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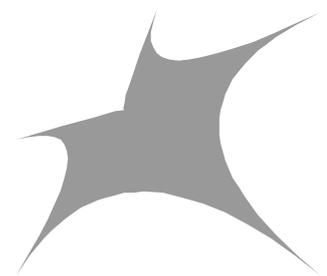
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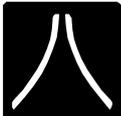
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3. SOURCE OF ENERGY, NUCLEAR FISSION & FUSION

INTRODUCTION

Energy is the capacity of a body for doing work. Energy stored in a body or a system is equivalent to total work done by the body till whole of its energy has been completely exhausted. Most of our energy requirement is fulfilled from the fuels & electricity. Solar energy is also available to us in the form of a variety of fuels that have been stored in the earth's crust. Energy can be converted from one form to another.

A. SOURCE OF ENERGY

We have a wide range of sources of energy such as the sun, the wind, the earth (geothermal), flowing water, coal, gasoline, diesel, natural gas, biogas, etc. at our disposal. We utilize this energy to perform a wide range of activities, i.e. industrial, commercial, household etc.

(a) Types of Sources of Energy :

There are two types of sources of energy :

(i) Renewable sources of energy (or non-conventional sources of energy) : The sources of energy which are in constant supply to us by nature and are inexhaustible are known as renewable sources of energy.

Example: The sun (solar energy), oceans (ocean thermal energy), tides (tidal energy), wind (kinetic energy), running water (hydro energy), wood (thermal energy) etc.

(ii) Nonrenewable sources of energy (or conventional sources of energy) :

The sources which can't be used again and again and are exhaustible are known as non-renewable sources of energy.

Example: Coal, natural gas, petroleum, fossil fuels etc.

(b) Characteristics of Sources of Energy :

For a good source of energy, following conditions must be fulfilled by it:

(i) It should provide large amount of useful energy.

(ii) It must be easily storable in small space.

(iii) It must be easily transportable.

(iv) It must provide the energy in regular manner.

(v) It should be convenient to use

(c) Solar energy :

The sun is the primary source of energy for all living beings on the earth. It provides all of us heat and light. The energy generated by the sun is the result of reaction called nuclear fusion, occurring continuously in the interior part of the sun. **Hans Bethe**, a physicist proposed that the enormous release of energy from the sun is due to the fusion (combination) of four hydrogen atoms to yield a single helium atom (${}^4_2\text{He}$).

For this discovery he was awarded the **1967** Noble prize in Physics. The sun emits energy in all directions in space.



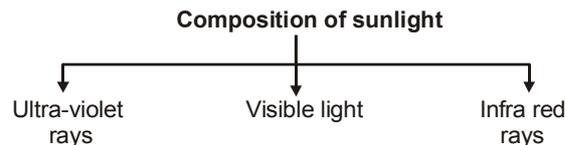


Solar energy is trapped by plains, plateaus, mountains, rivers, lakes, oceans and ponds. Plants use solar energy to manufacture food by photosynthesis and solar energy is also the source of wind storms, rain, snow fall and ocean waves. It is the perennial (forever) source of energy.

This perennial source of energy has some features :

- It comes to earth surface in a very diffused form.
- Upper atmosphere gets **1.3 KJ** of energy per second per square metre of this only **47%** i.e. approximately **0.64 KJ** energy reaches per second per square metre on earth's surface.
- Moreover this amount of energy is not available uniformly and keeps changing everyday at a place and place to place during a day.

(i) Composition of Solar Energy (Sunlight) :



(I) Ultra violet rays : The invisible rays whose wavelength is shorter than that of the visible violet light are called ultra violet rays. We can detect these rays by using a photographic film or a fluorescent paper because they darken the photographic film just like ordinary light rays. They are used to kill bacteria in food stuff and drinking water. Too much ultra-violet radiation is dangerous for our health due to its ionising effect and can cause skin cancer.

(II) Visible light : The visible rays whose wavelength range from **400 nm** (in violet) to **700 nm** (in red) are called visible light. The visible part of the sunlight consists of seven different wavelength, each wavelength corresponding to a different colour. Thus the visible part of the sunlight consists of seven different colours.

(III) Infrared rays : The invisible rays whose wavelength is longer than that of the visible red light are called infra-red rays. They can heat the object on which they fall.

About one-third of the solar energy consists of infrared rays. They can be detected by its heating effect, by using a thermometer. Every hot object emit infrared rays. They are used to get relief from body-aches.

(ii) Uses of Solar Energy :

(I) Solar cooker absorb solar energy and cook food.

(II) Solar water heaters are used for heating water.

(III) Solar cell convert solar energy into electricity to run watches, calculators and in spaceships for various experiments.

(IV) Solar energy is absorbed by green plants to make their food by photosynthesis.

(V) Solar energy is used for drying clothes and food grains.

(VI) Solar energy is used for making salt from sea water.

(iii) Advantages of Solar Energy :

(I) It is inexhaustible and renewable as it is producing continuously in the core of sun by nuclear fusion of **H-atoms**.

(II) Its quantity is unlimited and is available in all parts of the world in abundance.

(III) It does not cause any pollution.

(IV) It can be put to practical appliances.

(iv) Limitations of Solar Energy :

(I) It is not available at night.

(II) It is not available uniformly in all parts of world.

(III) Solar energy received by the earth is quite diffused and in scattered form and hence only a part of it, is utilized.

(IV) It is not available at constant rate due to clouds, fog, mist, haze, winds etc.



(v) Direct and Indirect Harnessing (or Collection) of Solar Energy :

(I) Direct utilization of solar energy can be done by collecting the heat radiation on reflecting these by plane mirrors on to black boxes containing uncooked food (in solar cooker) and for heating water in solar heaters.

These rays can be converted into electrical energy as in solar cells.

(II) Indirect utilization of solar energy can be done by first converting solar energy into chemical energy as in biomass of plants. Heat energy of sun can be utilized in sea waves (ocean thermal energy) and into energy of winds etc.

(vi) Solar Heating Devices :

These are the devices which can collect and store heat obtained from solar energy. These are used for heating and cooking purposes. Solar heating devices are designed in such a way so that these can make maximum utilization of solar heat radiations. It is done by adopting following procedure:

- **Concentration of solar energy by using reflectors :** For moderate heating sun rays are reflected by using plane mirrors, as in solar cookers and solar water heaters. For high temperature, sun's energy is concentrated using concave mirrors as reflectors.
- **Black paint :** Since black bodies are good absorbers as well as good radiators of heat, hence black paint used to absorb and store heat radiations in large quantity by using large surface area.
- **Glass-sheet cover :** Glass sheet cover is used to protect the hot infra red rays of solar energy from escaping the body of black box. It allow the IR radiations (of shorter wavelength) to enter the box of solar heating device and do not allow IR radiations (of longer wavelength) to escape from the solar heating device. Hence more heat is retained by solar heating device for long time.

NOTE :

Green house effect

The property of glass of trapping heat by allowing shorter wavelength heat rays to pass through it but not allowing longer wavelength heat rays to pass it is called green house effect.

(I) Box type solar cooker :

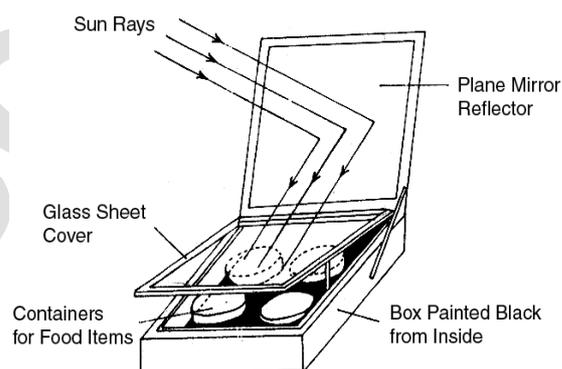


Fig. 1

Solar cooker is a device used for cooking food with the help of solar energy. A box is made of a non-conducting material like plastic or fiber glass and painted black from inside is used for making the solar cooker.

The cooker is placed in the sunlight and the position of the reflector is adjusted in such a way that a strong beam of light falls over the cooker top. These rays pass through the transparent glass sheet, therefore the box and the containers absorb maximum amount of infrared radiations from the sunlight falling on it. As a result the temperature inside the box rises to about **100°C to 130°C**.



(II) **Spherical reflector type solar cooker** : In this type of solar cooker, there is an insulated metal box, painted black from inside. A spherical reflector is used here (in place of plane mirror) because a very high temperature is required, the spherical reflector is either a concave reflector or a parabolic reflector. The sunlight falling on the surface of spherical reflector get concentrate to one point. This will produce a lot of heat at that point and temperature in that region will become very high, therefore in this type, an utensil is placed at this point. Since a high temperature can be produced, so it can be used for making chappaties and for frying purposes.

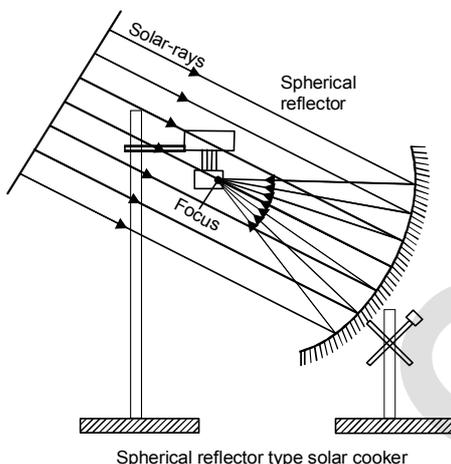


Fig. 2

Difference between box – type and spherical reflector type solar cooker			
	Box – type solar cooker		Spherical reflector type solar cooker
1	A plane mirror reflector is used.	1	Spherical reflector is used
2	In a box type solar cooker, comparatively low temperature is produced	2	Quite high temperature is produced in the spherical reflector type solar cooker.
3	It cannot be used for making chappaties	3	It can be used for frying and making chappaties.
4	Used for cooking food requiring slow heating.	4	Used for cooking food requiring strong heating.

(III) **Solar cells** : Solar cell is a device which converts solar energy directly into electricity. Energy radiated from the sun also contains light energy. So solar cells are also known as photo voltaic cells. The process of generating electricity directly from sunlight is referred to as a photo voltaic effect. The photo voltaic effect occurs when solar radiation strikes certain sensitive material directly and results in the flow of electrons. It was found that when **0.6%** of the solar energy falling on the selenium layer got converted into electricity. With the advancement in the field of semiconductors, the solar cells made from these semiconductors can convert **10 to 15%** of solar energy into electricity.

(1) **Semiconductors** : Semiconductors are those substances which have very low electrical conductivity. Under ordinary conditions, semi-conductor materials conduct only a small amount of electric current, but if certain impurities are added to semiconductor materials then their electrical conductivity increases considerably. Semiconductors are neither good conductor of electricity nor they are completely insulators. The process of adding impurity is called doping. The material (semiconductors) doped with boron has an affinity to attract electrons and is termed as p-type (acceptor) semiconductor. The phosphorous doped silicon material, which has a surplus of electrons, is termed as n-type (donor) semiconductor. When solar energy falls on semiconductor material, even then their electrical conductivity increases.



(2) Conduction of solar cell : It is constructed usually from silicon & gallium. Its conductivity increases when light falls on them. Therefore in a solar cell, the pieces (usually wafers) of semi conducting materials containing impurities are so arranged that when light falls on them then a potential difference is produced between two regions of the semi conductor. It has been observed that a solar cell of about 4 cm^2 surface area, may produce potential difference of about **0.4V** to **0.5V** and generate a current of **60 mA**.

A large number of solar cells joined together in a definite pattern can provide much higher power for many uses. The group of solar cells is called solar cell panel.

(3) Solar cell panel : When solar cells are arranged side by side, connecting each other in such a way that total potential difference and the total capacity to provide electric current is much increased, then this arrangement is called solar cell panel.

The electric power required for the working of artificial satellites in outer space, street lighting in remote areas and running of irrigation water pumps in far-off areas obtained with the help of solar cell panels.

In a solar cell panel hundreds of solar cells are joined together, the electricity produced by this solar panel is stored in battery. This battery runs an electric motor and finally the motor drives the water pump, which pumps out the underground water.

The various solar cells in a solar cell panel are joined together by using connecting wires made of silver. This is because silver metal is the best conductor of electricity having very low resistance. The use of silver for connecting solar cells makes the solar cell panel more expensive but it increases the efficiency. This is because if connecting wires of other metals were used in solar cell panel, then a substantial part of the electricity generated by it could be lost in overcoming the resistance of such connecting wires.

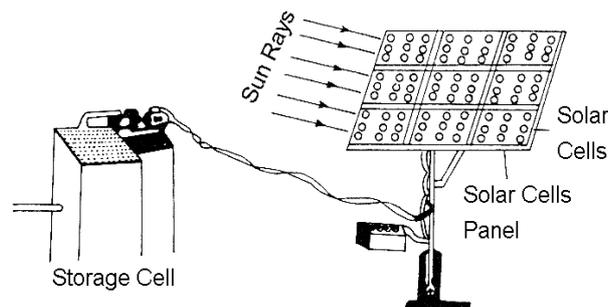


Fig. 3

(4) Uses of solar cell :

- Solar cells are used for providing electricity in artificial satellite and space probes.
- In India, solar cells are being used for street lighting, for traffic signals, for operating water pumps and for running radio and television sets in remote areas.
- Solar cells are used for providing electricity to **lighthouses** situated in the sea and to the offshore oil drilling rig platforms.
- Solar cells are used for operating electronic watches and calculators.

(5) Advantages (merits) :

- They directly utilize solar energy.
- They can work satisfactorily even in diffused radiations.
- They need no maintenance.
- They do not cause pollution.

(6) Disadvantages (demerits) :

- The energy stored in batteries, provides only direct current (d.c.). For devices which require alternating current (a.c.), d.c. is converted into a.c. This conversion reduces efficiency and increases its cost.
- They are very expensive because the semiconductor materials needed for the solar cell must be very pure.



(d) Wind energy :

Moving air is called wind. As the moving objects possess kinetic energy and as such they are capable of doing mechanical work by virtue of its motion. Wind also possess the ability of performing mechanical work because it is air in motion. So wind energy is the kinetic energy associated with large mass of air by virtue of its motion.

Solar energy is responsible for the blowing of air.

This can be explained as follows: The sunrays fall on the whole earth but the intensity of sun-rays is much more stronger near equator of the earth than in the polar regions. Due to more intense sun-light, the air near the surface of earth in equatorial regions becomes quite hot. This hot air, being lighter, rises upwards. The cooler air from the polar regions of the earth start flowing towards the equatorial regions of the earth to fill the space vacant by the hot rising air. In this way air flows from the higher pressure regions to the lower pressure regions of the earth. This flow of air from one place to another constitutes wind.

(i) Advantages of Wind Energy :

- (I) Use of wind energy is not a source of pollution.
- (II) Wind energy is available free of cost.
- (III) The source of wind energy i.e. air is an inexhaustible and renewable source.

(ii) Disadvantages of Wind Energy :

- (I) One of the most important limitation of wind energy is that it may not be available at all times.
- (II) The windmills and sailboats remain unoperational and no useful work can be done unless there is a plenty of fast blowing wind.
- (III) The speed of the wind at a place varies with time and season.
- (IV) The kinetic energy of the wind can be utilized only at the site.
- (V) There is no guarantee that we will get wind energy when required, since there is no place in the world where wind blows all the time.
- (VI) The wind is not predictable.

(iii) Practical Devices Making use of Wind Energy :

(I) **Wind mill** : A windmill is a machine, which works with the energy of blowing air or wind. It consists of large blades to catch the wind. When the wind strikes against these blades, they start rotating. The motion can then be passed on the other connected parts and is used to do useful work. A windmill consists of a system of big blades (or vanes) capable of rotating about a horizontal axis. The system of vanes is mounted on the top of a high tower. Its working is based on the transformation of kinetic energy of wind into the rotational energy of the blade.

The system of blades is connected to one end of the rod called shaft. The other end of the shaft is connected to a pump rod in case of waterpump. This end is bent in form of inverted V and is connected to the free end of the pump rod of the water pump. When the wind blows, it rotates the blades of the windmill. The shaft turning about its axis rotates the crank. The rotation of the crank moves the piston rod of the water pump up and down and draws water from the well.

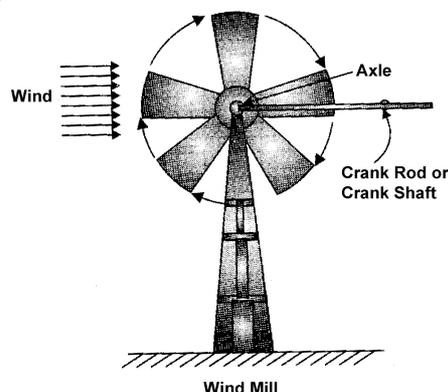


Fig. 4



(II) **Windmill to operate flourmill** : It is similar to one used to grind grains by suitable arrangements of toothed wheel & shafts. The other end of the shaft is connected to a toothed wheel. Grinding arrangement of flour mill has a fixed mill stone A and another heavy mill stone B. B is capable of rotating by a shaft rod (W_2) having a toothed wheel (W_2). The wheel (W_1) is coupled with the wheel (W_2) such that the rotation of wheel (W_1) about a horizontal axis rotates the wheel (W_2) about a vertical axis. The wheel (W_1) rotates as the shaft (W_1) connected to blades rotates due to rotation of blades of windmill. Thus the kinetic energy of wind by virtue of this motion rotates the windmill which in turn operates a flourmill and is able to grind grains.

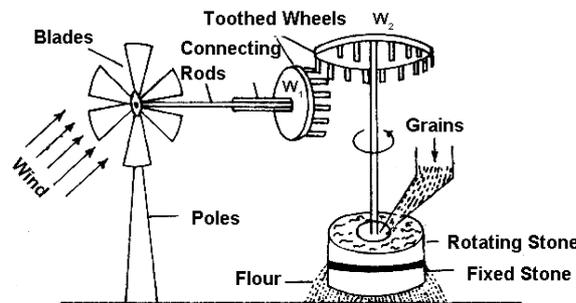


Fig. 5

(III) **Wind generator** : A modern generator, which is used to generate electricity by using wind energy is wind generator. When the fast moving wind strikes the blades of wind turbine, then the wind turbine starts rotating continuously. The coil of a small electric generator is attached to the shaft of wind turbine. So when the wind starts rotating and generates electricity. The electricity generated by a single wind turbine is quite small. So, in order to generate a large amount of electricity, a large amount of wind turbines are erected over a big area of land. Such a set-up of having a large number of wind turbines working at a place to generate electrical energy on a large scale is called a wind energy farm.

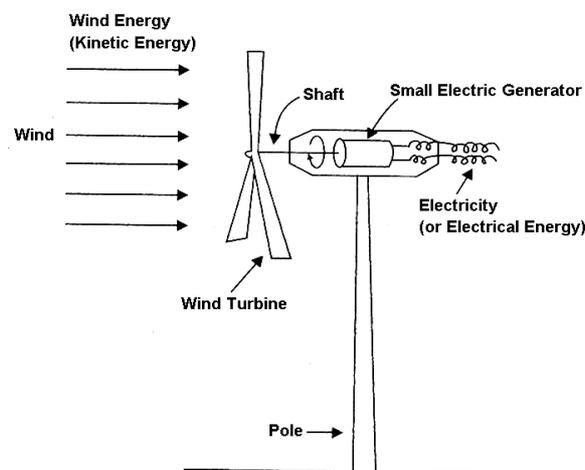


Fig. 6

(e) **Hydro energy :**

Flowing water having a lot of kinetic energy can be utilized as hydro energy. Hydro energy can be stored by storing water in high altitude dams. Hence it is a renewable source of energy. Solar energy is the source of hydro energy. Hydro energy is used to grind crops, to irrigate fields and to transport logs of wood from remote areas. Energy trapped in flowing water is used to generate electricity on a large scale at hydroelectric power stations. Dams are needed to be constructed to utilize the kinetic energy of flowing water. The water stored in dam is made to fall from a height through pipes and made to run over the blades of huge turbines at the bottom. This moves the turbine which in turn rotate the coils of an electrical generator to produce power or electricity.

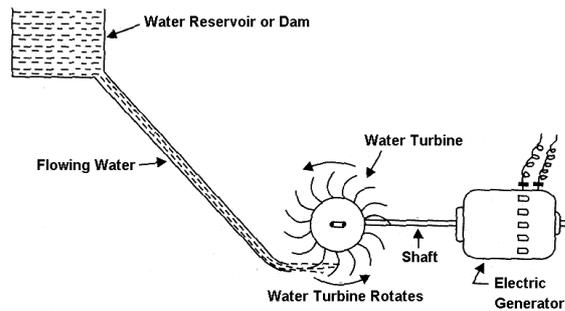


Fig. 7 : Hydro electric power plant

(i) Advantage of Hydel Power :

- (I) The process of hydel power does not cause any environment pollution.
- (II) The moving water needed for the purpose is available free of cost.
- (III) Water energy is a renewable source of electrical energy which will never get exhausted.
- (IV) The construction of dams on rivers helps in controlling floods and in irrigation.

(ii) Limitations of Hydel Power :

- (I) Moving or flowing water is not available at all places. It is available near the sites of flowing rivers.
- (II) To generate a reasonable amount of electricity from water, fast moving water should be available in large quantities.
- (III) The construction of dam on a river disturbs the ecological balance in downstream area of the river.
- (IV) The soil in the downstream area may become poor in quality because there were no annual floods to deposit nutrient rich silt on the bank of the river. Therefore there may be ecological problem

(f) Tidal energy :

Tidal waves as a source of energy :

(i) Definition : Due to attraction of moon on sea water, water surface rises and falls and the waves are formed. These waves are called tidal waves and energy possessed by rising and falling water tides is known as tidal energy.

(ii) Energy in tidal waves : Rise of ocean water is called “**high tide**” and the fall of ocean water is called “**low tide**”. These waves (jwar-bhata) in the oceans build up and recede (rise and fall) twice a day. Between the high tides and low tides, there is an enormous movement of water which can be used to generate large amount of energy. This type of energy generation can take place in coastal areas.

(iii) Harnessing tidal energy : Tidal energy can be harnessed by constructing a tidal barrage (or tidal dam) across a narrow opening to the sea and fixing a turbine at the opening of the barrage.

During high tide, when the level of water in the sea rises, sea-water flows into the reservoir of tidal barrage and turns the turbines to generate electricity.

During low tide, when the level of water in the sea falls, the stored sea-water in the tidal barrage reservoir flows out into the sea and turns the turbines again to generate electricity.

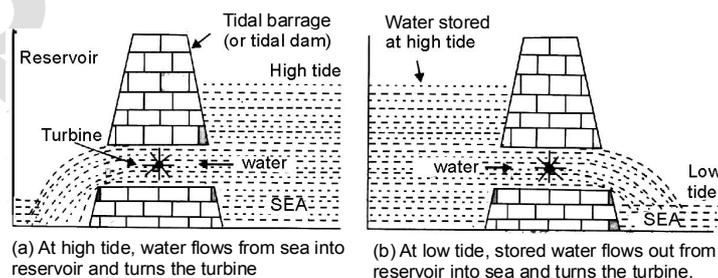


Fig. 8



(I) **Limitations of tidal energy** : The rise and fall of water during tides is not high enough to generate electrical energy on a large scale. There are very few places suitable for building dams. It is for these reasons that the tidal energy is not likely to be a major source of energy.

Locations in India :

- Gujarat. Gulf of Kutch Lamba
- West Bengal. Sunderbans

(g) **Sea waves energy** :

Due to the blowing of wind on the surface of ocean, very fast sea-waves move on its surface. Due to their high speed, sea waves have a lot of kinetic energy in them. The energy of moving sea-waves can be used to generate electricity. This can be done as follows :

(i) One idea is to set up floating generators in the sea. These would move up and down with the sea-waves. This movement would drive the generators to produce electricity.

(ii) Another idea is to let the sea-waves move up and down inside large tubes. As the waves move up, the air in the tubes is compressed. This compressed air can then be used to turn a turbine of a generator to produce electricity.

(h) **Ocean thermal energy** :

(i) **Definition** : The energy due to difference in the temperatures of the water at the surface of the ocean and at deeper levels is called ocean thermal energy.

(ii) **How is ocean thermal energy harnessed ?**

The devices used to harness the ocean thermal energy are known as **Ocean Thermal Energy Conversion (OTEC) power plants**.

To operate an OTEC plant efficiently, the temperature of ocean water at the surface should be higher by 20°C or more than the water at certain depth (about 1000 m).

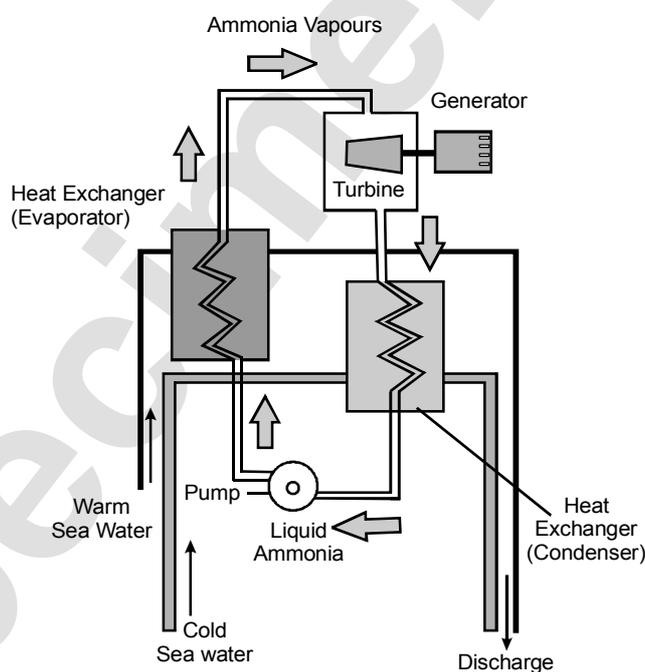


Fig. 9 : OTEC Power plant using ammonia

Warm surface water is used to boil liquid such as ammonia or a chlorofluorocarbon (CFC). The vapour of such liquid is used to run the turbine and generate electricity. The cold water from the depth is used to convert the vapour into liquid. The cycle is then continued.

(iii) **Advantages of ocean thermal energy** :

- (I) It can be used continuously **24 hours** a day throughout the year.
- (II) It is a renewable source of energy and its use does not cause any pollution.



(i) **Ocean wave energy :**

(i) **Definition :** The energy associated with ocean waves is known as ocean wave energy.

In another innovation, the electricity generated is used to electrolyse water to produce hydrogen and oxygen gases. Hydrogen so produced is piped to the shore.

(ii) **Harnessing ocean wave energy :** Wind blowing across the surface of the oceans causes ocean waves. The kinetic energy of the huge amount of water that moves along the waves is called **ocean wave energy**.

The most common devices that can be used for harnessing ocean wave energy are :

(I) Surface-followers using floats or pitching devices

(II) Oscillating water columns (OWC)

(I) **The surface-followers** consist of a series of floating objects that are pivoted about a rigid shaft along a coastline. The mechanical energy produced in the shaft is then converted into electricity.

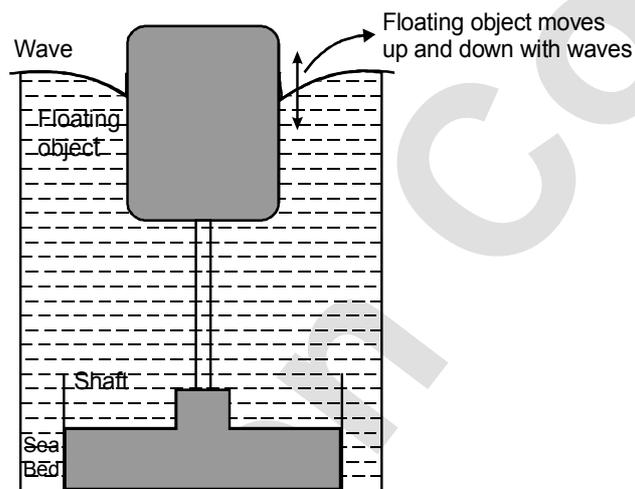


Fig. 10 : A surface follower used to harness ocean energy

(II) **Oscillating water columns (OWC)** use the force of the ocean waves entering a fixed device to do mechanical work or generate electricity.

For example, in anchored navigational buoys, the waves compress the air. The compressed air is then used to rotate turbine and generate electricity.

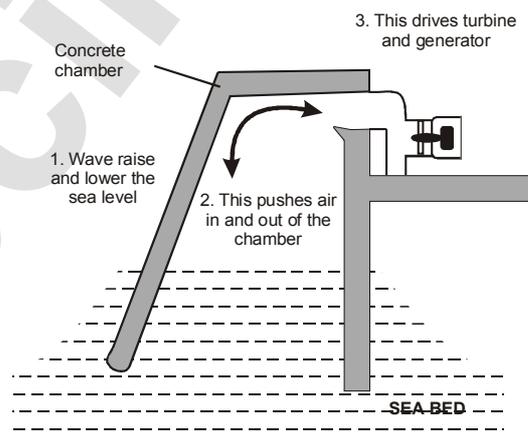


Fig. 11 : An oscillating water column wave power generator

(j) **Geothermal energy :**

Geothermal energy is the heat energy of hot rocks present inside the earth. This heat can be used as a source of energy to produce electricity. Geothermal energy is one of the few sources of energy that do not come directly or indirectly from solar energy. The places where very hot rocks occur at same depth below the surface of earth are called 'hot spots' and are sources of geothermal energy.



The geothermal energy is harnessed as follows :

(i) The extremely hot rocks present below the surface of earth, heat the underground water and turn it into steam. As more and more steam is formed between the rocks, it gets compressed to high pressures. A hole is drilled into the earth and the hot rocks comes up through the pipe at high pressure. This high-pressure steam run the turbine of a generator to produce electricity.

(ii) Large rocks are present in the underground rocks, which allow steam and hot water to go up. The steam and hot water gushing out of the ground are a kind of natural geyser. This steam is then used to turn turbines and generate electricity and the hot water is used to cook food.

(k) Bio energy :

The energy obtained from the biomass of plants and animals is called bio energy. Biomass is a renewable source of energy because it is obtained from plants (or animals) which are produced again and again.

The waste material of living things and dead parts of living things is called biomass. Biomass includes cattle dung, wood, sewage, agricultural wastes or crop residues like bagasse (Bagasse is the remaining part of the sugar cane or ganna, from which juice has been extracted). Biomass are carbon compounds and it is the oldest source of heat energy for domestic purposes. There are two ways of using biomass as a fuel. One is to burn the dry biomass like cattle-dung or wood directly to produce heat. Another method is to convert the biomass into more useful fuels and then use these fuels for heating purposes.

(i) **Biogas** : The decomposition which takes place in the absence of oxygen is called anaerobic degradation. Anaerobic degradation is carried out by anaerobic bacteria. Biogas is a mixture of **methane, carbon dioxide, hydrogen** and **hydrogen sulphide**. The major constituents of biogas is **methane**. Biogas is produced by the anaerobic degradation of animal wastes like animal dung in the presence of water.

(ii) **Biogas Plant** : Biogas is prepared by anaerobic degradation of animal wastes like cow dung in biogas plant. The two types of biogas plant are :

(I) Floating gas holder type biogas plant.

(II) Fixed-dome type bio-gas plant.

The raw material used for producing biogas in both the plants is the same, it is a mixture of cattle dung and water.

Fixed dome type biogas plant :

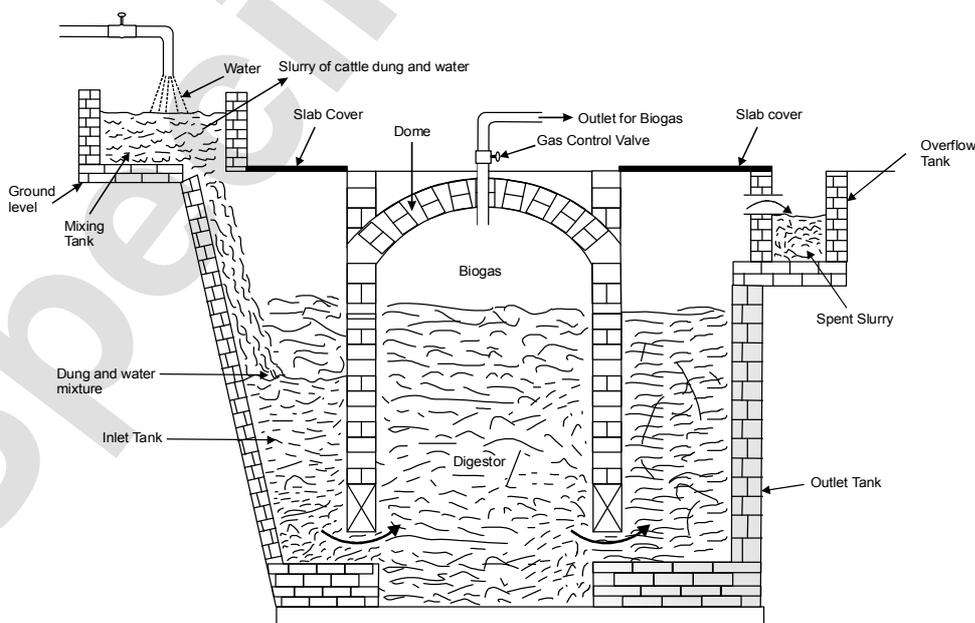


Fig. 12 Fixed dome type biogas plant



(iii) Description : It has following sections.

(I) Digester : It is a well like structure made from bricks. Its roof is dome shaped which acts as a fixed storage tank (gas holder) for biogas.

A tapped-outlet for biogas is provided at the top of the dome as shown in figure .

(II) Mixing tank : It is made above the ground level on one side of the digester.

(III) Inlet tank : It is below the ground level under the mixing tank.

(IV) Over flow tank : It is made on other side of the digester at a level lower than mixing tank.

(V) Outlet tank : It is below the ground level under the overflow tank.

Mixing tank is connected with inlet tank and the overflow tank is connected with outlet tank.

(iv) Working : Cattle dung (and also human wastes and domestic sewage) and water are mixed in equal proportion in mixing tank to form a slurry.

The cattle dung undergoes fermentation by anaerobic bacteria to form biogas which gets collected in the dome. As the amount of gas collected in dome increases, it exerts pressure over the slurry and forces the spent slurry in the digester to go out into the outlet tank and from there in overflow tank. The spent slurry is rich in nitrogen and phosphorus compounds and forms a good manure.

The biogas collected in the dome is taken out through the tapped-outlet at the top, through a pipe provided with a gas control valve. It is then distributed as desired.

Once the gas plant starts functioning, more cattle dung slurry is added to the digester. A continuous supply of biogas can be obtained in this manner.

(v) Uses of Biogas :

(I) It is used as domestic fuel for cooking food (in smokeless chulhas) and for other heating purposes.

(II) It is sometimes used to run engines and water pumping sets.

(III) It is used for street lighting for rural roads.

(vi) Advantages of using domestic sewage in production of biogas :

(I) It provides smokeless fuel.

(II) It provides spent slurry which is a good manure for agriculture.

(III) It helps to control water pollution by decomposing unwanted water pollutants.

(vii) Merits of biogas as a fuel :

(I) It is a clean fuel, does not produce smoke and pollution.

(II) It has high calorific value i.e. it produces a large amount of heat per unit mass.

(III) It is cheaper.

(IV) Its use is convenient.

(V) It does not require storage space in the house. It is directly supplied to the house through pipes from the plant.

(I) Fuel :

A fuel is a chemical which releases energy when heated with oxygen. The energy may release in the form of heat and light.

Eg : Wood, gas, petrol, kerosene, diesel, coal and animal waste.

Note : Fuels are combustible substances.

(i) Characteristics of a good fuel :

(I) It should have high calorific value.

(II) It should have a proper ignition temperature so that it may burn easily.



(III) It should leave no residue (or very small amount of residue) or ash after burning.

(IV) It should burn smoothly i.e. it should have a moderate rate of combustion and burn at a steady rate.

(V) It should not be more valuable for some other purpose than fuel. For e.g. coke is a good fuel but it is more valuable as a reducing agent in the extraction of metals.

(VI) It should be cheap and easily available.

(VII) It should be easy to handle, safe to transport and convenient to store.

(ii) Types of Fuels :

There are three types of fuels solid fuels, liquid fuels and gaseous fuels.

(I) **Solid fuels** : The various kinds of solid fuels are wood, charcoal, coke, coal, paraffin and tallow. Wood was the first solid fuel to be used by humans. Paraffin and tallow are used to make candles.

(II) **Liquid fuels** : Petrol, kerosene, diesel and methanol are some common liquid fuels. Most of the liquid fuels are obtained from petroleum. They leave no solid residue when burnt and can be stored easily.

(III) **Gaseous fuels** : Natural gas, coal gas, producer gas, water gas and liquefied petroleum gas are some examples of gaseous fuels.

(iii) **Fossil Fuels** : Fossil fuels are the remains of the prehistoric animals or plants, buried under the earth, millions of years ago.

Eg. Coal, petroleum and natural gas.

Fossil fuels are formed in the absence of oxygen. The chemical effects of pressure, heat and bacteria convert the buried remains of plants and animals into fossil fuels like coal, petroleum and natural gas.

It was the sunlight of long ago that made plants grow, which were then converted into fossil fuels. Fossil fuels are energy rich compounds of carbon, which were originally made by the plants with the help of sun's energy.

(iv) **Calorific value of fuels** : All the fuels produce heat energy on burning. Different fuels produce different amount of heat on burning. The usefulness of a fuel is measured in terms of its calorific value. **The amount of heat produced by burning a unit mass of the fuel completely is known as its calorific value.**

The unit of mass usually taken for measuring the calorific value of a fuel is gram. So it can be said that **the amount of heat produced by burning 1 gram of a fuel completely is called its calorific value.** For example, when one gram of a carbon fuel (like charcoal) is burned completely, it produces 33000 joules of heat. So the calorific value of charcoal is 33000 joules per gram or 33000 J/gm. Since joule is a very small unit of heat energy so the calorific value is usually expressed as kilojoules per gram (KJ/g). The SI unit of measuring calorific value is kilojoules per gram.

The calorific value of some common fuels are given in the table below.

Calorific value of some common fuels :

S.No.	Fuel	Calorific value
1	Dung cake (Upla)	6 to 8 kJ/g
2	Wood	17 kJ/g
3	Coal	25 to 30 kJ/g
4	Charcoal	33 kJ/g
5	Alcohol (Ethanol)	30 kJ/g
6	Diesel (and Fuel oil)	45 kJ/g
7	Kerosene oil	48 kJ/g
8	Petrol	50 kJ/g
9	Bio-gas	35 to 40 kJ/g
10	Natural gas	30 to 50 kJ/g
11	Butane (LPG)	50 kJ/g
12	Methane	55 kJ/g
13	Hydrogen gas	150 kJ/g



Of all the common elements, hydrogen has the highest calorific value. So a fuel containing higher percentage of hydrogen will have a higher calorific value than another fuel which has a lower percentage of hydrogen in it.

Wood is a mixture of carbon compounds called carbohydrates like cellulose $(C_6H_{10}O_5)_n$. Thus, when wood is burnt, only carbon and hydrogen atoms contained in it burn and produce heat. Oxygen atoms do not produce any heat, they only help in the burning process. So due to comparatively lower percentage of carbon and hydrogen in wood, it has a low calorific value.

