$

Object distance, $u = -18$cm

We need to calculate the focal length (f) and the image distance (v).

$$m = \frac{v}{u} = \frac{1}{3}$$

According to the formula,

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

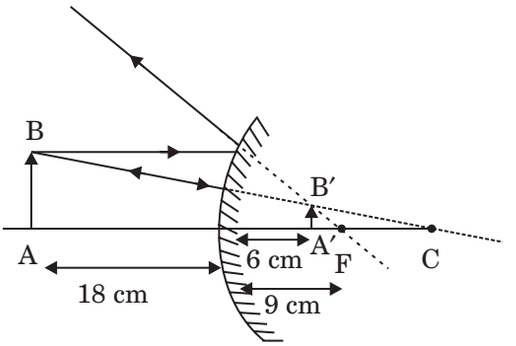
$$\Rightarrow \frac{1}{6} + \frac{1}{-18} = \frac{1}{f}$$

$$\Rightarrow \frac{1}{f} = \frac{2}{18}$$

$f = 9$ cm

As the focal length is positive, it is a convex mirror. [1]

Ray diagram is as follows:



[1]

Topic 2: Refraction, Lenses, Power of Lens

Summary

REFRACTION OF LIGHT

- The phenomenon of bending of light from its original path on passing from one medium to another is known as refraction.

CAUSE OF REFRACTION

- The light travels with different speeds in different media. Therefore when light goes from one medium to another, its speed changes. This change in speed of light on going from one medium to another causes the refraction of light.
- When a ray of light passes from a rarer to a denser medium,it bends towards the normal.
- When a ray of light passes from a denser to a rarer medium, it bends away from the normal.

LAWS OF REFRACTION

1. The incident ray, the refracted ray and the normal to the interface of two transparent media at the point of incidence, all lie in the same plane.
2. The ratio of sine of angle of incidence to the sine of angle of refraction is a constant, for the light of a given colour (wavelength) and for the given pair of media. This law is also known as Snell's law of refraction.

$$\frac{\sin i}{\sin r} = \text{constant}$$

where i = angle of incidence

r = angle of refraction

This constant value is called the refractive index of the second medium with respect to the first.

$$\text{Absolute Refractive Index of a medium} = \frac{\text{speed of light in air (or vacuum)}}{\text{Speed of light in medium}}$$

$$\boxed{n_m = \frac{c}{v}}$$

Relative refractive index of medium 2 with respect to medium 1

$$= \frac{\text{Speed of light in medium 1 (other than vacuum or air)}}{\text{Speed of light in medium 2}}$$

$$\boxed{n_{21} = \frac{v_1}{v_2}}$$

Where n_{21} = Relative refractive index of medium 2 with respect to medium 1.

v_1 = Speed of light in medium 1.

v_2 = Speed of light in medium 2.

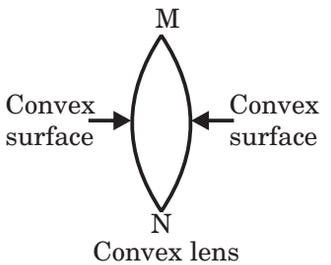
$$\boxed{n_{12} = \frac{v_2}{v_1}}$$

$$\boxed{n_{21} = \frac{1}{v_{12}}}$$

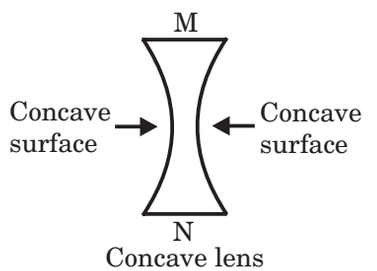
OPTICAL DENSITY VS. MASS DENSITY

Optical density of a substance is different from its mass density. A medium (substance) may have higher optical density than another medium (substance) but its mass density may be less. For example oils (kerosene, mustard etc.) having higher refractive index has a higher optical density than water which has a lower refractive index, but the mass density of oils (Kerosene, mustard etc.) is less than that of water. That is why the oils generally float on the water surface.

Lens



Convex lens



Concave lens

Images formed by concave and convex lenses at different postions of the object

Lens	Object position	Image position	Image size	Nature of image
CONVEX	At infinity	At focus F_2	Highly diminished, point sized	Real and inverted
	Beyond $2F_1$	Between F_2 and $2F_2$	Diminished	Real and inverted
	At $2F_1$	At $2F_2$	Same size	Real and inverted
	Between F_1 and $2F_1$	Beyond $2F_2$	Enlarged	Real and inverted
	At focus F_1	At infinity	Highly enlarged	Real and inverted
	Between focus $F_1$and optical centre O	On the same side of the lens as the object	Enlarged	Virtual and erect

CONCAVE	At infinity	At focus F_1	Highly diminished, point sized	Virtual and erect
	Between infinity and optical centre O of the lens	Between focus F_1 and optical centre O	Diminished	Virtual and erect

LENS FORMULA

The relationship between the image distance (v), object distance (u) and focal length (f) of a spherical lens is known as the lens formula.

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

Linear magnification, $\boxed{m = \frac{h'}{h} = \frac{v}{u}}$

(i) A concave Lens always forms an image smaller than the object. Therefore linear magnification (m) of a concave lens is less than one.

(ii) A convex lens forms an image

(a) equal in size to the object (i.e. m = 1)

(b) less than the size of the object (i.e. m<1) (iii) more than the size of the object (i.e. m > 1). Therefore linear magnification of a convex lens can be one, less than one or more than one.

Power

The power of a lens is the degree of convergence or divergence of light rays achieved by a lens.

$$\boxed{P = \frac{1}{f(\text{in meters})}}$$

where P = power of a lens

and f = focal length of the lens in meters.

The S.I. unit of power is dioptre. It is denoted by the letter 'D'.

One dioptre is the power of a lens whose focal length is 1 metre.

Power of a combination of lenses

$$\boxed{P = p_1 + p_2 + p_3 + ...}$$

Where P = power of combination of lenses.

$p_1, p_2, p_3, \ldots\ldots\ldots\ldots\ldots$ = Powers of individual lens placed close to each other.

- A convex lens has positive focal length so the power of a convex lens is positive.

- A concave lens has a negative focal length, so the power of a concave lens is negative.

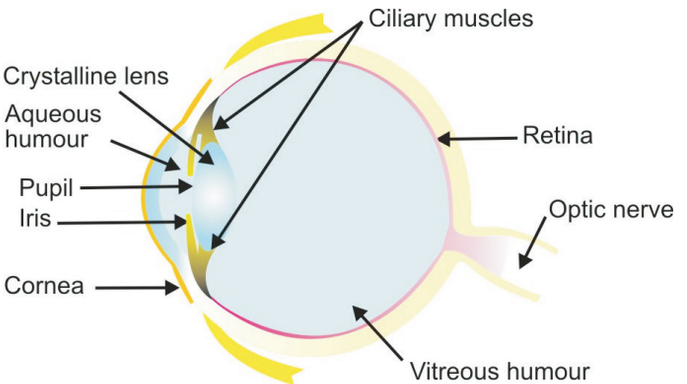
Topic 1: Structure of Eye & Eye Defects

Summary

Knowing your Chapter at Glance:

- Eye is a natural optical device using which man could see objects around him. It forms an inverted, real image on a light sensitive surface called retina.

STRUCTURE OF THE EYE



- The front part of the eye, which is transparent and bulging outwards is called as **cornea**.
- Cornea serves as a window of the eye as the light coming from objects enters the eye through the cornea.
- Behind the cornea, is a circular diaphragm called **iris**. There is a hole in the middle of the iris which is called **pupil** of the eye.
- Behind the pupil, is a convex lens called eye lens. It is composed of transparent, fibrous jelly like material. It is held in position by ciliary muscles. The converging power of eye len can be changed by changing its shape by the action of ciliary muscles.
- The eye lens forms an inverted real image of the object on the screen called retina. The retina is behind the eye lens. The retina is a delicate membrane having enormous number of light sensitive cells- Rods and Cones.
- The Rods respond to the intensity of light and the cones respond to colour of light. These cells get activated upon illumination and send electric signals to brain through optic nerve.
- **Far point**

  The maximum distance at which object can be seen clearly is far point of the eye. For a normal adult eye, its value is infinity.
- **Near point or Least distance of distinct vision**

  The minimum distance at which objects can be seen most distinctively without strain.

  For normal adult eye, its value is 25cm.
- The ability of an eye to focus both near and distant objects by adjusting its focal length is called the power of accommodation of an eye.