All the fuels which contain oxygen burn readily but produce less heat energy per unit weight.

Solved Examples

Illustration 1. A concentrator-type solar water heater has a surface area of $5m^2$ and it can absorb 80% of the incident solar radiation falling on it, while it reflects the rest. Calculate the energy concentrated by the heater at its focus in a time period of 2hrs, if solar energy incident on it is at the rate of $0.4 \text{ KJ}/m^2s$.

Sol. Surface area of the reflector, $A = 5 \text{ m}^2$

Energy incident on the solar heater,

$$E = 0.4 \text{ KJ}/m^2s$$

$$\text{So energy concentrated} = E \times A \times t \times \frac{20}{100}$$

$$= 0.4 \times 5 \times 7200 \times \frac{20}{100} = 2880 \text{ KJ}$$



Check Your Progress

- 1._ State two source of energy which is non renewable in nature.
- 2._ State the type of energy in which a solar cell convert heat and light energy.
- 3._ What is tidal energy?
- 4._ What are the limitations of wind energy?
- 5._ Name two renewable sources of energy?
- 6._ Name any two radiations emitted by the sun that are not visible to human eye?
- 7._ Give three example each of solid fuel and liquid fuel.
- 8._ Name the radiations we used to get relief from bodyaches.
- 9._ Name any two type of energy available from the oceans.



B. NUCLEAR ENERGY

Energy released, when some changes take place in the nucleus of an atom of a substance, is called nuclear energy.

Nature :

It is partly renewable and partly non-renewable.

Nuclear fusion is renewable because hydrogen needed for this process is available in plenty in nature.

Nuclear fission is nonrenewable because uranium needed for this process has only limited existence.



(a) Binding energy :

The particles present in the nucleus (protons and neutrons) are called nucleons. The sum of the individual mass of various particles in the nucleus must be equal to the nuclear mass. But this is not so. The nuclear mass is somewhat less than the sum of the individual masses of various nuclear particles. The difference between the actual nuclear mass and the expected nuclear mass (sum of the individual masses of nuclear particles) is referred to as mass defect. The mass defect can be converted into equivalent energy by means of Einstein equation ($E = mc^2$).

The energy equivalent to mass defect is responsible for holding the nucleons together and is called binding energy of the nucleus.

The binding energy per nucleon is a measure of the stability of nucleus. Binding energy may also be considered as the energy required to separate the individual particles of the nucleus.

Mass defect Δm in amu can be directly obtained by using the following formula.

$$\Delta m = [Zm_p + (A - Z)m_n] - m_N$$

where z is atomic number

A is mass number

m_p is mass of proton

m_n is mass of neutron

m_N is mass of nucleus.

(b) Nuclear reactions :

In nuclear reactions, the nucleus of an atom undergoes a change forming new atoms and releasing a tremendous amount of energy. New atoms (or new elements) can be produced in a nuclear reaction, which is not possible in the case of a chemical reaction. Thus, a nuclear reaction can convert one element into another element. Some of the nuclear reactions take place in nature on their own in order to attain stability. This process is called as Radioactivity. However nuclear reactions can also be invoked artificially to obtain large amounts of energy.

Such reactions are of two types :

(i) Nuclear fission

(ii) Nuclear fusion

(i) Nuclear Fission : In **1939** two German scientists **Otto Hahn** and **Friz Strassman** very carefully analysed the products of their experiments on bombardment of uranium with neutrons. One of the product was found to be a barium isotopes emitting β -rays and having a half life of **86 minutes**. This was identical to the known characteristics of ^{139}Ba . Another product of this reaction was an isotope of lanthanum ^{140}La , which had a half-life of **40 hours**. The uranium atom with **$Z = 92$** and atomic mass number of 235 disintegrates into atoms, whose atomic number(Z) **56** and atomic mass number **139** (barium) and **$Z=57$** has atomic mass number **140** (lanthanum). The mass of the products = **$139 + 140 = 279 \text{ u}$** [unified atomic mass unit]. This is more than the mass of uranium nucleus and therefore only one of the two products would be produced in a given reaction. The other product would be an atomic species with atomic number of nearly **36** and atomic mass of about **100 u**. Hahn and Strassman were indeed able to find active isotopes of Strontium ^{38}Sr , and Yttrium ^{39}Y . In simple language they showed that the heavy uranium atoms split into lighter atoms of smaller atomic numbers. This process is named as nuclear fission.

(I) Fission Products : Fission of uranium produces nuclei that have mass number range from 72 [$^{72}\text{Zn}_{30}$] to mass number 158 [$^{158}\text{E}_{63}$]. Nuclei of different mass numbers can be produced by fission of uranium. Fission of $^{235}\text{U}_{92}$ yields mainly two group of nuclei. One of the group is a light group with atomic mass numbers in the range 85 to **104 u**. The second group is a heavy group with mass numbers range from **130 to 149 u**. Most commonly occurring products are molybdenum [$_{42}\text{Mo}$] and lanthanum [$_{57}\text{La}$]. There are some **prompt** and **delayed** categories. In first category prompt, the uranium nucleus splits immediately when a projectile of proper energy strikes. In delayed fission, the projectile enters the nucleus and causes instability which leads to fission of host nucleus, $^{236}\text{U}_{92}$. The fission of natural uranium and some other isotope take place without any projectile being hit on the same.



(II) **Types of Fission Reactions** : All the nuclear fission reactions can be divided into three categories :

- (1) Spontaneous fission
- (2) Prompt fission and
- (3) Delayed fission.

(1) Spontaneous fission : When a nucleus undergoes fission on its own (without being hit by a projectile like neutron), it is called spontaneous fission.

A spontaneous nuclear fission does not need to be initiated. In spontaneous nuclear fission, the natural shaking motion (or oscillations) of the nucleons in a heavy nucleus causes it to break into smaller nuclei. Spontaneous fission keeps on taking place in natural uranium all the time, but at a very very slow rate.

(2) Prompt fission : When a nucleus splits up into smaller nuclei instantaneously as soon as it is bombarded with a projectile (like neutrons), it is called prompt fission. About **99** percent of the **uranium-235** fission caused by slow neutrons is prompt fission. The prompt fission is produced by prompt neutrons which are emitted instantaneously by the splitting nuclei.

(3) Delayed fission : When a projectile like neutron enters a nucleus and causes an instability which leads to the fission of the nucleus after a short while, it is called delayed fission. About **1** percent of the uranium – 235 fission caused by neutrons is delayed fission. The delayed fission is caused by delayed neutrons, which are emitted slowly by the splitting nuclei.

Different amount of energies are required to produce fission from one isotope to the other. There is threshold energy of projectiles below which no fission takes place.

Fission of nuclei is often accompanied by emission of neutrons that cause further fission. The fission of uranium is accompanied by **2** or **3** neutrons per fission. Energies of such neutrons lie in a wide range.

Unit of energy usually used in nuclear reactions is eV or MeV.

$$1\text{eV} = 1.6 \times 10^{-19} \text{ J}$$

$$1\text{MeV} = 1.6 \times 10^{-13} \text{ J}$$

(III) **Energy Released by Fission Reaction** : Energy released in a fission reaction can be calculated by comparing the masses of nucleus which has undergone fission together with that of projectile used to cause fission and the masses of fission products.

Illustration 2. Consider fission of ${}_{92}^{235}\text{U}$, fission takes place when it is bombarded with low energy neutrons (neutrons having an energy of about 0.025 eV). Velocity of such neutrons is about $2,200 \text{ ms}^{-1}$ which is about ten times that of modern jet plane. There are many fission reactions possible. Consider most portable reaction in which ${}_{35}^{95}\text{Mo}$ and ${}_{57}^{139}\text{La}$ is produced with emission of **2** neutrons.



$$\text{Mass of } {}_{92}^{235}\text{U} = 235.124 \text{ amu}$$

$$\text{Mass of } 1 {}_0^1\text{n} = 1.009 \text{ amu}$$

$$\text{Initial mass} = 236.133 \text{ amu} \quad \dots (i)$$

$$\text{Mass of } {}_{35}^{95}\text{Mo} = 94.946 \text{ amu}$$

$$\text{Mass of } {}_{57}^{139}\text{La} = 138.955 \text{ amu}$$

$$\text{Mass of } 2 {}_0^1\text{n} = 2.018 \text{ amu}$$

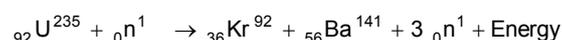
$$\text{Final mass} = 235.919 \text{ amu} \quad \dots (ii)$$

We find that the initial mass is more than final mass. This means that mass defect [(i) – (ii)] i.e., $236.133 \text{ u} - 235.919 \text{ u} = 0.214 \text{ amu}$

We know that 1 amu or 1 u gives 931 MeV energy.

$\therefore 0.214 \times 931 = 199.234 \approx 199.2 \text{ MeV}$ of energy is released.

Illustration 3. An another popular nuclear reaction of ${}_{92}^{235}\text{U}$ is,





Initial mass = mass of ${}_{92}\text{U}^{235}$ + mass of ${}_0\text{n}^1$ = 235.0439 + 1.0087 = 236.0526 amu

Final mass = mass of Kr^{92} + mass of Ba^{141} + 3 × mass of ${}_0\text{n}^1$

Final mass = 91.8954 + 140.9177 + 3.0261 = 235.8392 u

Difference of mass = 236.0526 amu - 235.8392 u

= 0.2134 amu

But 1 amu gives 931 MeV energy.

∴ Energy produced = 0.213 amu × 931 = 198.7 MeV

Illustrations 4. Energy produced from 1 Kg of ${}_{92}\text{U}^{235}$.

We know that 235 g of ${}_{92}\text{U}^{235}$ contains 6.023×10^{23} atoms

Number of atoms in 1Kg of

$$\begin{aligned} {}_{92}\text{U}^{235} &= \frac{6.023 \times 10^{23}}{235} \times 1000 \text{ atoms.} \\ &= 25.63 \times 10^{23} \text{ atoms} \end{aligned}$$

If one atom releases 200 MeV of energy, then energy released by 1Kg of ${}_{92}\text{U}^{235}$ = $25.63 \times 10^{23} \times 200$ MeV

$$= 5.126 \times 10^{23} \text{ MeV}$$

$$= 5.126 \times 10^{23} \times (1.6 \times 10^{-13} \text{ J})$$

$$= 8.2014 \times 10^{10} \text{ J} = 8.201 \times 10^{10} \text{ J}$$

This is the energy produced by burning **2,500** tons of coal.

(IV) Process of Nuclear Fission : The process of nuclear fission is explained by the **Liquid drop model** of the nucleus. The liquid drop model of the nucleus to explain the process of fission was proposed by **Yakov Frenkel, Neils Bohr** and **John Wheeler**. According to the liquid drop model of the nucleus it is said that in just the same way that a drop of water might become unstable if another small drop hits it, the uranium nucleus becomes unstable and breaks up when hits by a neutron. In this model, the uranium nucleus is treated like a drop of a liquid, which is not compressible and has a uniform positive charge. It is imagined that a stretchable skin-like membrane surrounds the drop like nucleus and holds all the protons and neutrons together inside its body. In the stable stage, the uranium nucleus, like a drop of water is spherical in shape. The nuclear fission of uranium– 235 isotope by means of a slow moving neutron can be explained diagrammatically as follows:

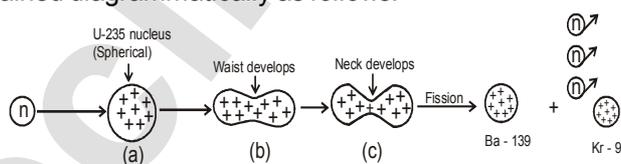


Figure (a) shows that uranium nucleus to be spherical. In this spherical nucleus the nuclear particles like protons and neutrons are very close together because of which the nuclear force of attraction and the electrostatic force of repulsion are very delicately balanced. Now, when a slow moving neutron attacks the uranium–235 nucleus and enters into it, then the delicate balance of force inside the nucleus is disturbed. The energy of neutron is transferred to the nucleons (protons and neutrons) and by gaining this energy, the nucleons start oscillating more and more. Due to increased oscillations of the nuclear particles, the skin-like outer membrane of the nucleus gets stretched, the nucleus gets elongated and a waist develops in it. When the nucleus gets elongated then the distances between nuclear particles (protons and neutrons) increase. This increased inter-particle distance weakens the nuclear force of attraction so that the electrostatic force of repulsion becomes more dominant. Due to the increased repulsion between the protons, a neck develops in the nucleus as shown. The formation of neck decreases the nuclear force further and the increased repulsion between protons ultimately leads to the breaking up of the **uranium–235** nucleus to form two smaller nuclei of **barium–139** and **krypton–94**, along with the emission of three neutrons.



(V) **Chain reaction** : A reaction in which the particle which initiates (starts) the reaction is also produced during the reaction to carry on the reaction further and further is called a chain reaction. Once started a chain reaction will go on propagating by itself, until one of the reactant is all used up. The fission of **uranium-235** by means of slow moving neutrons is a chain reaction, because this reaction is started by neutrons and neutrons are also produced during this reaction. The neutrons produced during the fission of a uranium atom initiate the fission of more uranium atoms, and this process goes on, like an unending chain, with the liberation of a large amount of energy at each step. The chain reaction taking place during the fission of **uranium-235** can be represented more clearly with the help of a diagram.

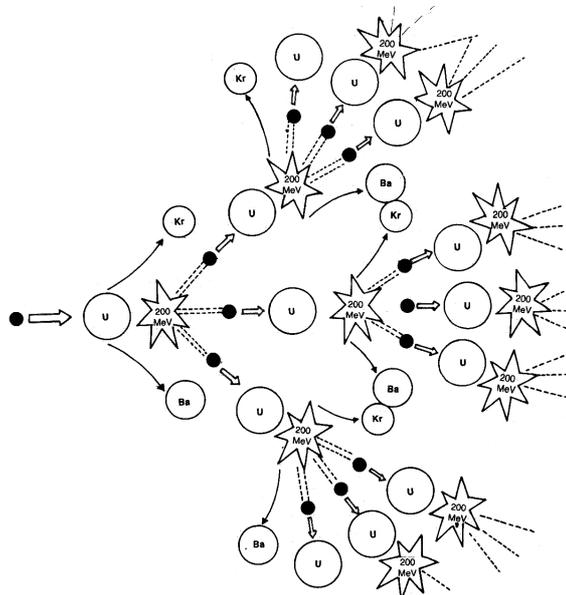
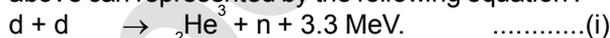


Fig. 13

The fact that only **1** neutron is used up in each fission process but **3** neutrons are produced, makes the fission process in **uranium-235** a self-sustaining process or self-propagating process called chain reaction. If on the other hand on an average less than **1** neutron had been produced per fission, then the reaction would have died down like a fire in a wet fuel. It should be noted that a chain reaction involves a large number of uranium atoms. So, a chain reaction cannot occur in a very small lump of **uranium-235** isotopes, but it can take place in a sufficiently large mass of **uranium-235** isotopes. The minimum mass of **uranium-235** atoms or any other fissionable material which can support a chain reaction is called critical mass of that material.

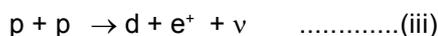
(ii) **Nuclear fusion** : Under special conditions, it is possible that nuclei of lighter elements can combine to form a nucleus of higher atomic number. For example, two deuterons can join together to form a ${}^3\text{He}$ nucleus plus a neutron. The deuteron (**D**) is the heavy hydrogen nucleus (${}^2_1\text{H}$) consisting of one proton and one neutron. In simple language, two heavy hydrogen nuclei can combine to form a nucleus of helium (${}^3_2\text{He}$). This process, in which nuclei of low atomic numbers combine to form a heavier atomic nucleus, is known as nuclear fusion. The fusion reaction is also accompanied by release of energy, like the fission phenomena. Fusion was discovered nearly **70** years ago in **1930**. The typical fusion reaction mentioned above can be represented by the following equation :



Here, d represents the deuteron. Reaction is also possible:



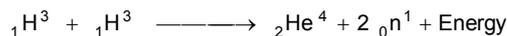
Here, t is a triton (proton + two neutrons) or a heavy hydrogen nucleus (${}^3_1\text{H}$) with two extra neutrons. This means that two deuterons can fuse to form either ${}^3_2\text{He} + n$, or triton + a proton. Another type of important fusion reaction involves conversion between neutron and protons. The simplest among these is the synthesis of deuteron from hydrogen by the following reaction:



In this reaction one of the two protons is converted into a deuteron with simultaneous creation of a positron e^+ (identical to an electron except that it has a positive charge) and a neutrino ν . The neutrino is a neutral particle whose mass is negligible and therefore has enormous penetrating power.



(deuterium) (tritium)



(Note: - Tritium has to be prepared within the hydrogen bomb because it is not stable)

Facts about H-Bomb (Thermo-nuclear bomb) :

1. 5-countries have tested H-bomb.

Countries	Test Explosion
(a) United States of America	March 1954
(b) Russia	Nov 1955
(c) United Kingdom	Oct 1957
(d) China	June 1967
(e) France	August 1968

2. 4-other countries who are not signatories of the **NPT** agreement and believed to be in possession of H-Bomb:

(a) India	May 1998
(b) Pakistan	May 1998
(c) North Korea	6-January 2016

NOTE : Jor-Bomba is the first dangerous H-Bomb in the world by USA.

(e) **Difference between nuclear fission and nuclear fusion :**

Nuclear fission	Nuclear fusion
1. It is confined to heavy nuclei only.	1. It is confined to lighter nuclei.
2. A heavy nucleus splits into two lighter nuclei .	2. Two lighter nuclei fuse to form a heavy nucleus.
3. It is a chain reaction .	3. it is not a chain reaction.
4. Temperature required for the reaction is not high .	4. It is a thermo nuclear reaction i.e. it requires high temperature .
5 Fission reaction can be controlled .	5. Fusion reaction is very difficult to control.
6. Large amount of energy is released.	6. Energy released is far more than that released in a fission reaction.
7. Large number of radioactive products are obtained i.e. large amount of nuclear waste is left .	7. No nuclear waste is left .



Check Your Progress

- Does the nuclear force depend on the charge of the particles?
- Uranium 235 has an atomic number 92, it has _____ neutrons.
- Nuclear fission is the process of splitting of _____ nucleus into _____ nuclei.
- Why is the fusion process called thermo-nuclear reaction?
- Which process is responsible for energy generation in the sun?
- Is the energy released per nucleon in fission greater than that released during fusion?



7. Nuclear fusion is the process of fusion of _____ nuclei into _____ nuclei.
8. Named the isotopes of uranium present in naturally occurring uranium.
9. 1 amu = _____ kg.
10. Is the energy released per nucleon in fission greater than that released during fusion?



Board Level Exercise

TYPE (I) : VERY SHORT ANSWER TYPE QUESTIONS :

[01 MARK EACH]

1. What is a good source of energy?
2. If you could use any source of energy for heating your food, which one would you use and why?
3. What are the limitations of the energy that can be obtained from the oceans?
4. When we cannot use a solar water heater to get hot water?
5. On what basis would you classify energy sources as (a) renewable and non-renewable? (b) exhaustible and inexhaustible?

TYPE (II) : SHORT ANSWER TYPE QUESTIONS :

[02 MARK EACH]

6. What are the disadvantages of fossil fuels?
7. Why are we looking at alternate sources of energy?
8. What kind of mirror – concave, convex or plane – would be best suited for use in a solar cooker? Why?
9. What is geothermal energy?
10. What are the advantages of nuclear energy?

TYPE (III) : LONG ANSWER TYPE QUESTIONS :

[03 MARK EACH]

11. Can any source of energy be pollution-free? Why or why not?
12. Hydrogen has been used as a rocket fuel. Would you consider it a cleaner fuel than CNG? Why or why not?
13. Name two energy sources that you would consider to be renewable. Give reasons for your choices.
14. Give the names of two energy sources that you would consider to be exhaustible. Give reasons for your choices.
15. Compare and contrast fossil fuels and the Sun as direct sources of energy.
16. Compare and contrast bio-mass and hydro electricity as sources of energy.
17. What are the limitations of extracting energy from the wind?
18. What are the quantities of an ideal source of energy?
19. What are the advantages and disadvantages of using a solar cooker? Are there places where solar cookers would have limited utility?



TYPE (IV) : VERY LONG ANSWER TYPE QUESTIONS :

[05 MARK EACH]

20. What are the environmental consequences of the increasing demand for energy? What steps would you suggest to reduce energy consumption?

PREVIOUS YEAR PROBLEMS

- 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. **[3 Marks/CBSE 10TH BOARD: 2013]**
- 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. **[3 Marks/CBSE 10TH BOARD: 2014]**
- What is tidal energy ? **[1 Marks/CBSE 10TH BOARD: 2015]**
- Write the characteristic features of the micro organisms which help in the production of biogas in a biogas plant. **[1 Mark/CBSE 10TH BOARD: 2016]**
- Explain the principle and process of converting ocean thermal energy into electricity **[3 Mark/CBSE 10TH BOARD: 2016]**

Exercise-1

☞ Marked Questions can be used as Revision Questions.

SUBJECTIVE QUESTIONS

SUBJECTIVE EASY, ONLY LEARNING VALUE PROBLEMS

SECTION (A) : SOURCES OF ENERGY AND DIFFERENT FORM OF ENERGY

- ☞ **A-1.** Can you place alcohol under the category of renewable source of energy?
- A-2.** Describe the principle of solar cell.
- A-3.** Name the devices in which solar energy is harnessed directly.
- A-4.** State three advantages of solar cooker?
- A-5.** What are the forms of ocean energy that can be harnessed? Give some places in our country where it can be harnessed ?
- A-6.** A concentrator type solar heater having a surface area of 4 m^2 can absorb only 80% of the solar radiations incident on it, while the rest is reflected. Calculate the energy concentrated by the heater at its focus in 3 hrs, if the rate of solar energy incident on it is $0.5 \text{ KJ/m}^2\text{s}$.

SECTION (B) : NUCLEAR ENERGY

- B-1.** Define nuclear fusion.
- B-2.** Define nuclear fission.
- B-3.** Differentiate between nuclear fission and nuclear fusion.



- B-4.** Define nuclear fusion reaction. Describe the conditions for the occurrence of a nuclear fusion reaction.
- B-5.** What are the advantages of nuclear energy ?
- B-6.** What measures we can take to minimize hazards caused by nuclear reactors?
- B-7.** It is said that energy from nuclear fusion would create fewer pollution problems than energy from fission. Can you give reason, why?
- B-8.** 48 kJ of energy is produced in 60 s in a nuclear reactor. Find the number of fissions which would be taking place per second if the energy released per fission is 3.2×10^{-11} J.

OBJECTIVE QUESTIONS

SINGLE CHOICE OBJECTIVE, STRAIGHT CONCEPT/FORMULA ORIENTED

SECTION (A) : SOURCES OF ENERGY AND DIFFERENT FORM OF ENERGY

- A-1.** Solar energy can be used to produce :
 (A) electrical energy (B) heat energy (C) mechanical energy (D) all of the above
- A-2.** The energy possessed by wind is :
 (A) kinetic energy (B) potential energy (C) thermal energy (D) sound energy
- A-3.** A solar cell convert heat and light energy into :
 (A) heat energy (B) sound energy (C) electrical energy (D) nuclear energy
- A-4.** Biogas is a mixture of :
 (A) $\text{CO} + \text{H}_2 + \text{CH}_4$ (B) $\text{CO} + \text{H}_2$ (C) $\text{CO}_2 + \text{CH}_4 + \text{H}_2 + \text{H}_2\text{S}$ (D) $\text{CO}_2 + \text{N}_2$
- A-5.** The sources of energy which are being produced continuously in nature and are inexhaustible are called :
 (A) conventional sources (B) non-conventional sources
 (C) non-renewable sources (D) none of these
- A-6.** Choose the source of energy which is different from others :
 (A) Wood (B) Falling water (C) Wind (D) Petroleum
- A-7.** The vast amount of sea weeds present in oceans may provide an endless source of :
 (A) nuclear energy (B) ocean thermal energy
 (C) methane (D) none of these
- A-8.** Energy available from the oceans is :
 (A) OTE (B) sea-waves energy (C) tidal energy (D) all of the above
- A-9.** Which of the following is not a solid fuel :
 (A) Coke (B) Coal (C) Charcoal (D) Kerosene
- A-10.** Maximum temperature that can be attained in box type solar cooker is :
 (A) 20°C to 50°C (B) 10°C to 20°C (C) 100°C to 140°C (D) 300°C to 350°C
- A-11.** The fuel used in a steam engine is :
 (A) water (B) carbon monoxide (C) carbon dioxide (D) None of these
- A-12.** Wood is a :
 (A) primary fuel (B) liquid fuel (C) processed fuel (D) secondary fuel



- A-13.** Which of the following is an example of fossil fuel ?
 (A) Coal gas (B) Coke (C) Natural gas (D) Producer gas
- A-14.** Gobar gas is a :
 (A) Solid fuel (B) Liquid fuel (C) Primary fuel (D) Secondary fuel
- A-15.** Methane gas has highest among all hydrocarbons :
 (A) Ignition temperature (B) Ratio of hydrogen to carbon
 (C) Calorific value (D) Both B and C are correct

SECTION (B) : NUCLEAR ENERGY

- B-1.** The device in which the nuclear fission and release of energy is controlled, is known as :
 (A) Thermopile (B) Thermostat (C) Nuclear reactor (D) Cloud chamber
- B-2.** Neutron was discovered by :
 (A) Rutherford (B) Anderson (C) Chadwick (D) Millikan
- B-3.** Moderator is used in nuclear reactor for :
 (A) slowing neutrons (B) accelerating neutrons
 (C) stopping neutrons (D) heating the neutrons
- B-4.** The fusion reactions occur at :
 (A) low pressures (B) low temperature
 (C) extremely high temperature (D) high temperature and low pressures
- B-5.** The number of neutrons in an atom X of atomic number Z and mass number A is :
 (A) Zero (B) Z (C) A – Z (D) A
- B-6.** In nuclear reactions :
 (A) Energy is conserved (B) Charge is conserved
 (C) Momentum is conserved (D) Both (B) and (C)
- B-7.** Which of the following has least penetrating power ?
 (A) Alpha particles (B) Gamma rays
 (C) Beta particles (D) All have the same penetrating power
- ~~**B-8.**~~ In the nuclear reaction

$${}_{92}\text{U}^{235} + {}_0\text{n}^1 \longrightarrow {}_{56}\text{Ba}^{141} + {}_{36}\text{Kr}^{92} + 3\text{X} + 200 \text{ MeV}$$
 X represents :
 (A) Proton (B) Neutron (C) Electron (D) Alpha particle
- ~~**B-9.**~~ In the fission of U-235, the percentage of mass converted into energy is about :
 (A) 0.01% (B) 0.1% (C) 1% (D) 10%
- B-10.** Nuclear energy is :
 (A) Renewable (B) Non-renewable
 (C) Both renewable & non-renewable (D) None of these
- B-11.** In a neutral atom n_e and n_p represent number of electrons & protons, then :
 (A) $n_e < n_p$ (B) $n_e = n_p$ (C) $n_e > n_p$ (D) None of these
- B-12.** A nucleus has 16 neutrons & its mass number is 31. The atomic number of this is :
 (A) 47 (B) 31 (C) 15 (D) 16
- B-13.** Number of nucleons in the nucleus, is called :
 (A) Mass number (B) Atomic number (C) Neutron number (D) Electron number





- B-14.** Central core of the atom, is called :
 (A) Ion (B) Orbit (C) Molecule (D) Nucleus
- B-15.** Energy of sun is available on earth in the form of :
 (A) Heat only (B) Light only (C) Heat and light both (D) None of these

Exercise-2

☒ **Marked Questions can be used as Revision Questions.**

OBJECTIVE QUESTIONS

- In thermal power plant, heat energy is converted into:
 (A) light energy. (B) electrical energy.
 (C) sound energy. (D) potential energy.
- The minimum speed of wind that is required in a particular area to run a windmill is:
 (A) 10 kmph. (B) 15 kmph. (C) 20 kmph. (D) 25 kmph.
- Hydro Power Plants utilize the potential energy of water stored at a height by (HYDRO ENERGY)
 (A) Changing potential energy to kinetic energy of flowing (falling) water and then converting it to electrical energy.
 (B) Changing potential energy to heat energy of water and then converting it to electrical energy.
 (C) Changing potential energy to gravitational energy of water and then converting it to electrical energy.
 (D) There is no interchange of energy takes place
- ☒ Oxides of Carbon, Nitrogen and Sulphur released on burning of fossils fuels are harmful because
 (A) They are acidic oxides and can cause acid rains.
 (B) They cause noise pollution
 (C) They cause sound problem
 (D) They cause vision disorder.
- Which of the following is not a bio-mass source?
 (A) coal (B) nuclear energy (C) gobar gas (D) wood
- Semiconductors are used in:
 (A) solar furnaces. (B) solar cells. (C) solar cookers. (D) solar water heaters.
- Kinetic energy of moving air or winds in coastal or hilly areas is harnessed to do mechanical work or generate electricity by using:
 (A) Wind Mills (B) Generators (C) Electric Motors (D) Shafts
- The radiations absorbed by ozone layer are _____
 (A) ultra-violet (B) infra-red (C) visible (D) gamma rays
- The digester of a biogas plant is a sealed chamber in which, there is no:
 (A) carbon. (B) nitrogen. (C) hydrogen. (D) oxygen.
- ☒ A hydrogen bomb is based on:
 (A) nuclear fission reaction. (B) controlled chain reaction.
 (C) thermonuclear fusion reaction. (D) uncontrolled chain reaction.



11. Biogas is an excellent fuel because it contains up to:
 (A) 75% methane. (B) 75% carbondioxide.
 (C) 75% hydrogen. (D) 75% hydrogen sulphide.
12. The ultimate source of energy for fuels is:
 (A) coal. (B) sun. (C) natural gas. (D) petroleum.

Exercise-3

Marked Questions can be used as Revision Questions.

NTSE PROBLEMS (PREVIOUS YEARS)

1. The particles not emitted from radioactive substances are : **(Raj./ NTSE Stage-I/2007)**
 (A) Electron (B) Proton (C) γ -particles (D) Helium
2. Liquified gases in the fuel used in geo-stationary satellite launch vehicle are **(Raj./ NTSE Stage-I/2007)**
 (A) liquid hydrogen and liquid oxygen (B) liquid nitrogen and liquid oxygen
 (C) liquid hydrogen and liquid helium (D) liquid nitrogen and liquid helium
3. The source of energy of the sun is : **(West Bengal/ NTSE Stage-I/2013)**
 (A) Nuclear fission (B) Chemical reaction (C) Nuclear fusion (D) None of these
4. Which country is called the country of Wind mills ? **(Raj./ NTSE Stage-I/2013)**
 (A) Holland (B) Britain (C) India (D) America
5. Who was the first President of Atomic energy commission in India : **(Raj./ NTSE Stage-I/2013)**
 (A) Homi Jahangir Bhabha (B) Vikram Sarabhai
 (C) Prof. M.S. Swaminathan (D) Prof. Meghnad Saha
6. The type of radiation absorbed by CO_2 molecule in atmosphere are **(Delhi/ NTSE Stage-I/2013)**
 (A) X-rays (B) Gamma rays (C) Infra-red rays (D) UV-rays
7. Which of the following statement is incorrect? **(M.P./ NTSE Stage-I/2013)**
 (A) Charges on an electron and proton are equal and opposite
 (B) Neutron have no charge
 (C) Electron and proton have same mass
 (D) Masses of proton and neutron are nearly the same
8. In a nuclear reaction given below the total energy released is 355 kev and the binding energy of electron is 35 kev. The energy E of the neutrino will be : **(Bihar/ NTSE Stage-I/2014)**
- $${}_{55}^{131}\text{Cs} + {}_0^{-1}\text{e} \rightarrow {}_{54}^{131}\text{Xe} + \text{V (neutrino)}$$
- (A) $E < 355 \text{ kev}$ (B) $E = 355 \text{ kev}$ (C) $E > 355 \text{ kev}$ (D) None of the above
9. Energy released per fission of a ${}_{92}\text{U}^{238}$ nucleus is nearly equal to : **(Jharkhand/ NTSE Stage-I/2015)**
 (A) 931 MeV (B) 1000 MeV (C) 8 MeV (D) 800 MeV



10. In the sun four hydrogen nuclei combine to form a helium nucleus and the amount of energy released is -
(A) 13 MeV (B) 26 MeV (C) 39 MeV (D) None of these
(Bihar/ NTSE Stage-I/2015)
11. What is the energy within each nucleon ? (mass = 1.66×10^{-27} Kg)
(A) 934 MeV (B) 944 MeV (C) 954 MeV (D) None of these
(Bihar/ NTSE Stage-I/2015)
12. What is the full form of PNG ?
(A) Petrol Natural Gas (B) Pipe Natural Gas
(C) Pressurise Natural Gas (D) Pure Natural Gas
(Gujrat/ NTSE Stage-I/2017)
13. Which of the following is renewable source of energy ?
(A) Wood (B) Petroleum (C) Natural gas (D) Uranium
(Bihar/ NTSE Stage-I/2017)
14. Which metal is used to connect solar cell to solar panels ?
(A) Gold (B) Silver (C) Copper (D) Aluminium
(Delhi/ NTSE Stage-I/2017)



Answers

EXERCISE - 1

SUBJECTIVE QUESTIONS

SUBJECTIVE EASY, ONLY LEARNING VALUE PROBLEMS

SECTION (A) : SOURCES OF ENERGY AND DIFFERENT FORM OF ENERGY

A-6. 4320 KJ

SECTION (B) : NUCLEAR ENERGY

B-8. 2.5×10^{13}

OBJECTIVE QUESTIONS

SINGLE CHOICE OBJECTIVE, STRAIGHT CONCEPT/FORMULA ORIENTED

SECTION (A) : SOURCES OF ENERGY AND DIFFERENT FORM OF ENERGY

A-1. (D) A-2. (A) A-3. (C) A-4. (C) A-5. (B) A-6. (D)

A-7. (C) A-8. (D) A-9. (D) A-10. (C) A-11. (D) A-12. (A)

A-13. (D) A-14. (D) A-15. (C)

SECTION (B) : NUCLEAR ENERGY

B-1. (C) B-2. (C) B-3. (A) B-4. (C) B-5. (C) B-6. (A)

B-7. (A) B-8. (B) B-9. (A) B-10. (C) B-11. (B) B-12. (C)

B-13. (A) B-14. (D) B-15. (C)

EXERCISE - 2

OBJECTIVE QUESTIONS

Que.	1	2	3	4	5	6	7	8	9	10	11	12
Ans.	B	B	A	A	B	B	A	A	D	C	A	B

EXERCISE - 3

NTSE PROBLEMS (PREVIOUS YEARS)

Que.	1	2	3	4	5	6	7	8	9	10
Ans.	B	A	C	A	A	D	C	A	C	B
Que.	11	12	13	14						
Ans.	A	B	A	B						



CHEMICAL REACTIONS AND CHEMICAL EQUATIONS



(A) GENERAL INTRODUCTION OF CHEMISTRY & CHARACTERISTICS OF CHEMICAL REACTIONS :

INTRODUCTION

Chemistry is defined as that branch of science which deals with the composition and properties of matter and the changes that matter undergoes by various interactions.

Some differences between physical and chemical changes	
Physical change	Chemical change
1. No new substance is formed	A new substance is formed
2. Temporary change	Permanent change
3. Easily reversible	Cannot be easily reversed

Examples of physical and chemical change			
Physical change		Chemical change	
Set A		Set B	
(i)	Melting of ice	(i)	Conversion of milk into curds
(ii)	Evaporation of water	(ii)	Digestion of food in human body
(iii)	Dissolution of salt in water	(iii)	Burning of petrol
(iv)	Stretching a rubber band	(iv)	Rusting of iron

A chemical compound is formed as a result of a chemical change and in this process different types of energies such as heat, electrical energy, radiation etc. are either absorbed or evolved. The total mass of the substance remains the same throughout the chemical change.

CHEMICAL ACTION OR REACTION

When we heat sugar crystals they melt and on further heating they give steamy vapour, leaving behind brownish black mass. On cooling no sugar crystals appear. Thus change which takes place on heating sugar is a chemical change and the process which brings about this chemical change is called chemical reaction.

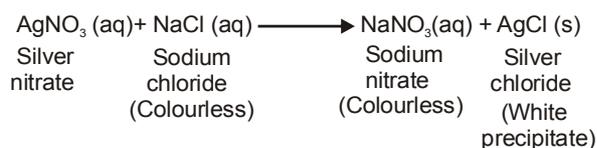
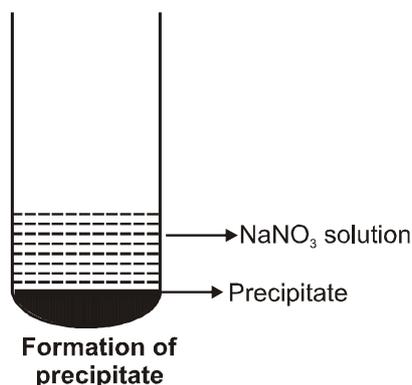
(a) Characteristics of a Chemical Reaction:

- In this reaction the substances which take part in bringing about chemical change are called reactants.
- The substances which are produced as a result of chemical change are called products.
- These reactions involve breaking and making of chemical bonds.
- Product(s) of the reaction is/are new substances with new name(s) and chemical formulae.
- It is often difficult to reverse a chemical reaction.
- Properties of products formed during a chemical reaction are different from those of the reactants.
- Apart from heat other forms of energies are light and electricity which are also used in carrying out chemical changes.

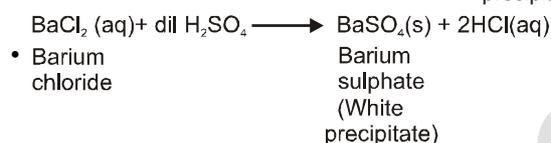
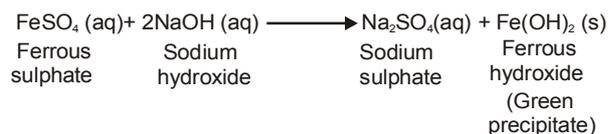
In all chemical reactions, the transformation from reactants to products is accompanied by various characteristics, which are-



- When silver nitrate solution is mixed with a solution of sodium chloride, a white precipitate of silver chloride is formed.

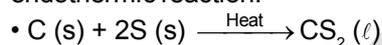


- A dirty green precipitate of ferrous hydroxide is formed, when a solution of ferrous sulphate is mixed with sodium hydroxide solution.



(iv) Energy changes : All chemical reactions proceed either with the absorption or release of energy. On the basis of energy changes, there are two types of reactions :

(A) Endothermic reaction : A chemical reaction which is accompanied by the absorption of energy is called an endothermic reaction.



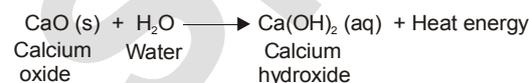
- Light energy is essential for biochemical reaction, photosynthesis, by which green plants prepare their food from carbon dioxide & water.

(B) Exothermic reaction : A chemical reaction which is accompanied by the release of energy is called exothermic reaction.

- When magnesium wire is heated from its tip in a bunsen flame, it catches fire and burns with a dazzling white flame with release of heat and light energy.

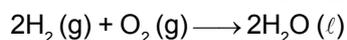


- When quick lime (calcium oxide) is placed in water, the water becomes very hot and sometimes starts boiling. It is because of release of heat energy during the reaction.

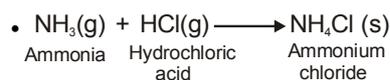
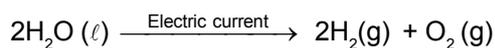


(v) Change of state : Some chemical reactions are characterised by a change in state - i.e. solid, liquid or gas.

- Two volumes of hydrogen gas react with one volume of oxygen gas to form water.



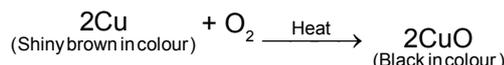
or when electric current is passed through water it splits into its elements .



Solved Examples

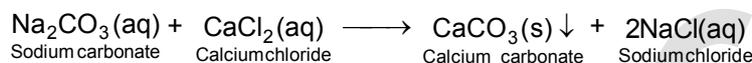
Example1: A shiny brown-coloured element 'X' on heating in air becomes black in colour. Name the element 'X' and the black coloured compound formed.

Solution: 'X' is copper (Cu) and the black-coloured compound formed is copper oxide (CuO). The equation of the reaction involved on heating copper is given below.



Example2: What do you mean by a precipitation reaction? Explain by giving examples.

Solution: A reaction in which an insoluble solid (called precipitate) is formed is called a precipitation reaction. For example:



In this reaction, calcium carbonate is obtained as a precipitate. Hence, it is a precipitation reaction. Another example of precipitation reaction is :



In this reaction, barium sulphate is obtained as a precipitate



Check Your Progress

- What will happen when an iron rod is dipped in CuSO_4 solution ?
- Give the characteristic tests for the following gases
(a) CO_2 (B) SO_2 (C) O_2 (D) H_2



(B) CHEMICAL EQUATIONS & BALANCING :

CHEMICAL EQUATION

All chemical changes are accompanied by chemical reactions. These reactions can be described in sentence form, but the description would be quite long. Chemical equations have been framed to describe the chemical reactions.

“A chemical equation is a shorthand representation of a chemical reaction using the symbols and formulae of substances involved in the chemical reaction.”

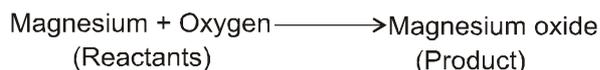


❖ Note :

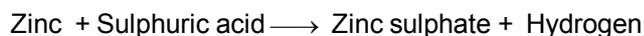
A chemical reaction can be summarised by chemical equation.

(a) Types of Chemical Equations :

(i) **Word equation :** A word equation links together the names of the reactants with those of the products. For example, the word equation, when magnesium ribbon burns in oxygen to form a white powder of magnesium oxide, may be written as follows-



Similarly, the word equation for the chemical reaction between granulated zinc and hydrochloric acid may be written as -



In a word equation

- The reactants are written on the left hand side with a plus sign (+) between them.
- The products are written on the right hand side with a plus sign (+) between them.
- An arrow (\rightarrow) separates the reactants from the products.
- The direction of the arrow head points towards the products.

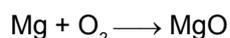
❖ Note :

Although word equations are quite useful, yet they don't give the true picture of chemical reactions.

(ii) Symbol equation : A brief representation of a chemical reaction in terms of symbols and formulae of the substances involved is known as a symbol equation.

In a symbol equation, the symbols and formulae of the elements and compounds are written instead of their word names.

e.g. Burning of magnesium in oxygen to form magnesium oxide may be written as follows :

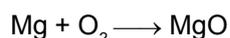


❖ Note :

Symbol equations are always written from the word equations.

(B) Unbalanced and Balanced Chemical Equations :

In an unbalanced equation, the number of atoms of different elements on both sides of the equation are not equal. For example, in the equation given below, the number of Mg atoms on both sides of the equation is one (same), but the number of oxygen atoms are not equal. It is known as an unbalanced equation.

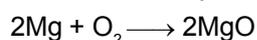


❖ Note :

An unbalanced equation is also called skeletal equation.

In a balanced equation, the number of atoms of different elements on both sides of the equation are always equal.

The balanced equation for the burning of magnesium ribbon in oxygen is written as -



(i) Importance of balanced chemical equation : The balancing of a chemical equation is essential or necessary to fulfil the requirement of "Law of conservation of mass".

(ii) Balancing of chemical equations : Balancing of chemical equations may be defined as -

"The process of making the number of different types of elements, on both sides of the equation, equal."

The balancing of a chemical equation is done with the help of Hit and Trial method. In this method, the coefficients before the symbols or formulae of the reactants and products are adjusted in such a way that the total number of atoms of each element on both the sides of the arrow head become equal. This balancing is also known as mass balancing because if the atoms of elements on both sides are equal and their masses will also be equal.

The major steps involved in balancing a chemical equation are as follows -

- Write the chemical equation in the form of a word equation. Keep the reactants on the left side and the products on the right side. Separate them by an arrow (\rightarrow), whose head points from the reactants towards the products.



- Convert the word equation into the symbol equation by writing the symbols and formulae of all the reactants and products.
- Make the atoms of different elements on both sides of the equation equal by suitable method. This is known as balancing of equation.
- Do not change the formulae of the substances while balancing the equation.
- Make the equation more informative if possible.

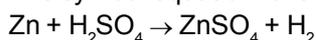
Examples :

1. Zinc reacts with dilute sulphuric acid to give zinc sulphate and hydrogen.

Sol. The word equation for the reaction is -

Zinc + Sulphuric acid → Zinc sulphate + Hydrogen

The symbol equation for the same reaction is -



Let us count the number of atoms of all the elements in the reactants and products on both sides of the equation.

Element	No. of atoms of reactants (L.H.S.)	No. of atoms of products (R.H.S.)
Zn	1	1
H	2	2
S	1	1
O	4	4

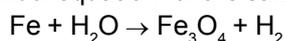
As the number of atoms of the elements involved in the reactants and products are equal, the equation is already balanced.

2. Iron reacts with water (steam) to form iron (II,III) oxide and liberates hydrogen gas.

Sol. The word equation for the reaction is -

Iron + Water → Iron (II,III) oxide + Hydrogen

The symbol equation for the same reaction is -



The balancing of the equations is done in the following steps :

I : Let us count the number of atoms of all the elements in the reactants and products on both sides of the equation .

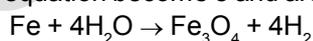
Element	No. of atoms of reactants (L.H.S.)	No. of atoms of products (R.H.S.)
Fe	1	3
H	2	2
O	1	4

Thus, the number of H atoms are equal on both sides. At the same time, the number of Fe and O atoms are not equal.

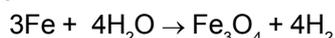
II : On inspection, the number of O atoms in the reactant (H_2O) is 1 while in the product (Fe_3O_4), these are 4. To balance the atoms, put coefficient 4 before H_2O on the reactant side. The partially balanced equation may be written as



III : In order to equate H atoms, put coefficient 4 before H_2 on the product side. As a result, the H atoms on both sides of the equation become 8 and are thus balanced. The partially balanced equation may now be written as



IV : In order to balance the Fe atoms, put coefficient 3 before Fe on the reactant side. The equation formed may be written as -

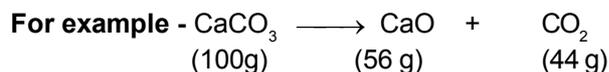




V : On final inspection, the number of atoms of all the elements on both sides of the equation are equal. Therefore, the equation is balanced.

(C) Specialities of Chemical Equation :

- (i) We get the information about the substances which are taking part and formed in the reaction.
- (ii) We get the information about the number of molecules of elements or compounds which are either taking part or formed in the chemical reaction.
- (iii) We also get the information of weight of reactants or products.

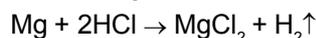


Total weight of reactants is equal to the total weight of products because matter is never destroyed. In the above example total weight of calcium carbonate (reactant) is 100g and of product is also 100g (56 g + 44 g).

(iv) In a chemical equation if any reactant or product is in gaseous state, then its volume can also be determined. For example in the above reaction volume of carbon dioxide is 22.4 litres at S.T.P.

(v) In a chemical equation with the help of product we can get information about the valency as well.

For example -



In the above reaction one atom of Mg displaces two atoms of hydrogen, so valency of magnesium is two.

❖ Note :

All chemical equations are written under N.T.P. conditions (at 298 K and 1 atmosphere pressure) if conditions are not otherwise mentioned.

(D) Limitations of Chemical Equations and their Rectifications :

- (i) We do not get information about the physical state of reactants and products.
For example solid, liquid or gas.
 - (ii) No information about the concentration of reactants and products is obtained .
 - (iii) No information about the speed of reaction and sense of timing can be obtained.
 - (iv) Information regarding the favourable conditions of the reactions such as pressure, temperature, catalyst etc. can't be obtained during the reaction.
 - (v) We do not get information whether energy is absorbed or evolved during the reaction.
 - (vi) We do not get information whether the reaction is reversible or irreversible.
 - (vii) We do not get information about the necessary precautions to be taken for the completion of reaction.
- The above limitations are rectified in the following manner -**

(i) The physical state of reactants and products are represented by writing them in bracket.

Writing State Symbols :

The chemical equations or symbol equations which we have enlisted don't mention the physical states of the reactant and product species involved in the reaction. In order to make the equation more informative, the physical states are also mentioned with the help of certain specific symbols known as state symbols. These symbols are

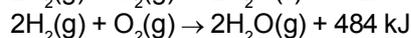
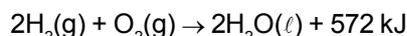
- (s) for solid state • (l) for liquid state
- (g) for gaseous state
- (aq) for aqueous solution i.e., solution prepared in water.



Sometimes a gas is evolved in a reaction is shown by the symbol (\uparrow) i.e., by an arrow pointing upwards. Similarly the precipitate, if formed during the reaction, is indicated by the symbol (\downarrow) i.e., by an arrow pointing downwards.

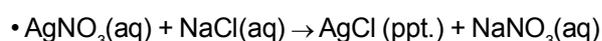
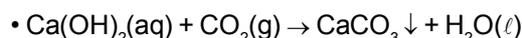
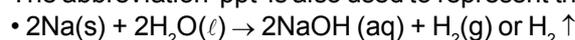
Significance of State Symbols :

The state symbols are of most significance for those chemical reactions which are either accompanied by the evolution of heat (exothermic) or by the absorption of heat (endothermic). For example.

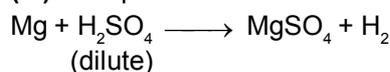


Both these reactions are of exothermic nature because heat has been evolved in these. However, actual amounts of heat evolved are different when water is in the liquid state and when it is in the vapour state.

(ii) The precipitate formed in the reaction is represented by \downarrow symbol and gaseous substance by \uparrow symbol. The abbreviation 'ppt' is also used to represent the precipitate, if formed.



(iii) To express the concentration, dilute or conc. is written below the formula.

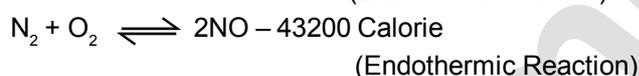
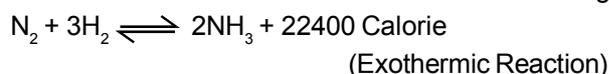


(iv) Favourable conditions required for the completion of reaction are written above and below the arrow.



(v) Reversible reaction is represented by (\rightleftharpoons) symbol and irreversible reaction by (\rightarrow) symbol.

(vi) The heat absorbed in the chemical reaction is written on the right side by putting negative (-) sign and heat evolved in the chemical reaction is written on the right side by putting positive (+) sign.



Solved Examples

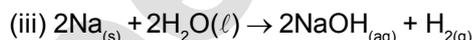
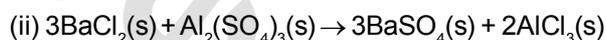
Example1: Write the balanced equation for the following chemical reactions.

(i) Hydrogen + Chlorine \rightarrow Hydrogen chloride

(ii) Barium chloride + Aluminium sulphate \rightarrow Barium sulphate + Aluminium chloride

(iii) Sodium + Water \rightarrow Sodium hydroxide + Hydrogen

Solution:

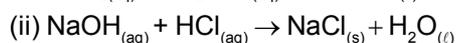
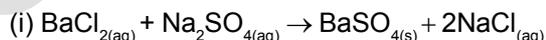


Example2: Write a balanced chemical equation with state symbols for the following reactions.

(i) Solutions of barium chloride and sodium sulphate in water react to give insoluble barium sulphate and the solution of sodium chloride.

(ii) Sodium hydroxide solution (in water) reacts with hydrochloric acid solution (in water) to produce sodium chloride solution and water

Solution:



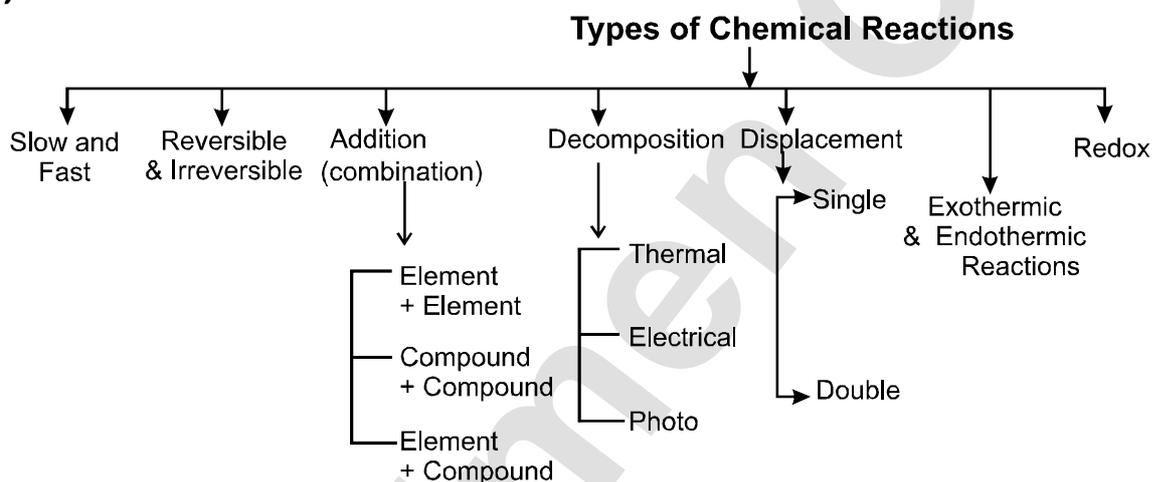


Check Your Progress

- Action of water on calcium carbide (CaC_2) is used for the preparation of acetylene gas (C_2H_2) used in welding. After the reaction, calcium carbide is converted into slaked lime. Write the balanced equation for the reaction.
- In the reaction $2\text{KClO}_3 \xrightarrow[\text{MnO}_2]{\Delta} 2\text{KCl} + 3\text{O}_2$, what do the symbol Δ and MnO_2 written on the arrow signify.
- A pinch of solid sodium carbonate is added into dilute hydrochloric acid in a test tube. Sodium chloride and water formed remain in the solution whereas carbon dioxide escapes out. The tube is found to become hot. How will the reaction be represented to make it maximum informative?
- Balance the following chemical equations
 - $\text{Al} + \text{O}_2 \longrightarrow \text{Al}_2\text{O}_3$
 - $\text{C}_4\text{H}_{10} + \text{O}_2 \longrightarrow \text{CO}_2 + \text{H}_2\text{O}$



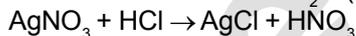
(C) TYPES OF CHEMICAL REACTIONS



(A) Slow and Fast reaction

On the basis of rate of reaction, chemical reactions are of two types - slow and fast

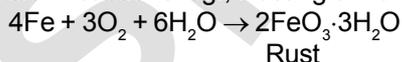
(a) Fast reaction : These reactions take place very fast on adding reactants. Generally these reactions are ionic reactions. For example, the reaction between strong acid and strong base become complete in 10^{-10} sec.



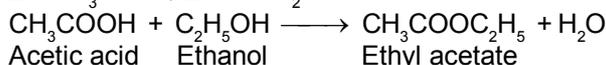
(White ppt)

The white precipitate of silver chloride (AgCl) is obtained on combination of silver nitrate and hydrochloric acid. The rate of photosynthesis is also very fast in plants. The half-life period ($+1/2$) this reaction is 10^{-12} sec. [Half-life period of the reaction is the time to convert the half amount of reactants into products]

(B) Slow reaction : There are many reaction which complete in hours the days or years. These reactions are slow reactions. eg., Rusting of iron completes in years which is the best example of slow chemical reaction.



Other examples :



(B) Reversible -Irreversible reaction



(a) Irreversible reactions : The reactions in which reactants form products on reaction and these reactions take place in one direction only, are called irreversible reactions. In such reactions, the concentration of reactants goes on decreasing and concentration of products goes on increasing. When these chemical reactions are written in the form chemical equation then it is represented by sign of arrow (\longrightarrow)

Example -



Coal burns in air to form carbon dioxide.



methane

Methane on combustion gives carbon dioxide and water and very stable so they do not form methane on further reaction. Hence, chemical changes take place generally in these reactions and form products. Products do not form again reactants.

(b) Reversible reactions : The reaction in which reactants react to form products and at that time products on reaction in these conditions to form reactants, are called reversible reactions. These reactions take place in both directions. The quantity of reactant is never zero in these reactions. These reactions are represented by sign of half arrow on both side in place of sign of arrow



Reversible reactions are divided in to two reactions which occur simultaneously ;

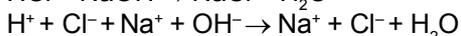
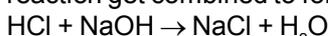


It is called forward reaction.

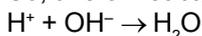
When strong acid and strong base of same concentration react together, then pH of solution will be 7.

However, when strong acid reacts with weak base, its pH is less than 7. when strong base reacts with weak acid, then pH of the solution is more than 7.

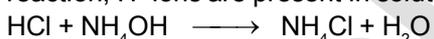
It can also be understood in the way solution is neutral on adding acid and base then acid and base of same mass form salt. One mole H^+ ion given by acid reacts with one mole OH^- ion of base to form water and becomes neutral. Strong acid and strong base are completely ionized. So all H^+ ions formed in the neutralization reaction get combined to form water and the pH of solution becomes 7.



So, overall reaction is :



Where as, in the neutralisation reaction between weak bases and strong acids, weak bases are not completely ionized, and remain in molecular form in some amount. So, the H^+ ion concentration is greater than OH^- ion concentration by taking same moles of acid and base in such solution. It is thus, even after neutralization reaction, H^+ ions are present in solution and the pH of solution is less than 7.



Ammonium hydroxide

Here, NH_4OH is weak base.

Similarly, in neutralization reaction between weak acid and strong bases, weak acid are not completely ionized or non ionized and remain in molecular form in some amount. So, the OH^- ion concentration is greater than H^+ ion concentration by taking equal moles of acid and base in such solution. Hence, after neutralization reaction, OH^- ions are maximum in solution and the pH of solution is more than 7.



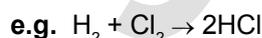
Acetic acid

Sodium acetate

Here, acetic acid is a weak acid.

(C) Addition Reactions :

It is a union of two or more than two substances to form a new substance. It may be brought about by the application of heat, light, electricity or pressure.



In the above example H_2 and Cl_2 two elements combine to form hydrogen chloride.

Addition reactions may be formed in the following conditions -

(i) When two or more elements combine to form a new compound.



Synthesis reaction : It is a type of addition reaction in which a new substance is formed by the union of its component elements.

e.g. $N_2 + 3H_2 \rightarrow 2NH_3$ (Haber's Process)

Ammonia is synthesised from its components, nitrogen and hydrogen, so it is a synthesis reaction.

❖ **Note :**

All synthesis reaction are addition reactions but all addition reactions are not synthesis reactions.

Other examples of synthesis reactions are -

- $2H_2 + O_2 \rightarrow 2H_2O$
- $2Mg + O_2 \rightarrow 2MgO$
- $2Na + Cl_2 \rightarrow 2NaCl$

(ii) When two or more compounds combine to form a new compound.

e.g.

- $NH_3 + HCl \rightarrow NH_4Cl$
- $CaO + CO_2 \rightarrow CaCO_3$
- $CH_2 = CH_2 + Br_2 \rightarrow \begin{array}{c} CH_2-Br \\ | \\ CH_2-Br \end{array}$
1,2-Dibromoethane

(iii) When an element and a compound combine to form a new compound.

e.g.

- $2CO + O_2 \rightarrow 2CO_2$
- $2SO_2 + O_2 \rightarrow 2SO_3$

❖ **Note :**

Only single substance is formed as a product in the addition reactions.

(D) Decomposition Reaction :

It is breaking up of a substance into simpler compounds and it may be brought about by the application of heat, light, electricity etc.

(i) A decomposition reaction brought by heat is known as thermal decomposition.

e.g.

- $CaCO_3 \xrightarrow{\Delta} CaO + CO_2$
- $2Pb(NO_3)_2 \xrightarrow{\Delta} 2PbO + 4NO_2 + O_2$

(ii) Decomposition performed by electricity is known as electrolysis.

e.g.

- $2H_2O \xrightarrow{\text{Electricity}} 2H_2 + O_2$
- $2NaCl \text{ (molten)} \xrightarrow{\text{Electricity}} 2Na + Cl_2$
- $2Al_2O_3 \xrightarrow{\text{Electricity}} 4Al + 3O_2$

(iii) A decomposition reaction brought by light is known as photo decomposition.

e.g.

- $2AgBr \xrightarrow{\text{Light}} 2Ag + Br_2$
- $2AgCl \xrightarrow{\text{Light}} 2Ag + Cl_2$

(iv) Decomposition reaction in which a compound decomposes into its elements is known as analysis reaction.

e.g.

- $2HgO \xrightarrow{\Delta} 2Hg + O_2$
- $2HI \xrightarrow{\Delta} H_2 \uparrow + I_2 \uparrow$



All analysis reactions are decomposition reactions, but all decomposition reactions are not analysis reactions.

❖ **Note :**

Decomposition reaction is just opposite of the addition reaction.

(e) Displacement Reactions :

It involves displacement of one of the constituents of a compound by another substance and may be regarded as a displacement reaction.

Types of Displacement Reactions

The displacing group may have many types of electronic configuration and hence many types of substitution reactions are possible. In general :

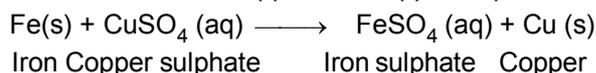
(i) A more active metal will displace a less active metal from compound.

(ii) Some active nonmetals will displace less active non metals.

(iii) Some metals will displace a non metal.

**Displacement of A Less Active Metal By A More Active Metal
Reaction 1.**

When an iron nail is dipped in a copper sulphate solution, it gets coated with copper.



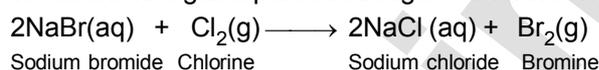
In this reaction, Fe has taken the place of Cu in the compound CuSO_4 . In other words, we say that Fe has displaced Cu from the compound CuSO_4 .

Conclusion

From this reaction we conclude that Fe (iron) is more reactive metal than Cu (Copper).

**Displacement of A Less Active Non metal By A More Active Non metal
Reaction 1.**

When chlorine gas is passed through sodium bromide solution, sodium chloride and bromine are formed.



Conclusion.

In this reaction, chlorine has displaced bromine from NaBr. Therefore, chlorine is more reactive than bromine.

Reaction 2.

When chlorine is bubbled through sodium iodide solution, sodium chloride and iodine are formed



Conclusion

In this reaction chlorine has displaced I_2 from sodium iodide (NaI).

Therefore, Cl (chlorine) is more reactive than I (Iodine).

Displacement of Hydrogen From Acids By Active Metals

When zinc reacts with sulphuric acid, hydrogen gas is liberated and zinc sulphate is formed.



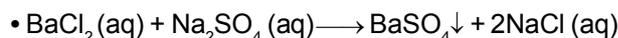
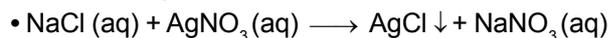
Conclusion

Zn (Zinc) is more reactive than H (hydrogen).

(f) Double Displacement :



It is mutual exchange of the radicals of two compounds taking part in the reaction and results in the formation of two new compounds.



❖ **Note :**

Acid base neutralisation reactions are double displacement reactions.

(g) Redox Reactions :

In our daily life we come across processes like rusting of objects made of iron, fading of the colour of the clothes, burning of the combustible substances such as cooking gas, wood, coal, etc. All such processes fall in the category of specific type of chemical reactions called oxidation - reduction reactions or redox reactions.

Most of the elements are reactive and react with oxygen and hydrogen. Initially, on the basis of addition of oxygen and hydrogen, the chemical reactions were considered as oxidation and reduction reactions but afterwards, the definition was expanded, on the basis of addition or displacement of other elements except O_2 and H_2 , which are as follows -

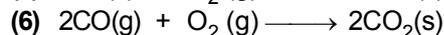
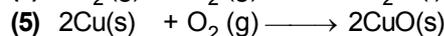
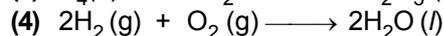
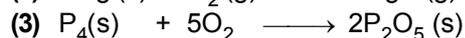
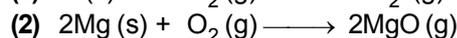
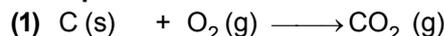
Oxidation :

Definitions : The oxidation of a substance takes place when :

(a) There is addition of oxygen to a substance.

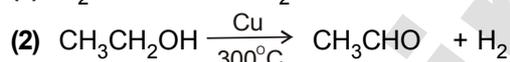
(i) The chemical reactions in which oxygen combines with some other substance.

Examples

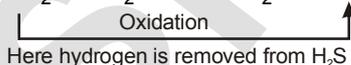
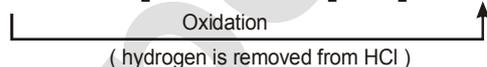
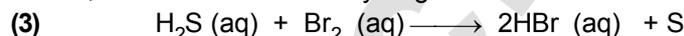


(B) There is removal of hydrogen from a substance

(i) The chemical reactions in which hydrogen is lost from a substance.

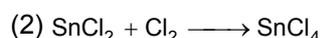


In ethyl alcohol, 6 hydrogen atoms are present and 4 hydrogen atoms are present in acetaldehyde, so formed. Hence, there is a loss of two hydrogen atoms so this reaction is an oxidation reaction.



(C) There is addition of an electronegative element to a substance

Examples



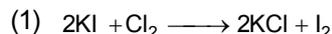
In these reactions, numbers of atoms of electronegative element chlorine is increased in Fe and SnCl_2 and forms



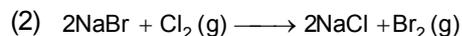
FeCl_3 and SnCl_4 respectively

(D) There is removal of electropositive element from a substance

Examples



The electropositive element K (Potassium) is lost and in this way oxidation of KI takes place.



In this reaction NaBr changes to Br_2 . This involves removal of electropositive atom i.e. oxidation thus NaBr is oxidised to Br_2

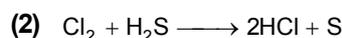
So, in short oxidation is a chemical reaction in which substances combine with oxygen or an electronegative element or lose hydrogen or an electropositive element.

Reduction :

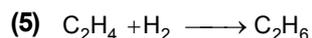
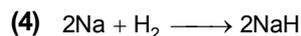
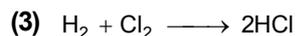
Definitions : The reduction of a substance takes place when :

(a) There is addition of hydrogen to a substance.

Examples

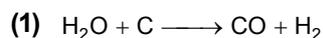


Hydrogen sulphide (H_2S) when reacted with chlorine (Cl_2) gets oxidised to sulphur where as chlorine gets reduced to HCl



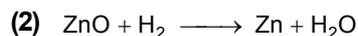
(B) There is removal of oxygen from a substance

Examples :

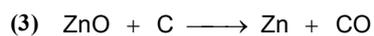


Steam coke water gas

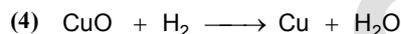
In this case, water has been reduced to hydrogen by the removal of oxygen



Here Zinc oxide has been reduced to zinc by the removal of oxygen



Reduction
(Removal of oxygen)



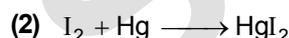
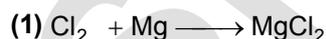
Reduction
(Removal of oxygen)



Reduction
(Removal of oxygen)

(C) There is addition of electropositive element to a substance.

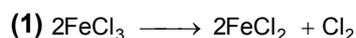
Examples



In above reaction, Cl_2 is reduced to MgCl_2 and I_2 is reduced to HgI_2

(D) There is removal of an electronegative element from a substance.

Examples :





In the above reactions change of FeCl_3 and FeS to FeCl_2 and Fe respectively are examples of reduction.

So, in short, reduction is a chemical reaction in which substance combine with hydrogen or an electropositive element or lose oxygen or an electro negative element.

A substance that brings about oxidation that is addition of oxygen or an electronegative element and removal of hydrogen or an electropositive element is called oxidising agent.

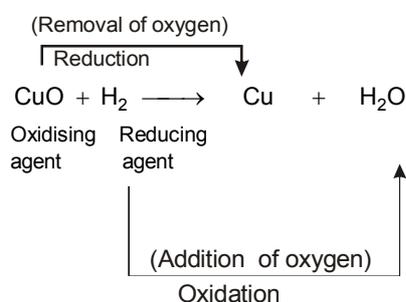
On the other hand, a substance that brings about reduction, that is removal of oxygen or an electronegative element and addition of hydrogen or an electropositive element is called reducing agent.

Consider the reaction



In this reaction, hydrogen removes oxygen from copper oxide. Thus, CuO is reduced and hydrogen behaves as reducing agent.

Copper oxide gives oxygen to hydrogen and hydrogen is oxidised to water by CuO . Therefore, CuO is acting as oxidising agent



CuO makes oxidation to occur \rightarrow Oxidising agent

H_2 makes reduction to occur \rightarrow Reducing agent

NOTE :

(i) The substance to which oxygen is added or substance from which hydrogen is removed is said to be oxidised.

(ii) The substance from which oxygen is removed or substance to which hydrogen is added is said to be reduced.

(iii) The substance which gets oxidised acts as reducing agent.

(iv) The substances which gets reduced acts as an oxidising agent.

MODERN CONCEPT OF OXIDATION AND REDUCTION

Besides earlier concepts of oxidation and reduction, two modern concepts of oxidation and reduction are more common.

(i) Electronic concept (ii) Oxidation number concept

Here we will study only electronic concept.

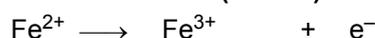
Oxidation

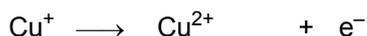
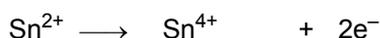
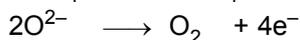
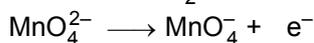
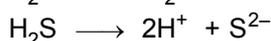
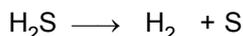
According to electronic concept, those chemical reactions in which an atom, ion or molecule loses electron are known as Oxidation reaction. This is also known as **de-electronation**.

(i) Oxidation of atom



(ii) Oxidation of ion (Cation)

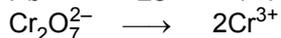
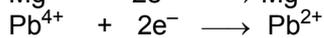
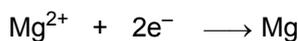


**(iii) Oxidation of ion (Anion)****(iv) Oxidation of molecule**

In oxidation reaction, electrons are lost due to which, positive charge on substance is increased and negative charge on substance is decreased.

Reduction

Reduction is the chemical reaction in which an atom, ion or molecule gains one or more electron. This is also known as electronation.

(i) Reduction of atom**(ii) Reduction of ion****(iii) Reduction of molecule**

In reduction reaction, gain of electrons takes place due to which there is increase in negative charge or decrease in positive charge.

TABLE : COMPARATIVE STUDY OF OXIDATION AND REDUCTION REACTIONS

	Oxidation	Reduction
1	Combination of substance with oxygen	Combination of substance with hydrogen
2	Combination of substance with electronegative element	Combination of substance with electropositive element
3	Loss of hydrogen from substance	Loss of oxygen from substance
4	Loss of electropositive element from substance	Loss of electronegative element from substance
5	Loss of electron from an atom or ion.	Gain of electron by an atom or ion.

OXIDATION NUMBER

“The charge, which an atom has in its ionic form, or appears to have when all other atoms are removed from it as ions.”

Rules for the determination of oxidation number

Oxidation number (O.N.) of an atom in a molecule is calculated on the basis of following rules:

- The oxidation number of an element in its free or uncombined form is zero. Thus, oxidation number of the atoms in N_2 , Cl_2 , P_4 , S_8 , He, Fe etc. is zero.

Oxidation state of an element is zero whatever may be its allotropic form. Oxidation state of all components of an alloy is zero.

- The oxidation number of a monoatomic ion is the same as the charge on it.





Example: O.N. of $\text{Na}^+ = +1$, $\text{Mg}^{2+} = +2$ and $\text{Al}^{3+} = +3$. Similarly $\text{Cl}^- = -1$, $\text{S}^{2-} = -2$ and $\text{N}^{3-} = -3$.

- The O.N. of hydrogen is +1, when combined with non-metal, and -1 when combined with active metals. (i.e., in hydrides).
- The O.N. of oxygen is -2 in most of its compounds except in peroxides where it is -1.
O.N. of oxygen in OF_2 is +2 since fluorine is the most electronegative element with O.N. -1.
- In binary compounds of metals and non-metals, the O.N of the metal is always positive while that of the non-metal is always negative.
 - The O.N. of alkali metals is always +1 and that of alkaline earth metals is always +2.
 - The O.N. of halogens is usually -1.
Oxidation number of fluorine is always -1.
But, oxidation number of other halogens may be positive. For example, in Cl_2O , O.N. of chlorine is +1 and that in Cl_2O_7 is +7, since oxygen is more electronegative. In inter-halogen compounds, less electronegative halogen has +ve O.N. For example, in IF_7 , O.N. of I is +7.
- In compounds formed by the combination of two non-metallic elements, the atom with higher electronegativity has negative O.N.
O.N. of N is -3 in NH_3 but +3 in NCl_3 .
- In a neutral molecule, the algebraic sum of the oxidation numbers of all the atoms is zero.
- In an ion, the algebraic sum of the oxidation numbers of all the atoms is equal to the charge on the ion.
For example in SO_4^{2-} ion, the sum of oxidation numbers of S and O atoms must be equal to -2.
By applying these rules, we can calculate the O.N. of any element in a molecule or an ion.

Procedure for calculation of O.N.

Calculation of O.N. of an atom in the molecule of a compound

Example: O.N. of S in H_2S

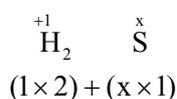
- (i) Write down the formula



- (ii) Write the given/known O.N. of the atom (from the data) and x for the O.N. of the atom which has to be calculated.



- (iii) Write down the total O.N.



- (iv) Equate the sum of O.N. to zero, as a molecule is always neutral. $2 + x = 0$

- (v) Calculate x.

$$2 + x = 0 \quad \therefore x = -2$$

Thus the O.N of S in H_2S is -2.

Calculate the O.N. of

- (i) S in H_2SO_4 (ii) N in $(\text{NH}_4)_2\text{SO}_4$

Calculation of O.N. of an atom in simple radicals

1. O.N. of N in NO_3^-



[all steps are similar as in the case of a compound, except step-(iv). Here, the sum of O.N. is equated to the charge present on the ion/radical]



(iii) $x + (-2 \times 3) = x + (-6) = x - 6$

(iv) $x - 6 = -1$

(v) $x = -1 + 6 = +5$

(vi) Thus, the O.N. of N in NO_3^- is +5

2. O.N. of Cl in ClO_4^-



$x - 8 = -1$

$x = -1 + 8 = +7$

3. O.N. of Cr in $\text{Cr}_2\text{O}_7^{2-}$



$2x - 14 = -2$

$x = \frac{-2 + 14}{2} = +6$

Calculation of O.N. of the metal atom in complex ions

1. O.N. of Fe in $[\text{Fe}(\text{CN})_6]^{4-}$

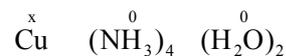


$x + (-1 \times 6) = -4$

$x - 6 = -4$

$x = -4 + 6 = +2$

2. O.N. of Cu in $[\text{Cu}(\text{NH}_3)_4(\text{H}_2\text{O})_2]^{2+}$



$x + (0 \times 4) + (0 \times 2) = +2$

$x = +2$

Calculate the oxidation number of the underlined atom in each of the following:

1. $\underline{\text{Cl}}\text{O}_3^-$

$x + (-2 \times 3) = -1$

$x - 6 = -1$

$x = -1 + 6 = +5$

2. $\underline{\text{Br}}\text{F}_3$

$x + (-1 \times 3) = 0$

$x - 3 = 0$

$x = +3$



3. $\underline{\text{C}}_6\text{H}_{12}\underline{\text{O}}_6$

$$6x + (1 \times 12) + (-2 \times 6)$$

$$6x + 12 - 12 = 0$$

$$6x = 0$$

$$x = 0$$

4. $\text{Na}_2\underline{\text{B}}_4\underline{\text{O}}_7$

$$(+1 \times 2) + (x \times 4) + (-2 \times 7)$$

$$2 + 4x - 14 = 0$$

$$4x = -2 + 14$$

$$x = 12 \div 4 = +3$$

5. $\underline{\text{C}}\text{H}\underline{\text{C}}\text{l}_3$

$$x + (+1 \times 1) + (-1 \times 3)$$

$$x + 1 - 3 = 0$$

$$x = 3 - 1 = +2$$

6. $\underline{\text{C}}\text{O}$ and $\underline{\text{C}}\text{O}_2$

$$\text{CO}$$

$$x + (-2 \times 1) = 0$$

$$x - 2 = 0$$

$$x = +2$$

$$\text{CO}_2$$

$$x + (-2 \times 2) = 0$$

$$x - 4 = 0$$

$$x = +4$$

7. $\text{H}\underline{\text{C}}\text{O}_3^-$

$$(+1 \times 1) + x + (-2 \times 3) = -1$$

$$1 + x - 6 = -1$$

$$x = -1 - 1 + 6 = +4$$

8. $\text{H}_2\underline{\text{P}}\text{O}_4^-$

$$(+1 \times 2) + x + (-2 \times 4) = -1$$

$$2 + x - 8 = -1$$

$$x = -1 - 2 + 8 = +5$$

9. $\underline{\text{B}}_4\underline{\text{O}}_7^{2-}$

$$4x + (-2 \times 7) = -2$$

$$4x - 14 = -2$$

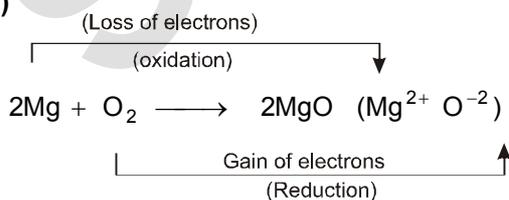
$$x = (-2 + 14) \div 4 = +3$$

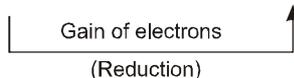
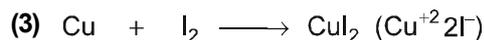
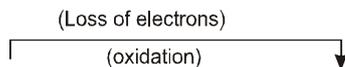
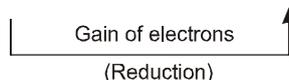
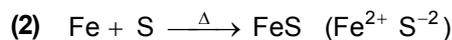
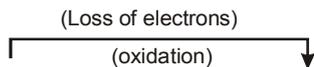
Redox Reactions

Generally, oxidation and reduction reaction takes place simultaneously because in a chemical reaction, one atom, ion or molecule of a substance loses electron while another atom, ion or molecule gains electron. In this way oxidation of one substance while reduction of another substance takes place. Thus such reaction are known as Redox reactions.