DEFECTS OF VISION AND THEIR CORRECTION

Following are the four common defects of vision:

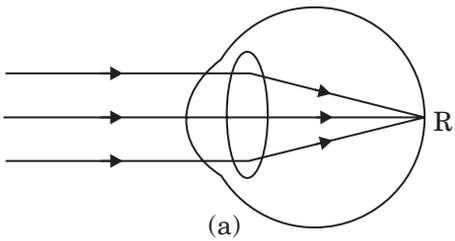
(i) Myopia or short-sightedness
(ii) Hypermetropia or long-sightedness
(iii) Presbyopia

- **Myopia or short-sightedness**

  Myopia or near-sightedness is the defect of an eye due to which a person can see nearby objects clearly but he cannot see far away (distant) objects clearly and distinctly.

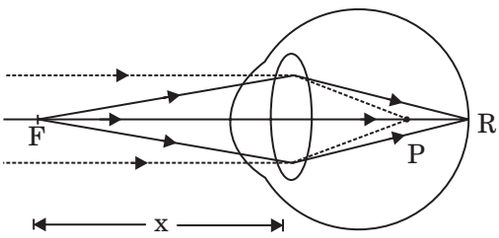
  A person with this defect has the far point nearer than infinity.

- **Causes of Defect**
  (a) Excessive curvature of the eye lens or due to the high converging power of eye lens
  (b) Elongation of the eye ball.
- **Corrective Measures**
  This defect can be corrected by using spectacles with concave lens of suitable focal length or power.



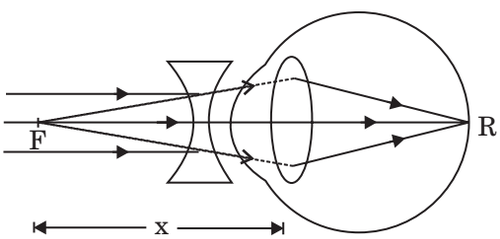
Normal Eye
(Sharp image of object at infinity)

(a)



Myopic Eye
[Blurred image of object at infinity
and sharp image of object at F (far point)]

(b)



Corrected
myopic eye
(Sharp image of object at infinity)

(C)

Hypermetropia or Long-sightedness

It is the defect of an eye due to which a person can see far away (distant) objects clearly but cannot see nearby objects clearly and distinctly.

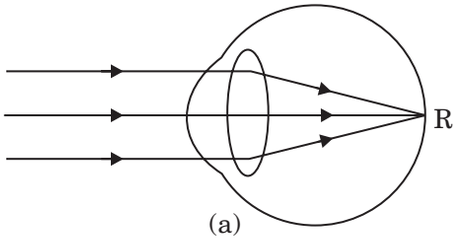
A person with this defect has the near point farther away from the normal point (25 cm).

Causes of Defect

(a) Excessive curvature of the eye lens or due to the high converging power of eye lens
(b) Elongation of the eye ball.

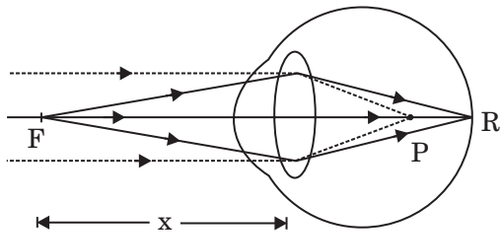
Corrective Measures

This defect can be corrected by using spectacles with concave lens of suitable focal length or power.



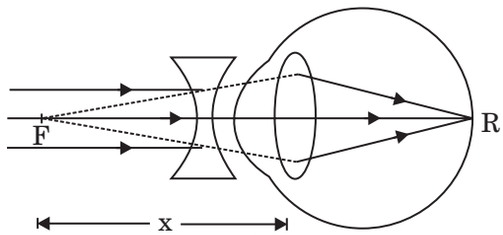
Normal Eye
(Sharp image of object at infinity)

(a)



Myopic Eye
[Blurred image of object at infinity
and sharp image of object at F (far point)]

(b)



Corrected
myopic eye
(Sharp image of object at infinity)

(c)

- **Presbyopia or old sight**

  It is the defect of the eye due to which an old person cannot see the nearby objects clearly. The near point of the old person having presbyopia gradually recedes and becomes much more than 25 cm.

Cause of Defect

Presbyopia arises due to the gradual weakening of the ciliary muscles and diminishing flexibility of the eye lens with age.

Corrective Measures

Presbyopia defect is corrected in the same way as hypermetropia i.e. by using spectacles having convex lenses.

Topic 2: Dispersion & Refraction

DISPERSION OF WHITE LIGHT BY A GLASS PRISM

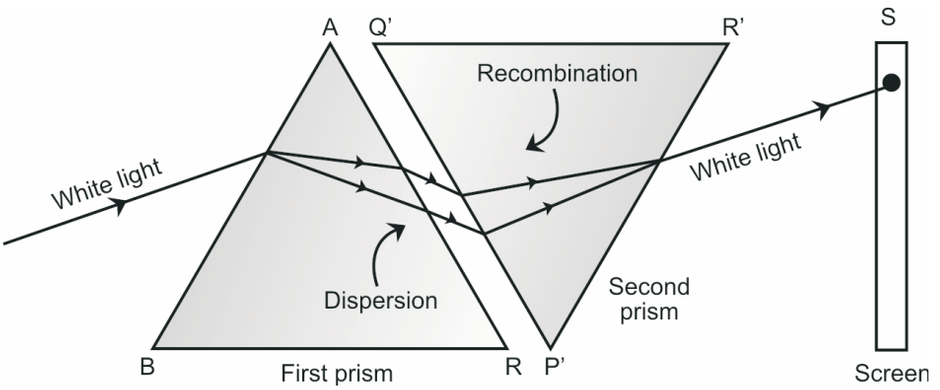
The phenomenon of splitting up of white light into its constituent seven colours on passing through a prism is called dispersion of light.

In the year 1665, Newton discovered that if a beam of white light is passed through a triangular glass prism, the white light splits to form a band of seven colours on a white screen held on the other side of the prism.

The colour sequence obtained on the screen is given by the famous acronym VIBGYOR where :

V stands for Violet
I stands for Indigo
B stands for Blue
G stands for Green
Y stands for Yellow
O stands for Orange
R stands for Red

- Violet colour bends through maximum angle whereas the red colour bends the least on passing through the prism.
- If the second identical prism is placed in an inverted position with respect to the first prism,all the seven colours recombine to form white light.



Atomspheric Refraction

The refraction of light caused by the earth's atmosphere is called atmospheric refraction.

- **TWINKLING OF STARS**

  The twinkling of stars is due to the atmospheric refraction of star's light.

  When the light coming from a star enters the earth's atmosphere, it undergoes refraction due to the varying optical densities of layers of air. This causes the star's image to change slightly in brightness and position, hence "twinkle."

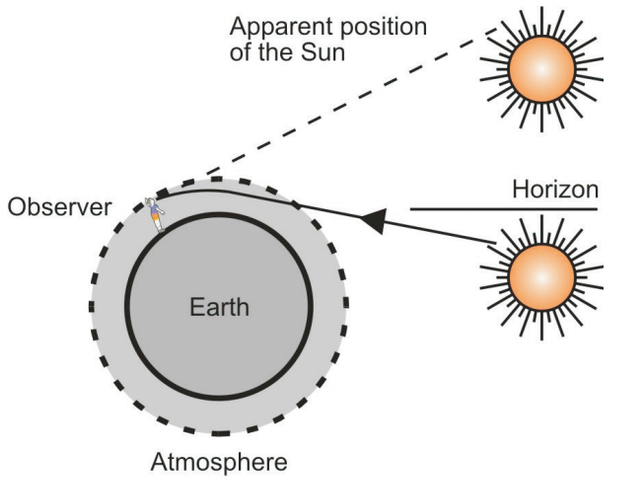
- **PLANETS DO NOT TWINKLE**

  The planets are much closer to the earth and are thus considered as the collection of infinite point sources of energy.

  The total variation in the amount of light entering our eye from all the point sources of light will average out to be zero. Thereby nullifying the twinkling effect. Hence planets do not twinkle.

- **ADVANCED SUNRISE AND DELAYED SUNSET**

  The sun is visible to us about 2 minutes before the actual sunrise and 2 minutes after the actual sunset because of atmospheric refraction. The actual sunrise takes place when the sun is just above the horizon.



Atmospheric refraction effects at sunrise and sunset

Scattering of light

The phenomenon in which a part of the light incident on a particle is redirected in different direction is called scattering of light.

TYNDALL EFFECT

The scattering of light by the colloidal particles of the medium due to which the path of the light becomes visible is known as Tyndall effect.

Tyndall effect can also be observed when sunlight passes through a dense forest.

BLUE COLOUR OF THE CLEAR SKY

The sunlight consists of seven coloured lights mixed together. When sunlight passes through the atmosphere, the shorter wavelength of blue light is scattered all around the sky by the tiny particles (atoms and molecules) present in the atmosphere. Some of the scattered blue light enters in our eyes as a result the sky appears blue.