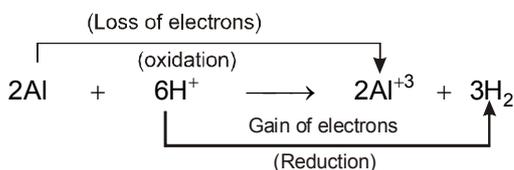
Example :

(1)





OR



Oxidizing agent according to electronic concept

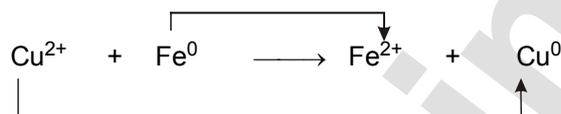
Those substances which gain electrons or get reduced are known as oxidizing agent.

Reducing agent according to electronic concept

Those substances which lose electrons or get oxidised are known as reducing agent,



Oxidation



Reduction

In this reaction, Fe loses electrons and get oxidised so it is **reducing agent**, while CuSO_4 gains electrons and get reduced, so clearly it is an **oxidizing agent**.

Solved Examples

Example1: Write the balanced chemical equation for the following and identify the type of reaction in each case.

- Potassium bromide (aq) + Barium iodide (aq) \rightarrow Potassium iodide (aq) + Barium bromide(s)
- Zinc carbonate (s) \rightarrow Zinc oxide (s) + Carbon dioxide (g)
- Hydrogen (g) + Chlorine (g) \rightarrow Hydrogen chloride (g)
- Magnesium (s) + Hydrochloric acid (aq) \rightarrow Magnesium chloride (aq) + Hydrogen (g)

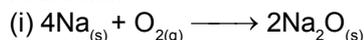
Solution: (a) $2\text{KBr}(\text{aq}) + \text{BaI}_2(\text{aq}) \longrightarrow 2\text{KI}(\text{aq}) + \text{BaBr}_2(\text{s})$; Double displacement reaction

(B) $\text{ZnCO}_3(\text{s}) \longrightarrow \text{ZnO}(\text{s}) + \text{CO}_2(\text{g})$; Decomposition reaction

(C) $\text{H}_2(\text{g}) + \text{Cl}_2(\text{g}) \longrightarrow 2\text{HCl}(\text{g})$; Combination reaction

(D) $\text{Mg}(\text{s}) + 2\text{HCl}(\text{aq}) \longrightarrow \text{MgCl}_2(\text{aq}) + \text{H}_2(\text{g})$; Displacement reaction

Example2: Identify the substances that are oxidised and the substances that are reduced in the following reactions.





Solution:

(i) Sodium (Na) is oxidised as it gains oxygen and oxygen gets reduced.

(ii) Copper oxide (CuO) is reduced to copper (Cu) while hydrogen (H₂) gets oxidised to water (H₂O).



Check Your Progress

- On heating blue coloured powder of copper (II) nitrate in a boiling tube, copper oxide (black), oxygen gas and a brown gas X is formed
 - Write a balanced chemical equation of the reaction.
 - Identify the brown gas X evolved.
 - Identify the type of reaction.
 - What could be the nature of aqueous solution of the gas X?
- In the following reaction, name the substance oxidized and the substance reduced :
 $\text{PbS}_{(s)} + 4\text{H}_2\text{O}_2_{(aq)} \rightarrow \text{PbSO}_4_{(s)} + 4\text{H}_2\text{O}_{(l)}$
 Which substance acts as oxidizing agent and which one as reducing agent ?
- Why does zinc plate develop holes when placed in copper sulphate solution for few hours/days ?
- What is observed when a solution of potassium iodide is added to a solution of lead nitrate taken in a test tube ?
 - What type of reaction in this ?
 - Write a balanced chemical equation to represent the above reaction.
- Give an example of a double displacement reaction accompanied by evolution of a gas.
- What is the name and formula of the product formed when water is added to quick lime for white wash?
 - After white washing the walls, why the walls begin to shine after 2-3 days ?

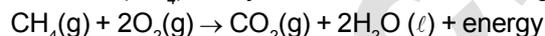


(D) EFFECT OF OXIDATION REACTIONS IN DAILY LIFE

We are all aware of the fact that oxygen is most essential for sustaining life. One can live without food or even water for a number of days but not without oxygen. It is involved in a variety of actions which have wide range of effects on our daily life. Most of them are quite useful while a few may be harmful in nature. Some of these effects are briefly discussed.

(a) Combustion Reactions :

A chemical reaction in which a substance burns or gets oxidised in the presence of air or oxygen is called combustion reaction. For example, kerosene, coal, charcoal, wood etc. burn in air and thus, undergo combustion. Methane (CH₄) a major constituent of natural gas undergoes combustion in excess of oxygen upon heating.



Methane

Similarly, butane (C₄H₁₀), the main constituent of L.P.G. also undergoes combustion.



Butane

All combustion reactions are of exothermic nature and are accompanied by release of heat energy. The human body may be regarded as a furnace or machine in which various food stuffs that we eat undergo oxidation. The heat energy evolved keeps our body working. Carbohydrates such as glucose, fructose, starch etc. are the major source of energy to the human body. They undergo oxidation with the help of oxygen that we inhale to form carbon dioxide and water. For example.



All combustion reactions are not accompanied by flame. Combustion is basically oxidation accompanied by release of energy.

(B) Respiration :

Respiration is the most important biochemical reaction which releases energy in the cells. When we breathe in



(iii) By galvanisation, i.e. coating the surface of iron objects with a thin layer of zinc.

(iii) Rancidity :

Oxidation also has damaging effect on foods containing fats and oils. When the food materials prepared in fats and oils are kept for a long time, they start giving unpleasant smell and taste, this is called rancidity. This happens as follows :

When the fats and oils present in food materials get oxidised by the oxygen (of air), their oxidation products have unpleasant smell and taste. The condition produced by aerial oxidation of fats and oils in foods marked by unpleasant smell and taste is called rancidity. Rancidity spoils the food materials prepared in fats and oils which have been kept for a considerable time and makes them unfit for eating. Rancidity is called 'vikritgandhita' in Hindi.

The development of rancidity of food can be prevented or retarded (slowed down) in the following ways :

1. Rancidity can be prevented by adding anti-oxidants to foods containing fats and oils :

Anti-oxidant is a substance (or chemical) which prevents oxidation. Anti-oxidants are actually reducing agents. When anti-oxidants are added to foods, then the fats and oils present in them do not get oxidised easily and hence do not turn rancid. So the foods remain good to eat for a much longer time. The two common anti-oxidants used in foods to prevent the development of rancidity are BHA (Butylated Hydroxy-Anisole) and BHT (Butylated Hydroxy Toluene).

2. Rancidity can be prevented by packaging fat and oil containing foods in nitrogen gas :

When the packed food is surrounded by an unreactive gas like nitrogen, there is no oxygen (of air) to cause its oxidation and make it rancid. The manufacturers of potato chips (and other similar food products) fill the plastic bags containing chips with nitrogen gas to prevent the chips from being oxidised and turn rancid.

3. Rancidity can be retarded by keeping food in a refrigerator :

The refrigerator has a low temperature inside it. When the food is kept in a refrigerator, the oxidation of fats and oils in it is slowed down due to low temperature. So, the development of rancidity due to oxidation is retarded.

4. Rancidity can be retarded by storing food in air-tight containers :

When food is stored in air-tight containers, then there is little exposure to oxygen of air. Due to reduced exposure to oxygen, the oxidation of fats and oils present in food is slowed down and hence the development of rancidity is retarded.

5. Rancidity can be retarded by storing foods away from light :

In the absence of light, the oxidation of fats and oils present in food is slowed down and hence the development of rancidity is retarded.

Solved Examples

Example1: Why is respiration considered as an exothermic reaction? Explain.

Solution: Energy is required to support life. Energy in our body is obtained from the food we eat. During digestion, large molecules of food are broken down into simpler substances such as glucose. Glucose combines with oxygen in the cells and provides energy. The special name of this combustion reaction is respiration. Since energy is released in the whole process, it is an exothermic process.



Example2: Why do we apply paint on iron articles?

Solution: Iron articles are painted because it prevents them from rusting. When painted, the contact of iron articles from moisture and air is cut off. Hence, rusting is prevented because their presence is essential for rusting to take place.

Example3: Oil and fat containing food items are flushed with nitrogen. Why?

Solution: Nitrogen is an inert gas and does not easily react with these substances. On the other hand, oxygen reacts with food substances and makes them rancid. Thus, bags used in packing food items are



flushed with nitrogen gas to remove oxygen inside the pack. When oxygen is not present inside the pack, rancidity of oil and fat containing food items is avoided.



Check Your Progress

- Why iron corrodes but aluminium does not ?
- A silver article generally turns black when kept in the open for a few days. The article when rubbed with toothpaste again starts shining.
 - Why do silver articles turn black when kept in the open for a few days? Name the phenomenon involved.
 - Name the black substance formed and give its chemical formula.



Board Level Exercise

TYPE (I) : VERY SHORT ANSWER TYPE QUESTIONS :

[01 MARK EACH]

- Which among the following changes are exothermic or endothermic in nature?
 - Decomposition of ferrous sulphate
 - Dilution of sulphuric acid
 - Dissolution of sodium hydroxide in water
 - Dissolution of ammonium chloride in water
- Complete the missing components/variables given as x and y in the following reactions
 - $\text{Pb}(\text{NO}_3)_2(\text{aq}) + 2\text{KI}(\text{aq}) \longrightarrow \text{PbI}_2(x) + 2\text{KNO}_3(y)$
 - $\text{Cu}(\text{s}) + 2\text{AgNO}_3(\text{aq}) \longrightarrow \text{Cu}(\text{NO}_3)_2(\text{aq}) + x(\text{s})$
 - $\text{Zn}(\text{s}) + \text{H}_2\text{SO}_4(\text{aq}) \longrightarrow \text{ZnSO}_4(x) + \text{H}_2(y)$
 - $\text{CaCO}_3(\text{s}) \longrightarrow \text{CaO}(x) + \text{CO}_2(y)$

TYPE (II) : SHORT ANSWER TYPE QUESTIONS :

[02 MARKS EACH]

- Identify the reducing agent and oxidising agent in the following reactions
 - $4\text{NH}_3 + 5\text{O}_2 \longrightarrow 4\text{NO} + 6\text{H}_2\text{O}$
 - $\text{CuO} + \text{H}_2 \longrightarrow \text{Cu} + \text{H}_2\text{O}$
 - $\text{Fe}_2\text{O}_3 + 3\text{CO} \longrightarrow 2\text{Fe} + 3\text{CO}_2$
 - $2\text{H}_2 + \text{O}_2 \longrightarrow 2\text{H}_2\text{O}$
 - $\text{Pb}_3\text{O}_4 + 8\text{HCl} \longrightarrow 3\text{PbCl}_2 + \text{Cl}_2 + 4\text{H}_2\text{O}$
 - $2\text{Mg} + \text{O}_2 \longrightarrow 2\text{MgO}$
 - $\text{CuSO}_4 + \text{Zn} \longrightarrow \text{Cu} + \text{ZnSO}_4$
 - $\text{V}_2\text{O}_5 + 5\text{Ca} \longrightarrow 2\text{V} + 5\text{CaO}$
 - $3\text{Fe} + 4\text{H}_2\text{O} \longrightarrow \text{Fe}_3\text{O}_4 + 4\text{H}_2$
- During the reaction of some metals with dilute hydrochloric acid, following observations were made.
 - Silver metal does not show any change
 - The reaction of sodium metal is found to be highly explosive
 - Some bubbles of a gas are seen when lead (Pb) is reacted with the acid.
 Explain these observations by giving suitable reasons
- Write a balanced chemical equation for each of the following reactions and also classify them.
 - Lead acetate solution is treated with dilute hydrochloric acid to form lead chloride and acetic acid solution.
 - Iron (III) oxide on heating with carbon monoxide gas reacts to form solid iron and liberates carbon dioxide gas.

TYPE (III) : LONG ANSWER TYPE QUESTIONS:

[03 MARK EACH]

- Write the balanced chemical equations for the following reactions
 - Sodium carbonate on reaction with hydrochloric acid in equal molar concentrations gives sodium chloride



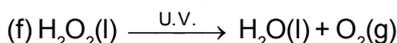
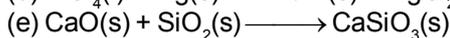
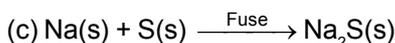
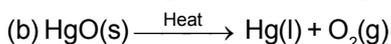
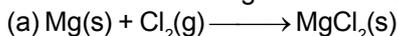


and sodium hydrogencarbonate.

(b) Sodium hydrogencarbonate on reaction with hydrochloric acid gives sodium chloride, water and liberates carbon dioxide.

(c) Copper sulphate on treatment with potassium iodide precipitates cuprous iodide (Cu_2I_2), liberates iodine gas and also forms potassium sulphate.

7. Balance the following chemical equations and identify the type of chemical reaction.



8. A magnesium ribbon is burnt in oxygen to give a white compound X accompanied by emission of light. If the burning ribbon is now placed in an atmosphere of nitrogen, it continues to burn and forms a compound Y.

(a) Write the chemical formulae of X and Y.

(b) Write a balanced chemical equation, when X is dissolved in water.

TYPE (IV): VERY LONG ANSWER TYPE QUESTIONS

[05 MARK EACH]

9. You are provided with two containers made up of copper and aluminium. You are also provided with solutions of dilute HCl, ZnCl_2 and H_2O . In which of the above containers these solutions can be kept?

10. What happens when a piece of

(a) zinc metal is added to copper sulphate solution?

(b) Aluminium metal is added to dilute hydrochloric acid?

(c) silver metal is added to copper sulphate solution? Also, write the balanced chemical equation if the reaction occurs



PREVIOUS YEAR PROBLEMS

SECTION-A

1. Define the term rancidity.

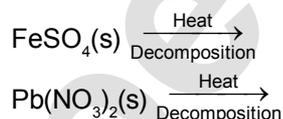
[1 MARKS/CBSE 10TH BOARD: 2014]

2. (a) What happens when copper is burned in air? Give the equation. What type of a reaction is it?

(b) What happens when hydrogen gas is passed over the product obtained in step above? Give the equation also.

[3 MARKS/CBSE 10TH BOARD: 2014]

3. Complete the following reactions and write the balanced equations:



[3 MARKS/CBSE 10TH BOARD: 2014]

4. Why decomposition reactions are called the opposite of combination reactions?

[1 MARKS/CBSE 10TH BOARD: 2015]

5. A solution of potassium chloride when mixed with silver nitrate solution, an insoluble white substance is formed. Write the chemical reaction involved and also mention the type of the chemical reaction?

[2 MARKS/CBSE 10TH BOARD: 2015]

6. Explain why?



- (a) Digestion of food is a decomposition reaction.
 (b) All decomposition reactions are endothermic reactions.
 (c) A popping sound is produced when a burning candle is brought near mouth of a test tube used in electrolysis of water. **[3 MARKS/CBSE 10TH BOARD: 2015]**
7. (a) What happens when a strip of lead metal is placed in a solution of copper chloride? Write the balanced chemical equation for the reaction along with the colour changes observed during the reaction.
 (b) What are precipitation reactions? Give one example of precipitation reaction. **[3 MARKS/CBSE 10TH BOARD: 2015]**
8. A solution of a substance 'X' is used for white washing.
 (a) Name the substance 'X' and write its formula.
 (b) Write the reaction of the substance 'X' named in (a) above with water.
 (c) Write the balanced equation for the following chemical reaction:
 Barium chloride + Aluminium sulphate → Barium sulphate + Aluminium chloride **[3 MARKS/CBSE 10TH BOARD: 2013/2015]**
9. Write balanced chemical equations for the following chemical reactions.
 (a) Hydrogen + Chlorine $\square \rightarrow$ Hydrogen Chloride
 (b) Lead + Copper Chloride \rightarrow Lead Chloride + Copper
 (c) Zinc Oxide + Carbon \rightarrow Zinc + Carbon Monoxide **[3 MARKS/CBSE 10TH BOARD: 2016]**
10. "Respiration is an exothermic reaction." Justify this statement giving the chemical equation for the reaction involved. **[2 MARKS/CBSE 10TH BOARD: 2017]**
11. The color of copper sulphate solution changes when an iron nail is dipped in it. State the giving chemical equation for the reaction involved. Write the name of reaction involved. **[3 MARKS/CBSE 10TH BOARD: 2017]/[1 MARKS/CBSE 10TH BOARD: 2013/2017]**
12. (a) Identify the substance oxidized, substance reduced, oxidizing agent and reducing agent in the following reaction:

$$\text{ZnO} + \text{C} \rightarrow \text{Zn} + \text{CO}$$

 (b) packets of potato chips are flushed with nitrogen gas, why? **[3 MARKS/CBSE 10TH BOARD: 2017]**

SECTION-B

1. When crystals of FeSO_4 are strongly heated the residue obtained is:
 (A*) red in colour (B) blue in colour (C) green in colour (D) colourless **[1 MARKS/CBSE 10TH BOARD: 2013]**
2. Rahul took some zinc granules in a test tube and added dilute HCl to it. He observed that the colour of the zinc granules changed to
 (A) Yellow (B) brown (C) black (D*) white **[1 MARKS/CBSE 10TH BOARD: 2013]**
3. Which of the statements about the reaction below are incorrect?

$$2\text{PbO}(\text{s}) + \text{C}(\text{s}) \rightarrow 2\text{Pb}(\text{s}) + \text{CO}_2(\text{g})$$

 (i) Lead is getting reduced (ii) Carbon dioxide is getting oxidised
 (iii) Carbon is getting oxidised (iv) Lead oxide is getting reduced
 (A*) (i) and (ii) (B) (i) and (iii) (C) (i), (ii) and (iii) (D) All **[1 MARKS/CBSE 10TH BOARD: 2014]**



4. 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
[1 MARKS/CBSE 10TH BOARD: 2015]
5. 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
[1 MARKS/CBSE 10TH BOARD: 2016]
6. Barium Sulphate is:
 (A*) White (B) Yellow (C) Green (D) Red
[1 MARKS/CBSE 10TH BOARD: 2016]
7. 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
[1 MARKS/CBSE 10TH BOARD: 2017]



Exercise-1

SUBJECTIVE QUESTIONS

SUBJECTIVE EASY, ONLY LEARNING VALUE PROBLEMS

SECTION (A) : GENERAL INTRODUCTION AND CHARACTERISTICS OF CHEMICAL REACTIONS

- A-1. What happens when silver nitrate is mixed with a solution of sodium chloride ?
- A-2. What do you mean by exothermic reactions ?
- A-3. What do you mean by endothermic reactions ?

SECTION (B) : CHEMICAL EQUATIONS & BALANCING :

- B-1. Write the balanced chemical equations for the following chemical reactions -
 (i) Aqueous solution of sulphuric acid and sodium hydroxide react to form aqueous sodium sulphate and water.
 (ii) Phosphorus burns in chlorine gas to form phosphorus pentachloride.
- B-2. Write the balanced chemical equations for the following reactions -
 (i) Zinc carbonate(s) \rightarrow Zinc oxide(s) + Carbon dioxide(g)
 (ii) Potassium bromide(aq) + Barium iodide (aq) \rightarrow Potassium iodide (aq) + Barium bromide(aq)
- B-3. Balance the following equations -
 (i) $\text{HgO} \rightarrow \text{Hg} + \text{O}_2$
 (ii) $\text{C}_4\text{H}_{10}(\text{g}) + \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + \text{H}_2\text{O}(\ell)$
 (iii) $\text{BaCl}_2(\text{aq}) + \text{Al}_2(\text{SO}_4)_3(\text{aq}) \rightarrow \text{AlCl}_3(\text{aq}) + \text{BaSO}_4(\text{aq})$
- B-4. What information do we get from a chemical equation? Explain with the help of examples.

**SECTION (C) : TYPES OF CHEMICAL REACTIONS :**

- C-1.** Identify the substances that are oxidized and the substances that are reduced in the following reactions-
- (a) $3\text{Mg} + \text{N}_2 \longrightarrow \text{Mg}_3\text{N}_2$
 (b) $\text{MnO}_2 + 4\text{HCl} \longrightarrow \text{MnCl}_2 + 2\text{H}_2\text{O} + \text{Cl}_2$
 (c) $2\text{FeCl}_3 + \text{H}_2\text{S} \longrightarrow 2\text{FeCl}_2 + \text{S} + 2\text{HCl}$
- C-2.** (i) What is observed when a solution of potassium iodide is added to a solution of lead nitrate taken in a test tube ?
 (ii) Which type of reaction is this ?
 (iii) Write a balanced chemical equation to represent the above reaction.
- C-3.** Classify the following reactions -
- (i) $\text{N}_2 + \text{O}_2 \xrightarrow{\text{Heat}} 2\text{NO}$
 (ii) $2\text{HgO} \longrightarrow 2\text{Hg} + \text{O}_2$
 (iii) $\text{Na}_2\text{SO}_4 + \text{BaCl}_2 \longrightarrow 2\text{NaCl} + \text{BaSO}_4$
 (iv) $\text{CuSO}_4(\text{aq.}) + \text{Zn} \longrightarrow \text{ZnSO}_4(\text{aq.}) + \text{Cu}$
 (v) $\text{NH}_3 + \text{HCl} \longrightarrow \text{NH}_4\text{Cl}$
- C-4.** When a white compound 'X' is placed under sunlight, it turns grey. Give the name of reaction and write the balanced chemical equation.

SECTION (D) : EFFECT OF OXIDATION REACTION IN DAILY LIFE :

- D-1.** Oxidation reactions have some harmful effects. Comment on the sentence.
- D-2.** What do you mean by corrosion ?
- D-3.** What reaction take place during the digestion of food in our body ?

OBJECTIVE QUESTIONS

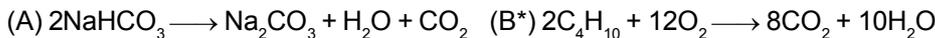
SINGLE CHOICE OBJECTIVE, STRAIGHT CONCEPT/FORMULA ORIENTED**SECTION (A) : GENERAL INTRODUCTION AND CHARACTERISTICS OF CHEMICAL REACTIONS**

- A-1.** Which of the following statements is/are true ?
 (A) The total mass of the system remains same in a chemical change.
 (B) A chemical change is permanent and irreversible.
 (C) A physical change is temporary and reversible.
 (D*) All of these.
- A-2.** Which of the following statements is/are correct ?
 (A) A chemical equation tells us about the substances involved in a reaction.
 (B) A chemical equation informs us about the symbols and formulae of the substances involved in a reaction.
 (C) A chemical equation tells us about the atoms or molecules of the reactants and products involved in a reaction.
 (D*) All are correct.
- A-3.** $\text{Zn}(\text{s}) + \text{H}_2\text{SO}_4(\text{aq}) \longrightarrow \text{ZnSO}_4(\text{aq}) + \text{H}_2(\text{g})$ is an example of -
 (A) precipitation reaction (B) endothermic reaction
 (C*) evolution of gas (D) change in colour
- A-4.** Neutralization reaction is an example of -
 (A*) exothermic reaction (B) endothermic reaction



(C) oxidation reaction

(D) none of these

SECTION (B) : CHEMICAL EQUATIONS & BALANCING :**B-1.** Which of the following reactions is not balanced ?**B-2.** The equation - $\text{Cu} + x\text{HNO}_3 \rightarrow \text{Cu}(\text{NO}_3)_2 + y\text{NO}_2 + 2\text{H}_2\text{O}$

The values of x and y are -

(A) 3 and 5

(B) 8 and 6

(C*) 4 and 2

(D) 7 and 1

B-3. When dilute hydrochloric acid is added to iron fillings -

(A*) hydrogen gas and ferric chloride are produced.

(B) chlorine gas and ferric hydroxide are produced.

(C) no reaction takes place.

(D) iron salt and water are produced.

B-4. In the reaction $x\text{Pb}(\text{NO}_3)_2 \xrightarrow{\text{Heat}} y\text{PbO} + z\text{NO}_2 + \text{O}_2$ x, y and z are -

(A) 1,1,2

(B*) 2,2,4

(C) 1,2,4

(D) 4,2,2

B-5. In the reaction $\text{FeSO}_4 + x \longrightarrow \text{Na}_2\text{SO}_4 + \text{Fe}(\text{OH})_2$, x is -(A) Na_2SO_4 (B) H_2SO_4 (C*) NaOH

(D) none of these

SECTION (C) : TYPES OF CHEMICAL REACTIONS:**C-1.** In the reaction $\text{Mg} + \text{Cl}_2 \rightarrow \text{MgCl}_2$

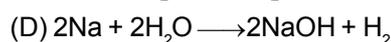
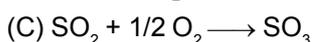
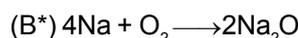
Chlorine may be regarded as -

(A*) an oxidising agent

(B) a reducing agent

(C) a catalyst

(D) providing an inert medium

C-2. Which of the following equations is representing combination of two elements ?**C-3.** Which of the following statements is correct for oxidation reaction ?

(A) Gain or addition of electronegative radical or element

(B) Removal of hydrogen atom

(C) Removal or loss of electropositive radical or element

(D*) All the above statements are correct.

C-4. $\text{H}_2\text{SO}_4 + 2\text{NaOH} \longrightarrow \text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O}$

Above equation is a -

(i) neutralization reaction

(ii) double displacement reaction

(iii) decomposition reaction

(iv) addition reaction

(A) (i) to (iv) all

(B*) (i) and (ii)

(C) (i) and (iii)

(D) (ii) and (iv)

C-5. In the process of burning of magnesium in air, magnesium undergoes -

(A) reduction

(B) sublimation

(C*) oxidation

(D) all of these



- C-6.** A substance which oxidises itself and reduces other is known as -
 (A) an oxidising agent (B*) a reducing agent (C) Both of these (D) None of these
- C-7.** A redox reaction is one in which -
 (A) both the substances are reduced.
 (B) both the substances are oxidised.
 (C) an acid is neutralised by the base.
 (D*) one substance is oxidised, while the other is reduced.

SECTION (D) : EFFECT OF OXIDATION REACTIONS IN DAILY LIFE:

- D-1.** The antioxidant which is used to prevent rancidity in foods is
 (A*) butylated hydroxyl anisole. (B) sodium hydroxide.
 (C) sodium carbonate. (D) methylated hydroxyl anisole
- D-2.** Corrosion of silver occurs due to the formation of
 (A) Ag₂O (B) AgCl (C) Ag₂CO₃ (D*) Ag₂S

Exercise-2

Marked Questions can be used as Revision Questions.

OBJECTIVE QUESTIONS

1. Which of the following is an example of oxidation reaction ?
 (A*) $\text{Sn}^{+2} - 2e^- \rightarrow \text{Sn}^{+4}$ (B) $\text{Fe}^{+3} + e^- \rightarrow \text{Fe}^{+2}$ (C) $\text{Cl}_2 + 2e^- \rightarrow 2\text{Cl}^-$ (D) None of these
2. In the reaction

$$\begin{array}{ccccccc} \text{CaO} & + & \text{H}_2\text{O} & \longrightarrow & \text{Ca(OH)}_2 & + & \text{Heat energy} \\ \text{Calcium} & & \text{Water} & & \text{Calcium} & & \\ \text{oxide} & & & & \text{hydroxide} & & \end{array}$$

 the possible state of Ca(OH)₂ is -
 (A) liquid. (B*) aqueous. (C) gaseous. (D) solid.
3. Match the following -
- | Column A | Column B |
|---|--|
| Types of chemical reaction | Chemical equations |
| (a) Combination reaction | (i) $\text{CaCO}_3 \xrightarrow{\Delta} \text{CaO} + \text{CO}_2$ |
| (b) Decomposition reaction | (ii) $2\text{H}_2\text{O} \xrightarrow{\text{Electricity}} 2\text{H}_2 + \text{O}_2$ |
| (c) Displacement reaction | (iii) $\text{CaO} + \text{CO}_2 \longrightarrow \text{CaCO}_3$ |
| (d) Analysis reaction | (iv) $\text{Fe(s)} + \text{CuSO}_4(\text{aq.}) \longrightarrow \text{FeSO}_4(\text{aq.}) + \text{Cu(s)}$ |
| (A) (a)-(ii), (b)-(i), (c)-(iv), (d)-(iii) | (B) (a)-(i), (b)-(ii), (c)-(iii), (d)-(iv) |
| (C*) (a)-(iii), (b)-(i), (c)-(iv), (d)-(ii) | (D) (a)-(iii), (b)-(i), (c)-(iii), (d)-(iv) |
4. Which of the following reactions is/are a double displacement reaction(s) ?
 (i) $\text{AgNO}_3 + \text{NaBr} \longrightarrow \text{NaNO}_3 + \text{AgBr}$ (ii) $\text{BaCl}_2 + \text{H}_2\text{SO}_4 \longrightarrow \text{BaSO}_4 + 2\text{HCl}$
 (iii) $\text{As}_2\text{O}_3 + 3\text{H}_2\text{S} \longrightarrow \text{As}_2\text{S}_3 + 3\text{H}_2\text{O}$ (iv) $\text{NaOH} + \text{HCl} \longrightarrow \text{NaCl} + \text{H}_2\text{O}$
 (A) (i) & (ii) (B) only (iii) (C) only (iv) (D*) (i) to (iv) all



5. The colour of the chemical that changes when it is left open in sunlight is -
 (A) FeSO_4 (s). (B) $\text{Pb}(\text{NO}_3)_2$ (s) (C*) AgCl (s). (D) BaCl_2 (aq)
6. Which of the following statement(s) is/are correct ?
 (A) Many compounds can be used as oxidizing as well as reducing agent .
 (B) We need equal moles and equal volumes of strong monobasic acid and strong monoacidic base to completely neutralize themselves.
 (C) The quantity of a catalyst does not change at the end of a chemical reaction .
 (D*) All of these are correct
7. The decomposition of KClO_3 to KCl and O_2 on heating is an example of:
 (A) Intermolecular redox change (B*) Intramolecular redox change
 (C) Disproportionation or auto redox change (D) None of the above
8. AgNO_3 (aq) + NaCl (aq) \longrightarrow AgCl (s) + NaNO_3 (aq)
 Above reaction is a -
 (A) precipitation reaction (B) double displacement reaction
 (C) combination reaction (D*) (A) and (B) both
9. Conversion of PbSO_4 to PbS is -
 (A*) reduction of S (B) oxidation of S (C) dissociation (D) none of these
10. Which of the following is redox reaction ?
 (A) $\text{NaOH} + \text{HCl} \longrightarrow \text{NaCl} + \text{H}_2\text{O}$ (B) $\text{AgNO}_3 + \text{KI} \longrightarrow \text{AgI} + \text{KNO}_3$
 (C) $\text{BaO}_2 + \text{H}_2\text{SO}_4 \longrightarrow \text{BaSO}_4 + \text{H}_2\text{O}_2$ (D*) $\text{SnCl}_2 + \text{HgCl}_2 \longrightarrow \text{SnCl}_4 + \text{Hg}$

Exercise-3

Marked Questions can be used as Revision Questions.

NTSE PROBLEMS (PREVIOUS YEARS)

1. The reaction between aqueous solutions of sodium chloride and silver nitrate is - [Raj. NTSE Stage-I/05]
 (A) displacement reaction (B) synthesis reaction
 (C*) double displacement reaction (D) analysis reaction
2. $\text{CH}_4 + \text{Cl}_2 \rightarrow \text{CH}_3\text{Cl} + \text{HCl}$ reaction is an example of - [Raj. NTSE Stage-I/06]
 (A) Synthetic (B) Analytical (C*) Displacement (D) Neutralisation
3. A Brown and bright element "x" when heated in presence of air turns into black substance "y". If Hydrogen gas is passed over this heating material again "x" is obtained. "x" and "y" are - [Raj. NTSE Stage-I/13]
 (A*) Cu & CuO (B) S & SO_2 (C) C & CO_2 (D) Na & NaH
4. $\text{H}_2\text{S}(\text{g}) + \text{Cl}_2(\text{g}) \rightarrow 2\text{HCl}(\text{g}) + \text{S}(\text{s})$
 The reaction is interpreted as : [Delhi. NTSE Stage-I/13]
 (A*) H_2S is getting oxidised and Cl_2 is getting reduced
 (B) H_2S is getting reduced and Cl_2 is getting oxidised
 (C) Only H_2S is oxidised
 (D) Both H_2S and Cl_2 are reduced
5. Oxidation is defined as : [M.P. NTSE Stage-I/13]
 (A*) loss of electron (B) gain of electron (C) loss of proton (D) gain of proton
6. From the following metals whose nitrate produces NO_2 gas on heating [West Bengal NTSE Stage-I/13]
 (A) Na (B) K (C*) Pb (D) None of these
7. Displacement reaction is : [Rajasthan NTSE Stage-I/14]
 (A) $\text{CaO}(\text{s}) + \text{H}_2\text{O}(\text{l}) \rightarrow \text{Ca}(\text{OH})_2(\text{aq})$



- (B*) $\text{Pb(s)} + \text{CuCl}_2(\text{aq}) \rightarrow \text{PbCl}_2(\text{aq}) + \text{Cu(s)}$
 (C) $\text{MnO}_2(\text{s}) + 4\text{HCl(l)} \rightarrow \text{MnCl}_2(\text{s}) + 2\text{H}_2\text{O(l)} + \text{Cl}_2(\text{g})$
 (D) $\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O}$

8. Which of the following is endothermic reaction ? **[Haryana NTSE Stage-I/14]**
 (A) $\text{C(s)} + \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g})$ (B*) $\text{N}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{NO(g)}$
 (C) $2\text{H}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{H}_2\text{O(l)}$ (D) $2\text{CH}_3\text{OH(l)} + 3\text{O}_2(\text{g}) \rightarrow 2\text{CO}_2(\text{g}) + 4\text{H}_2\text{O(l)}$
9. Precipitate formation during chemical reaction is indicated by this arrow : **[Maharashtra_NTSE Stage-I/15]**
 (A) \uparrow (B) \rightarrow (C*) \downarrow (D) \leftarrow
10. $\text{BaCl}_2(\text{aq}) + \text{Na}_2\text{SO}_4(\text{aq}) \rightarrow \text{BaSO}_4(\text{s}) + 2\text{NaCl}(\text{aq})$ **[Maharashtra_NTSE Stage-I/15]**
 The types of reaction are :
 (a) Displacement (b) Precipitation (c) Combination (d) Double displacement
 (A) (a) & (C) (B) (a), (B), & (C) (C) (B) & (C) (D*) (B) & (D)
11. The chemical reaction $\text{HNO}_3 + \text{KOH} \rightarrow \text{KNO}_3 + \text{H}_2\text{O}$ is an example of **[Rajasthan_NTSE Stage-I/15]**
 (A) neutralization (B) double displacement
 (C*) neutralization and double displacement (D) combination
12. Hydrolysis of water is which type of following reactions? **[Chandigarh NTSE Stage-1/ 2015]**
 (A) Endothermic (B) Decomposition (C*) Both A and B (D) Combination
13. When a burning splinter is brought near the gas jar containing hydrogen gas a popping sound is observed. It is due to **[Chandigarh NTSE Stage-1/ 2015]**
 (A*) exothermic (B) endothermic
 (C) exothermic and endothermic (D) none of these
14. Identify the correct oxidant and reductant in the following reaction : **[Delhi NTSE Stage-1/ 2015]**
 $\text{PbS} + 4\text{H}_2\text{O}_2 \rightarrow \text{PbSO}_4 + 4\text{H}_2\text{O}$
 (A) PbS – Oxidant (B) PbS – Reductant
 H_2O_2 – Reductant PbSO_4 – Oxidant
 (C*) PbS – Reductant (D) H_2O_2 – Oxidant
 H_2O_2 – Oxidant H_2O – Reductant
15. Match the given column-I with column-II and choose the correct option : **[Uttarakhand Stage-1/ 2015]**
- | I | II |
|---|-----------------------------|
| a. $2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO}$ | i. Exothermic reaction |
| b. $\text{CaO} + \text{H}_2\text{O} \rightarrow \text{Ca(OH)}_2$ | ii. Dissociation |
| c. $2\text{AgCl} \rightarrow 2\text{Ag} + \text{Cl}_2$ | iii. Reduction |
| d. $\text{CuO} + \text{H}_2 \rightarrow \text{Cu} + \text{H}_2\text{O}$ | iv. Oxidation |
| (A) a-i, b-ii, c-iii, d-iv | (B) a-ii, b-i, c-iv, d-iii |
| | (C) a-iv, b-iii, c-i, d-ii |
| | (D*) a-iv, b-i, c-ii, d-iii |
16. Identify the type of reaction for each of the following as **[Andhra Pradesh NTSE Stage-1/ 2015]**
 Combination – (p)
 Decomposition – (q)
 Displacement – (r)
 Double displacement – (s)
 or Combustion – (t)
 (i) A compound breaks apart into its elements
 (ii) A metal and a non-metal react to form an ionic compound.
 (iii) A compound of Hydrogen and Carbon reacts with Oxygen to produce Carbon-dioxide and water
 (iv) Silver ion from $\text{Ag}(\text{NO}_3)$ (aq.) forms a precipitate with bromide ion from KBr aq.
 (A) (i) – q (ii) – p (iii) – r (iv) – s (B*) (i) – q (ii) – p (iii) – t (iv) – s
 (C) (i) – s (ii) – r (iii) – q (iv) – p (D) (i) – p (ii) – t (iii) – q (iv) – r
17. Container made of Copper metal on exposure to air for longtime turns green. The green layer is due to **[West Bengal NTSE Stage-1/ 2017]**



- (A) CuO (B*) $\text{CuCO}_3, \text{Cu(OH)}_2$ (C) $\text{CuSO}_4, 3\text{Cu(OH)}_2$ (D) All of the above

18. All of the following processes involve a separation of either a mixture into its components, or a compound into elements. For each, decide whether a physical process or a chemical reaction is required.

[Andhra Pradesh NTSE Stage-1/2017]

- a. Sodium metal is obtained from the substance sodium chloride.
 b. Iron fillings are separated from sand by using a magnet.
 c. Sugar crystals are separated from sugar syrup by evaporation of water.
 d. Fine crystals of silver chloride are separated from a suspension of the crystals in water.
 e. Copper is produced when zinc metal is placed in a solution of copper (II) sulphate, a compound.

Physical processes Chemical processes.

- (A) a, b, c d, e
 (B) a, d b, c, e
 (C*) b, c, d a, e
 (D) c a, b, c, d

19. Addition of HCl to an aqueous solution of $\text{Pb(NO}_3)_2$ gives a [Jharkhand NTSE Stage-1/2017]
 (A*) Yellow Precipitate (B) Brown Precipitate (C) White Precipitate (D) Black Precipitate

VALUE BASED / PRACTICAL BASED QUESTIONS

This Section is not meant for classroom discussion. It is being given to promote self-study and self testing amongst the Resonance students.

1. When FeSO_4 crystals are heated in a test tube, the pale green colour of FeSO_4 fades away, due to :
 (A) loss of electrons (B) loss of dye
 (C) Oxidation is the gain of oxygen. (D*) loss of water of crystallization
2. On heating ferrous sulphate crystal, one would get :
 (A) sweet smell (B) rotten egg smell
 (C*) smell of burning sulphur (D) no solid residue
3. When Anupreeta heated ferrous sulphate crystals in a test tube, she observed :
 (i) green colour changes to yellow (ii) green colour changes to reddish brown
 (iii) blue colour changes to brownish colour (iv) smell of burning sulphur is obtained
 (A) (i) and (iv) (B*) (ii) and (iv) (C) (ii) and (iii) (D) (i) and (iii)
4. Four students A, B, C and D were asked to carry out a decomposition reaction. Each one followed different method as mentioned :
 1 : Heated aqueous solution of iron sulphate in a test tube.
 2 : Added Zn granules to iron sulphate in a test tube and then heated the mixture.
 3 : Heated crystals of iron sulphate in a test tube.
 4 : Heated crystals of iron sulphate along with copper sulphate crystals in a china dish. The student who adopted the correct method is :
 (A) 1 (B) 2 (C*) 3 (D) 4
5. The correct pair of salt solutions to demonstrate double displacement reaction is :
 (A) barium sulphate and sodium sulphate (B) barium chloride and sodium chloride
 (C) barium chloride and barium sulphate (D*) barium chloride and sodium sulphate
6. Four students recorded their respective observations after performing the reaction for double displacement as :
 (i) The reactants are barium chloride and sodium sulphate
 (ii) A white precipitate is formed
 (iii) The white precipitate is barium sulphate
 (iv) A yellow precipitate is formed
 The correct statements are :
 (A) (i), (iii), (iv) (B) (ii), (iii), (iv) (C*) (i), (ii), (iii) (D) (i), (ii), (iv)



Specimen Copy



Answers

PREVIOUS YEAR PROBLEMS

SECTION-B

1. A 2. D 3. A 4. C 5. D 6. A 7. C

EXERCISE - 1

OBJECTIVE QUESTIONS

SINGLE CHOICE OBJECTIVE, STRAIGHT CONCEPT/FORMULA ORIENTED

SECTION (A) : GENERAL INTRODUCTION AND CHARACTERISTICS OF CHEMICAL REACTIONS

- A-1. D A-2. D A-3. C A-4. A

SECTION (B) : CHEMICAL EQUATIONS & BALANCING :

- B-1. B B-2. C B-3. A B-4. B B-5. C

SECTION (C) : TYPES OF CHEMICAL REACTIONS :

- C-1. A C-2. B C-3. D C-4. B C-5. C C-6. B C-7. D

SECTION (D) : EFFECT OF OXIDATION REACTIONS IN DAILY LIFE :

- D-1. A D-2. D

EXERCISE - 2

OBJECTIVE QUESTIONS

SINGLE CHOICE OBJECTIVE, STRAIGHT CONCEPT/FORMULA ORIENTED

Ques	1	2	3	4	5	6	7	8	9	10
Ans	A	B	C	D	C	D	B	D	A	D

EXERCISE - 3

NTSE PROBLEMS (PREVIOUS YEARS)

Ques	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans	C	C	A	A	A	C	B	B	C	D	C	C	A	C	D
Ques	16	17	18	19											
Ans	B	B	C	A											

VALUE BASED / PRACTICAL BASED QUESTIONS

1. D 2. C 3. B 4. C 5. D 6. C



REAL NUMBERS



(A) INTRODUCTION AND EUCLID'S DIVISION LEMMA

(a) Classification of numbers

In earlier classes you have studied different types of numbers such as natural numbers, whole numbers, integers, rational and irrational numbers. All these together are called Real numbers. In this chapter, we shall study some properties of numbers, especially valid for integers

- (i) **Real numbers:** Numbers which can represent actual physical quantities in a meaningful way are known as real numbers. These can be represented on the number line. Number line is geometrical straight line with arbitrarily defined zero (origin). Real numbers includes all rational and irrational numbers.
- (ii) **Prime numbers :** All natural numbers that have one and itself only as their factors are called prime numbers i.e. prime numbers are exactly divisible by 1 and themselves. e.g. 2, 3, 5, 7, 11, 13, 17, 19, 23,...etc.
- (iii) **Composite numbers :** All natural numbers having more than two distinct factors.

NOTE : that 1 is neither prime nor composite number.

- (iv) **Co-prime Numbers :** If the H.C.F. of the given numbers (not necessarily prime) is 1 then they are known as co-prime numbers. e.g. 4, 9 are co-prime as H.C.F. of (4, 9) = 1.

NOTE :

Any two consecutive numbers will always be co-prime. Any two prime numbers are always coprime.

(b) Divisibility

A non-zero integer 'b' is said to divide an integer 'a' if there exists an integer 'q' such that $a = bq$. The integer 'a' is called dividend, integer 'b' is known as the divisor and integer 'q' is known as the quotient.

For example : 5 divides 35 because there is an integer 7 such that $35 = 5 \times 7$.

If a non-zero integer 'b' divides an integer a, then it is written as $b \mid a$ and read as "b divides a", $b \nmid a$ is written to indicate that a is not divisible by b.

(c) Lemma

Lemma is a proven statement used to prove another statement or theorem.

(d) Statement of Euclid's Division Lemma

Let 'a' and 'b' be any two positive integers. Then, there exists unique integers 'q' and 'r' such that $a = b \cdot q + r$, where $0 \leq r < b$. If $b \mid a$, then $r = 0$.

This can easily be remembered as follows

$$\begin{array}{r} q \\ b \overline{)a} \\ \underline{} \\ r \end{array}$$

This can be restated as follows : Dividend = Divisor \times Quotient + Remainder.



NOTE : In Division Lemma, q or r may be 0 but r is always less than b .

Solved Examples

Example.1

Prove that any positive odd integer can be written in the form $4q + 1$ or $4q + 3$ where q is an integer.

Solution :

Let a be any positive odd integer. Taking 4 as a divisor, we can write a as, $a = 4q + r$, where $0 \leq r < 4$ (division Lemma). Now let us put $r = 0, 1, 2, 3$. Then,

$$a = 4q \quad \dots \text{(i)}$$

$$a = 4q + 1 \quad \dots \text{(ii)}$$

$$a = 4q + 2 \quad \dots \text{(iii)}$$

$$a = 4q + 3 \quad \dots \text{(iv)}$$

(i) and (iii) give only even numbers.

Since a is odd, it must be of the form (ii) or (iv) namely $4q + 1$ or $4q + 3$.

Example.2

Prove that the square of any positive integer of the form $5q + 1$ is of the same form.

Solution.

Let x be any positive integer of the form $5q + 1$.

$$\text{When } x = 5q + 1$$

$$x^2 = 25q^2 + 10q + 1$$

$$x^2 = 5q(5q + 2) + 1$$

$$\text{Let } m = q(5q + 2).$$

$$x^2 = 5m + 1.$$

Hence, x^2 is of the same form i.e. $5m + 1$.

Example.3

Show that one and only one out of n , $n + 2$ or $n + 4$ is divisible by 3, where n is any positive integer.

Solution.

Let n is any positive integer of form $3q + r$ where $0 \leq r < 3$

Case I When $r = 0$

$$n = 3q, \text{ which is divisible by 3.}$$

$$n + 2 = 3q + 2$$

$\Rightarrow n + 2$ leaves remainder 2, when divided by 3

$\Rightarrow n + 2$ is not divisible by 3

$$n + 4 \Rightarrow 3q + 4 = 3(q + 1) + 1$$

$\Rightarrow n + 4$ is not divisible by 3

Thus, n is divisible by 3 but $n + 2$ and $n + 4$ is not divisible by 3.

Case II When $r = 1$

$$n = 3q + 1$$

$$n + 2 = 3q + 3$$

$$\text{and } n + 4 = 3q + 5$$

Thus $n + 2$ is divisible by 3 but n and $n + 4$ are not divisible by 3.

Case III When $r = 2$

$$n = 3q + 2$$

$$n + 2 = 3q + 4$$

$$\text{and } n + 4 = 3q + 6$$

Thus $n + 4$ is divisible by 3 but n and $n + 2$ is not divisible by 3.

**Example.4**

Use Euclid's Division Lemma to show that the cube of any positive integer is of the form $9m$, $9m + 1$ or $9m + 8$, for some integer m .

Solution.

Let x be any positive integer. Then, it is of the form $3q$ or, $3q + 1$ or, $3q + 2$.

Case -I When $x = 3q$

$$\Rightarrow x^3 = (3q)^3 = 27q^3 = 9(3q^3) = 9m, \text{ where } m = 3q^3.$$

Case-II when $x = 3q + 1$

$$\Rightarrow x^3 = (3q + 1)^3$$

$$\Rightarrow x^3 = 27q^3 + 27q^2 + 9q + 1$$

$$\Rightarrow x^3 = 9q(3q^2 + 3q + 1) + 1$$

$$\Rightarrow x^3 = 9m + 1, \text{ where } m = q(3q^2 + 3q + 1).$$

Case-III when $x = 3q + 2$

$$\Rightarrow x^3 = (3q + 2)^3$$

$$\Rightarrow x^3 = 27q^3 + 54q^2 + 36q + 8$$

$$\Rightarrow x^3 = 9q(3q^2 + 6q + 4) + 8$$

$$\Rightarrow x^3 = 9m + 8, \text{ where } m = q(3q^2 + 6q + 4)$$

Hence, x^3 is either of the form $9m$ or $9m + 1$ or $9m + 8$



Check Your Progress

- 1._ Let 'a' and 'b' be any two positive integers. Then, there exists unique integers 'q' and 'r' such that $a = bq + r$. If $b = 5$, then find the possible values of r .
- 2._ Check whether the number $21q + 18$ is of the form $7q + 4$, for some integer q .
- 3._ If $n = 3q + 2$, then check whether $n + 7$ is divisible by 3, for some integer q .
- 4._ If $n = 5q + 4$, then check whether $n^2 - 1$ is divisible by 5, for some integer q .
- 5._ Show that cube of the number of the form $4q + 3$ is of the form $4q + 3$, for some integer q .
- 6._ Out of the numbers n , $n + 1$ and $n + 2$, show that only one number is divisible by 3.

Answers

1. 0, 1, 2, 3, 4 2. Yes 3. Yes 4. Yes



(B) EUCLID'S DIVISION ALGORITHM

(a) Algorithm

You may be familiar with computer program which is a sequence of steps to do a given task, the order of steps being very important.

(b) Euclid's Division Algorithm

If 'a' and 'b' are positive integers such that $a = bq + r$, then every common divisor of 'a' and 'b' is a common divisor of 'b' and 'r', and vice-versa. The HCF of positive integers a and b where $a > b$ is obtained as follows.

Step 1: Apply Euclid's division Lemma to a and b. That is, find whole numbers q and r such that

$$a = bq + r, 0 \leq r < b$$

Step 2: If $r = 0$, then b is the HCF of a and b. If $r \neq 0$, apply division Lemma to b and r.

Step 3: Continue the process till r is 0. The divisor at this stage is the HCF of a and b.

This procedure has to work because the HCF of a and b is same as HCF of b and r.





Solved Examples

Example.5

Use Euclid's division algorithm to find the H.C.F. of 196 and 38318.

Solution.

Applying Euclid's division lemma to 196 and 38318.

$$38318 = 195 \times 196 + 98$$

$$196 = 98 \times 2 + 0$$

The remainder at the second stage is zero. So, the H.C.F. of 38318 and 196 is 98.

Example.6

Use Euclid's division algorithm to find the HCF of (i) 56 and 814 (ii) 6265 and 76254

Solution :

(i) HCF of 56 and 814

$$814 = 56 \times 14 + 30$$

$$56 = 30 \times 1 + 26$$

$$30 = 26 \times 1 + 4$$

$$26 = 4 \times 6 + 2$$

$$4 = 2 \times 2 + 0$$

Hence, the HCF of 56 and 814 = 2.

(ii) HCF of 6265 and 76254

$$76254 = 6265 \times 12 + 1074$$

$$6265 = 1074 \times 5 + 895$$

$$1074 = 895 \times 1 + 179$$

$$895 = 179 \times 5 + 0$$

Hence, the HCF of 6265 and 76254 is 179.

Example.7

If the H.C.F of 657 and 963 is expressible in the form $657x + 963 \times (-15)$, find x.

Solution.

Applying Euclid's division lemma on 657 and 963.

$$963 = 657 \times 1 + 306$$

$$657 = 306 \times 2 + 45$$

$$306 = 45 \times 6 + 36$$

$$45 = 36 \times 1 + 9$$

$$36 = 9 \times 4 + 0$$

So, the H.C.F of 657 and 963 is 9.

Given : $657x + 963 \times (-15) = \text{H.C.F of 657 and 963.}$

$$657x + 963 \times (-15) = 9$$

$$657x = 9 + 963 \times 15$$

$$657x = 14454$$

$$x = \frac{14454}{657} = 22.$$

Example 8.

If d is the HCF of 468 and 222, find x, y satisfying $d = 468x + 222y$. Also, show that x and y are not unique.

Sol. Applying Euclid's division lemma to 468 and 222, we get

$$468 = 222 \times 2 + 24 \quad \dots (i)$$

Since the remainder $24 \neq 0$. So, we consider the divisor 222 and the remainder 24 and apply division lemma to get

$$222 = 24 \times 9 + 6 \quad \dots (ii)$$



We consider the divisor 24 and the remainder 6 and apply division algorithm to get

$$24 = 6 \times 4 + 0 \quad \dots \text{(iii)}$$

We observe that the remainder at this stage is zero. Therefore, last divisor 6 (or the remainder at the earlier state) is the HCF of 468 and 222.

$$6 = 222 - 24 \times 9$$

$$\Rightarrow 6 = 222 - (468 - 222 \times 2) \times 9 \quad [\because 24 = 468 - 222 \times 2 \text{ (from (i))}]$$

$$\Rightarrow 6 = 222 - 468 \times 9 + 222 \times 18$$

$$\Rightarrow 6 = 19 \times 222 - 468 \times 9$$

$$\therefore x = -9 \text{ and } y = 19.$$

$$\text{Now, } 6 = 19 \times 222 - 468 \times 9 + 222 \times 468 - 222 \times 468$$

$$6 = 19 \times 222 + 222 \times 468 - 468 \times 9 - 222 \times 468$$

$$\Rightarrow 8 = (19 + 468) \times 222 - (9 + 222) \times 468$$

$$\Rightarrow 8 = 487 \times 222 - 231 \times 468$$

$$\therefore x = -231 \text{ and } y = 487$$

Hence, x and y are not unique.

Example.9

144 cartons of coke cans and 90 cartons of pepsi cans are to be stacked in a canteen. If each stack is of same height and is to contain cartons of the same drink, what would be the greatest number of cartons each stack would have ?

Solution.

In order to arrange the cartons of the same drink in the same stack, we have to find the greatest number that divides 144 and 90 exactly. Using Euclid's division algorithm, to find the H.C.F. of 144 and 90.

$$144 = 90 \times 1 + 54$$

$$90 = 54 \times 1 + 36$$

$$54 = 36 \times 1 + 18$$

$$36 = 18 \times 2 + 0$$

So, the H.C.F. of 144 and 90 is 18.

Number of cartons in each stack = 18.



Check Your Progress

- Find the HCF of 1650 and 847
- Find the HCF of 2781 and 1242
- Find HCF of 13281 and 15844
- Find HCF of 97 and 101.
- If the H.C.F. of 408 and 1032 is expressible in the form $1032m - 408 \times 5$, find m.
- 105 goats, 140 sheep have to be taken across a river. There is only one boat which will have to make many trips in order to do so. The lazy boatman has his own conditions for transporting them. He insists that he will take the same number of animals in every trip and they have to be of the same kind. He will naturally like to take the largest possible number each time. Can you tell how many animals went in each trip.

Answer

- | | | | | | | | |
|----|--------|----|----|----|-----|----|---|
| 1. | 11 | 2. | 27 | 3. | 233 | 4. | 1 |
| 5. | m = 2. | 6. | 35 | | | | |





(C) FUNDAMENTAL THEOREM OF ARITHMETIC

(a) Fundamental Theorem of Arithmetic

Every composite number can be expressed as a product of primes, and this factorisation is unique, except for the order in which the prime factors occurs.

(b) HCF and LCM

HCF and LCM of numbers can be determined by prime factorization. This is nothing but an application of the fundamental theorem of arithmetic.

HCF = Product of the smallest power of each common factor.

LCM = Product of the biggest power of each prime factor

Let a and b be natural numbers. Then their

$$\text{HCF} \times \text{LCM} = a \times b$$

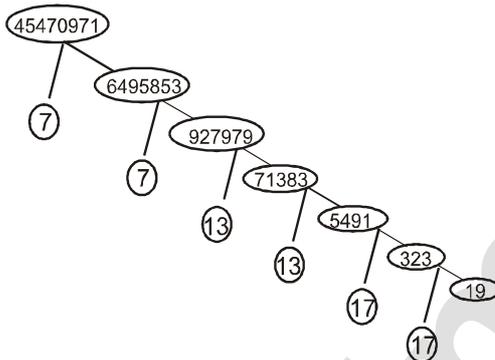
NOTE : LCM is always divisible by HCF.

Solved Examples

Example.10

Determine the prime factors of 45470971.

Solution.



$$\therefore 45470971 = 7^2 \times 13^2 \times 17^2 \times 19.$$

Example.11

Check whether 6^n can end with the digit 0 for any natural number.

Solution.

Any positive integer ending with the digit zero is divisible by 5 and so its prime factorization must contain the prime 5.

$$6^n = (2 \times 3)^n = 2^n \times 3^n$$

⇒ The prime in the factorisation of 6^n is 2 and 3.

⇒ 5 does not occur in the prime factorisation of 6^n for any n.

⇒ 6^n does not end with the digit zero for any natural number n.

Example.12

Find the LCM and HCF of 84, 90 and 120 by applying the prime factorisation method.

Sol. $84 = 2^2 \times 3 \times 7$, $90 = 2 \times 3^2 \times 5$ and $120 = 2^3 \times 3 \times 5$.

Prime factors	Least exponent
2	1
3	1
5	0
7	0



(D) PROOF OF IRRATIONALITY AND DECIMAL REPRESENTATION

(a) Some important results

- (i) Let 'p' be a prime number and 'a' be a positive integer. If 'p' divides a^2 , then 'p' divides 'a'.
- (ii) Let x be a rational number whose decimal expansion terminates. Then, x can be expressed in the form $\frac{p}{q}$, where p and q are co-primes, and prime factorization of q is of the form $2^m \times 5^n$, where m, n are non-negative integers.
- (iii) Let $x = \frac{p}{q}$ be a rational number, such that the prime factorisation of q is not of the form $2^m \times 5^n$, where m, n are non-negative integers. Then, x has a decimal expansion which is non-terminating repeating.

In earlier classes you have studied different types of numbers such as natural numbers, whole numbers, integers, rational and irrational numbers. All these together are called Real numbers. In this chapter, we shall study some properties of numbers, especially valid for integers

Solved Examples

Example.14

Prove that $\sqrt{2}$ is an irrational number.

Solution.

Let us assume on the contrary that $\sqrt{2}$ is a rational number.

Then, there exists positive integer a and b such that $\sqrt{2} = \frac{a}{b}$ where, a and b are coprime i.e. their HCF is 1.

$$\Rightarrow (\sqrt{2})^2 = \left(\frac{a}{b}\right)^2 \quad \Rightarrow \quad 2 = \frac{a^2}{b^2}$$

$$\Rightarrow a^2 = 2b^2 \quad \Rightarrow \quad a^2 \text{ is a multiple of } 2$$

$$\Rightarrow a \text{ is a multiple of } 2 \quad \dots(i)$$

$a = 2c$ for some integer c .

$$\Rightarrow a^2 = 4c^2 \quad \Rightarrow \quad 2b^2 = 4c^2$$

$$\Rightarrow b^2 = 2c^2 \quad \Rightarrow \quad b^2 \text{ is a multiple of } 2$$

$$\Rightarrow b \text{ is a multiple of } 2 \quad \dots(ii)$$

From (i) and (ii), a and b have at least 2 as a common factor. But this contradicts the fact that a and b are co-prime. This means that $\sqrt{2}$ is an irrational number.

Example. 15

Prove that $5\sqrt{3}$ is not rational

Solution.

If possible let $5\sqrt{3}$ be rational

Let $5\sqrt{3} = \frac{a}{b}$ where a and b are coprime integers

$$\sqrt{3} = \frac{a}{5b}$$

This means that $\sqrt{3}$ which is irrational is equal to a rational number $\frac{a}{5b}$.

$\therefore 5\sqrt{3}$ cannot be rational

**Example.16**

Prove that $3 - \sqrt{5}$ is an irrational number.

Solution.

Let us assume that on the contrary that $3 - \sqrt{5}$ is rational.

Then, there exist co-prime positive integers a and b such that,

$$3 - \sqrt{5} = \frac{a}{b} \quad \Rightarrow \quad 3 - \frac{a}{b} = \sqrt{5}$$

$$\Rightarrow \quad \frac{3b - a}{b} = \sqrt{5} \quad \Rightarrow \quad \sqrt{5} \text{ is rational}$$

[\because a, b are integer $\therefore \frac{3b - a}{b}$ is a rational number]

This contradicts the fact that $\sqrt{5}$ is irrational.

Hence, $3 - \sqrt{5}$ is an irrational number.

Example 17.

Prove that $\sqrt{2} + \sqrt{5}$ is irrational.

Solution.

Let us assume on the contrary that $\sqrt{2} + \sqrt{5}$ is a rational number, Then, there exist co-prime positive

integers a and b such that $\sqrt{2} + \sqrt{5} = \frac{a}{b}$

$$\Rightarrow \quad \sqrt{5} = \frac{a}{b} - \sqrt{2}$$

Squaring both sides

$$\Rightarrow \quad \left(\frac{a}{b} - \sqrt{2}\right)^2 = (\sqrt{5})^2$$

$$\Rightarrow \quad \frac{a^2}{b^2} - \frac{2a}{b}\sqrt{2} + 2 = 5$$

$$\Rightarrow \quad \frac{a^2}{b^2} - 3 = \frac{2a}{b}\sqrt{2}$$

$$\Rightarrow \quad \frac{a^2 - 3b^2}{2ab} = \sqrt{2}$$

$\Rightarrow \quad \sqrt{2}$ is a rational number.

[$\because \frac{a^2 - 3b^2}{2ab}$ is a rational number]

$\Rightarrow \quad \sqrt{2}$ is an irrational number.

So, our assumption is wrong. Hence, $\sqrt{2} + \sqrt{5}$ is irrational.

Example.18

Without actually performing the long division, state whether $\frac{13}{3125}$ has terminating decimal expansion or not.

Solution.

$$\frac{13}{3125} = \frac{13}{2^0 \times 5^5}$$

This, shows that the prime factorisation of the denominator is of the form $2^m \times 5^n$.

Hence, it has terminating decimal expansion.

**Example.19**

What can you say about the prime factorization of the denominators of the following rationals :

- (i) 43.123456789 (ii) $43.\overline{123456789}$

Solution.

- (i) Since, 43.123456789 has terminating decimal, so prime factorization of the denominator is of the form $2^m \times 5^n$, where m, n are non - negative integers.
- (ii) Since, $43.\overline{123456789}$ has non - terminating repeating decimal expansion. So, its denominator has factors other than 2 or 5.

Check Your Progress

- 1._ Show that $\sqrt{11}$ is an irrational number.
- 2._ Show that $4 - \sqrt{3}$ is an irrational number.
- 3._ Show that $2\sqrt{5}$ is an irrational number.
- 4._ Show that $\sqrt{8}$ is an irrational number.
- 5._ Show that $\sqrt{5} - \sqrt{3}$ is an irrational number.
- 6._ Without actually performing the long division, state whether $\frac{343}{875}$ has terminating decimal expansion or not.

Answer

- 6._ Terminating decimal expansion



**Board Level Exercise****TYPE (I) : VERY SHORT ANSWER TYPE QUESTIONS :****[01 MARK EACH]**

1. Find the largest number which divides 70 and 125, leaving remainders 5 and 8, respectively.
2. If two positive integers a and b are written as $a = x^3y^2$ and $b = xy^3$; x, y are prime numbers, then find the HCF (a, b)
3. If two positive integers p and q can be expressed as $p = ab^2$ and $q = a^3b$; a, b being prime numbers, then find the LCM (p, q)
4. Find the least number that is divisible by all the numbers from 1 to 10 (both inclusive).
5. The decimal expansion of the rational number $\frac{14587}{1250}$ will terminate after how many decimal places ?
6. Can two numbers have 18 as their HCF and 380 as their LCM? Give reasons.

TYPE (II) : SHORT ANSWER TYPE QUESTIONS :**[02 MARKS EACH]**

7. "The product of two consecutive positive integers is divisible by 2". Is this statement true or false? Give reasons.
8. Prove that $\sqrt{3} + \sqrt{7}$ is irrational.
9. Explain why $3 \times 5 \times 7 + 7$ is a composite number.
10. Without actually performing the long division, find if $\frac{987}{10500}$ will have terminating or non-terminating (repeating) decimal expansion. Give reasons for your answer.
11. A rational number in its decimal expansion is 327.7081. What can you say about the prime factors of q , when this number is expressed in the form $\frac{p}{q}$?

TYPE (III) : LONG ANSWER TYPE QUESTIONS:**[03 MARK EACH]**

12. Show that cube of any positive integer is of the form $4m, 4m + 1$ or $4m + 3$, for some integer m .
13. Show that the square of any positive integer cannot be of the form $5q + 2$ or $5q + 3$ for any integer q .
14. If n is an odd integer, then show that $n^2 - 1$ is divisible by 8.
15. Using Euclid's division algorithm, find the largest number that divides 1251, 9377 and 15628 leaving remainders 1, 2 and 3, respectively.
16. Prove that $\sqrt{7}$ is irrational.
17. Show that 12^n cannot end with the digit 0 or 5 for any natural number n .



18. On a morning walk, three persons step off together and their steps measure 40 cm, 42 cm and 45 cm, respectively. What is the minimum distance each should walk so that each can cover the same distance in complete steps?

TYPE (IV): VERY LONG ANSWER TYPE QUESTIONS

[04 MARK EACH]

19. Show that the cube of a positive integer of the form $6q + r$, q is an integer and $r = 0, 1, 2, 3, 4, 5$ is also of the form $6m + r$.
20. Prove that one of any three consecutive positive integers must be divisible by 3.
21. Show that one and only one out of $n, n + 4, n + 8, n + 12$ and $n + 16$ is divisible by 5, where n is any positive integer. [Hint: Any positive integer can be written in the form $5q, 5q+1, 5q+2, 5q+3, 5q+4$].

PREVIOUS YEAR PROBLEMS

1. Which of the following numbers has terminating decimal expansion ? **[1 MARK/CBSE 10TH BOARD 2013]**
 (A) $\frac{37}{45}$ (B) $\frac{21}{2^3 5^6}$ (C) $\frac{17}{49}$ (D) $\frac{89}{2^2 3^2}$
2. If a rational number x is expressed as $x = \frac{p}{q}$, where p, q are integer, $q \neq 0$ and p, q have no common factor (except 1), then the decimal expansion of x is terminating if and only if q has a prime factorization of the form:
[1 MARK/CBSE 10TH BOARD: 2013]
 (A) $2^m \cdot 5^n$ (B) $2^m \cdot 3^n$ (C) $2^m \cdot 7^n$ (D) $5^m \cdot 3^n$
 Where m and n are non-negative integers.
3. Which of the following numbers has non-terminating repeating decimal expansion ?
[1 MARK/CBSE 10TH BOARD: 2013]
 (A) $\frac{7}{80}$ (B) $\frac{17}{320}$ (C) $\frac{20}{100}$ (D) $\frac{93}{420}$
4. Use Euclid's division algorithm to find HCF of 870 and 225. **[1 MARK/CBSE 10TH BOARD: 2013]**
5. Explain $5 \times 4 \times 3 \times 2 \times 1 + 3$ is a composite number. **[2 MARKS/CBSE 10TH BOARD: 2013]**
6. Prove that $3 + \sqrt{2}$ is an irrational number
 or
 Prove that $5\sqrt{2}$ is irrational number. **[3 MARKS/ CBSE 10TH BOARD: 2013]**
7. Show that 5^n can't end with the digit 2 for any natural number n . **[3 MARKS/ CBSE 10TH BOARD: 2013]**
8. The HCF of two numbers is 145 and their LCM is 2175. If one number is 725, then the other number is
[1 MARK/CBSE 10TH BOARD: 2014]
 (A) 415 (B) 425 (C) 435 (D) 445
9. If $\text{HCF}(96, 404) = 4$, then $\text{LCM}(96, 404)$ is
[1 MARK/CBSE 10TH BOARD: 2014]
 (A) 9626 (B) 9696 (C) 9656 (D) 9676



10. Check whether 6^n can end with the digit 0 for any natural number n .
[3 MARKS/CBSE 10TH BOARD: 2014]
11. Prove that $\sqrt{3} + \sqrt{5}$ is an irrational number
OR
Prove that $5 + \sqrt{2}$ is an irrational number
[3 MARKS/CBSE 10TH BOARD: 2014]
12. Use Euclid's division algorithm to find the HCF of 10224 and 9648.
[3 MARKS/ CBSE 10TH BOARD: 2015]
13. Which of the following is not a rational number ?
(A) $\sqrt{3}$ (B) $\sqrt{9}$ (C) $\sqrt{16}$ (D) $\sqrt{25}$
[1 MARK/CBSE 10TH BOARD: 2015]
14. Prove that $\sqrt{7}$ is an irrational number
OR
Prove that $3 + \sqrt{5}$ is an irrational number
[3 MARKS/CBSE 10TH BOARD: 2015]
15. Use Euclid's division lemma to show that the square of any positive integer is either of the form $3m$ or $3m + 1$ for some integer m .
[3 MARKS/CBSE 10TH BOARD: 2015]
16. The [HCF \times LCM] for the number 50 and 20 is
(A) 10 (B) 1000 (C) 100 (D) 110
[1 MARK/CBSE 10TH BOARD: 2016]
17. If the HCF of 210 and 55 is expressible in the form $210 \times 5 + 55 \times p$, then the value of p is
(A) -17 (B) -18 (C) -20 (D) -19
[1 MARK/CBSE 10TH BOARD: 2016]
18. Prove that $\sqrt{5}$ is an irrational number
OR
Prove that $5 + 3\sqrt{2}$ is an irrational number
[3 MARKS/CBSE 10TH BOARD: 2016]
19. Prove that for any positive integer n , $n^3 - n$ is divisible by 6. [3 MARKS/CBSE 10TH BOARD: 2016]
20. Find the LCM and HCF of 510 and 92 and verify that LCM \times HCF = product of the two numbers
[1 MARK/CBSE 10TH BOARD: 2017]
21. The largest number that will divide 398, 436 and 542 leaving remainder 7, 11 and 15 respectively is
(A) 11 (B) 17 (C) 34 (D) 51
[1 MARK/CBSE 10TH BOARD: 2017]
22. Prove that $\frac{7}{3}\sqrt{5}$ is irrational number.
OR
Prove that $5 - 2\sqrt{3}$ is an irrational number
[3 MARKS/CBSE 10TH BOARD: 2017]
23. Prove that $n^2 - n$ is divisible by 2 for any positive integer n . [3 MARKS/CBSE 10TH BOARD: 2017]





Exercise-1

☞ Marked Questions can be used as Revision Questions.

SUBJECTIVE QUESTIONS

SUBJECTIVE EASY, ONLY LEARNING VALUE PROBLEMS

Section (A) : Introduction and Euclid's Division Lemma

- A-1.** Write a rational number between $\sqrt{2}$ and $\sqrt{3}$.
- A-2.** Write whether $\frac{2\sqrt{45} + 3\sqrt{20}}{2\sqrt{5}}$ on simplification gives a rational or an irrational number.
- A-3.** Use Euclid's Division Lemma to show that the square of any positive integer is either of the form $3m$ or $3m + 1$ for some integer m .
- A-4.** Show that of the numbers n , $n+2$ and $n+4$, only one of them is divisible by 3.
- A-5.** Let $n=640640640643$, without actually computing n^2 prove that n^2 leave remainder 1 when divided by 8.
- A-6.** There is remainder of 3 when a number is divided by 6. what will be the remainder if the square of the same number is divided by 6?

Section (B) : Euclid's Division Algorithm

- B-1.** Using Euclid's Division algorithm, find the HCF of 210 and 55.
- B-2.** Using Euclid's Division algorithm, find the HCF of 101 and 1277.
- B-3.** If d is the HCF of 56 and 72, find x , y satisfying $d = 56x + 72y$. Also, show that x and y are not unique.
- B-4.** Using Euclid's Division algorithm, find the greatest number that divides 445, 572 and 699 leaving remainder 4, 5 and 6 respectively.
- B-5.** Find the largest number that divides 245 and 1029 leaving a remainder of 5 in each case.

Section (C) : Fundamental Theorem of Arithmetic

- C-1.** Can we have any natural number n , where 7^n ends with the digit zero.
- C-2.** Find the $[HCF \times LCM]$ for the numbers 105 and 120.
- C-3.** Find the HCF and LCM of following using Fundamental Theorem of Arithmetic method.
 (i) 426 and 576 (ii) 625, 1125 and 2125
- C-4.** Explain why $7 \times 11 \times 13 + 13$ and $7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1 + 5$ are composite numbers.
- C-5.** An army contingent of 616 members is to march behind an army band of 32 members in a parade. The two groups are to march in the same number of columns. What is the maximum number of columns in which they can march ?



- A-5.** $(n^2 - 1)$ is divisible by 8, if n is
 (A) any natural number (B) any integer
 (C) any odd positive integer (D) any even positive integer
- A-6.** A positive integer n when divided by 9, gives 7 as remainder. What will be the remainder when $(3n - 1)$ is divided by 9?
 (A) 1 (B) 2 (C) 3 (D) 4

Section (B) : Euclid's Division Algorithm

- B-1.** If the HCF of 85 and 153 is expressible in the form $85n - 153$, then value of n is :
 (A) 3 (B) 2 (C) 4 (D) 1
- B-2.** If the HCF of 79 and 97 is expressible in the form $97n - 79m$, then value of $m - n$ is :
 (A) 3 (B) 2 (C) 5 (D) 1
- B-3.** If the HCF of 144 and 90 is expressible in the form $144x + 90y$, then value of $x - y =$:
 (A) 3 (B) 2 (C) 5 (D) 1
- B-4.** If the HCF of 420 and 130 is expressible in the form $420p + 130q$, then value of $p + q$ is :
 (A) 17 (B) 6 (C) 5 (D) 9
- B-5.** For positive integers a and b , if $a = bq + r$, then
 (A) every common divisor of 'a' and 'q' is a common divisor of 'b' and 'r', and vice-versa.
 (B) every common divisor of 'a' and 'b' is a common divisor of 'q' and 'r', and vice-versa.
 (C) every common divisor of 'a' and 'b' is a common divisor of 'b' and 'r', and vice-versa.
 (D) None of these

Section (C) : Fundamental Theorem of Arithmetic

- C-1.** The [HCF \times LCM] for the numbers 125 and 80 is :
 (A) 100 (B) 1000 (C) 10000 (D) 500
- C-2.** If $x = 2^3 \times 3 \times 5^2$, $y = 2^2 \times 3^3$, then HCF (x, y) is :
 (A) 12 (B) 108 (C) 6 (D) 36
- C-3.** Given that HCF (253, 440) = 11 and LCM (253, 440) = $253 \times R$. The value of R is :
 (A) 400 (B) 40 (C) 440 (D) 253
- C-4.** If least prime factor of a is 5 and the least prime factor of b is 11, the least prime factor of $(a + b)$ is :
 (A) 2 (B) 3 (C) 5 (D) 11
- C-5.** How many prime factors are there in prime factorization of 5005.
 (A) 2 (B) 4 (C) 6 (D) 7
- C-6.** The product of the HCF and LCM of the smallest prime number and the smallest composite number is :
 (A) 2 (B) 4 (C) 6 (D) 8


Section (D) : Proof of Irrationality and Decimal Representation

- D-1** The decimal expansion of the rational number $\frac{31}{2^2 \times 5}$ will terminate after :
- (A) one decimal place (B) two decimal places
(C) three decimal places (D) more than three decimal places
- D-2.** Which of the following is a non-terminating repeating decimal ?
- (A) $\frac{35}{14}$ (B) $\frac{14}{35}$ (C) $\frac{1}{7}$ (D) $\frac{7}{8}$
- D-3.** The decimal representation of $\frac{27}{400}$ is :
- (A) Terminating (B) Non terminating recurring
(C) Non terminating non recurring (D) None of these
- D-4.** How many rational numbers exist between any two distinct rational numbers?
- (A) 2 (B) 3 (C) 11 (D) Infinite
- D-5.** 3.24636363..... is
- (A) an integer (B) A rational number (C) an irrational number (D) None of these
- D-6.** A rational number can be expressed as terminating decimal if the denominator has factor
- (A) 2,3 or 5 (B) 3 or 5 (C) 2 or 3 (D) 2 or 5

Exercise-2

Marked Questions can be used as Revision Questions.