If the earth had no atmosphere, there would not have been any scattering and the sky would have looked dark. The sky appears dark to the astronaut flying at very high attitudes because scattering is not prominent at such heights due to the lack of atmosphere.

COLOUR OF THE SUN AT SUNRISE AND SUNSET

At the time of sunrise and sunset, the sun is near the horizon. The sun rays have to travel much larger part of the atmosphere to reach on earth. As a result most of the light of smaller wavelength i.e. blue coloured light gets scattered away. Where as the light of larger wavelength i.e. red coloured light is scattered least and hence reaches the earth. Hence, the sun appears reddish at sunrise and sunset.

When the sun is overhead, the sunlight has to travel much smaller portion of earth's atmosphere. As a result, a little of the blue and violet colours are scattered out, due to which the sun appears shiny silver (white).

DANGER SIGNALS ARE RED

Out of all the colours of visible light, red colour has the longest wavelength. Therefore red colour is least scattered. That is why danger signals are red.

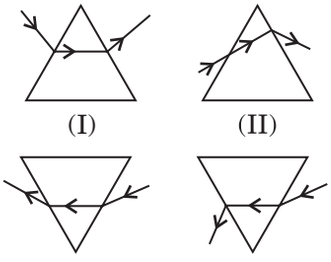
PREVIOUS YEARS' EXAMINATION QUESTIONS

TOPIC 2

1 Mark Questions

1. Give an example of a phenomenon where Tyndall effect can be observed. **[TERM 2, 2011]**

2. While performing the experiment to trace the path of a ray of light passing through a glass prism, four students marked the incident ray and the emergent ray in their diagrams in the manner shown below.



The correct path of the rays has been showed by:
(a) I
(b) II
(c) III
(d) IV **[TERM 2, 2012, 2013, 2014]**

3. In an experiment to trace the path of a ray of light through a glass prism for different values of angle of incidence a student would find that the emergent ray:
(A) is parallel to the incident ray
(B) perpendicular to the incident ray
(C) is parallel to the refracted ray
(D) bends at an angle to the direction of incident ray **[TERM 2, 2012, 2013]**

Summary

Knowing your Chapter at Glance:

- A switch makes a conducting link between the cell and the bulb.
- A continuous and closed path of an electric current is called an electric circuit.

  Electric charge is the property of matter due to which it produces and experience electrical effects.

Charges are of two types:

(a) Positive charge

(b) Negative charge

- The unit of electric charge is **coulomb** and 1 coulomb is the charge contained in 6x1018 electrons.

Properties of electric charge

(a) Electric charges can neither be destroyed nor be created.

(b) Charges are additive i.e. total charge is the algebraic sum of the individual charges.

- Unlike (opposite) charges attract each and like (similar) charges repel each other.

COULOMB'S LAW

The force of attraction or repulsion between two charges is directly proportional to the product of two charges and inversely proportional to the square of distance (r) between them,

$F = \frac{K\, q_1 q_2}{r^2}$ where K is constant of proportionality.

- Electrostatics is the branch of electricity, which deals with the study of charges at rest.

ELECTRIC CURRENT

Electric Current can be defined as the rate of flow of electric charge through any section of a conductor.

or

The quantity of charge flowing per unit time.

$$I = \frac{Q}{t} \text{ or } Q = It$$

- SI unit of current is Ampere (A)

$$1 \text{ Ampere} = \frac{1 \text{ coulomb}}{1 \text{ second}}$$

Therefore, 1 ampere of current is said to be flowing through the conductor if one coulomb of charge flows through it in one second.

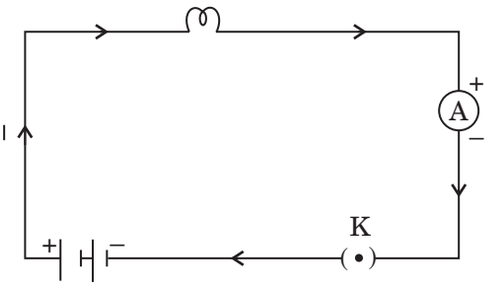
- 1 mA (milliampere) =10 – 3 A

  1 μ A (microampere) = 10 – 6 A
- Ammeter is the instrument used for measuring the current and has low resistance.

  It is connected in series always. The symbol is

DIRECTION OF CURRENT

Conventional current is said to flow from positive to negative, that is, opposite to the flow of electrons.



ELECTRIC POTENTIAL DIFFERENCE (or POTENTIAL DIFFERENCE)

Electric potential difference between two points P and Q on a conductor through which a current is flowing is defined as the amount of work done to move a unit charge from P to Q.

$$V = \frac{W}{Q} \text{ or } W = QV$$

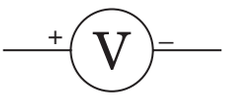
V = Electric potential difference, Q = charge, W = work done.

The S.I. unit of electric potential difference is volt (V)

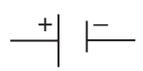
$$1 \text{ Volt (V)} = \frac{1 \text{ Joule (J)}}{1 \text{ Coulomb (C)}}$$

Electric potential difference or potential difference is said to be one volt if one joule of work is done to move one coulomb of charge from one point to other.

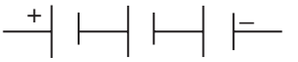
- Voltmeter is the instrument used for measuring potential difference between 2 points and has high resistance. It is always connected in parallel. Symbol is



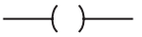
Symbols of commonly used components in circuit diagram



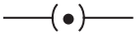
An electric cell



Battery

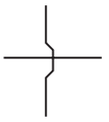


Open electric circuit



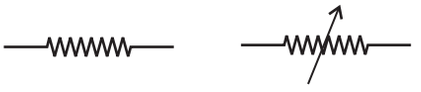
Closed electric circuit

Connecting wires

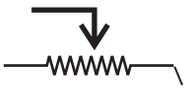


Wires crossing without joining

Electric bulb

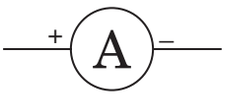


Resistor

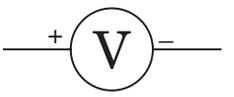


Rheostats

Galvanometer



Ammeter



Voltmeter

Ohm's Law

Potential difference across the two points of a metallic conductor is directly proportional to current through the circuit provided that temperature remains constant.

$I \propto V$

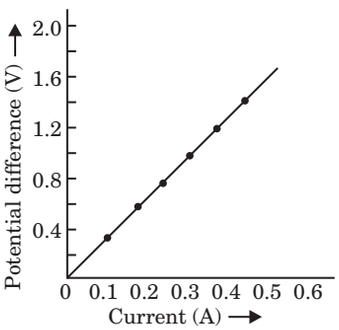
$V \propto I$ V = Potential difference

$V = RI$ R = Resistance

I = Current

Here, R is called the electrical resistance or resistance of the conductor.

- Thus, V/I is a constant ratio which is called resistance (R).



- Resistance is the property of a conductor to resist the flow of charges through it.

$$R = \frac{V}{I}$$

- The S.I. unit of resistance is Ohm (Ω) $\quad 1 \text{ Ohm } (\Omega) = \dfrac{1 \text{ volt (1 V)}}{1 \text{ Ampere (1 A)}}$

- The resistance of a conductor is said to be one ohm if a current of one ampere flows through it when a potential difference of one volt is applied across its ends.

FACTORS AFFECTING RESISTANCE OF A CONDUCTOR

- Resistance of a conductor is directly proportional to its length

$$R \propto l$$

R = Resistance, l = length of wire.

- Resistance of a conductor is inversely proportional to cross-section area (thickness) of the conductor.

$$R \propto \frac{1}{A}$$

- Different metals offer different resistances to the flow of current. This is also called as the specific resistance or resistivity of a metal.
- The resistance of a conductor changes with temperature.

$$R \propto \ell$$
$$R \propto \frac{1}{A}$$
$$R \propto \frac{\ell}{A}$$
$$R \propto \frac{\rho\ell}{A}$$

where,

R	-	Resistance
ρ	-	Resistivity
l	-	Length of a conductor
A	-	Cross-sectional area

RESISTIVITY

If the length of the wire is 1 m and cross-section area is 1 m^2,

$$R = \frac{\rho l}{A}$$
$$R = \frac{\rho \times 1}{1^2}$$
$$\Rightarrow R = \rho$$

- Therefore, resistivity of a material is defined as the resistance offered by a cube of side 1 m of that material.
- The S.I. unit of resistivity is Ωm.
- Resistivity does not change with change in length or area of cross sectional but it changes with change in temperature.
- Resistivity range of metals and alloys is 10-8 to 10-6 Ωm.
- Range of resistivity of insulators in 1012 to 1017 Ωm.
- Resistivity of alloy is generally higher than that of its constituent metals.
- Alloys do not oxidise readily at high temperature,so they are commonly used in electrical heating devices.
- Copper and aluminum are used for electrical transmission lines as they have low resistivity.
- Semiconductors are materials having resistivity between that of insulator and a conductor. They are used in making integrated circuits.
- Superconductors are materials that lose their resistivity at low temperature. The phenomenon of complete loss of resistivity by substances below a certain temperature is called superconductivity.