OBJECTIVE QUESTIONS

- The positive integers A, B, A – B and A + B are all prime numbers. The sum of these four primes is
(A) even (B) divisible by 3 (C) divisible by 5 (D) prime
- V is product of first 41 natural numbers. A = V + 1. The number of primes among A + 1, A + 2, A + 3, A + 4 A + 39, A + 40 is :
(A) 1 (B) 2 (C) 3 (D) 0
- If $a^2 - b^2 = 13$ where a and b are natural numbers, then value of a is :
(A) 6 (B) 7 (C) 8 (D) 9
- H.C.F. of 3240, 3600 and a third number is 36 and their L.C.M. is $2^4 \times 3^5 \times 5^2 \times 7^2$. Then the third number is
(A) $2^2 \times 3^5 \times 7^2$ (B) $2^2 \times 5^3 \times 7^2$ (C) $2^5 \times 5^2 \times 7^2$ (D) $2^3 \times 3^5 \times 7^2$
- The number of ordered pairs (a, b) of positive integers such that a + b = 90 and their greatest common divisor is 6 equals.
(A) 5 (B) 4 (C) 8 (D) 10
- If HCF (p, q) = 12 and $p \times q = 1800 \times n$, where n belongs to natural number then LCM (p, q) is :
(A) 3600 (B) 900 (C) 150 (D) 90



7. The value of the digit d for which the number d456d is divisible by 18, is :
 (A) 3 (B) 4 (C) 6 (D) 9
8. Which of the following number is divisible by 99 ?
 (A) 3572404 (B) 135792 (C) 913464 (D) 114345
9. There is an N digit number ($N > 1$). If the sum of digits is subtracted from the number then the resulting number will be divisible by :
 (A) 7 (B) 2 (C) 11 (D) 9
10. If x is a positive integer such that $2x + 12$ is perfectly divisible by 'x', then the number of possible values of 'x' is :
 (A) 2 (B) 5 (C) 6 (D) 12
11. The least number which on division by 35 leaves a remainder 25 and on division by 45 leaves the remainder 35 and on division by 55 leaves the remainder 45 is :
 (A) 2515 (B) 3455 (C) 2875 (D) 2785
12. A number divided by 14 gives a remainder 8. What is the remainder, if this number is divided by 7 ?
 (A) 1 (B) 2 (C) 3 (D) 4
13. The sum of the digits of two digit number is 11, if the digits are reversed the number decreases by 45. The number is :
 (A) 38 (B) 65 (C) 74 (D) 83
14. One hundred monkeys have 100 apples to divide. Each adult gets three apples while three children share one. Number of adult monkeys are :
 (A) 20 (B) 25 (C) 30 (D) 33

Exercise-3

NTSE PROBLEMS (PREVIOUS YEARS)

* Marked Questions may have more than one correct option.

1. If $2^x = 4^y = 8^z$ and $\frac{1}{2x} + \frac{1}{4y} + \frac{1}{6z} = \frac{24}{7}$, then the value of z is - (Rajasthan NTSE Stage-1 2005)
 (A) $\frac{7}{16}$ (B) $\frac{7}{32}$ (C) $\frac{7}{48}$ (D) $\frac{7}{64}$
2. If $\left(\frac{a}{b}\right)^{x-1} = \left(\frac{b}{a}\right)^{x-3}$ then the value of x is - (Rajasthan NTSE Stage-1 2005)
 (A) 1 (B) 2 (C) 3 (D) 4
3. If $a^x = b$, $b^y = c$ and $c^z = a$, then value of xyz is (Rajasthan NTSE Stage-1 2007)
 (A) 1 (B) 0 (C) -1 (D) $a + b + c$.



4. Rationalising the denominator of $\frac{5}{\sqrt{3}-\sqrt{5}}$ is: **(Rajasthan NTSE Stage-1 2013)**
 (A) $\left(\frac{5}{2}\right)(\sqrt{3} + \sqrt{5})$ (B) $\left(-\frac{5}{2}\right)(\sqrt{3} + \sqrt{5})$ (C) $\left(\frac{5}{2}\right)(\sqrt{3} - \sqrt{5})$ (D) $\left(-\frac{5}{2}\right)(\sqrt{3} - \sqrt{5})$
5. Value of $\frac{2^{100}}{2}$ is: **(Rajasthan NTSE Stage-1 2013)**
 (A) 1 (B) 50^{100} (C) 2^{50} (D) 2^{99}
6. Number of zero's in the product of $5 \times 10 \times 25 \times 40 \times 50 \times 55 \times 65 \times 125 \times 80$, is **(M.P. NTSE Stage-1 2013)**
 (A) 8 (B) 9 (C) 12 (D) 13
7. A farmer divides his herd of x cows among his 4 son's such that first son gets one-half of the herd, the second son gets one fourth, the third son gets one-fifth and the fourth son gets 7 cows, then the value of x is : **(M.P. NTSE Stage-1 2013)**
 (A) 100 (B) 140 (C) 160 (D) 180
8. H.C.F. (28, 35, 91) = **[Gujarat NTSE Stage-1 2013]**
 (A) 1 (B) 5 (C) 7 (D) 14
9. Which real number lies between 2 and 2.5 **(Chandigarh NTSE Stage-1 2014)**
 (A) $\sqrt{11}$ (B) $\sqrt{8}$ (C) $\sqrt[3]{7}$ (D) $\sqrt[3]{9}$
10. Which of the following time expressions is right for the fraction $\frac{1}{4}$? **[Gujarat NTSE Stage-1 2014]**
 (A) 15 minute (B) 30 minute (C) 45 minute (D) 10 minute
11. The HCF of any two prime numbers a and b, is **(Rajasthan NTSE Stage-1 2015)**
 (A) a (B) ab (C) b (D) 1
12. Which number is the inverse of the opposite of $-\frac{5}{8}$? **[Gujarat NTSE Stage-1 2015]**
 (A) $\frac{5}{8}$ (B) $1\frac{3}{5}$ (C) $2\frac{2}{5}$ (D) $-\frac{8}{5}$
13. If $x = \sqrt[4]{16} + \sqrt[4]{625}$ than what is x = ? **[Gujarat NTSE Stage-1 2015]**
 (A) 7 (B) 29 (C) 12 (D) 5
14. Find HCF of $\frac{6}{5}, \frac{4}{15}, \frac{2}{5}$ **[Delhi NTSE Stage-1 2015]**
 (A) $\frac{6}{15}$ (B) $\frac{2}{15}$ (C) $\frac{2}{5}$ (D) $\frac{4}{15}$
15. The simplified value of $\frac{1}{\sqrt{2} + \sqrt{3} - \sqrt{5}} + \frac{1}{\sqrt{2} - \sqrt{3} - \sqrt{5}}$ is **[Delhi NTSE Stage-1 2015]**
 (A) 1 (B) 0 (C) $\sqrt{2}$ (D) $\frac{1}{\sqrt{2}}$
16. Raj wanted to type the first 200 natural numbers, how many times does he have to press the keys **[Delhi NTSE Stage-1 2015]**
 (A) 489 (B) 492 (C) 400 (D) 365



17. Which is the greatest among $\sqrt[6]{100}$, $\sqrt[3]{12}$ and $\sqrt{3}$ [Delhi NTSE Stage-1 2015]
 (A) $\sqrt{3}$ (B) $\sqrt[6]{100}$ (C) $\sqrt[3]{12}$ (D) cannot be determined
18. The traffic lights at three different signals change after 48 seconds, 72 seconds and 108. If they change at 7 a.m. simultaneously. How many times they will change between 7 a.m. to 7 : 30 a.m. simultaneously ? (Haryana NTSE Stage-1 2015)
 (A) 3 (B) 4 (C) 5 (D) 2
19. If $x = 2 + \sqrt{3}$ and $xy = 1$ then $\frac{x}{\sqrt{2} + \sqrt{x}} + \frac{y}{\sqrt{2} - \sqrt{y}} = \dots\dots\dots$ [Bihar NTSE Stage-1 2015]
 (A) $\sqrt{2}$ (B) $\sqrt{3}$ (C) 1 (D) None of these
20. Raj wanted to type the first 200 natural numbers, how many times does he have to press the keys (Delhi NTSE Stage-1 2016)
 (A) 489 (B) 492 (C) 400 (D) 365
21. If a number m is divided by 5 leaves a remainder 2, while another number n is divided by 5 leaves a remainder 4, then the remainder, when $(m + n)$ is divided by 5 is : (Haryana NTSE Stage-1 2016)
 (A) 1 (B) 2 (C) 3 (D) 4
22. What is the square root of $9 + 2\sqrt{14}$? [Bihar NTSE Stage-1 2016]
 (A) $1 + 2\sqrt{2}$ (B) $\sqrt{3} + \sqrt{6}$ (C) $\sqrt{2} + \sqrt{7}$ (D) $\sqrt{2} + \sqrt{5}$
23. $\sqrt[3]{1 - \frac{127}{343}}$ is equal to [Bihar NTSE Stage-1 2016]
 (A) $\frac{5}{9}$ (B) $1 - \frac{1}{7}$ (C) $\frac{4}{7}$ (D) $1 - \frac{2}{7}$
24. What is the value of $2.\bar{6} - 1.\bar{9}$? [Bihar NTSE Stage-1 2016]
 (A) $0.\bar{6}$ (B) $0.\bar{9}$ (C) $0.\bar{7}$ (D) 0.7
25. An equivalent expression of $\frac{5}{7 + 4\sqrt{5}}$ after rationalizing the denominator is [Gujarat NTSE Stage-1 2016]
 (A) $\frac{20\sqrt{5} - 35}{31}$ (B) $\frac{20\sqrt{5} - 35}{129}$ (C) $\frac{35 - 20\sqrt{5}}{31}$ (D) $\frac{35 - 20\sqrt{5}}{121}$
26. Four positive integers sum to 125. If the first of these numbers is increased by 4, the second is decreased by 4. The third is multiplied by 4 and the fourth is divided by 4 we find four equal numbers then four original integers are (Delhi NTSE Stage-1 2016)
 (A) 16, 24, 5, 80 (B) 8, 22, 38, 57 (C) 7, 19, 46, 53 (D) 12, 28, 40, 45
27. If $a = \sqrt{6} + \sqrt{5}$; $b = \sqrt{6} - \sqrt{5}$, the find the value of $2a^2 - 5ab + 2b^2$ [Maharashtra NTSE Stage-1 2016]
 (A) 36 (B) 37 (C) 39 (D) 41
28. $\sqrt{m^4 n^4} \times \sqrt[6]{m^2 n^2} \times \sqrt[3]{m^2 n^2} = (mn)^k$, then find the value of k . [Maharashtra NTSE Stage-1 2017]
 (A) 6 (B) 3 (C) 2 (D) 1

**VALUE BASED / PRACTICAL BASED QUESTIONS**

MARKED QUESTIONS MAY HAVE FOR REVISION QUESTIONS.

This Section is not meant for classroom discussion. It is being given to promote self-study and self testing amongst the Resonance students.

1. 96 defective pens are accidentally mixed with 105 good pens (a) What is LCM of 96 and 105? (b) the shopkeeper draws a pen and finds it to be defective. The shopkeeper did not sell and kept the pen aside. Which value is shown by the shopkeeper?
2. Aakash, Kushal and Harish go for a morning walk. They step off together and their steps measure 40cm, 42cm and 45cm, respectively. (a) What is the minimum distance each should walk so that each can cover the same distance in complete steps? (b) How is morning walk useful?

Specimen Copy



Answers

BOARD LEVEL EXERCISE

TYPE (I) : VERY SHORT ANSWER TYPE QUESTIONS :

1. 13 2. xy^2 3. a^3b^2 4. 2520
5. four 6. No

TYPE (II) : SHORT ANSWER TYPE QUESTIONS :

7. True.
10. it is terminating decimal.

TYPE (III) : LONG ANSWER TYPE QUESTIONS:

15. 625 18. 2520 cm

PREVIOUS YEAR PROBLEMS

1. (B) 3. (D) 4. 15 8. (C)
2. (A) 12. 144 13. (A) 16. (B)
9. (B) 20. HCF = 2, LCM = 23460 21. (B)
17. (D)

EXERCISE - 1

SUBJECTIVE QUESTIONS

Section (A)

- A-1 $\frac{3}{2}$ A-2 a rational number. A-6. remainder = 3

Section (B)

- B-1. 5 B-2. 1 B-3 $x = 76$ and $y = (-59)$
B-4. 63 B-5 16.

Section (C)

- C-2 12600 C-3. (i) HCF = 6, LCM = 40896 (ii) HCF = 125, LCM = 95625
C-5 8 C-6 36 minutes
C-7 (a) 2520 cm (b) It's good for health

Section (D)

- D-4. (i) non-terminating (ii) terminating

OBJECTIVE QUESTIONS

Section (A)

- A-1. (C) A-2 (D) A-3. (A) A-4. (C)
A-5. (C) A-6.. (B)



Section (B)

- B-1. (B) B-2. (C) B-3. (C) B-4. (D)
 B-5. (C)

Section (C)

- C-1 (C) C-2. (A) C-3. (B) C-4. (A)
 C-5. (B) C-6. (D)

Section (D)

- D-1 (B) D-2. (C) D-3. (A) D-4. (D)
 D-5. (B) D-6. (D)

EXERCISE - 2

OBJECTIVE QUESTIONS

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Ans.	D	D	B	A	C	B	C	D	D	C	B	A	D	B

EXERCISE - 3

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans.	C	B	A	B	D	B	B	C	D	A	D	B	A	B	D	B	C	B	A	B
Ques.	21	22	23	24	25	26	27	28												
Ans.	A	C	B	A	A	A	C	B												

VALUE BASED / PRACTICAL BASED QUESTIONS

1. (a) LCM = 3360 (b) Value : Honesty & Loyalty
 2. (a) 2520 cm (b) It's good for health



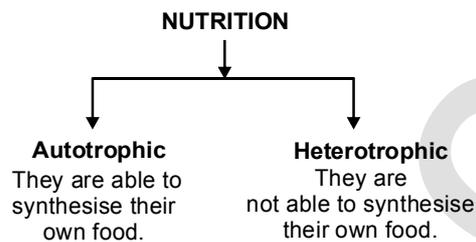
NUTRITION

INTRODUCTION

Nutrition is a process of intake of nutrients (like carbohydrates, fats, proteins, minerals, vitamins and water) by an organism as well as the utilisation of these nutrients by the organism. A nutrient can be defined as a substance which an organism obtains from its surroundings and uses it as a source of energy or for the biosynthesis of its body constituents (like tissues and organs) to provide energy for performing various metabolic activities of the organism.

A. MODE OF NUTRITION

There are several modes of nutrition on the basis of which organisms are classified as follows :



(a) Autotrophic : (Auto = self, trophic = food) :

It is a mode of nutrition in which organisms prepare their own food. Inorganic molecules like CO_2 and H_2O are converted into organic molecules like carbohydrates in the presence of sunlight and chlorophyll. e.g. Green plants. Autotrophs are further categorized as :

- (i) **Photoautotrophs** : Those which utilize sunlight for preparing their food. e.g. plants, algae, purple red and green bacteria.
- (ii) **Chemoautotrophs** : Those which utilize chemical energy for preparing their food. e.g. Nitrifying bacteria, iron bacteria, sulphur bacteria, methane bacteria.

(b) Heterotrophic (Hetero = different ; trophic = food) :

It is a mode of nutrition in which organisms derive their food from some other animals or plants. They cannot prepare their own food. All the animals have a heterotrophic mode of nutrition. Most bacteria and fungi also have heterotrophic mode of nutrition. The non-green plants (like yeast) are also heterotrophs. Heterotrophs are further categorized depending on the **nature of food** they consume :

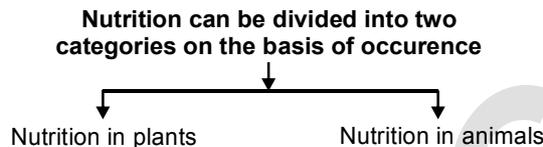
- (i) **Herbivores** : Animals which eat only plants, e.g. Cow , goat etc.
- (ii) **Carnivores** : They feed on flesh of other animals, e.g. Lion , Tiger etc.
- (iii) **Omnivores** : They feed on plants and animals both, e.g. Dog, human, sparrow, cockroach, rat.
- (iv) **Detritivores** : Feed on detritus or dead organic remains, e.g. Earthworm.
- (v) **Sanguivorous** : Feed on blood, e.g. Leech , female mosquito, vampire bats.
- (vi) **Frugivorous** : Feed on fruits, e.g. Parrot, monkey, birds.
- (vii) **Insectivores** : Feed on insects, e.g. Bats, lizards, spiny ant eater, pitcher plant.

On the Basis of **Mode of Feeding** Organisms are categorised as :

- (i) **Holozoic** : 'Holozoic nutrition' means 'feeding on solid food'. The large organic molecules of ingested food are broken down into smaller soluble substances with the help of digestive enzymes. The simple molecules are then absorbed into the cell and utilized. The undigested and unabsorbed part of the food thrown out of the body of the organism by the process of egestion. e.g., Amoeba , Human, etc.
- (ii) **Saprotrophic** : 'Sapro' means 'rotten' . These organisms obtain food from dead and decaying organic matter. They secrete some extracellular enzymes which break down the complex organic compounds into simple forms. Examples: Fungi and bacteria. e.g., Bacteria , fungi etc.



- (iii) **Parasitic** : These are organisms which live on or inside other living organisms called hosts and obtain their food from them. In this type of mode Guest get benefitted while host get harmed. The mode of feeding depends upon the habit, habitat and modifications of the parasite. Example: Tapeworm, *Plasmodium*, *Cuscuta*. Several fungi (Albugo, Phytophthora, Puccinia etc.), bacteria, some flowering plants like *Cuscuta* (amarbel) and some animals like, 'Plasmodium' (which causes malaria in human), *Ascaris* (round worm), *Enterobius* (pin worm), *Taenia* (tape worm), *Fasciola* (liver fluke) etc. *Cuscuta* is a parasitic plant that lacks both chlorophyll and leaves. It attaches to the host and gives out haustoria or the sucking roots that get attached to the phloem of the host and derive nutrition.
- (iv) **Symbiotic Association** : It is also known as **mutualism**. A mode of nutrition in which two organism lives in such a association that both of them will be benefitted. This is the case with some symbionts whose nutrition is referred to as **symbiotic nutrition**. For example: *Escherichia coli* that lives in the intestine of man synthesizes vitamin B₁₂, which is used by man and the *E. coli* receives, in return, simpler food from the intestine of man.



Check Your Progress

- Q.1 What are various steps of holozoic mode of nutrition ?
 Q.2 Why do insectivorous plants eat insects ?
 Q.3 Differentiate between Detritivores and Sanguivores.



B. NUTRITION IN PLANTS

- Plants are autotrophic in nature. They prepare their own food. Hence, they are called as producers.
- They contain a green pigment called chlorophyll which can entrap solar energy which is then converted into chemical energy in the form of food and the process is called as "Photosynthesis".

(a) Photosynthesis :

- (i) **Definition** : 'Photo' means 'light' and 'synthesis' means 'to build', thus 'photosynthesis' means 'building up by light'. The synthesis of organic compounds like glucose from simple inorganic molecules like CO₂ and H₂O by the cells of green plants having chlorophyll in the presence of sunlight is called as photosynthesis.

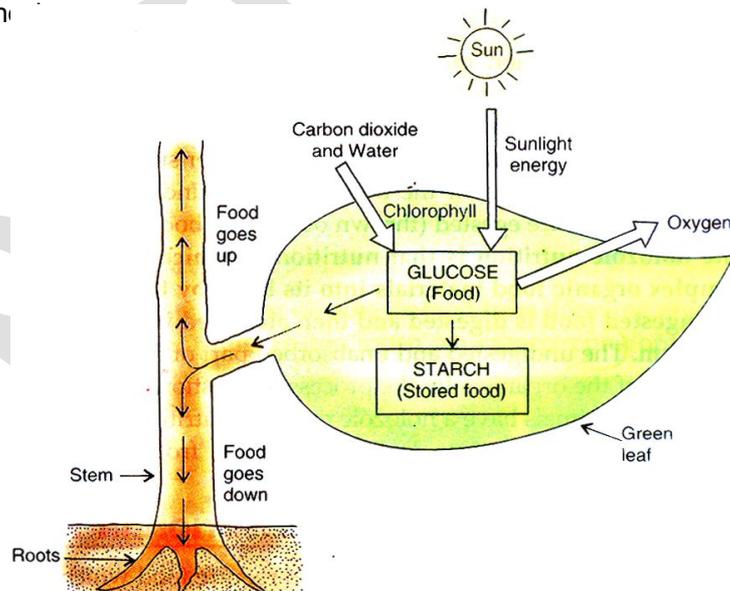
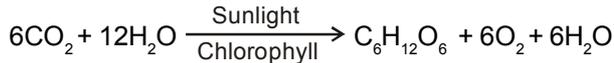
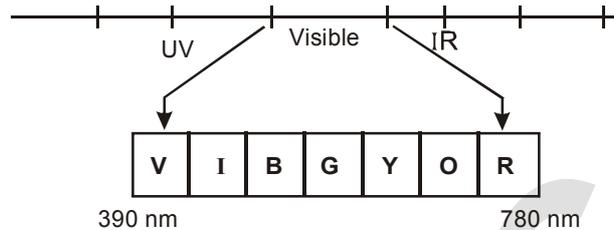


Fig.1.1 : Green plants make their own food by photosynthesis.

(ii) **Equation of photosynthesis :**(iii) **Essential Elements of Photosynthesis :**(I) **Sunlight :**

- For plants sun is the basic source of radiant energy.
- Plants utilize the light in the visible region of solar spectra (electromagnetic spectrum) which comes under the range of 400 nm – 700 nm.
- Visible region consists of white light which is a mixture of seven lights of different wavelengths.



- Maximum photosynthesis occurs in **Red** region.
- There is minimum photosynthesis in **Green** region because green parts of plants reflect whole of the green light.

(II) **Chlorophyll** : These are the green pigments present in chloroplast. They are found in green leaves in a maximum amount as well as in other green aerial parts of plant. There are six different types of chlorophyll, they are chlorophyll a, b, c, d, e and bacteriochlorophyll, amongst them chlorophyll a and chlorophyll b are the most commonly occurring chlorophylls.

◆ Besides chlorophyll certain other pigments are also present in plants like :

- (1) **Carotenes** : Orange in colour e.g. Carrot.
- (2) **Xanthophylls** : Orange yellow in colour e.g. Maize.
- (3) **Phycobilins** : Different colours like red , violet e.g. Blue-green algae, brown algae etc.

(iv) **Raw Materials of Photosynthesis :**

(I) **Carbondioxide** : Terrestrial plants obtain carbon dioxide from the atmosphere through the small openings present on leaves called as stomata. 'Stomata' are the small pores present on the surface of leaves .They help in exchange of gases and transpiration. Stomatal opening is guarded by the presence of guard cells (kidney shaped).

- Aquatic plants obtain CO_2 dissolved in water through their general body surface so they perform more photosynthesis than terrestrial plants.

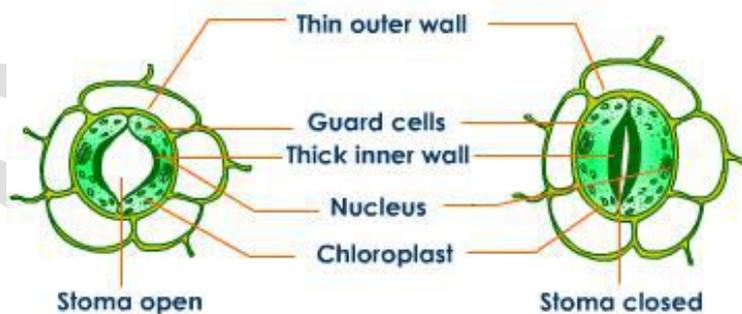


Fig.1.2 : Stomata

(II) **Water** : Plants absorb water from the soil by the process of osmosis. This water is transported to leaves by a special type of tissue called as xylem.



- Plants utilize carbon dioxide during photosynthesis, the intensity of light at which amount of CO_2 used during photosynthesis becomes equal to the amount of CO_2 released during respiration by plants is called as **Compensation Point**.
 - Compensation point occurs at low light intensity that is during morning and during evening hours.
- (v) **Site of Photosynthesis** : Site of photosynthesis is different in prokaryotes and eukaryotes.
- In prokaryotes** : Photosynthesis occurs in lamellar chromatophores.
 - In eukaryotes** : Photosynthesis occurs in chloroplast
 - In higher plants chloroplast is the main site of photosynthesis.
 - Chloroplast is also called as green plastid.
 - Plastids are of 3 different types on the basis of pigments present in them.
- (I) **Leucoplast** : White in colour, found in underground parts, lacks any coloured pigment. Helps in storage of protein (Aleuroplast), oil (Elaioplast), starch (Amyloplast)
- (II) **Chromoplast** : Colour other than green, found in aerial parts of the plants.
- (III) **Chloroplast** : Contain green pigment, called as chlorophyll.

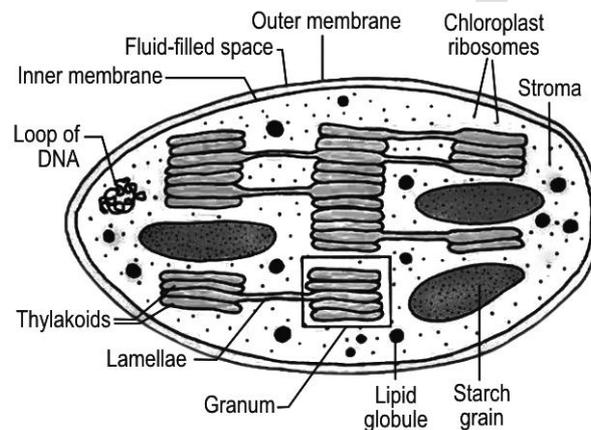


Fig.1.3 Internal structure of Chloroplast

- A typical structure of chloroplast is a double membraneous structure having two parts.
- Grana** : It is a lamellar system consisting of stacks of grana lamella each bounded by a membranous box called as thylakoid.
 - They are 40 – 60 per cell. Number of thylakoids per grana is 50 or more. Chlorophyll molecules are found inside the thylakoid membrane where they trap solar energy in the form of small energy packets called 'photons' or 'quanta'.
 - Grana are interconnected to each other by a channel called as stroma lamellae or **Fret's channel**.
 - Stroma** : It is a non pigmented proteinaceous matrix in which grana remain embedded. It contains enzymes for dark reaction.
- (vi) **Mechanism of Photosynthesis** :
- (I) **Light reaction** :
- It is also called as photochemical process.
 - It was discovered by → 'Robert Hill'. Therefore it is also called as Hill's reaction.
 - Site** : Grana of chloroplast.
 - Raw materials** : Light and water.
 - Products** - ATP , NADPH_2 and O_2



- Place this plant in a completely dark place for about three days to destarch its leaves.
 - Take out the potted plant from the dark place and keep it in bright sunshine for three to four days.
 - Boil these leaves in water for a few minutes and then remove its green colour 'chlorophyll' by boiling it in alcohol. The green parts of the leaf get decolourised.
 - Wash the decolourised leaf with hot water to soften it and remove any chlorophyll.
 - Pour iodine solution over the colourless leaf and observe the change in colour of the leaf.
 - The outer part of leaf that was originally white (without chlorophyll) does not turn blue-black on adding iodine solution showing that no starch is present in this outer part of the leaf.
- From this observation, **we conclude that the photosynthesis to make starch does not take place without chlorophyll.**
- The inner part of leaf which was originally green (contained chlorophyll) turns blue-black on adding iodine solution showing that starch is present in this inner part of the leaf. From this observation **we conclude that the photosynthesis to make starch takes place in the presence of chlorophyll.**
 - Select a potted plant having long leaves. Destarch its leaves by keeping the plant for two or three days in a dark place.
 - Insert half of the leaf in the bottle through a split cork.
 - Some concentrated potassium hydroxide solution has already been kept in this bottle.
 - KOH will absorb all the CO_2 present in the bottle.
 - Now place the apparatus in sunlight. Test the leaf for starch after 3 to 4 hours with iodine solution.
 - Only that part of the leaf will show blue colour, which was present outside the bottle and therefore received carbon dioxide. **We conclude that the photosynthesis to make starch in the leaf does not take place without carbon dioxide.**

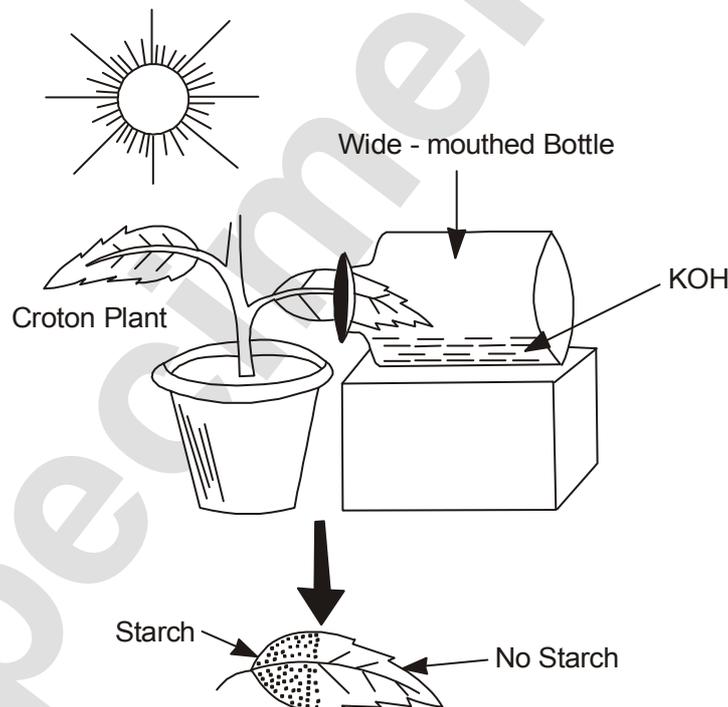
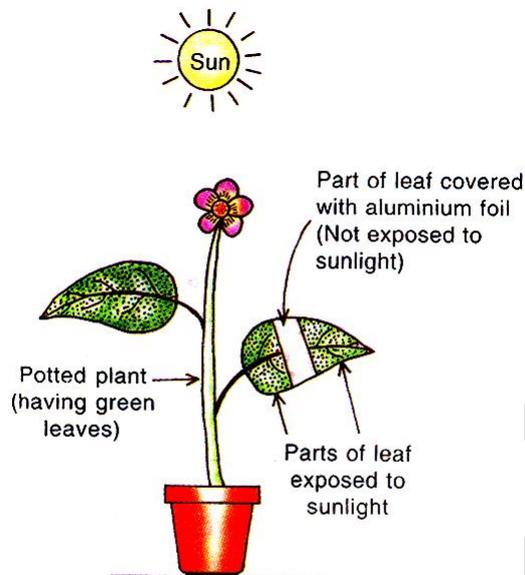


Fig. 1.4 Moll's half leaf experiment to show that CO_2 is necessary for photosynthesis

- ◆ **Experiment to show that Sunlight is necessary for the Photosynthesis.**
- Take a potted plant and destarch its leaves by keeping it in dark for 2-3 days.
- Take a thin strip of aluminium foil (or black paper) and wrap it in the centre of one leaf on both the sides (while the leaf is still attached to the plant). The aluminium foil should be fixed tightly to the leaf that sunlight may not enter it from the sides. The aluminium foil should cover only a small part of the leaf so that the remaining part of the leaf remains uncovered and exposed to sunlight



- Place the plant in sunlight for three to four days and then again test for starch.
- Positive starch test will be obtained only in the portion of leaf exposed to light and negative test in parts with aluminium foil. **We conclude that sunlight is necessary for photosynthesis to make food like starch.**



Potted plant with one leaf partly covered with aluminium foil and kept in sunlight.

Fig.1.5 : Experiment to show that light is essential for photosynthesis

Check Your Progress

- Q.1 Define compensation point.
 Q.2 Write down the types of leucoplast.
 Q.3 Define photons.



C. NUTRITION IN ANIMALS

- Animals are heterotrophic in nature. They are directly or indirectly dependent on plants to obtain their food
- The mode of nutrition may be parasitic or saprotrophic but usually animals are holozoic.
- All the basic steps of holozoic nutrition are same in unicellular to multicellular organism.
- Nutrition in animals consists of following steps:
 - ◆ **Ingestion** : The process of intake of food.
 - ◆ **Digestion** : It is the breakdown of large and complex molecules into simpler, smaller and soluble forms.
 - ◆ **Absorption** : Taking up of the digested food through intestinal wall to blood or body fluid.
 - ◆ **Assimilation** : In this process absorbed food is taken by body cells.
 - ◆ **Egestion** : The process by which undigested matter is expelled out.
- Digestive system is regulated by various hormones secreted by some endocrine glands.
- Alimentary canal was first of all developed in the phylum Platyhelminthes but only mouth was present in them.
- Coiled and well developed alimentary canal was developed in annelida till mammals.



(a) Nutrition in Unicellular Animals as Amoeba :

It is a unicellular organism living in water.

- Mode of nutrition is holozoic.
- The process of obtaining food is by **phagocytosis** (cell eating)
- Steps involved in digestion in amoeba are :
 - (i) **Ingestion** : Since it is unicellular so a single cell is responsible for carrying out all the vital activities. Food is ingested with the help of pseudopodia. Animal engulfs the food particle lying near it by forming pseudopodia around it and forming a food vacuole which is considered as its temporary stomach.
 - (ii) **Digestion** : The enzymes from surrounding cytoplasm enter the food vacuole and break down the food into smaller and soluble forms.
 - (iii) **Absorption** : The digested food is now absorbed by cytoplasm by simple diffusion and then the food vacuole disappears.
 - (iv) **Assimilation** : The food absorbed in amoeba is used to obtain energy from respiration, for its growth and reproduction.
 - (v) **Egestion** : Undigested food is thrown out of the cell.

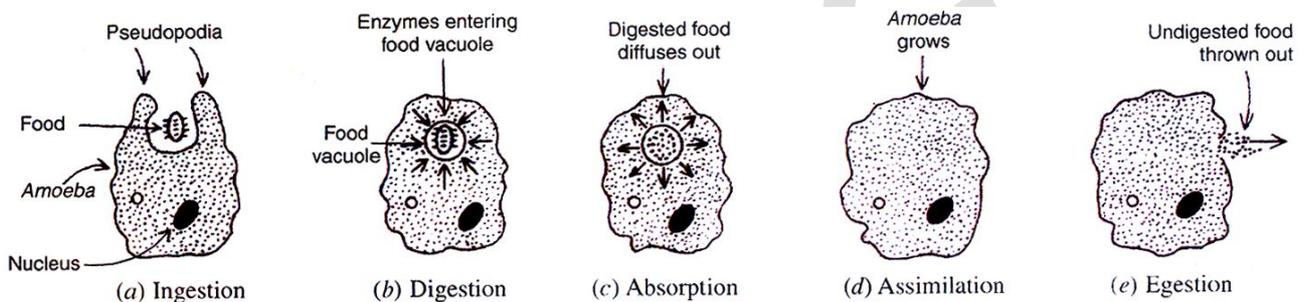


Fig.1.6 : Nutrition in Amoeba

(b) Nutrition in Higher Animal as Humans :

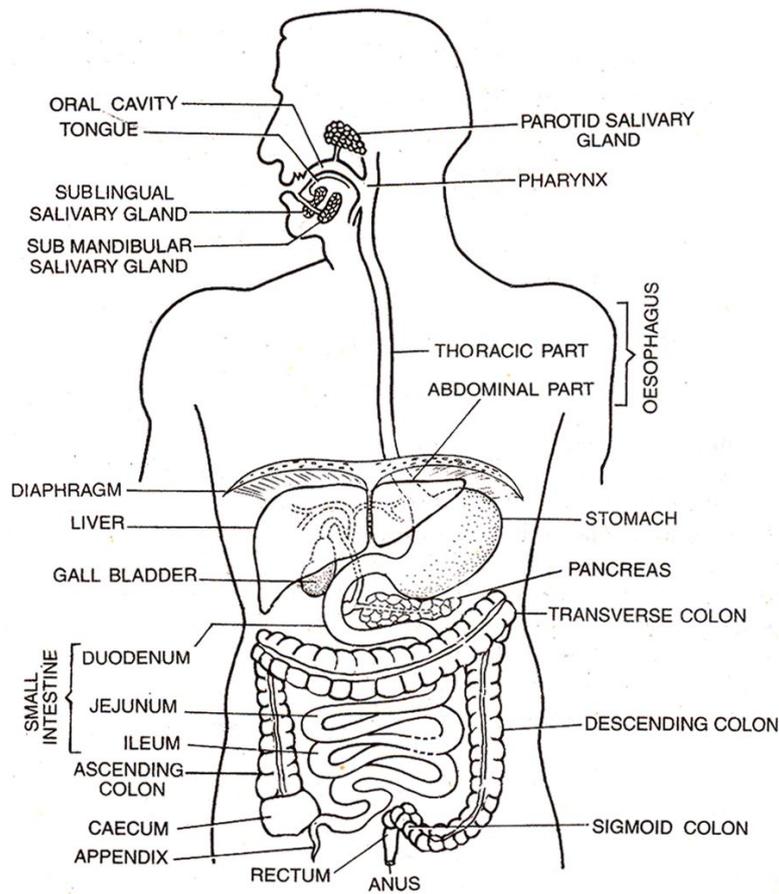
- Humans have highly evolved and complicated digestive system consisting of an alimentary canal & different types of digestive glands.
- (i) **Alimentary canal** : Long, hollow, tubular structure consisting of various organs for digestion.
- Alimentary canal consists of following organs :
 - (I) **Mouth** : It is a small slit through which food is ingested.
 - (II) **Buccal Cavity** : Mouth is a slit or a pore which opens into a chamber called as buccal cavity.
 - 1 **Palate** : Roof of buccal cavity is called palate.
 - 2 **Tongue** : At the floor of this cavity thick muscular structure is present called tongue. It helps in chewing, swallowing, tasting and speaking. Tongue has various types of papilla having taste buds.
 - 3 **Teeth** : The teeth cut the food into small pieces, chew and grind it. So, the teeth help in physical digestion.
- Jaws present in buccal cavity are provided with four different types of teeth :
 - Incisors : For cutting
 - Canines : For tearing
 - Premolars : For grinding
 - Molars : For grinding
- Dental formula of humans :
 - Milk teeth → These are temporary, arise at 6 – 11 month age, 20 in number

$$\frac{\text{Half upper jaw}}{\text{Half lower jaw}} = \frac{2102}{2102}, i \frac{2}{2}, c \frac{1}{1}, pm \frac{0}{0}, m \frac{2}{2}$$



- Permanent teeth → In adult 32 in number.

$$\frac{\text{Half upper jaw}}{\text{Half lower jaw}} = \frac{2123}{2123} \quad i \frac{2}{2}, c \frac{1}{1}, pm \frac{2}{2}, m \frac{3}{3}$$



Human digestive system.

Fig.1.7 : Alimentary canal of Human along with Digestive glands

- (III) **Oesophagus** : Also called as food pipe . It leads the food from mouth to stomach. Oesophagus has highly muscular walls, no digestion occurs here. The contraction and expansion movement of the walls of food pipe is called **peristaltic movement**. This peristaltic movement of food pipe (or oesophagus) pushes the slightly digested food into the stomach (it moves food in all the digestive organs throughout the alimentary canal).
- (IV) **Stomach** : It is a 'J' shaped bag present on left side of abdomen. It contains several branched and tubular glands present on the inner surface of its wall, which secrete gastric juice.
- (V) **Small Intestine** : It is the longest part of the alimentary canal. It is about 6.5 metres long in an adult man. It is very long, it is called small intestine because it is very narrow. It is have 3 regions:
(1) Duodenum **(B) Jejunum** **(C) ileum**
- Duodenum is proximal part of small intestine receives secretion from liver and pancreas.
 - On the inner wall of small intestine numerous finger like projections are found which are called as **microvilli**, they increase the surface area for absorption of digested food.
- (VI) **Large Intestine** : Small intestine opens into large intestine from where the undigested food material is passed to anus through rectum. It is divided into three parts :
(1) Caecum **(B) Colon** **(C) Rectum**
- (ii) **Digestive Glands** :
- They secrete enzymes / hormones which help in digestion.