RESISTANCES IN SERIES

Resistances are said to be connected in series if they are joined end to end and the same current flows through each one of them, when a potential difference is applied across the combination.

Then, equivalent resistance of the combination

$$R = R1 + R2 + R3$$

RESISTANCES IN PARALLEL

Resistors are said to be in a parallel connection if one end of each resistance is connected to one point and the other is connected to another point. The potential difference across each resistor is the same and is equal to the applied potential difference between the two points.

Then, equivalent resistance of the combination

$$\frac{1}{R_e} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

Heating effect of current

When an electric current is passed through a conductor, heat is produced in it. This is known as Joule's Heating Effect. Mathematically, it can be expressed as

$$H = I^2Rt$$

Electrical energy

The total work done by a current in an electric circuit is known as Electric Energy.

$$W = H = VIt = I^2Rt = \frac{V^2}{R}t$$

S.I. unit of energy is Joule(J).

$$1\ KJ = 1000\ J$$

Electric Power

The rate at which work is done by an electric current is called Electric Power.

$$P = VI$$

$$P = I^2R$$

$$P = \frac{V^2}{R}$$

S.I. unit of power is Watt(W).

$$1 \text{ watt} = \frac{1 \text{Joule}}{1 \text{second}} = 1 \text{ volt} \times 1 \text{ ampere}$$

$1 W = 1 Js^{-1} = 1 VA$

1 kilowatt = 1000W

1 Horse Power = 746 W

- The commercial unit of electric energy is called kilowatt hour (kWh) or unit.

  1 KWh = 3.6 × 106 J

  1 KWh = 1 unit of electrical energy.

  1 KW = 1000 W

Applications of heating effect of current

- The following electrical appliances are based on heating effect: Electric iron, geyser, toaster, oven, kettle etc.
- **Electric fuse**: If the electric current flowing through the circuit increases above a specified value, more heat is produced, the fuse melts, breaks the circuit and therefore saves the valuable electrical appliances and gadgets.

Power rating

It is the electrical energy consumed per second by the appliance when connected across the marked voltage of the mains.

Efficiency of an electrical device

It is ratio of the output power to the input power.

$$\text{Efficiency } \eta = \frac{\text{Output power}}{\text{Input power}}$$

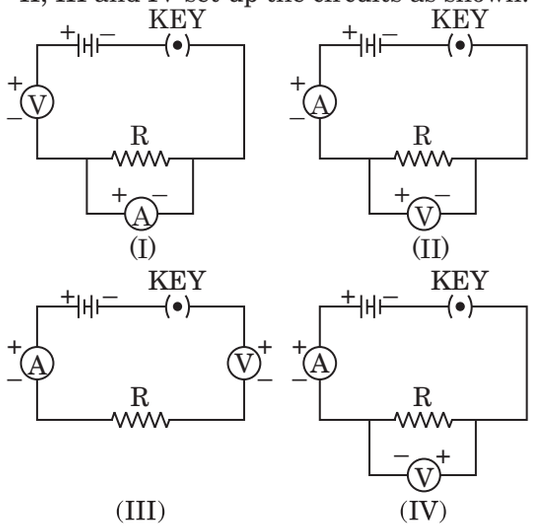
PREVIOUS YEARS' EXAMINATION QUESTIONS

1 Mark Questions

1. Mention any two factors on which the resistance of a cylindrical conductor depend

[TERM 1, 2011, 2013]

2. While performing the experiment on studying the dependence of current (I) on the potential difference (V) across a resistor, four students I, II, III and IV set up the circuits as shown:

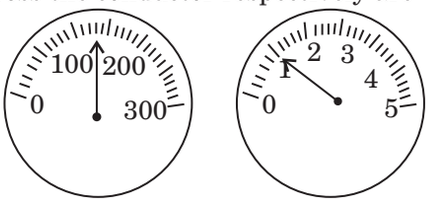


The correct result will be obtained by student:

(a) I
(b) II
(c) III
(d) IV

[TERM 1, 2011]

3. The figures given below show the readings of a milliammeter and a voltmeter connected in an electric circuit. Assuming that the instruments do not have any zero error, the current flowing through the circuit and the potential difference across the conductor respectively are



(a) 160 mA and 1.1 V
(b) 130 mA and 1.2 V
(c) 130 mA and 1.1 V
(d) 130 mA and 1.5 V

[TERM 1, 2011]

Summary

Knowing your Chapter at Glance:

- A magnet is a substance, which has both attractive and directive properties. Magnet is also known as Lodestone and it is chemically the oxide of iron (Fe_3O_4).
- H.C. Oersted first noticed the magnetic effect of electric current. According to him, a needle kept near the wire carrying current will deflect due to the magnetic field produced. Any change in the direction of current will show variation in the deflection.

PROPERTIES OF MAGNET

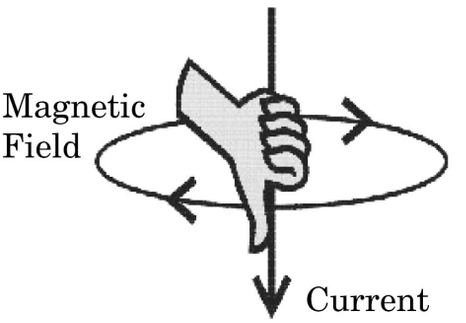
- Every magnet has two poles i.e. North and South pole.
- Like poles attract and Unlike poles repel each other.
- If a bar magnet is suspended by a thread and if it is free to rotate, its South Pole will move towards the North Pole of the earth and vice versa.
- Magnets attract objects of iron, cobalt and nickel.
- The space around them in which the force of attraction and repulsion can be detected. This space is known as magnetic field.
- SI unit of magnetic field is Tesla(T).
- Magnetic field has both magnitude as well as direction.
- We can describe the magnetic field around a magnet by magnetic field lines. These are the curved paths along which magnetic force is acting on them in the magnetic field of the bar magnet. These lines are called magnetic lines of forces.

CHARACTERISTICS OF FIELD LINES

1. Magnetic lines of force start from the North Pole and end at the South Pole(outside).
2. Field lines are closed curves.
3. Field lines are closer means greater is the strength of magnetic field.
4. Two magnetic lines of force can not intersect each other because if they do so, there would be two directions of magnetic field at that point, which is not possible.
5. Direction of field lines inside a magnet is from South to North.

Right Hand Thumb Rule

Imagine the straight conductor in your right hand such that the thumb points in the direction of current. The direction of curling of fingers of the right hand gives the direction of magnetic field lines.



Magnetic Field Due to Current Through a Straight Conductors

It can be represented by concentric circles at every point on conductor.

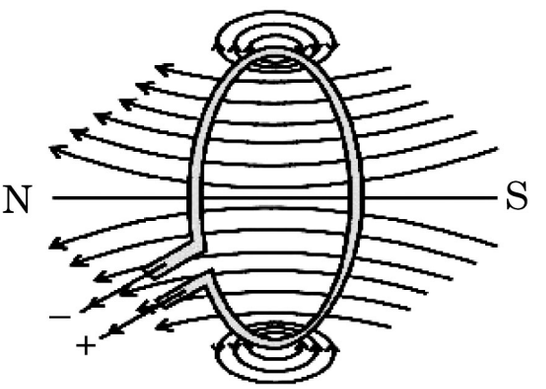
If the current (I) in the conductor is increased, then the strength of magnetic field is also increased.

$$\mathbf{B} \propto \mathbf{I}$$

If the distance (r) of the compass from the conductor is increased, the deflection of the needle decreases,

$$B \propto \frac{1}{r}$$

Magnetic Field Due to Current Through a Circular Loop



- It can be represented by concentric circles at every point.
- The direction of the magnetic field at the centre is perpendicular to the plane of the coil.

Factors affecting magnetic field of a circular current carrying conductor

Magnitude (B) of magnetic field

The magnitude of the magnetic field (B) at the centre of the coil is

1. Directly proportional to the current (I) flowing through it,

$$\mathbf{B \propto I}$$

Current is in clockwise direction

2. Inversely proportional to the radius (r) of the coil,

$$\mathbf{B \propto \frac{1}{r}}$$

3. Directly proportional to the total number of turns (N) in the coil,

$$\mathbf{B \propto N}$$

Looking at the face of the coil, if the current around that face is in clockwise direction, the face is the South Pole; while if the current around that face is in the anticlockwise direction, the face is the North Pole.

Current is in anticlockwise direction

An insulated copper wire wound on a cylindrical cardboard (or plastic) tube such that its length is greater than its diameter is called a solenoid.

1. The magnetic field lines inside the solenoid are nearly straight and parallel to its axis. Thus, the magnetic field inside a solenoid is uniform.
2. The magnetic field lines are exactly identical to those due to a cylindrical bar magnet with one end of the solenoid acting as a South Pole and its other end as a North-Pole. Thus, a current-carrying solenoid behaves like a bar magnet with fixed polarities at its ends.

The magnitude of the magnetic field inside the solenoid is

(i) Directly proportional to the current (I) flowing through the solenoid,

$$B \propto I$$

(ii) Directly proportional to the number of turns per unit length of the solenoid (n) and not on the total number of turns on the solenoid,

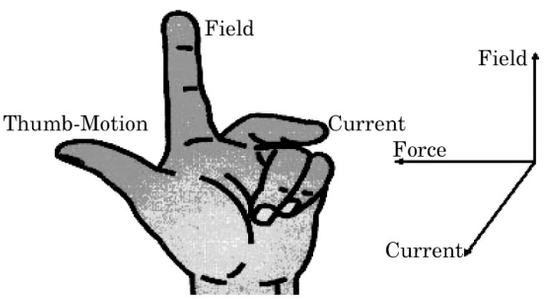
$$B \propto n$$

($n = \frac{N}{\ell}$, where N is the total number of turns in the solenoid and l is its length)

$$B \propto nI$$

- A permanent magnet is made from steel. As steel has more retentivity than iron, it does not lose its magnetism easily.
- Apart from different varieties of steel (carbon steel, chromium steel, cobalt and tungsten steel), some alloys like Alnico (aluminium, nickel and cobalt) and Nipermag (an alloy of iron, nickel, aluminum and titanium) are used to make very strong permanent magnets.
- An electromagnet is a temporary strong magnet and is just a solenoid with its winding on a soft iron core.
- Electro magnetic induction is the conversion of mechanical energy into electrical energy.
- Ampere suggested that when a current I passes through a conductor of length l placed in a perpendicular magnetic field B, then the force experienced is given by $F=IBl\sin\theta$, where θ is the angle between the length of the conductor and magnetic field.

Fleming Left-Hand Rule



- Stretch the thumb, the first finger and the central finger of the left hand so that they are mutually perpendicular to each other. If the first (fore) finger points in the direction of the magnetic field, the central finger points in the direction of current, then the thumb points in the direction of motion of the conductor (i.e., direction of force on the conductor).

ELECTRIC MOTOR

It is a device used to convert electrical energy to mechanical energy. It works on the principle of force experienced by a current carrying conductor in a magnetic field. The two forces in the opposite sides are equal and opposite.

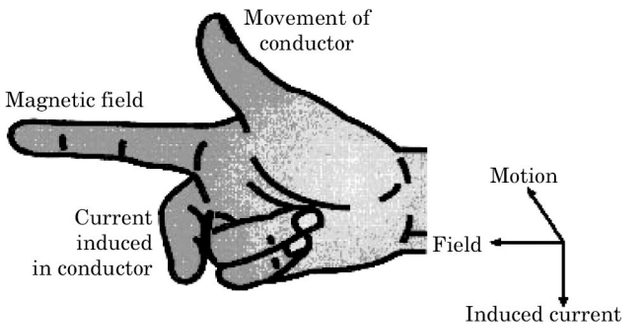
FARADAY'S LAW

The rate at which the magnetic flux linked with a coil changes, produces the induced emf or current. more the rate ,more the current and vice versa.

$$I = \frac{e}{R \times t} = \frac{\text{Change in flux}}{\text{Resistance} \times \text{Time}}$$

FLEMING'S RIGHT-HAND RULE (DYNAMO RULE)

Stretch the thumb, the fore finger and the central finger of the right hand so that they are mutually perpendicular to each other. If the first (fore) finger points in the direction of magnetic field, the thumb points in the direction of motion of the conductor, then the central finger points in the direction of induced current.



- Working principle of electric generator
- Used to find direction of induced current.
- Generator works on the principle of Electromagnetic Induction. It converts the mechanical energy available into electrical energy. A.C. Generator produces potential which reverses after every 180° rotation of the coil. D.C. Generator means the generator which produces unidirectional current.

DOMESTIC ELECTRIC CIRCUITS

The electric power to a house is supplied either through overhead wires or through underground cables. The cable has three separate insulated wires:

(a) Live wire (positive) with red insulation cover

(b) Neutral wire (negative) with black insulation cover

(c) Earth wire with green insulation cover

- The potential difference between live and neutral wire in India is 220V.

Alternating Current

An electric current which changes its direction (i.e., polarity) after a certain fixed interval of time is called alternating current.

Direct Current

An electric current which always flows in the same direction is called direct current. The polarities (+ve and -ve) of DC are fixed. The current supplied by a cell or a battery is DC.

Short-circuiting

'In household connections, short-circuiting occurs when the live (positive) wire and the neutral (negative) wire come in direct contact with each other.

Reasons of short-circuiting

(a) Damage to the insulation of the power-lines

(b) A fault in an electric appliance due to which current does not pass through it.

An electric fuse is a device, which is used in series to limit the current in an electric circuit so that it easily melts due to overheating when excessive current passes through it. A fuse is a wire of a material with very low melting point.

EARTHING

Connecting the outer frame of an appliance to earth to avoid shock caused by the fault or current leakage.

Topic 1: Source of Energy

Summary

Knowing your Chapter at Glance:

- **Source of Energy.** The actual resource from which energy can be harnessed directly or indirectly is called source of energy. They can be classified into two groups.
- Characteristics of a Source of Energy.

  A good source of energy should fulfill the following characteristics :

(i) Provide adequate amount of energy per unit mass or volume at constant rate over a long period of time.

(ii) Burn without giving out any smoke or harmful gases.

(iii) Easily available and convenient to use.

(iv) Easy to store, handle and safe to transport.

Conventional Source of energy	Non- Conventional Source of energy
Sources which are being used since long time.	Sources whose use has started only recently.
Examples: coal,wood,wind etc.	Examples: Sun,wave

All the forms of energy are stated under the **law of conservation of energy**. According to this law, "The total energy in the universe always remain constant, i.e., energy can neither be created nor destroyed, but can only be transformed from one form into another e.g., friction turns kinetic energy into thermal energy.

Fuel : The material which are burnt to produce heat energy are known as fuels. E.g wood,coal,LPG etc.

Characteristics of a good fuel

(i) free from any kind of pollution.

(ii) easy to store and transport.

(iii) easily accessible.

(iv) economical.

(v) having a high calorific value

(vi) having a low content of non-combustible substances i.e., it should leave less residue on burning.

Conventional sources of energy

- **Fossil fuels** are those fuels which are formed from the organic remains of prehistoric plants and animals, e.g., coal, oil and natural gas (petroleum).

  It is non-renewable source of energy

Disadvantages of fossil fuel:

It causes air pollution. When we burn fossil fuel,poisonous gases like oxides of carbon,nitrogen, sulphur are released.

Fossil fuels release a lot of smoke.

They cause acid rain.

- **Thermal Power Plant.** A power-generating plant which uses heat energy to generate electricity

  Working of thermal power plant

  Such plants use coal, petroleum and natural gas to produce electricity. The steam produced by burning of fossil fuels runs the turbine to generate electricity. The transmission of electricity is more efficient. These plants are setup near coal or oil fields to minimise the cost of transportation and production.
- **Hydroelectric power plants.** A power generating plant that uses the energy of flowing water to produce electricity is called hydroelectric power plant. The electricity generated is called hydroelectricity.

Working of hydropower plant

Stored water behind the dam is allowed to fall freely from a suitable height on the blades of a turbine. This rotates the armature coil of generator rapidly and electricity is generated.

Disadvantages of hydropower plant

- Hydropower can be established in certain locations. Also, a large area is required to build a dam and results in rehabitation people.
- Vegetation gets submerged under water.
- **Biomass.** The residue of living organisms such as remains of plants, animal and their products from which fuel can be obtained is called biomass.
- Biomass is a renewable source of energy.
- Biomass can be used

(a) as a bio fuel

(b) for the production of fibre, paper, chemicals or heat

(c) as a source of energy in industries

(d) to generate electricity

(e) to produce biogas by its anaerobic digestion.

Benefits of charcoal over wood:

- No flame
- Charcoal produces more energy
- Release less smoke
- **Biogas.** The mixture of gases produced during decomposition of bio mass such as cow-dung, various plant materials like residue of harvested crops, vegetable waste and sewage in the absence of oxygen is called bio gas. It is also known as 'go-bar gas'.