- (I) **Salivary glands** : Three pairs of salivary glands are found in buccal cavity. The salivary glands help in chemical digestion by secreting enzymes. The human saliva contains an enzyme called salivary amylase or ptyalin which partially digests the starch present in food into sugar. Thus, the digestion of starch (carbohydrate) begins in the mouth itself. Since the food remains in the mouth only for a short time, so the digestion of food remains incomplete in mouth.

Starch $\xrightarrow{\text{salivary amylase}}$ Maltose

- (II) **Gastric glands** : It is present in stomach. The food is churned in the stomach for about three to four hours. The stomach wall contains three tubular glands in its walls. The glands present in the walls of the stomach secrete gastric juice. The gastric juice contains three substances : hydrochloric acid, the enzyme pepsin and mucus. Due to the presence of hydrochloric acid, the gastric juice is acidic in nature. In the acidic medium, the enzyme pepsin begins the digestion of proteins present in food to form smaller molecules. The mucus helps to protect the stomach wall from its own secretions of hydrochloric acid. Thus, the protein digestion begins in the stomach.

Protein $\xrightarrow{\text{pepsin}}$ Peptons + Peptides

◆ **Function of HCl :**

- It activates the enzyme pepsinogen into pepsin, that is helpful in digestion of protein.
- Kills bacteria enter the stomach with food.

- (III) **Liver** : It is the largest gland, secretes bile into the small intestine. Bile contains bile juice and bile pigments. Bile juice does not contain enzymes. It is alkaline in nature and it is temporarily stored in gall bladder and helps in digestion and absorption of fats.

◆ **Function of bile :**

- Makes the acidic food coming from the stomach alkaline so that pancreatic enzymes can act on it.
- Bile salts break the fats present in the food into small globules making it easy for the enzymes to act and digest them.

- (IV) **Pancreas** : It lies parallel to and below the stomach. It secretes pancreatic juice into small intestine. Pancreas secretes pancreatic juice which contains digestive enzymes like pancreatic amylase, trypsin and lipase. The enzyme amylase breaks down the starch, the enzyme trypsin digests the proteins and the enzyme lipase breaks down the emulsified fats. Besides these enzymes pancreas also secretes 2 hormones i.e.:- Insulin and Glucagon, so it has both exocrine as well as endocrine functions. Both bile and pancreatic juice are released into the duodenum by a common duct.

- (V) **Intestinal glands** : They secrete intestinal juice (**succus entericus**) and mucus. From the stomach, the partially digested food enters the small intestine.

- ◆ **Digestion in small intestine** : Now the partly digested food moves to small intestine i.e. in the duodenum. Duodenum receives the secretion from liver and pancreas through a common duct (hepatopancreatic duct). The bile and pancreatic juice are alkaline in nature. So the digestion and emulsification of fats occurs at this place. This partially digested food now enters in the ileum where intestinal juice i.e. "**Succus entericus**" is secreted. At this place digestion is completed.

Carbohydrates \longrightarrow Glucose

Proteins \longrightarrow Amino acids

Fats \longrightarrow Fatty acids and glycerol

Here in the duodenum fats are emulsified by bile, remaining proteins are digested by trypsin and starch by pancreatic amylase proteins and fats).

- ◆ **Absorption** : After digestion, the molecules of food become so small that they can pass through the walls of the small intestine (which contain blood capillaries) and go into our blood. This is called absorption. The small intestine is the main region for the absorption of digested food. For absorption of fat lymph capillaries are present called as **lacteals**.

- ◆ **Assimilation** : The blood carries digested and dissolved food to all the parts of the body where it becomes assimilated as part of the cells. This assimilated food is used by the body cells for obtaining energy as well as for growth and repair of the body. The digested food which is not used by our body immediately is stored in the liver in the form of a carbohydrate called '**glycogen**'.



- ♦ **Egestion** : This undigested food cannot be absorbed in the small intestine. So, the undigested food passes from the small intestine into a wider tube called large intestine. The walls of large intestine absorb most of the water from the undigested food. So undigested part of food becomes almost solid. The last part of the large intestine called 'rectum' stores this undigested food for some time. Then this undigested food is passed out (or egested) from our body through anus as faeces or "stool" . The act of expelling the faeces is called **egestion** or **defaecation**.

Check Your Progress

- Q.1 Write down one function of bile juice.
 Q.2 Define succus entericus
 Q.3 What is the need of lacteal in digestive system.



Some Additional Points

- The herbivorous animals like cow which eat grass need a longer 'small intestine' to allow the cellulose present in grass to be digested completely.
- The carnivorous animals like tigers which eat meat have a shorter small intestine.
- In rabbits, rats digestion and absorption of cellulose are not complete in a single passage of food through intestine. So these animals eat their faeces containing much undigested cellulose. This habit of taking faecal matter is known as coprophagy.
- Maximum number of teeth (50) are present in opossum.
- Dysphagia Difficulty in swallowing.
- Diastema is a space in rabbit between the incisors and premolars.
- Reverse peristalsis or anti peristalsis in the stomach and duodenum causes vomiting.
- Salivary glands are absent in whales and sea cows.
- Elephant tusks are modified incisors.
- Ruminant Stomach. In ruminant animals such as cow, buffalos, sheep goat etc. The stomach is divided into four chamber. Rumen , reticulum, omasum, abomasums
- **Endosymbiosis** : The theory that explains how mitochondria and chloroplasts became organelles of other cells. Endosymbiosis is the condition of living within the body or cells of another organism. There is evidence that, millions of years ago, the ancestors of mitochondria and chloroplasts, two organelles ("mini organs") were actually prokaryotic organisms that entered into endosymbiotic relationships with eukaryotic cells.
- **Carbon fixation** : ATP and NADPH are used to fix CO_2 into carbohydrates. Carbon fixation takes place in the chloroplast.
- **Fatty Acids** : Fatty Acids are the basic constituents (parts) of many important lipids (fats), including e.g. triglycerides.
- **Enzyme** : Enzymes are proteinaceous that increase the rate of biological reactions without being used-up in the reactions themselves. That is, enzymes can act as catalysts. Enzymes form within living cells and may act either within the cell or outside it.
- **Peristalsis** : Peristalsis is a wave-like movement (motion) that progresses along some of the hollow tubes of the body that have circular and longitudinal muscles, such as the intestines. Peristalsis happens involuntarily.



Board Level Exercise

TOPIC NAME : NUTRITION

TYPE (I) : VERY SHORT ANSWER TYPE QUESTIONS :

[01 MARK EACH]

1. "All plants give out oxygen during day and carbon dioxide during night". Do you agree with this statement ? Give reason.
2. How do the guard cells regulate opening and closing of stomatal pores ?
3. Is 'nutrition' a necessity for an organism ? Discuss

TYPE (II) : SHORT ANSWER TYPE QUESTIONS :

[02 MARKS EACH]

4. If a plant is releasing carbon dioxide and taking in oxygen during the day, does it mean that there is no photosynthesis occurring ? Justify your answer
5. Differentiate between an autotroph and a heterotroph.

TYPE (III) : LONG ANSWER TYPE QUESTIONS:

[04 MARK EACH]

6. Explain the process of nutrition in *Amoeba*.
7. Describe the alimentary canal of man

TYPE (IV) : VERY LONG ANSWER TYPE QUESTIONS

[05 MARK EACH]

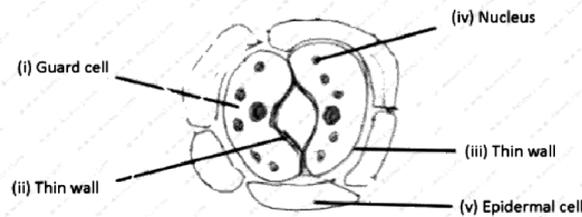
8. Explain the mechanism of photosynthesis.
9. Explain the three pathways of breakdown of food in living organisms.
10. Name the following
 - (a) The process in plants that links light energy with chemical energy
 - (b) Organisms that can prepare their own food
 - (c) The cell organelle where photosynthesis occurs
 - (d) Cells that surround a stomatal pore
 - (e) Organisms that cannot prepare their own food
 - (f) An enzyme secreted from gastric glands in stomach that acts on proteins.

PREVIOUS YEAR PROBLEMS

1. (a) Draw diagram of human alimentary canal and label the following [CBSE 10TH BOARD: 2013]
 - (i) Part in which starch digestion starts
 - (ii) Part in which bile is stored
 - (iii) Part in which nutrients are absorbed
 - (iv) Part in which water is absorbed
 (b) Mention the role of hydrochloric acid in the stomach.
 (c) What function is served by the following:
 - (i) Gastric sphincter
 - (ii) Anal sphincter
2. Write one feature which is common to each of the following pairs of terms: [CBSE 10TH BOARD: 2013]
 - (i) Glycogen and starch
 - (ii) Chlorophyll and haemoglobin
3. We test for starch and not glucose to prove that photosynthesis has taken place because [CBSE 10TH BOARD: 2013]
 - (a) Glucose is not produced during photosynthesis in variegated leaves.
 - (b) Glucose formed during photosynthesis get stored as sucrose.
 - (c) Glucose formed during photosynthesis get stored as starch.
 - (d) Glucose is a stable product and cannot be tested.
4. What are villi ? What is their function ? [CBSE 10TH BOARD : 2014]
5. Explain why : [CBSE 10TH BOARD : 2015]
 - (a) Digestion of food is a decomposition reaction.
 - (b) All decomposition reactions are endothermic reactions.
 - (c) A popping sound is produced when a burning candle is brought near mouth of a test tube used in electrolysis of water.



6. In the following diagram of the stomatal apparatus, which parts are correctly labelled ?



- (A) (i) and (v) (B) (ii) and (v) (C) (iv) and (ii) (D) (v) and (iv)
7. (a) Draw diagram to show the nutrition in amoeba and label the part used for this purpose. Mention any other purpose served by this part other than nutrition. **[CBSE 10TH BOARD: 2016]**
 (b) Name the glands associated with digestion of starch in human digestive tract and mention their role.
 (c) How is required pH maintained in the stomach and small intestine.

Exercise-1

Marked Questions can be used as Revision Questions.

SUBJECTIVE QUESTIONS

SUBJECTIVE EASY, ONLY LEARNING VALUE PROBLEMS

SECTION (A) : MODE OF NUTRITION

- A-1 Name the different modes of nutrition and classify them with one example of each ?
 A-2 How do autotrophs obtain CO_2 and H_2O to make their food ?

SECTION (B) : NUTRITION IN PLANTS

- B-1 Name the site of light and dark reaction of photosynthesis ?
 B-2 What is the product formed during C_3 cycle of dark reaction of photosynthesis ?
 B-3 What is the importance of the following process occurring during photosynthesis in plants ?
 (i) Emission of electrons from chlorophyll
 (ii) Photolysis of water
 B-4 Explain how water and temperature influence the rate of photosynthesis ?
 B-5 Describe the structure and role of chloroplast along with a well labelled diagram ?
 B-6 Describe the mechanism of photosynthesis ?
 B-7 Explain the process of 'Photosynthesis' in plants. List four factors which influence this process and describe how each of them, affects the rate of the photosynthesis.
 B-8 Explain the following aspects of photosynthesis in plants:
 (i) The role of chlorophyll
 (ii) Calvin – Benson Cycle / Dark reaction
 B-9 (i) Explain why the rate of photosynthesis in plants is low both at lower and higher temperatures ?
 (ii) Is green light most or least useful in photosynthesis and why ?
 (iii) Describe an activity to show that chlorophyll is necessary for photosynthesis in plants.

SECTION (C) : NUTRITION IN ANIMALS

- C-1 Name the different steps involved in digestion process.
 C-2 Name the different parts of large intestine.
 C-3 Where does the absorption of food takes place ?
 C-4 Name five different types of glands involved in human digestive system.
 C-5 Where does digestion of fat take place in our body ?
 C-6 Describe the digestion process of carbohydrate in humans.
 C-7 Draw a well labelled diagram of human alimentary canal. Mention the functions of liver in digestion.
 C-8 Explain various digestive glands present in man along with their secretions & functions.
 C-9 What is meant by assimilation of food ? Name the digestive glands of human.



OBJECTIVE QUESTIONS

SINGLE CHOICE OBJECTIVE, STRAIGHT CONCEPT/FORMULA ORIENTED

SECTION (A) : MODE OF NUTRITION

- A-1 Plants are -
 (A) chemoautotrophs (B) Photoautotrophs (C) Heterotrophs (D) none of these
- A-2 Those organisms which can feed on dead and decay material are known as -
 (A) Detritivores (B) Fruigivores (C) Scavengers (D) None of these
- A-3 Amoeba shows....mode of nutrition-
 (A) Saprophytic (B) Holozoic (C) Symbiotic (D) None of these

SECTION (B) : NUTRITION IN PLANTS

- B-1 The raw materials for photosynthesis are
 (A) CO_2 & O_2 (B) sunlight, O_2 & CO_2 (C) water and chlorophyll (D) CO_2 and water
- B-2 Most of the photosynthesis (80%) which takes place on this earth is carried out by
 (A) green plants on land (B) algae present in fresh water
 (C) algae found in ocean (D) algae present in ocean and fresh water sources
- B-3 Which of the following requires no enzyme ?
 (A) Light reaction (B) Photolysis of water (C) Dark reaction (D) Carboxylation
- B-4 Plants are green in colour because
 (A) they absorb green light only (B) they reflect green light
 (C) they absorb green light but reflect all other lights (D) none of the above are correct
- B-5 Full name of NADP is
 (A) Nicotinamide dinucleotide phosphate (B) Nicotine adenine dinucleotide phosphate
 (C) Nicotinamide adenine dinucleotide phosphate (D) None of the above
- B-6 Wavelength of visible light which is required for photosynthesis ?
 (A) 200 – 400 nm (B) 390 – 780 nm (C) 700 – 900 nm (D) 100 – 200 nm
- B-7 Compensation point occurs :
 (A) When intensity of light is high (B) During dark
 (C) During morning and evening hours (D) During mid-day
- B-8 The chlorophyll absorbs mostly :
 (A) Blue and green light (B) Blue and red light
 (C) Green and red light (D) Violet light
- B-9 CO_2 fixation occurs in :
 (A) Stroma (B) Grana (C) Outer membrane (D) Inner membrane
- B-10 Stroma is the ground matrix of :
 (A) Lysosomes (B) Oxsosomes (C) Ribosomes (D) Chloroplast
- B-11 Seedlings grown in dark are :
 (A) similar to those grow in light (B) taller than those grow in light
 (C) shorter than those grow in light (D) they don't grow at all

SECTION (C) : NUTRITION IN ANIMALS

- C-1 Number of teeth in human which grow twice are :
 (A) 18 (B) 14 (C) 12 (D) 20
- C-2 Bile juice is produced by -
 (A) Stomach (B) Liver (C) Gall bladder (D) Pancreas



- C-3 During digestion of food in alimentary canal, protein is acted upon by enzymes in the following sequence.
 (A) ptyalin, trypsin and peptidase (B) peptidase, trypsin and pepsin
 (C) pepsin, trypsin and peptidase (D) ptyalin, pepsin and trypsin
- C-4 In amoeba the digestion is intracellular because
 (A) amoeba is unicellular (B) amoeba is multicellular
 (C) amoeba is found in pond (D) amoeba is a microscopic animal
- C-5 The path taken by food material after ingestion is represented by
 (A) Mouth → Oesophagus → Stomach → Pharynx
 (B) Mouth → Pharynx → Oesophagus → Small Intestine → Stomach
 (C) Mouth → Pharynx → Oesophagus → Stomach
 (D) Oesophagus → Mouth → Pharynx → Stomach
- C-6 Teeth involved in cutting of food material are called
 (A) incisors (B) canines (C) molars (D) premolars
- C-7 The most important function of villi in the small intestine is
 (A) to provide strength to the intestine
 (B) to provide space for capillaries and lacteals
 (C) to provide increased surface area for absorption of digested food
 (D) to provide habitat for bacteria
- C-8 Which of the following secretions does not contain enzymes ?
 (A) Bile (B) Pancreatic juice (C) Intestinal juice (D) Saliva
- C-9 Chewing is an example of
 (A) chemical digestion (B) mechanical digestion
 (C) involuntary action (D) hydrolysis
- C-10 Microvilli are present in
 (A) stomach (B) small intestine (C) large intestine (D) mouth
- C-11 Pepsin differs from trypsin in that it digests :
 (A) protein in alkaline medium in stomach (B) protein in acid medium in stomach
 (C) protein in acid medium in duodenum (D) protein in alkaline medium in duodenum.
- C-12 Thorough mastication of food is essential because
 (A) mastication of food makes the teeth stronger
 (B) it makes the process of swallowing the food easier
 (C) by this process bigger pieces of food are broken down into smaller pieces
 (D) bigger pieces of food are broken down into smaller pieces and saliva is properly mixed with it
- C-13 The wave of contractions that pushes the food through the alimentary canal is called
 (A) peritoneum (B) peristalsis (C) cyclosis (D) polarisation
- C-14 In amoeba absorption of the digested nutrients occurs in
 (A) contractile vacuole (B) plasma membrane (C) cytoplasm (D) None of these
- C-15 Well developed alimentary canal first developed in
 (A) Protozoans (B) Mammals (C) Annelida (D) Poriferans
- C-16 Digestion of starch starts from
 (A) stomach (B) intestine (C) oesophagus (D) Buccal cavity
- C-17 The digestion of food is completed in which part of alimentary canal ?
 (A) duodenum (B) ileum (C) stomach (D) large intestine
- C-18 Ptyalin enzyme is secreted by
 (A) salivary glands (B) mouth (C) oesophagus (D) stomach
- C-19 The final product of digestion of carbohydrates and proteins are
 (A) glycerol and amino acids respectively (B) amino acids and glycerol respectively
 (C) glucose and amino acids respectively (D) amino acids and glucose respectively

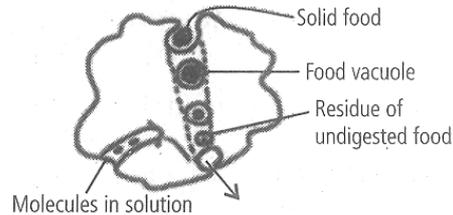


Exercise-2

Marked Questions can be used as Revision Questions.

OBJECTIVE QUESTIONS

- Chemosynthetic bacteria obtain energy from :
(A) Sun (B) Infra-red rays (C) Organic substances (D) Inorganic chemicals mainly
- In the diagram, which of the following processes are shown in Amoeba ?



- (A) Exocytosis (B) Phagocytosis (C) Pinocytosis (D) All of these
- The visible part of electromagnetic spectrum lies in between :
(A) X - ray and ultra-violet (B) Ultra violet and infra red
(C) Infra red and microwave (D) X-ray and infra red
- Partially digested food that leaves the stomach is called :
(A) Chyle (B) Chyme (C) Bolus (D) None of these
- Peristalsis occurs in
(A) liver (B) ureter (C) alimentary canal (D) hypothalamus
- Human beings have vestigial vermiform appendix. The ancestors must have been
(A) insectivorous (B) herbivorous (C) carnivorous (D) sanguivorous.
- Which one of the following lacks proteins ?
(A) Pancreatic juice (B) Saliva (C) Bile (D) Intestinal juice
- Liver stores glucose in the form of :
(A) Starch (B) Glycogen (C) Protein (D) Cholesterol
- Gastric juice contains :
(A) Pepsin, lipase and rennin (B) Trypsin, lipase and rennin
(C) Trypsin, pepsin and lipase (D) Trypsin, pepsin and rennin
- Partial removal of liver is not harmful because :
(A) Liver being a large organ can suffice the functions even if a part is removed
(B) Liver is not a very essential organ of the body
(C) Liver has regenerative capacity and will grow after partial hepatectomy
(D) The function of liver can be taken over by kidneys
- Insectivorous plants digest insects to get an essential nutrient. Other plants generally get this nutrient from the soil. What is this nutrient ?
(A) Oxygen (B) Nitrogen (C) Carbon dioxide (D) Phosphates
- Main function of HCl present in gastric juice is
(A) digestion of starch (B) emulsification of fat
(C) conversion of pepsinogen to pepsin (D) detoxification of harmful constituents of food
- What is the substrate for lipase enzyme ?
(A) Protein (B) Carbohydrate (C) Lipid (D) Nucleic acid
- Succus entericus is the other name of
(A) gastric juice (B) intestinal juice (C) bile juice (D) saliva



15. During prolong fasting, the sequence of organic compounds used by body is :
 (A) Carbohydrates, fats, proteins (B) Fats, carbohydrates, proteins
 (C) Carbohydrates, proteins, lipids (D) Proteins, lipids, carbohydrates
16. Absorption of glycerol, fatty acids and monoglycerides takes place by :
 (A) Lymph capillaries within villi (B) Walls of stomach
 (C) Colon (D) Capillaries within villi
17. Rennin acts on :
 (A) Proteins in stomach
 (B) Milk, changing casein into paracaseinate at 7.2 – 8.2 pH
 (C) Fat in intestine
 (D) Milk, changing casein into calcium paracaseinate at 1–3 pH.
18. The human intestine is long because :
 (A) Bacteria in food can be killed gradually (B) It provides more surface for food storage
 (C) It increases surface area for absorption of food (D) None of these
19. In the lunch, you ate boiled green vegetables, a piece of cooked meat, one boiled egg and a sugar candy. Which one of these foods may have been digested first ?
 (A) Boiled green vegetables (B) The piece of cooked meat
 (C) Boiled egg (D) Sugar candy
20. Glycogenesis refers to
 (A) conversion of glycogen to glucose (B) breakdown of glucose to form pyruvate
 (C) breakdown of pyruvate to form glucose (D) conversion of glucose to glycogen
21. Casein is digested in adults by –
 (A) Rennin (B) Renin (C) Chymotrypsin (D) Trypsin
22. Germs entering the body alongwith food are killed in where pH is
 (A) 10 (B) 7 (C) 3 (D) 11
23. Which one of the following association is incorrect ?
 (A) Protein - Trypsin (B) Fat - Lipase (C) Maltose - Pepsin (D) Starch - Amylase
24. Match the names of the glands listed under column I with the location given under column II and select the correct option from the codes given below :
- | Column I | Column II |
|--------------------------------|--------------------------------|
| A. Crypts of lieberkuhn | p. Loop of duodenum |
| B. Pancreas | q. Stomach |
| C. Adrenal gland | r. Intestine |
| D. Gastric gland | s. Kidney. |
| (A) A = r, B = p, C = q, D = s | (B) A = r, B = p, C = s, D = q |
| (C) A = q, B = s, C = r, D = P | (D) A=p, B = r, C = s, D = q |
25. Vitamin B₆ is also called
 (A) Thiamine (B) pantothenic acid (C) pyridoxine (D) retinol
26. Sometimes urea is fed to ruminates to improve their health. It works by
 (A) Helping growth of gut microbes that break down cellulose
 (B) Killing harmful microorganisms in their gut
 (C) Increasing salt content in the gut
 (D) Directly stimulating blood cell proliferation

Exercise-3

Marked Questions can be used as Revision Questions.

NTSE PROBLEMS (PREVIOUS YEARS)

- Bile Juice is secreted from – **(Raj/NTSE Stage-1/Nutrition/13)**
(A) Salivary glands (B) Intestinal glands (C) Stomach (D) Liver
- When acidity in Stomach increases, the medicine generally used is – **(Raj/NTSE Stage-1/Nutrition/13)**
(A) Sodium bicarbonate (B) Sodium Carbonate
(C) Ammonium Carbonate (D) Ammonium bicarbonate
- Substances necessary for autotrophic Nutrition are– **(Raj/NTSE Stage-1/Nutrition/13)**
(A) CO₂ and H₂O (B) Chlorophyll (C) Sun light (D) All of the above
- Hydrochloric acid facilitates the action of which enzyme ? **(Chandigarh/NTSE Stage-1/Nutrition/2013)**
(A) salivary amylase (B) pepsin (C) trypsin (D) Lipase
- Concentrated nitric acid is used in a test to detect adulteration of : **(Karnataka /NTSE Stage-1/Nutrition/2013)**
(A) Cooking oil (B) Milk (C) Salt (D) Tea powder
- Organisms capable of synthesizing their own food are called : **(Mizoram/NTSE Stage-1/Nutrition/2013)**
(A) heterotrophs (B) autotrophs (C) decomposers (D) parasites
- Which one of the following enzymes is present in saliva ? **(Mizoram/NTSE Stage-1/Nutrition/2013)**
(A) Pepsin (B) Chymotrypsin (C) Trypsin (D) Ptyalin
- Which part of the human alimentary canal, is the site for complete digestion of carbohydrates. **(Punjab/NTSE Stage-1/Nutrition/2013)**
(A) Stomach (B) Small Intestine (C) Large Intestine (D) Rectum
- In which one of the following alternatives the correct order of processes is given ? **(Maharashtra/NTSE Stage-1/Nutrition/2013)**
(A) Assimilation → Absorption → Digestion → Ingestion → Egestion
(B) Absorption → Digestion → Ingestion → Assimilation → Egestion
(C) Digestion → Ingestion → Assimilation → Absorption → Egestion
(D) Ingestion → Digestion → Absorption → Assimilation → Egestion
- This part of alimentary canal absorbs maximum amount of water and minerals : **(Maharashtra/NTSE Stage-1/Nutrition/2013)**
(A) Small intestine (B) Large intestine (C) Stomach (D) Oesophagus
- Which of the following enzymes is related with digestion of protein ? **(Raj/NTSE Stage-1/Nutrition/2013)**
(A) Lipase (B) Pepsin (C) Sucrase (D) Amylase
- What does liver secrete ? **(Gujarat/NTSE Stage-1/Nutrition/2013)**
(A) Insulin (B) Bile (C) Gastric juice (D) Mucus
- Which of the following plant is a parasite ? **(Gujarat/NTSE Stage-1/Nutrition/2013)**
(A) Cuscuta (B) Mushroom (C) Giloe (D) Fern
- Which two plant species obtain nutrition as symbionts in Lichens ? **(M.P./NTSE Stage-1/Nutrition/2013)**
(A) Rhizobium and Drosera (B) Fungi and Rose plant
(C) Algae and Virus (D) Algae and Fungi
- The substance essential for photosynthesis is **(Rajasthan/ntsestage I 2015)**
(A) glucose (B) oxygen (C) nitrogen (D) water
- Chlorophyll contains..... **(M.P./ntsestage I 2015)**
(A) Potassium (B) Iron (C) Manganese (D) Magnesium



17. Which of the following is an example of Insectivorous plant -
(A) Cuscuta (B) Rafflesia (C) Drosera (D) Tulsi
(M.P./ntsestage I 2015)
18. A leguminous plant grown in an autoclaved, sterilized soil fails to produce root nodules because
(A) autoclaved soil is not good for root growth. (B) autoclaved soil is devoid of bacteria.
(C) autoclaving reduces N_2 content of soil. (D) plants cannot form root hairs in such a soil.
(Nutriton Cell / 2015 NTSE Stage-2)
19. Deficiency of vitamin - 'A' causes -
(A) Beri-Beri (B) Anaemia (C) Night blindness (D) Scurvy
(M.P./ntse/stage I 2015)
20. Which of the following factors does a plant use for the process of photosynthesis ?
(A) Sunlight (B) Chlorophyll (C) CO_2 and H_2O (D) All of them
(Gujrat/ntse/stage I 2015)
21. Which is the longest organ of the digestive system ?
(A) Oesophagus (B) Stomach (C) Small Intestine (D) Large Intestine
(Gujrat/ntse/stage I 2015)
22. Gastric juice contains
(A) Pepsin and trypsin (B) Pepsin and HCl (C) Trypsin and HCl (D) Amylase and Pepsin.
(W.Bangal/ntse/stage I 2015)
23. What is the common product of both photosynthesis and respiration ?
(A) Oxygen (B) ADP (C) CO_2 (D) ATP
(Bihar/ntse/stage I 2015)
24. The substance not essential for photosynthesis is
(A) Sunlight (B) Chlorophyll (C) Nitrogen (D) Carbon dioxide
(Rajasthan/ntse/stage-I/2018)
25. In the process of Photosynthesis, the source of Oxygen is :
(A) CO_2 (B) H_2O (C) $C_6H_{12}O_6$ (D) None of these
(M.P./ntse/stage-I/2017)
26. The Grana & Stroma are the parts of which cell organelles :
(A) Mitochondria (B) Chloroplast (C) Ribosome (D) Golgi bodies
(M.P./ntse/photosynthesis/Nutrition/stage-I/2017)
27. Which of the following product of light dependent phase are used during the light independent phase of photosynthesis ?
(A) RUBP and ATP (B) H_2O and O_2 (C) NADPH and ATP (D) ATP and O_2
(Delhi/ntse/Nutrition/stage-I/2018)
28. Deficiency of one of the under mentioned vitamins causes cracking of lips in human beings :
(A) Vitamin A (B) Vitamin B2 (C) Vitamin K (D) Vitamin C
(Jharkhand/ntse/Nutrition/stage-I/2017)
29. Insectivorous plants grow only on such soils which are deficient in :
(A) Calcium (B) Nitrogen (C) Magnesium (D) Phosphorus
(Jharkhand/ntse/Nutrition/stage-I/2017)
30. The autotrophic mode of nutrition requires :
(A) Carbon dioxide and water (B) Chlorophyll
(C) Sunlight (D) All of the above
31. Enzyme which is absent in pancreatic juice
(A) Amylase (B) Lipase (C) Pepsin (D) Trypsin
(UP/ntse/Nutrition/stage-I/2017)
32. Retinol is a common name of
(A) Vit. A (B) Vit B1 (C) Vit. B2 (D) Vit C.
(UP/ntse/Nutrition/stage-I/2017)
33. Which one of the following is a type of nutrition in Amoeba ?
(A) Holozoic (B) Autotroph (C) Parasite (D) Saprotroph
(Chandigarh/ntse/Nutrition/stage-I/2017)
34. What type of teeth are absent in case of baby ?
(A) Incisor (B) Canine (C) Pre-molar (D) Molar
(Hariyana/ntse/Nutrition/stage-I/2017)



VALUE BASED / PRACTICAL BASED QUESTIONS

MARKED QUESTIONS MAY HAVE FOR REVISION QUESTIONS.

This Section is not meant for classroom discussion. It is being given to promote self-study and self testing amongst the Resonance students.

- When a person puts food in his mouth, then teeth cut it into small pieces, chew and grind it. The glands A in the mouth secrete a substance B which is mixed with the food by tongue. The substance B contains an enzyme C which starts the digestion of food in the mouth. The slightly digested food from the mouth goes down a tube D. The special type of movements E in the walls of tube D push the food into stomach for further digestion. The stomach wall secretes gastric juice containing three substances F, G and H. One of the functions of F is to kill bacteria which may enter the stomach with food. The substance G protects the inside layer of stomach from the damaging effect of substance F whereas substance H is an enzyme for digestion. The partially digested food then enters into small intestine for further digestion.
 - What is (i) gland A (ii) substance B, and (iii) enzyme C ?
 - Name the tube D
 - What is the movement E known as ?
 - What are (i) F (ii) G, and (iii) H ?
- A unicellular animal P having no fixed shape ingests a food particle by forming temporary finger-like projections Q. The food particle is engulfed with a little surrounding water to form a temporary stomach R inside it. The chemicals S from surrounding cytoplasm enter into R and break down food into small and soluble molecules by chemical reactions. The digested food is absorbed directly into cytoplasm by the process T. The undigested food is thrown out of the body by the rupture of a cell organelle U in a process called V.
 - Name the unicellular animal ?
 - What are (i) Q, and (ii) R ?
 - Name (i) chemical S, and (ii) process T.
 - Name (i) organelle U, and (ii) process V.

Answers

EXERCISE - 1

OBJECTIVE QUESTION

SECTION (A) : MODE OF NUTRITION

A-1 B A-2 A A-3 B

SECTION (B) : NUTRITION IN PLANTS

B.1 D B.2 D B.3 B B.4 B B.5 C B.6 B B-7 C **B-8 B** **B-9 A** B-10 D B-11 B

SECTION (C) : NUTRITION IN ANIMALS

C-1 D C-2 B C-3 C C-4 A C-5 C C-6 A C-7 C C-8 A C-9 B C-10 B C-11 B C-12 D C-13 B
C-14 C C-15 C C-16 D C-17 B C-18 A C-19 C

EXERCISE - 2

OBJECTIVE QUESTION

Q.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A.	D	D	B	B	C	B	C	B	A	C	B	C	C	B	A
Q.	16	17	18	19	20	21	22	23	24	25	26				
A.	A	D	C	D	D	C	C	C	B	C	A				

EXERCISE - 3

OBJECTIVE QUESTION

Q.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A.	D	A	D	B	B	B	D	B	D	B	B	B	A	D	D
Q.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
A.	D	C	B	C	D	C	B	D	C	B	B	C	B	B	D
Q.	31	32	33	34											
A.	C	A	A	C											



THE RISE OF NATIONALISM IN EUROPE

INTRODUCTION

During the 19th century, nationalism emerged as a force, which brought about massive changes in the political and mental world of Europe. It led the emergence of the nation-state in the place of the multi-national dynastic empires of Europe.

The theme will discuss the forms in which nationalism, collective belongingness and shared history developed along with the formation of nation states in Europe in the post-1830s period.

1.1 THE THEME OF FREDERIC SORRIEU'S PAINTING



Fig. — The Dream of Worldwide Democratic and Social Republics – The Pact Between Nations, a print prepared by Frédéric Sorrieu, 1848.

- (i) The first print of the series, shows the people of Europe and America – **men and women of all ages and social classes** – marching in a long train and offering homage to the statue of Liberty as they pass by it.
- (ii) A female figure was shown with the torch of Enlightenment in one hand and the Charter of the Rights of Man in the other.
- (iii) On the earth in the foreground of the image lie the shattered remains of the symbols of absolutist institutions.
- (iv) In Sorrieu's utopian vision, the peoples of the world are grouped as distinct nations, identified through their flags and national costume.

1.2 THE FRENCH REVOLUTION AND THE IDEA OF THE NATION

(a) Steps taken by French Revolutionaries :

- (i) The ideas of **La Patrie (the fatherland)** and **Le Citoyen (the citizen)** emphasized the notion of a united community enjoying equal rights under a constitution.
- (ii) A new French **flag, the tricolour**, was chosen to replace the former royal standard. New **hymns** were composed, **oaths** taken and martyrs commemorated, all in the name of a **nation**.
- (iii) The Estates General was elected by the body of active citizens and renamed the **National Assembly**.
- (iv) A **centralised administrative system** was put in place and it formulated **uniform laws** for all citizens within its territory.



- (v) Internal customs duties and dues were abolished and a **uniform system of weights and measures** was adopted.
- (vi) Regional dialects were discouraged and French, as it was spoken and written in Paris, became the common language of the nation.
- (vii) The revolutionaries further declared that it is was the mission and the destiny of the French nation to liberate the peoples of Europe from despotism.

(b) Civil Code of 1804 :

- (i) Napoleon set about introducing many of **the reforms in the territories that came under his control**, that he had already introduced in France.
- (ii) He introduced **Napoleonic code** which did away with all privileges based on birth, established equality before the law and secured the right to property.
- (iii) In many parts of Europe like in the Dutch Republic, Switzerland, Italy and Germany he **simplified administrative divisions, abolished the feudal system and freed peasants** from serfdom and manorial dues.
- (iv) He **removed guild restrictions** from the towns.
- (v) He laid **stress on infrastructure** i.e., transportation, communication and banking system. These new reforms were appreciated by the peasants, workers, businessmen, traders and even by the common people.

(c) Criticism of Napoleonic Code :

In the areas conquered, the **reactions of the local populations to French rule were mixed**. The initial enthusiasm soon turned to hostility, as it became clear that the new administrative arrangements did not go hand in hand with political freedom. Increased **taxation, censorship, forced conscription** into the French armies required to conquer the rest of Europe, all seemed to outweigh the advantages of the administrative changes.



Fig. — The courier of Rhineland loses all that he has on his way home from Leipzig. Napoleon here is represented as a postman on his way back to France after he lost the battle of Leipzig in 1813. Each letter dropping out of his bag bears the names of the territories he lost.



1.3 THE MAKING OF NATIONALISM IN EUROPE

In the mid-eighteenth century Germany, Italy and Switzerland were divided into kingdoms, duchies and cantons whose rulers had their autonomous territories of diverse peoples. They did not see themselves as sharing common identity.

They **spoke different languages** and **belonged to different ethnic groups**. Such differences did not easily promote a sense of political unity. The only tie binding to these diverse groups together was a common allegiance to the emperor.



(a) The Aristocracy and the New middle Class :

- (i) Socially and politically, a landed **aristocracy was the dominant class** on the continent. The members of this class were united by a common way of life that cut across regional divisions, owned estates in the countryside and also town-houses, spoke French, their families were often connected by **ties of marriage**. This powerful aristocracy was, however, numerically a small group. The majority of the population was made up of the peasantry.
- (ii) In Western and parts of Central Europe the growth of **industrial production** and **trade** meant the growth of towns and the emergence of **commercial classes** whose existence was based on production for the market.
- (iii) **New social groups came into being:** a working-class population, and middle classes made up of industrialists, businessmen, professionals. It was among the educated, liberal middle classes that ideas of national unity following the abolition of aristocratic privileges gained popularity.

(b) What did Liberal Nationalism Stand for?

- (i) The term '**liberalism**' derived from the Latin word **liber**, means **free**. For the new middle classes liberalism stood for freedom for the individual and equality of all before the law. Politically, it emphasised



the concept of government by consent. Since the French Revolution, liberalism had stood for the **end of autocracy** and clerical privileges, a constitution and representative government **through parliament**.

- (ii) Yet, equality before the law did **not necessarily stand for universal suffrage**. Only for a brief period under the Jacobins did all adult males enjoy suffrage. Throughout the nineteenth and early twentieth centuries women and non-propertied men organised opposition movements demanding equal political rights.
- (iii) In the economic sphere, liberalism stood for the **freedom of markets** and the **abolition of state-imposed restrictions** on the movement of goods and capital. During the nineteenth century this was a strong demand of the emerging middle classes.
- (iv) **Napoleon's administrative measures** had created out of countless small principalities a confederation of 39 states. Each of these possessed its own currencies, and weights and measures. Which involved time-consuming calculations.
- (v) In **1834**, a customs union or **zollverein** was formed by the initiative of Prussia and joined by most of the German states. The union abolished tariff barriers and reduced the number of currencies from over thirty to two. The creation of network of railways further stimulated mobility, harnessing economic interests to national unification. According to Prof. Friedrich List, **the aim of the zollverein was to bind the Germans economically into a nation**.

(c) A New Conservatism after 1815 :

Conservatives believed that **established, traditional institutions of state and society should be preserved**, however they did not propose return to the society of pre-revolutionary days. They realized from the changes initiated by Napoleon, that modernisation could in fact strengthen traditional institutions like the monarchy. It could make state power more effective and strong.

Major Proposals of the Vienna Congress :

In **1815**, representatives of the European powers who had collectively defected Napoleon, met at Vienna to draw up a settlement for Europe. The delegates drew up the **Treaty of Vienna of 1815** with the object of undoing most of the changes that had come about in Europe during the Napoleonic wars.