  Biogas is mixture of methane (75%), carbon dioxide (25%) with the traces of hydrogen, nitrogen and hydrogen sulphide.

Uses of biogas. Biogas can be used for :

- cooking and heating
- running tubewells and water pump engines
- as an illuminant in gas lanterns
- in bio-diesel production
- as a vehicle fuel
- **Wind Energy.** The kinetic energy possessed by the blowing wind is called wind energy.

Working

When wind passes through the blades of a windmill, the blades experience an upward force, due to its peculiar I shape known as aerodynamic air foil shape. This produces a lift and generates the torque which rotates the blades.

Advantages

No pollution

Renewable

No recurring cost

Disadvantages

Wind farms can only be established at those places where the wind speed is greater than 15 km/hr.

Wind turbine cannot work if there is no wind and wind speed is not so high. So we need to store a power backup.

High set up cost.

Towers and specially blades are exposed to rough weather. So blades get damaged and increases the cost of maintenance.

- **Wind Energy Farm.** The place where a large number of windmills are erected over a large area is called wind energy farm. In India, largest wind energy farm is established near Kanyakumari in Tamil Nadu. It generates 380 MW of electricity.

PREVIOUS YEARS' EXAMINATION QUESTIONS

TOPIC 1

1 Mark Questions

1. List two practical uses of biogas in rural areas.
[TERM 1, 2014]

2. Write the characteristic features of the micro organisms which help in the production of biogas in a biogas plant.
[TERM 1, 2016]

3. Thermal power plants are setup near coal or oil fields. Give reason.
[TERM 1, 2017]

2 Marks Question

4. Give two examples each of the following:
(i) Renewable sources of energy
(ii) Non-renewable sources of energy
[TERM 1, 2011]

3 Marks Questions

5. Differentiate between renewable and non-renewable sources of energy with one example for each
[TERM 1, 2017]

6. Draw a neat diagram of a biogas plant and label:
(i) inlet of slurry
(ii) digester
(iii) gas outlet
[TERM 1, 2017]

Solutions

1. Two practical uses of biogas in rural areas are:

(a) Bio-gas is an excellent fuel so it is used for cooking. [½]

(b) It is also used as a transportation fuel. [½]

2. These are the anaerobic bacteria. They help in the anaerobic (without oxygen) breakdown of the biomass that helps in conversion of biomass to biogas. [1]

3. Thermal power plants are setup near coal or oil fields because it is easier to transmit electricity over distance than transporting coal or oil over the same distance. [1]

4. (i) Renewable sources of energy are those sources that can be replenished. Examples of renewable sources of energy are wind and water. [1]

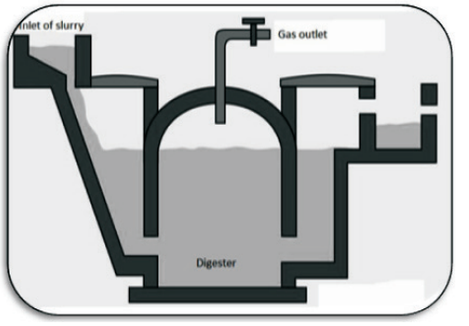
(ii) Non- renewable sources of energy are those sources that cannot be replenished because their formation takes billions of years. Examples non-renewable sources of energy are natural gas and petroleum. [1]

5.

Renewable Sources	Non-renewable Sources
• The resources that can be renewed are called renewable resources. • Renewable resources are inexhaustible. • Renewable resources are not affected by the human activities. • For example:-Wind	• The resources that are present in fixed quantities are called non-renewable resources. • Non-renewable resources are exhaustible. • Non-renewable resources are affected by human activities. • For example:-Fossil fuels

[3]

6. The following is the diagram of a biogas plant:-



[3]

Topic 2: Non Conventional Sources of Energy

Summary

Non conventional sources of energy

- **Solar Energy.** The enormous amount of energy radiated by the sun in all direction in the form of heat and light is called solar energy. It is the ultimate source of energy.
- **Solar Cooker.** The device which cooks the food without using any conventional cooking fuel and converts solar energy directly into heat energy is known as solar cooker.
- It works on the principle that black surface absorbs more heat as compared to white or a reflecting surface under identical conditions.

Construction and working

- It consists of a well metallic or wooden box which is painted dull black.
- The collection of solar energy is done either by using a plane mirror or a large concave mirror which acts as a reflector attached to one of the top edges of the box.
- The top of the box exposed to the sun and covered by one or more transparent cover such as glass plate to trap the heat inside the box.

- The glass lid allows the heat radiation (infrared rays) from sun to enter inside but does not allow the reflected heat radiation to escape or go outside the box. This heat is absorbed by the blackened surface. Thus the heat loss is reduced due to reflection.
- This heat is utilised to cook the food. Thus solar cooker saves substantial amount of cooking fuel and contributes towards the economy of a family.
- **Solar Cell.** The device that converts solar energy directly into electrical energy is called solar cell. They are made from special grade semi-conducting materials like silicon, germanium, gallium etc.
- **Solar Panel.** It consists of a large number of solar cells joined together in a particular pattern to obtain large electrical power for practical uses.

Uses of solar panel/solar cells.

They are used

(i) as a source of electric power in satellites and space probes.

(ii) to provide electric power to off-shore drilling rig platforms and light houses.

(iii) for recharging the batteries during day.

(iv) for operating traffic lights, water pumps, and other household electrical appliances in remote areas.

(v) in calculators and electronic watches.

(vi) by TV relay stations or wirless transmission systems located in remote areas use solar panels.

- Energy from Sea

The oceans cover about 70% of the earth's surface area. They contain a lot of energy because water has a high specific heat capacity. Ocean acts as a renewable source of energy. The energy from oceans is available in different forms,

(i) Tidal energy. The energy produced by the surge of ocean water during high and low tides due to difference in sea-levels is called tidal energy. The high and low tides occur due to the gravitational pull of the moon.

Tidal energy is harnessed by constructing a dam near the shores. During high tides water flows into the dam and during low tides, water flows out. This flowing water rotates the turbine, present at the opening of dam and produces electricity.

(ii) Sea-wave Energy.

The strong wind blowing across the sea generates waves in the sea. Kinetic energy possessed by these sea waves can be used to generate electricity.

(iii) Ocean Thermal Energy Conversion (OTEC)

- Water at the surface of an ocean or sea warms up by the solar energy while the deeper water remains cold.
- The temperature difference between the surface water and water at a depth of 2 km is approximately 20°C (293 K) or more.
- The energy available due to this temperature difference is called ocean thermal energy.
- **Geothermal Energy:** The energy obtained from hot molten rocks and trapped hot fluid inside the earth is called geothermal energy.
- At some depth below the surface of earth, the rocks get heated due to fission of radioactive materials present in it which liberates large amount of energy.
- Due to geological changes these molten rocks in the interior of earth are pushed upwards and trapped in certain regions are called 'hot spots'.
- The underground water which comes in contact with these hot spots gets heated and is converted into steam.
- The steam trapped inside the rocks at high pressure is taken out through a pipe to a turbine to generate electricity.
- In some places hot water comes to the surface through some outlets. These outlets are called 'hot-springs or geysers'.
- **Nuclear Energy:** The energy produced during nuclear reaction such as nuclear fission or fusion is called nuclear energy. According to Einstein theory, every substance has energy due to its mass also. If a substance loses an amount 'Δm' of its mass, an equivalent amount ΔE of energy is produced, where

$$\Delta E = (\Delta m)c^2$$

Where c is the speed of light which is equal to 3×10^8 m/s. This relation is known as 'Einstein's mass energy relation.

- **Nuclear Fission:** The process in which a heavy nucleus is broken into two nearly equal fragments producing a tremendous amount of energy. This process is called nuclear fission.
- This phenomenon is the basis of nuclear reactors to produce electricity, useful products and nuclear bomb also.
- **Nuclear Fusion:** The process in which lighter nuclei moving at very high speed fuse together to form a single heavier nucleus, releases a tremendous amount of energy called nuclear fusion.

- In practice, nuclear fusion is very difficult process.
- It needs millions of degrees of temperature and millions of pascals of pressure to carry it.
- Hydrogen bomb is based on this phenomenon.

  Major disadvantage is that the energy obtained from fusion process could not be controlled so far.
- Major Hazards and Limitations of Nuclear Power Generation.

(i) Environmental contamination due to improper nuclear waste storage and its disposal.

(ii) High cost of installation.

(iii) Limited availability of nuclear fuel.-

(iv) Risk of accidental leakage of harmful radiation during processing of nuclear fuel or damage.

(v) Land becomes barren.

- Environmental Consequences of Increasing Demand for Energy.

(i) Burning of fossil fuels pollutes the air and water.

(ii) Production of greenhouse gases, like CO^2 methane, increase the global warming.

(iii) Depletion of ozone layer increases the ultraviolet radiation in the environment causing harmful effects on the living things.

Steps to reduce the energy consumption.

- Avoid misuse of conventional sources of energy which are limited in nature.
- Alternate sources of energy such as solar energy, wind energy, hydro energy, etc., should be used instead of non-renewable sources of energy.
- Efficiency of energy sources should be repeatedly maintained for getting the maximum efficiency.

PREVIOUS YEARS' EXAMINATION QUESTIONS

TOPIC 2

1 Mark Questions

1. State any two reasons which make the large scale usage of nuclear energy prohibitive.

[TERM 1, 2011]

2. What is tidal energy?

[TERM 1, 2015]

2 Marks Questions

3. A student constructed a model of box type solar cooker. Instead of using glass sheet he used a transparent plastic sheet to cover the open face of the box. He found that this cooker does not function well. What could be the possible drawbacks in his model? Explain the advantage of painting black the inner and outer surfaces of the cooker and that of cooking vessels.

[TERM 1, 2011]

4. You are given two solar cookers, one with a plane mirror as reflector and the other with concave mirror as reflector. Which one is more efficient? Give reason for your answer. State one more use of concave mirror.

[TERM 1, 2013]

3 Marks Questions

5. (a) What is geothermal energy?

(b) What are the advantages of wind energy?

[TERM 1, 2011]

6. Dams are constructed to generate electricity from water stored at a height. People living in neighboring areas protested against it to save the flora and fauna.

(i) What type of energy is possessed by the stored water?

(ii) What is the energy transformation that takes place in hydroelectric power plant?

(iii) What values of the people are shown by this act? (Any two)

[TERM 1, 2014, 2018]

7. Why is it not possible to make use of solar cells to meet all our energy needs? State at least three reasons to support your answer.

[TERM 1, 2014]

8. List any three hazards of nuclear waste.

[TERM 1, 2015]

9. Explain the principle and process of converting ocean thermal energy into electricity.

[TERM 1, 2016]

Topic 1: Ecosystem & Food Chain

Summary

Knowing your Chapter at Glance:

ECOSYSTEM

All interacting organisms in an area together with the non-living constituents of the environment forms the ecosystem.

COMPONENTS OF ECOSYSTEM

Biotic component	Abiotic component
↓	↓
Living component	Non-living component
↓	↓
Includes producers, consumers, decomposers	Includes physical environment

TYPES OF ECOSYSTEM

Natural ecosystem

The ecosystem that exist in nature on its own. E.g. forest,lake,ocean.

Artificial ecosystem

Man-made ecosystem are called artificial ecosystem. E.g. crop field,aquarium,ponds.

- The biotic community of an ecosystem includes three types of organisms:

(a) Producer organisms (or Autotrophs) which synthesize their own food. All the green plants are producers.

(b) Consumer organisms (or Heterotrophs) which are dependent on others for food. All the animals are consumers.

(i) **Herbivores** : Some animals eat only plants. Those animals which eat only plants are called herbivores. Some of the examples are: cow, buffalo, goat, sheep, horse, deer, camel, ass, ox, elephant, monkey, squirrel, rabbit and hippopotamus. Since herbivores obtain their food directly from plants, therefore, herbivores (like cattle, deer, goat, etc.) are primary consumers.

(ii) **Carnivores** : Some animals eat only other animals. Those animals which eat only other animals as food are called carnivores. Some of the examples are : lion, tiger, frog, vulture, kingfisher, lizard, wolf, snake and hawk.

The carnivores are usually of two types

(a) small carnivores

(b) large carnivores.

The small carnivores which feed on herbivores (primary consumers) are called secondary consumers. For example, a grasshopper, rat, seed eating birds and frog, etc.

The large carnivores (or top carnivores) which feed upon the small carnivores (secondary consumers) are called tertiary consumers. For example, lion, tiger, birds of prey (such as hawk) and humans.

(iii) **Omnivores** : Some animals eat both, plants as well as other animals. Those animals which eat both, plants and animals, are called omnivores. Some of the examples are: man, dog, crow, sparrow, bear, mynah and ant.

(c) **Decomposer** organisms (or Saprotrophs) which consume the dead remains of other organisms. Certain bacteria and fungi are decomposers.

FOOD CHAIN

It is sequence of organisms through which energy is transferred in the form of food by the process of one organism consuming the other.

Algae (Producer) → Scorpion (Herbivore) →

Small Fish (Carnivore) → Swan (Large carnivore)

TROPHIC LEVEL

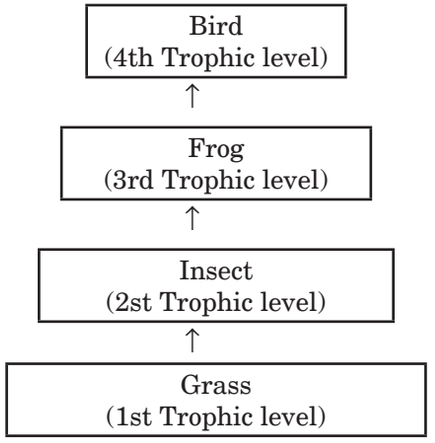
Each step or level of the food chain forms a trophic level.

(i) The autotrophs or the producers are at the first trophic level.

(ii) The herbivores or the primary consumers come at the second.

(iii) The small carnivores or the secondary consumers are at the third trophic level.

(iv) The larger carnivores or the tertiary consumer form the fourth trophic level.



CHARACTERISTICS OF A FOOD CHAIN

1. A food chain involves a nutritive interaction between the living organisms (biotic components) of an ecosystem.
2. In a food chain, there is unidirectional flow of energy from sun to producers and subsequently to series of different types of consumers.
3. Usually, there are 3 or 4 trophic levels in the food chain. In few chains, there may be maximum of 5 trophic levels.
4. At each transfer, generally 80-90% of energy is lost as heat in accordance with second law of thermodynamics.

10 percent law

Only 10% of energy is transferred to the next tropic level.

Biological magnification

The concentration of harmful chemicals increases with every next trophic level in a food chain is known as biological magnification.

PREVIOUS YEARS' EXAMINATION QUESTIONS

TOPIC 1

1 Mark Questions

1. What is meant by biological magnification?
[TERM 2, 2011]

2. Give an example to illustrate that indiscriminate use of pesticides may result in the degradation of the environment.
[TERM 2, 2014]

3. In a food chain, if 10,000 joules of energy is available to the producer, how much energy will be available to the secondary consumer to transfer it to the tertiary consumer?
[TERM 2, 2012]

4. Write one negative effect, on the environment, by affluent life style of few persons of a society.
[TERM 2, 2016]

3 Marks Questions

5. (a) What is an ecosystem? List its two main components.
(b) We do not clean ponds or lakes, but an aquarium needs to be cleaned regularly. Explain.
[TERM 2, 2013]

6. "Energy flow in a food chain is unidirectional." Justify this statement. Explain how the pesticides enter a food chain and subsequently get into our body.
[TERM 2, 2014]

7. Ramu has a piece of agricultural land in a village. He decides to set up a brick factory on it. His friend Shyam persuades him to change his decision in the interest of village because presence of a factory would severely affect the health of villagers as well as agricultural produce of others. Ramu understands and abandons his plans.
(a) Mention the values exhibited by Shyam.
(b) Explain how these values helped Shyam to save interests of his village
[TERM 2, 2016]

Solutions

1. Biological magnification is a process of progressive accumulation of chemicals which are toxic and non bio-degradable at each tropical level in nature. The maximum concentration of these chemicals gets accumulated in the organisms which occupy place in highest tropical level. [1]

Topic 2: Ozone Layer and Its Depletion

OZONE LAYER AND ITS DEPLETION

Ozone is a form of oxygen. The higher energy UV radiations split apart some molecular oxygen (O_2) into free oxygen (O) atoms. These atoms then combine with the molecular oxygen to form ozone.

$$O_2 \rightarrow O + O$$

$$O + O_2 \rightarrow O_3$$

(Ozone)

Function of ozone

Ozone is a poisonous gas but is not stable nearer to earth's surface. It absorbs the harmful radiations from the Sun. It shields the surface of the earth from the ultraviolet (UV) radiation of the sun.

Ozone depletion

The thinning of ozone layer is commonly called ozone depletion. Ozone is being depleted by air pollutants. Chlorofluorocarbons (CFC's) are the air pollutants that are mainly responsible for the depletion of ozone layer in the stratosphere. Besides, methane (CH4) and oxides of nitrogen also cause destruction of ozone.

Effects of ozone depletion

The thinning of ozone layer allows more ultraviolet (UV) radiations to pass through it which then strike the earth. These cause following harmful effects on man and animals :

(i) Skin cancer.

(ii) Damage to eyes and also increased incidence of cataract disease in eyes.

(iii) Damage to immune system.

WASTE DISPOSAL

The solid waste, that accumulate in the environment due to human activities can be categorized into two types :

(i) Bio-degradable waste

(ii) Non-biodegradable waste

Biodegradable waste

Those substances which are broken down by the activity of micro-organisms. These substances can easily be degraded by natural means i.e. by action of micro-organisms (like bacteria and fungi) into simpler harmless substances in some time.

Example : Domestic waste products, faecal matter, sewage, agricultural residue, paper, wood, cloth etc.

Non-biodegradable waste

These substances cannot be decomposed by microorganisms like bacteria. They are the major pollutants of the environment. They may enter into food-chain and harm the organisms.

Example : Insecticides, pesticides, DDT, mercury, lead, arsenic, aluminium, plastics, iron nails and radioactive waste. These non-biodegradable substances may occur in the environment in gaseous, liquid or solid form.

Methods of waste disposal

(a) **Sanitary land fills** : The waste is pulverised and spread over a low lying area. It is compacted and covered by a layer of earth. This reduces bulk of waste, prevents release of offensive odours and spread of pathogens.

(b) **Recycling of wastes** : Paper, glass, polythene, plastic, metals can be recycled. Waste coming from industries such as metals can be melted and recycled into solved metal.

(c) Composting : Organic waste is shredded, mixed with sewage sludge and spread in open to form compost. The domestic waste can easily be converted into manure.

(d) **Biogas and manure** can be prepared from the biodegradable waste. It costs much less than other fuel and fertilizers.

(e) **Pesticides and fertilizers** : Their use should be reduced by resorting to biological control (for pests) and organic farming.

(f) **Reuse**: It is a conventional technique to use an item again e.g. newspaper for making envelops.

Topic 1: Natural Resources

Summary

Knowing your Chapter at Glance:

Natural resources are substances which are being exploited for supporting life.

TYPES OF NATURAL RESOURCES

Natural resources on the basis of their availability and abundance are classified as **inexhaustible** (air, water) and **exhaustible** (minerals, fossil fuels) resources.

Exhaustible resources are present in limited quantity and can be of two types:

Renewable resources

These resources can maintain themselves if managed wisely. These include forest, crops, ground water, wildlife, etc.

Non-renewable resource

These get exhausted with use because they are not recycled or replenished and are also called conventional sources of energy. These include minerals, fossil fuels, etc.

Inexhaustible

These are present in unlimited quantity

The three R's can help to save the environment.

- **Reduce**

This means you use less. When we save electricity by switching off unnecessary lights and fans, we reduce its use.

- **Recycle**

Certain articles like plastic, paper, glass, metals can be recycled instead of making them fresh. For this, we need to segregate our wastes so that the material to be recycled is not dumped along with other wastes.

- **Reuse**

This is better than recycling because the process of recycling uses some energy. For example, the plastic bottles in which we buy certain food-items can be used for storing things in the kitchen.

CONSERVATION

Thus, conservation is defined as the utilization of natural resources for the benefit of life so that it may yield sustainable benefit to the present generation as well as the future generations.

We need to use our resources carefully for the following reasons:

- The human population is increasing at a tremendous rate. Hence the demand for all the resources is increasing at an exponential rate but it is limited.
- The use of natural resources is a long-term perspective so that these will last for generations to come and should not be exploited.
- An equitable distribution of resources should be there for all, so that not just a handful of rich and powerful people benefit from the development of these resources.

WHAT SHOULD MAN DO TO CONSERVE NATURAL RESOURCES ?

In order to conserve natural resources, man should-

- use the natural resources wisely to check their depletion,
- recover the used resources for reuse,
- discover new resources as alternatives,
- not pollute the natural resources to keep them fit for use.
- Afforestation should be practised.
- Forest is a 'biodiversity hotspot' because it is an area where number of species or range of different life form exists.

USES OF FORESTS

- They are the store house of many valuable things like wood (as timber, firewood, wooden crates, paper board, etc); food and spices (like coconut, almond, cashew nuts, clove, cinnamon, etc); tannins; gums; resins; drugs; etc.

- They maintain biological diversity.
- They help to maintain a perfect water cycle in nature.
- They prevent floods.
- They prevent soil erosion.
- Agro-forestry is an absolute commercial forestry developed to fulfil the need of various forest based industries. It is done on the fallow land or free grazing land.
- Urban forestry involves growing of ornamental trees along roads, vacant lands and common parts of urban areas.

WILDLIFE

Wildlife means all those naturally occurring animals, plants and their species which are not cultivated,domesticated and tamed.

CONSERVATION OF WILD LIFE

Some of the measures to be taken for the conservation of wild-life are:

(i) Laws should be enforced to impose a ban on poaching or capturing of any animal.

(ii) The conservation of wild life should be done in Biosphere reserves (i.e., multipurpose protected areas meant for conservation of wild life, traditional life style of tribals and their domesticated animals), National parks (i.e., areas for protection of wild life maintained by the government where cultivation, grazing, hunting, etc are not allowed), Sanctuaries (i.e., protected natural habitats where hunting is not allowed but other activities are allowed).

(iii) Special attention should be paid to the conservation of endangered species of wild animals and birds to prevent their extinction altogether.

- Necessity of judicious use of coal and petroleum

  Coal and petroleum are fossil fuels found in earth's crust. They are non-renewable and exhaustible resources.

POLLUTION CAUSED BY BURNING COAL AND PETROLEUM BASED FUELS

In addition to carbon, these contain hydrogen, nitrogen and sulphur. When these are burnt, the products are carbon dioxide, water, oxides of nitrogen and sulphur. When combustion takes place in insufficient air (oxygen), then carbon monoxide is formed instead of carbon dioxide. These products are harmful and hence pollute the environment.

For example :

(i) Sulphur dioxide causes bronchitis and when it dissolves in rain water, it makes it acidic. The acid rain damages trees, buildings, metals, etc.

(ii) Nitrogen oxides also attack the breathing system and cause acid rain.

(iii) Carbon monoxide is a very poisonous gas. It stops RBC's from carrying oxygen from lungs and thus causing suffocation.

(iv) Carbon dioxide is a greenhouse gas which traps solar energy and leads to global warming.

STEPS TO REDUCE THE CONSUMPTION OF COAL AND PETROLEUM

Some simple choices can make a difference in our energy consumption patterns.

1. Switch off the lights, fans, etc when not needed.
2. Use of bio gas as domestic fuel should be encouraged.
3. Pressure cookers should be used for cooking food.
4. Solar cookers should be used wherever possible.

Topic 2: Water Conservation

Summary

WATER FOR ALL

Water is a basic necessity for all terrestrial forms of life.

The pollution of river water is caused by dumping of untreated sewage and industrial wastes into it. This contamination can be found by two factors.

(i) The presence of coliform bacteria indicates its contamination by disease causing organisms.

(ii) If the measurement of pH of river water is below 7, then the river water is considered polluted.

- A multicrore, Ganga action plan, project was launched in 1985 to clean the river Ganga and make it pollution free.

DAMS

Dams are the large water storing bodies usually built by the government agencies. This stored water is then allowed to flow downstream at the desired rate.

Eg: Tehri dam - on river Ganga
Bhakra Nangal Dam - on river Satluj
Sardar Sarovar Dame - on river Narmada

Merits-

(a) Water stored in a dam is used for irrigation through a network of canals which ensures round the year water supply to the crop fields and help raise agricultural production. For example, the Indira Gandhi canal has brought greenery to considerable area of Rajasthan.

(b) Its continuous water supply to the people in towns and cities through pipelines after suitable treatment.

(c) The falling of water from the dam is used for generating electricity. The electricity thus produced is called hydro electricity.

Demerits:

Social problems :

Many tribals and peasants are displaced and rendered homeless.

These people are **NOT** given adequate compensation by the government for rehabilitation so as to start their life afresh.

Environmental problems :

Construction of dams contribute to deforestation and loss of biodiversity.

Variety of flora and fauna gets submerged under water.

Economic problems :

A huge amount of public money is spent without proportionate benefits.

MANAGEMENT AND CONSERVATION OF WATER RESOURCES

Rain Water Harvesting

This is done by saving and capturing rain water by special water harvesting structures. These structures include digging a series of deep pits on the beds of rivers, building small earthen dams, constructing dykes, sand and limestone reservoirs and setting roof-top water collecting units.

(a) Purpose of water harvesting system : To make rain water percolate under the ground so as to recharge ground water.

(b) Advantages of water harvesting system :

(i) The water stored in ground does not evaporate, spreads out to recharge wells and provides moisture for crops.

(ii) The water stored in ground does not promote breeding of mosquitoes.

(iii) The water stored in ground is protected from contamination by human and animal wastes.

(iv) The water stored in ground is utilized for the benefit of the local population.