- (i) The **Bourbon dynasty**, which had been deposed during the French Revolution, was **restored to power** and France lost the territories it had annexed under Napoleon.
- (ii) A **series of states were set up** on the boundaries of France to prevent French expansion in future. Thus the kingdom of the **Netherlands**, which included **Belgium**, was set up in the north and **Genoa** was added to **Piedmont** in the south.
- (iii) **Prussia** was given important new territories on its western frontiers, while **Austria** was given control of northern **Italy**.
- (iv) The **German confederation of 39 states** that had been set up by Napoleon was **left untouched**.
- (v) In the east, **Russia** was given part of **Poland** while **Prussia** was given a **portion of Saxony**.
- (vi) The main intention of the Congress was to **restore the monarchies** that had been overthrown by Napoleon and to create a new conservative order in Europe.

Criticism of Conservative Regimes :

- (i) Conservative regimes set up in **1815 were autocratic**, did not tolerate criticism and dissent, and sought to curb activities that questioned the legitimacy of autocratic governments.
- (ii) Most of them **imposed censorship** laws to control what was said in newspapers, books, plays and songs and reflected the ideas of liberty and freedom associated with the French Revolution.



(d) The Revolutionaries :

Revolutionaries at this time meant a commitment to oppose monarchical forms that had been established after the Vienna Congress, and to fight for liberty and freedom. Most of these revolutionaries also saw the creation of nation states as a necessary part of this struggle for freedom.

Giuseppe Mazzini :

Born in **Genoa in 1807** he became a member of the **secret society of the Carbonari**. As a young man of 24, he was sent into exile in 1831 for attempting a revolution in Liguria. He subsequently founded two more underground societies, first, **Young Italy in Marseilles**, and then, **Young Europe in Berne**, whose members were like-minded young men from Poland, France, Italy and the German states. Mazzini believed that God had intended nations to be the natural units of mankind. So Italy could not continue to be a patchwork of small states and kingdoms. It had to be forged into a **single unified republic** within a wider alliance of nations. This unification alone could be the basis of **Italian liberty**.



Fig. — Giuseppe Mazzini and the founding Young Europe in Berne 1833. Print by Giacomo Mantegazza.

1.4 AGE OF REVOLUTION 1830 – 1848

As conservative regimes tried to consolidate their power, liberalism and nationalism came to be increasingly associated with revolution in many regions of Europe. The revolutions were led by the liberal nationalists belonging to the educated middle class elite, among whom were professors, school teachers, clerks and members of commercial middle class.

(i) **Upheaval in France:** The first upheaval took place in France in July 1830.

The Bourbon kings who had been restored to power after the Vienna Congress by the conservatives were now overthrown by liberal revolutionaries who installed a constitutional monarchy with Louis Philippe as its head.

(ii) **Uprising in Brussels:** The July Revolution sparked an uprising in Brussels which led to Belgium breaking away from the United Kingdom of the Netherlands.

(iii) **Uprising in Greek:** Greece had been part of the Ottoman Empire since the fifteenth century. The growth of revolutionary nationalism in Europe sparked off a struggle for independence amongst the Greeks which began in 1821. Nationalists in Greece got support from other Greeks living in exile and also from many West Europeans who had sympathies for ancient Greek culture. Poets and artists lauded Greece as the cradle of European civilisation and mobilised public opinion to support its struggle against a Muslim empire. The English poet Lord Byron organised funds and later went to fight in the war, where he died of fever in 1824. Finally, the Treaty of Constantinople of 1832 recognised Greece as an independent nation.

Ottoman Empire.
 Turkish empire ruled by the Caliph—
 The spiritual and temporal head of the Muslims.





(a) **The Romantic Imagination & National Feeling :**

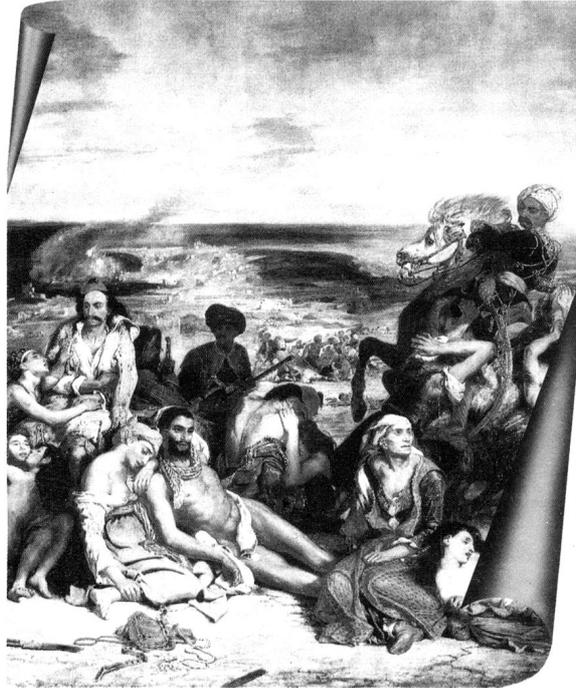


Fig. — *The Massacre at Chios, Eugene Delacroix, 1824.*
The French painter Delacroix was one of the most important French Romantic painters. This huge painting (4.19m x 3.54m) depicts an incident in which 20,000 Greeks were said to have been killed by Turks on the island of Chios. By dramatising the incident, focusing on the suffering of women and children, and using vivid colours, Delacroix sought to appeal to the emotions of the spectators, and create sympathy for the Greeks.

- (i) Though wars and territorial expansions played a major role in arousing the **feeling of nationalism** but **culture, art, poetry, stories, music** also played their role.
- (ii) Romantic artists were against the glorification of reasons and science and focused on **emotions, institutions** and **mystical feelings**. They wanted to share a collective heritage, a common cultural past as the basis of a nation.
- (iii) Romantics such as the **German philosopher Johann Gottfried Herder (1744-1803)** claimed that true German culture was to be discovered among the common people **das volk**.
- (iv) Romantic philosophers wanted to create the **true spirit of nationalism** through **folk songs, folk poetry** and **folk dances**.
- (v) The emphasis on **vernacular language** and the collection of **local folklore** was not just to recover an ancient national spirit, but also to carry the modern nationalist message to large audiences who were mostly illiterate.
- (vi) Even though **Poland** no longer existed as an independent territory, national feelings were kept alive through **music and language**. **Karol Kurpinski**, for example, celebrated the national struggle through his **operas** and **music**, turning **folk dances** like the polonise and mazurka into nationalist symbols.

(b) **Hunger, Hardship and Popular Revolt :**

- (i) The **1830s** were years of **great economic hardship in Europe**. The first half of the nineteenth century saw an enormous increase in population all over Europe.
- (ii) In **1848**, **food shortages** and **widespread unemployment** brought the population of Paris out on the roads. Barricades were erected and Louis Philippe was forced to flee. A **National Assembly proclaimed a Republic**, granted **suffrage** to all adult males above 21, and guaranteed the **right to work**. National workshops to **provide employment** were set up.
- (iii) In **1845**, weavers in Silesia had led a revolt against contractors who supplied them raw material and gave them orders for finished textiles but drastically reduced their payments.



Fig. — Peasants' uprising, 1848.

(c) **1848 : The Revolution of the Liberals :**

Events of February 1848 in France had brought about the abdication of the monarch and a republic based on universal male suffrage had been proclaimed. In other parts of Europe where independent nation-states did not yet exist - men and women of the liberal middle classes combined their demands for constitutionalism with national unification.

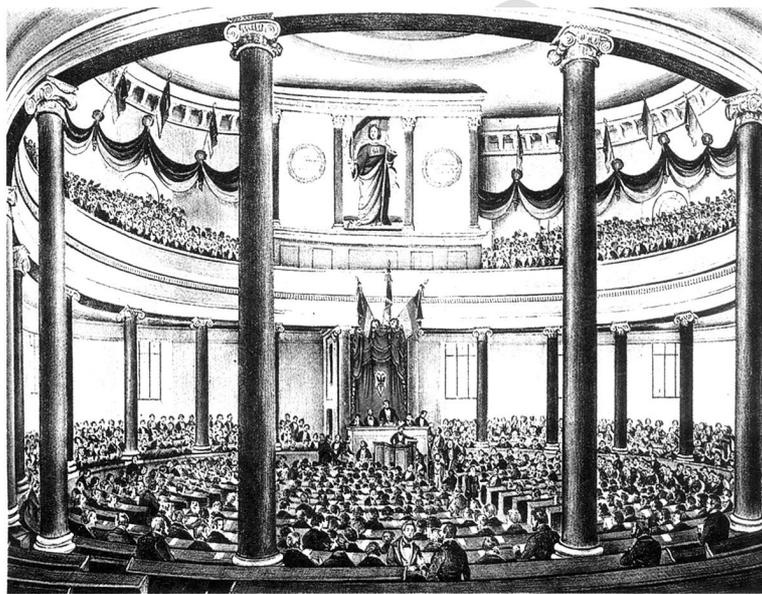


Fig. — The Frankfurt parliament in the Church of St Paul.
Contemporary colour print. Notice the women in the upper left gallery.

Frankfurt Parliament :

In the German regions a large number of political associations came together in the city of Frankfurt and decided to vote for an all-German National Assembly. On **18 May 1848**, **831** elected representatives marched in a festive procession to take their places in the Frankfurt parliament convened in the Church of **St. Paul**. They drafted a constitution for a German nation to be headed by a monarchy subject to a parliament.

Obstacles :

- (i) **Friedrich Wilhelm IV**, King of Prussia rejected it and joined other monarchs to **oppose the elected assembly**.
- (ii) While the opposition of the **aristocracy and military became stronger**, the social basis of parliament eroded. The parliament was dominated by the middle classes who resisted the demands of workers and artisans and consequently lost their support.



- (iii) Issue of extending political rights to **women** was a **controversial** one within the liberal movement, they were denied suffrage rights during the election of the Assembly.

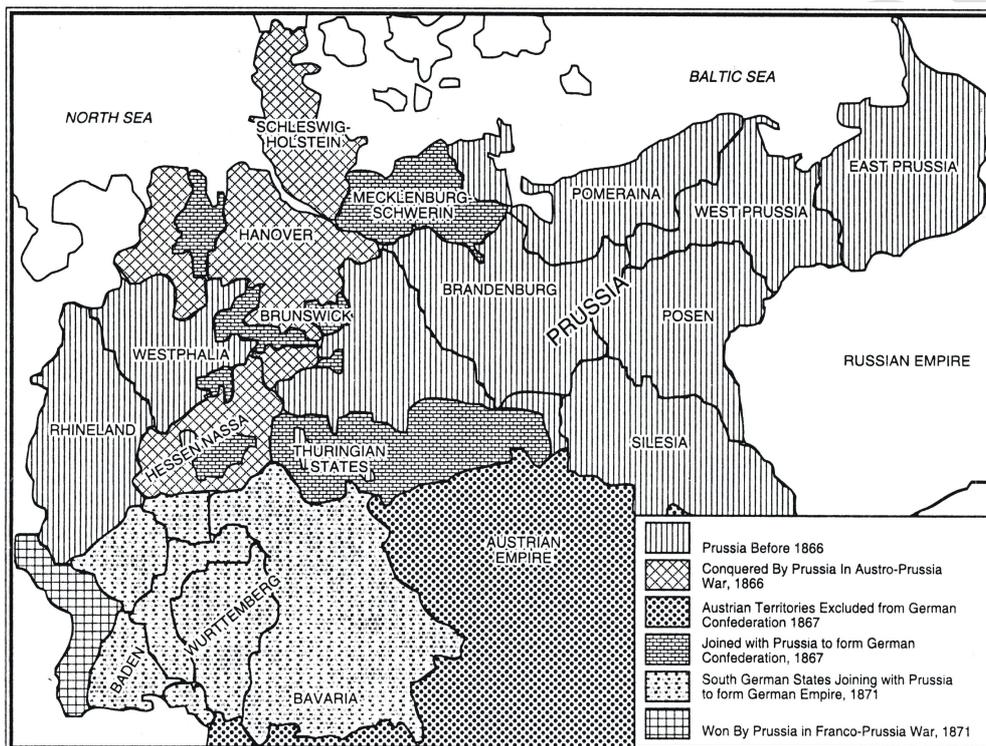
Outcomes :

- (i) Though conservative forces were able to **suppress liberal movements in 1848**, they could not restore the old order.
- (ii) In the years after 1848, the **autocratic monarchies** of Central and Eastern Europe began to introduce the changes that had already taken place in Western Europe before 1815.
- (iii) The Habsburg rulers granted more **autonomy to the Hungarians in 1867**.

1.5 THE MAKING OF GERMANY AND ITALY

(a) Germany - Can the Army be the Architect of a Nation ?

- (i) Nationalist feelings were widespread among middle-class Germans, who in 1848 tried to unite the different regions of the German confederation into a nation-state governed by an elected parliament.



Unification of Germany (1866 – 71)

- (ii) **Prussia** took on the leadership of the movement for national unification. Its Chief minister, **Otto von Bismarck** (who followed the policy of Blood and Iron), was the architect of this process carried out with the help of the Prussian army and bureaucracy.

Three wars over seven years - with Austria, Denmark and France - ended in Prussian victory and completed the process of unification. In **January 1871, the Prussian king, William I** was proclaimed German Emperor in a ceremony held at Versailles. On **18 January 1871**, an assembly gathered in the unheated Hall of mirrors in the Palace of Versailles to proclaim the new German Empire headed by **Kaiser William I of Prussia**.



Bismarck

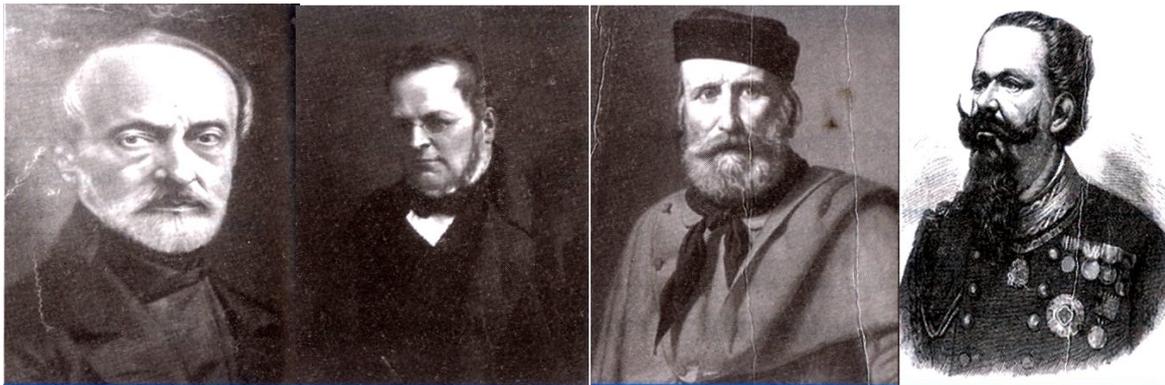


Kaiser William_I

- (iii) The new state placed a strong emphasis on **modernising the currency, banking, legal and judicial systems** in Germany.



(b) Italy Unified :



Mazzini

Cavour

Garibaldi

Victor Emmanuel II

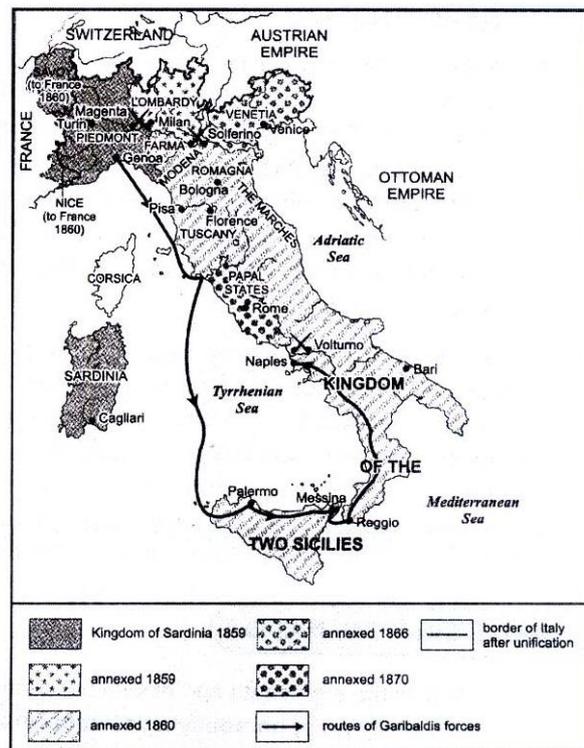
- (i) During the middle of the nineteenth century, Italy was divided into seven states, of which only one, **Sardinia-Piedmont**, was ruled by an Italian princely house. Even the Italian language had not acquired one common form and still had many regional and local variations.
- (ii) During the **1830s**, **Giuseppe Mazzini** had sought to put together a coherent programme for a unitary Italian Republic. He formed a secret society called **Young Italy** for the dissemination of his goals. The failure of revolutionary uprisings both in **1831** and **1848** meant that the mantle now fell on **Sardinia-Piedmont** under its ruler **King Victor Emmanuel II** to unify the Italian states through war & still had many problems.

ITALY

Befor Unification



After Unification



- (iii) Through a tactful diplomatic alliance with France engineered by **Cavour**, Sardinia-Piedmont succeeded in defeating the Austrian forces in 1859. Apart from regular troops, a large number of armed volunteers under the **leadership of Giuseppe Garibaldi** joined the fray. In 1860, they marched into South Italy and the Kingdom of the Two Sicilies and succeeded in winning the support of the local peasants in order to drive out the Spanish rulers. In 1861 Victor Emmanuel II was proclaimed king of united Italy.



(c) The Strange Case of Britain :

- (i) In Britain the formation of the nation-state was not the result of a **sudden upheaval or revolution**. It was the result of a long-drawn-out process. There was no British nation prior to the eighteenth century. The primary identities of the people who inhabited the British Isles were ethnic ones-such as **English, Welsh, Scot or Irish**.
- (ii) But as the **English nation steadily grew in wealth, importance and power**, it was able to extend its influence over the other nations of the islands. The English parliament, which had seized power from the monarchy in 1688 at the end of a protracted conflict, was the instrument through which a nation-state, with England at its centre, came to be forged.
- (iii) **The Act of Union (1707)** between England and Scotland that resulted in the formation of the '**United Kingdom of Great Britain**' meant, in effect that England was able to impose its influence on Scotland. The British parliament was henceforth dominated by its English members. The growth of a British identity meant that Scotland's distinctive culture and political institutions were systematically suppressed.
- (iv) Ireland suffered a similar fate. It was a country deeply divided between Catholics and Protestants. The English helped the Protestants of Ireland to establish their dominance over a largely Catholic country. After a failed revolt led by Wolfe Tone and his United Irishmen (1798). **Ireland was forcibly incorporated into the United Kingdom in 1801**.

A new '**British nation**' was forged through the propagation of a dominant English culture. The symbols of the new Britain-the British flag (Union Jack), the national anthem (God Save Our Noble King), the English language-were actively promoted and the older nations survived only as subordinate partners in this union.

1.6 VISUALISING THE NATION

- (i) Artists in the eighteenth and nineteenth centuries found a way out by **personifying a nation**. In other words they represented a country as if it were a person. Nation were than portrayed as female figures.
- (ii) The female form that was chosen to personify the nation did not stand for any particular woman in real life; rather it sought to give the abstract idea of the nation concrete form. That is, the **female figure became an allegory of the nation**.



Fig. Postage stamps of 1850 with the figure of Marianne representing the Republic of France.

- (iii) Female allegories were invented by artists in the nineteenth century to represent the nation. In France she was **christened Marianne**, a popular Christian name, which underlined the idea of a people's nation. Her characteristics were drawn from those of Liberty and the Republic-the red cap, the tricolour, the cockade. Statues of Marianne-were erected in public squares to remind the public of the national symbol of unity and to persuade them to identify with it. Marianne images were marked on coins and stamps.
- (iv) **Germania** became the allegory of the German nation. In visual representations, Germania wears a crown of oak leaves, as the German oak stands for heroism.



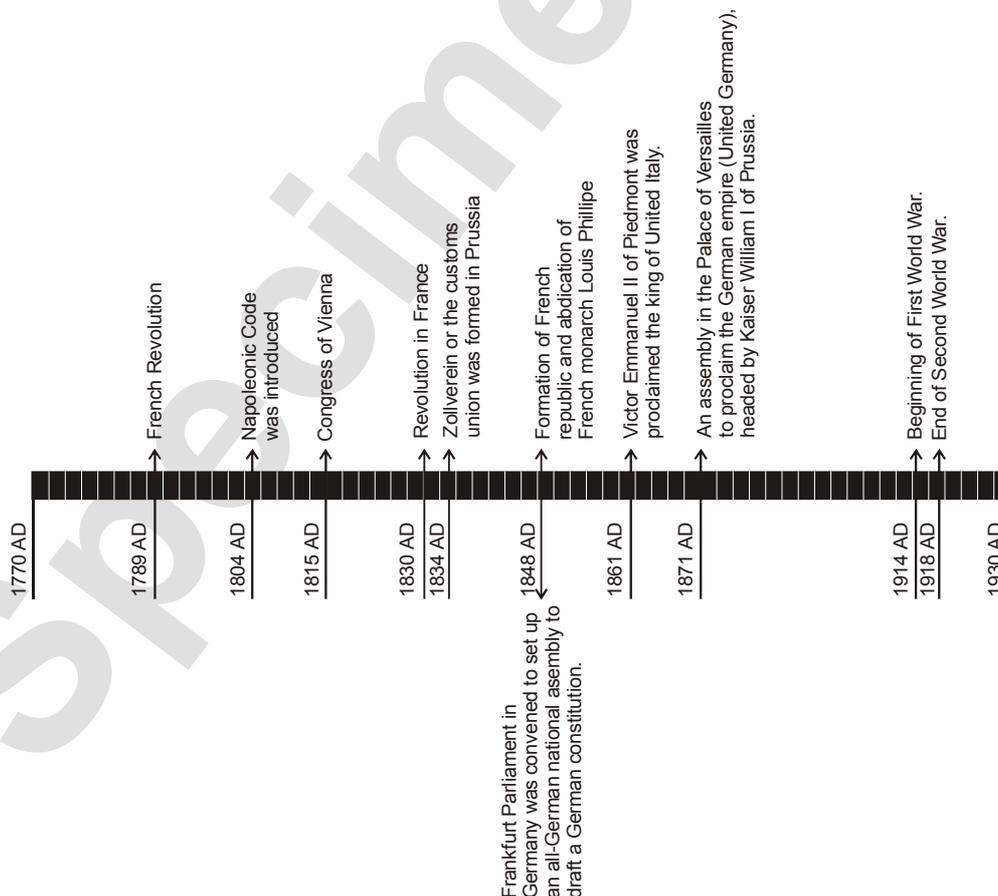
Fig. Germania, Philip Veit, 1848



1.7 NATIONALISM AND IMPERIALISM

- (i) By the last quarter of the nineteenth century the major European powers **manipulated the nationalist aspirations** of the subject peoples in Europe to further their own imperialist aims.
- (ii) The most serious source of nationalist **tension in Europe after 1871 was the area called the Balkans**. The Balkans was a region of geographical and ethnic variation comprising modern-day Romania, Bulgaria, Albania, Greece, Macedonia, Bosnia–Herzegovina, Slovenia, Serbia and Montenegro whose inhabitants were broadly known as the Slavs. A large part of the Balkans was under the control of the **Ottoman empire**.
- (iii) The spread of the ideas of romantic nationalism in the Balkans together with the disintegration of the Ottoman Empire made this region very explosive. One by one, its European subject nationalities broke away from its control and declared independence.
- (iv) All through the nineteenth century the Ottoman Empire had sought to strengthen itself through modernisation and internal reforms but with very little success. One by one, its European subject nationalities **broke away** from its control and **declared independence**.
- (v) The Balkan area became an area of intense conflict. The Balkan states were **fiercely jealous** of each other and each **hoped to gain more territory** at the expense of the others.
- (vi) During this period, there was **intense rivalry** among the European powers over trade and colonies as well as naval and military might. Each power- Russia, Germany, England, Austro-Hungary-was keen on countering the hold of other powers over the Balkans, and extending its own control over the area. This led a series of wars in region and finally the **First World War**. Nationalism, aligned with imperialism, led Europe to disaster in 1914.
- (vii) Many countries in the world which had been colonised by the European power in the nineteenth century began to oppose imperial domination. The **anti-imperial movements** that developed everywhere were nationalist, in the sense that they all struggled to form independent nation–states, and were inspired by a sense of collective national unity, forged in confrontation with imperialism.

The idea that societies should be organised into ‘**nation–states**’ came to be accepted as **natural** and universal.





Important Dates and Events

YEAR	EVENTS
1688 AD.	The English parliament seized power from the monarchy and formed a nation state.
1707 AD.	The Act of Union between England and Scotland resulted in the formation of the 'United Kingdom of Great Britain'.
1785 AD.	Birth of Jacob Grimm the liberal leader of Germany.
1786 AD.	Birth of Wilhelm Grimm, the liberal leader of Germany.
1789 AD.	French Revolution.
1797 AD.	Napoleon Bonaparte invaded Italy; Napoleonic wars began.
1801 AD.	Ireland was forcibly incorporated into the United Kingdom.
1804 AD.	Civil Code which was usually known as the Napoleonic Code was framed in France.
1807 AD.	Birth of famous Italian revolutionary Giuseppe Mazzini.
1812 AD.	The first collection of folk tales of Grimm brothers (Jacob and Wilhelm Grimm) was published.
1814-15 AD.	Fall of Napoleon; the Vienna Peace Settlement.
1815 AD.	The Battle of Waterloo.
1819 AD.	Birth of Louise Otto-Peters.
1821 AD.	The beginning of struggle for independence amongst the Greeks.
1821 AD.	Death of Napoleon.
1830 AD.	The July revolution of France.
1831 AD.	An armed rebellion against Russian took place.
1832 AD.	The Treaty of Constantinople recognised Greece as an independent nation.
1834 AD.	A customs union or <i>Zollverein</i> was formed at the initiative of Prussia and joined by most of the German states.
1848 AD.	Revolutions in Europe; artisans, industrial workers and peasants revolted against economic hardships; middle classes demanded constitutional representative governments. Italians, Germans, Magyars, Poles, Czechs etc. demanded nationstates.
1858-60 AD.	Unification of Italy.
1861 AD.	Emmanuel II was proclaimed the king of United Italy.
1866-71 AD.	Unification of Germany.
Jan 1871 AD.	The Prussian King William I was proclaimed German Emperor in the ceremony held at Versailles.
1905 AD.	Slav nationalism gathered force in the Habsburg and Ottoman Empire
1914 AD.	First World War began.

Exercise-1

FREE RESPONSE TYPE

VERY SHORT ANSWER TYPE

1. What is a nation?
2. Which revolutions took place in Europe before and after 1830?
3. Give the meaning of liberalism.
4. Mention the collective identities that kept the French people a united community.
5. Mention the major issues taken by liberals to criticize the conservatives.
6. Which incident greatly influenced the educated people of Europe?
7. With which treaty was Greek independence recognised?



8. Who played significant role in unification of Germany?
9. Who gave the blood and Iron policy?
10. Who was Mazzini?
11. Name the female allegory of the German nation.

SHORT ANSWER TYPE

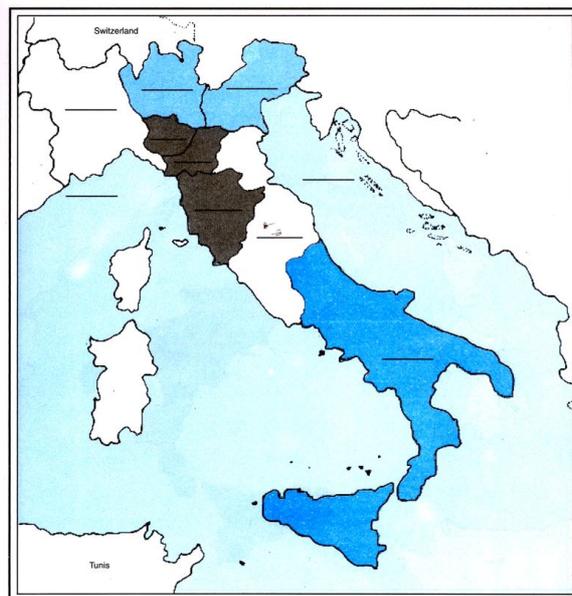
12. Why did the people who had welcomed Napoleon earlier, opposed him later?
13. Prove, giving evidences, that Habsburg empire was a patch work of many regions and peoples.
14. Explain any three features of the class of landed aristocracy of Europe.
15. Explain any three major hardships faced by small producers and peasants in Europe during 1830s.
16. Who were Marianne and Germania ? What is the importance of the way in which they were portrayed ?
17. What did the liberalism mean to the middle classes in Europe?
18. Who were given the right to vote in Revolutionary France and what were the changes introduced by Napoleon?
19. Why did economists think in terms of a national economy?
20. Why did the new commercial classes argue for the creation of a unified territory?
21. How did Romanticism seek to develop a particular form of nationalist sentiments during 18th century? Explain.
22. Explain any three beliefs of the conservatism that emerged after 1815.
23. Describe any three reforms introduced by Napoleon in the territories he conquered.
24. Explain the contribution of Otto Von Bismark in German unification.
25. Explain any three ways in which nationalist feelings were kept alive in Poland in the 18th and 19th centuries.

LONG ANSWER TYPE

26. Explain the impact of French Revolution on the rest of Europe.
27. Describe the conditions in eastern and central Europe before the emergence of nation states in the region.
28. What were the changes brought about in Europe by the Congress of Vienna ?
29. Compare and contrast the nationalism in Europe and Anticolonial nationalism.
30. How did culture play an important role in creating the idea of the nation in Europe ? Explain with four examples.
31. Describe the reaction of the German monarch to the demands made by the revolutionaries in 1848.
32. How was the formation of the nation state the result of a long-drawn-out process in Britain ? Explain.



33. Trace the events of unification of Italy, with reference to the role of Mazziny, Cavour and Garibaldi.
34. Explain the growth of modern nationalism in Europe.
35. Briefly trace the process of German unification.
36. Study the given passage and answer the question that follow :
'A nation is the culmination ofand only one master.'
(Source A, page no. 04)
(i) From whose speech have these words been quoted ?
(ii) Explain the meaning of 'Plebiscite'.
(iii) Examine the concept of 'nation' as given in the above passage.
37. How has French artist Fredric Sorrieu, visulaised in his first print, of the series of four prints, his dreams of a world made up of 'democratic and social republics'? Explain.
38. When did the first clear-cut expression of nationalism come in France ? How did the French Revolution lead to the transfer of sovereignty from the monarchy to a body of French citizens ? Explain any three measures taken by the French revolutionaries in this regard.
39. Explain liberalism in political and economic fields prevailing in Europe in the nineteenth century.
40. "Culture played an important role in creating the idea of the nation in Europe." Support the statement with examples.
41. Explain any four provisions of the Napoleon Civil Code -1804.
42. Explain any four measures introduced by French Revolutionaries to create a sense of collective identity among the people of France.
43. Explain any four economic hardships that Europe faced in the 1830s.
44. Explain any four ideas of Liberal Nationalists in the economic sphere.
45. Identify the Italian states before Italy's unification in 1858 and write their names on the space on the map given below.
46. Describe the role of French for the development of colonies.



Italian States before Unification, 1858.



FILL IN THE BLANKS

- _____ in history is the term refers to a form of monarchical government that was centralized, militarized and repressive.
- A direct vote by which all the people of a region are asked to accept or reject a proposal is known as _____.
- In Galicia, the aristocracy spoke _____ language.
- The Treaty of _____ of 1832 recognized Greece as an independent nation.
- _____ formed a secret society called young Italy for the dissemination of his goals.

TRUE / FALSE

- On August 27, 1791, Austria and prussia issued the Declaration of Pillnitz.
- The French Revolution was the deserving death knell for the old system of monarchy in Europe.
- The privileges of the Europeans gave way to 'equality, liberty and fraternity'.
- The ancient obligations to an aristocratic hierarchy gave way to a loyalty to the 'fatherland' or nation state.
- Middle class families in occupations that require effort, skill and experience develop patience and work ethics.

MATCH THE COLUMN

Column-A	Column-B
(i) Napoleonic wars	(a) Measure of cloth
(ii) Elle	(b) 1797
(iii) Giuseppe Mazzini	(c) Berne
(iv) Young Europe	(d) Prussia
(v) Kaiser William	(e) Geno
(A) (i)-(b), (ii)-(a), (iii)-(e), (iv)-(c), (v)-(d)	(B) (i)-(d), (ii)-(a), (iii)-(e), (iv)-(c), (v)-(b)
(C) (i)-(b), (ii)-(e), (iii)-(a), (iv)-(c), (v)-(d)	(D) (i)-(b), (ii)-(a), (iii)-(c), (iv)-(e), (v)-(d)

Exercise-2

FIXED RESPONSE TYPE

- Returning from exile, Giuseppe Mazzini formed a new organisation called
 (A) National Italy. (B) Young Italy. (C) United Italy. (D) Organised Italy.
- A vision of a society that is so ideal that it is unlikely to actually exist is known as
 (A) Utopian (B) Socialism (C) Communalism (D) Feminism
- The majority of revolutions that took place all over Europe were in the year
 (A) 1842 (B) 1849 (C) 1837 (D) 1848
- Guiseppe Garibaldi led an army of volunteers to Rome to fight the last obstacle in the unification of Italy in the year
 (A) 1857 (B) 1867 (C) 1877 (D) 1887
- "God Save our Noble king.." is the national anthem of
 (A) Britain (B) Germany (C) Russia (D) Italy



6. The revolutionary society started by Mazzini to arouse the whole of Italy to a greater unity and fight for independence was
(A) Young Italiano (B) Young Italy (C) The Italian (D) Young soldier
7. On 18 May 1848, 831 elected representatives marched in a festive procession to take their places in the Frankfurt parliament convened in
(A) the Church of St Paul (B) the Church of St Thomas
(C) the Church of St Mary (D) the Church of St Luthor
8. The theory that tries to make awareness of women's rights and interests based on the belief of the social, economic and political equality of the genders is known as
(A) Humanism (B) Feminism (C) Post modernism (D) Culturalism
9. 'When France sneezes the rest of Europe catches cold.' was observed by
(A) Duke Metternich (B) Napoleon (C) Otto von Bismarck (D) William I
10. The Architect of German unification process was
(A) Otto von Bismarck (B) Hitler (C) Giuseppe Mazzini (D) John Gottfried Herder
11. To further their imperialist aims, European powers manipulated the
(A) nationalist aspiration of subjects. (B) resources of colonies.
(C) political power. (D) economic power.
12. The term 'Suffrage' means
(A) right to vote (B) right to religious practice
(C) right to property (D) right to express
13. Liberalism stood for the end of autocracy and clerical privileges since the
(A) American Revolution. (B) Chinese Revolution. (C) French Revolution. (D) Chinese Revolution.
14. The body in France which consisted of the elected representatives and led the Revolt was
(A) Councils of clergies (B) General Assembly (C) National Assembly (D) People's Assembly
15. The Frankfurt Parliament was held in the year
(A) 1948 A.D. (B) 1748 A.D. (C) 1648 A.D. (D) 1848 A.D.
16. The term 'Bismarck of Italy' was used for
(A) Mazzini. (B) Cavour. (C) Garibaldi. (D) Victor Emmanuel.
17. The Frankfurt Parliament was convened in the
(A) hall of Mirrors. (B) hall of Fame. (C) church. (D) parliament.
18. Nationalism in Europe moved away from its association with democracy and revolution, after
(A) 1845. (B) 1846. (C) 1847. (D) 1848.
19. The claim that the true German culture could be discovered among the common people was made by
(A) Bismarck. (B) Jacob Grimm.
(C) Wilhelm Grimm. (D) Johann Gottfried Herder.
20. The English poet who had raised funds and went to fight against the Ottoman Turks for Greeks was
(A) William Blake. (B) Andre Breton. (C) Edwin Brock. (D) Lord Byron.
21. The growth of revolutionary nationalism in Europe sparked off a struggle for independence amongst the Greeks in
(A) 1821. (B) 1822. (C) 1823. (D) 1824.
22. Inspired by the events of the French Revolution, students and members of educated middle classes set up
(A) Abraham clubs. (B) Jacobin clubs. (C) Robespierre clubs. (D) St. Thomas clubs.



23. Greece was recognised as an independent nation by the
 (A) Treaty of Utrecht in 1713. (B) Treaty of Paris of 1783.
 (C) Treaty of Constantinople of 1832. (D) Treaty of Versailles of 1919.
24. During Greeks' struggle for independence, poets and artists lauded Greece as the cradle of
 (A) Asian civilisation. (B) American civilisation. (C) Chinese civilisation. (D) European civilisation.
25. The Act of Union 1707, between England and Scotland, resulted in the formation of the
 (A) British parliament. (B) Catholic clans.
 (C) United Kingdom of Great Britain. (D) United Irishmen.
26. The Napoleonic Wars began in the year
 (A) 1795. (B) 1797. (C) 1798. (D) 1799.
27. The Prussian king, William I, was proclaimed German Emperor in a ceremony held at Versailles in
 (A) January 1871. (B) February 1871. (C) March 1871. (D) April 1871.
28. In 1789, France was ruled by
 (A) an absolute monarchy. (B) a dictator.
 (C) a republican. (D) a socialist.
29. A direct vote by which all the people of a region are asked to accept or reject a proposal is called
 (A) plebiscite. (B) preferential voting. (C) secret voting. (D) in-direct voting.
30. The French philosopher Ernst Renan outlined his understanding of a nation in a lecture given at the
 (A) University of Cambridge. (B) University of Oxford.
 (C) University of Sorbonne. (D) University of Sussex.

Exercise-3

NTSE PREVIOUS YEARS' QUESTIONS

1. Who hosted Congress of Vienna ? **[Punjab NTSE Stage-1 2013]**
 (A) Bismark (B) Napoleon Bonaparte (C) Voltaire (D) Matternich
2. Which of following state was ruled by as Italian Princely House ? **(Haryana NTSE Stage I/2015)**
 (A) Sardinia Piedmont (B) Papal States (C) Venetia (D) Tuscany
3. Find out the statement which does not cause to Imperialism : **[Maharashtra_NTSE Stage-1_ 2014]**
 (A) Prosperity of Asia and Africa
 (B) Weakness of Asian and African Nations
 (C) Need of raw material from Asia and Africa
 (D) Growing agitation in Nationalistic movement in African and Asian continent
4. Who amongst the following ruled over Sardinia-pied mont during the middle of the nineteenth century. **[Haryana_NTSE Stage-1_ 2013-14]**
 (A) Italian Princely house (B) Austrian Habsburg
 (C) Pope (D) Bourbon king of Spain
5. Who was Paul Bernard ? **[Haryana_NTSE Stage-1_ 2013-14]**
 (A) Capitalist (B) Social worker (C) Social reformer (D) Economist
6. Who said "When France sneezes the rest of the Europe catches cold". **[Haryana_NTSE Stage-1_ 2013-14]**
 (A) Garibaldi (B) Mazzini (C) Bismarck (D) Matternich
7. Who is regarded as father of Italian unification ? **(M.P./ NTSE Stage I/2013)**
 (A) Mazini (B) Cavour (C) Garibaldi (D) None of these



8. What is the meaning of this French word "Le Citoyen"? **(Haryana / NTSE Stage I/2013)**
 (A) The people (B) The Citizen (C) Resident (D) All above
9. Chief Minister Cavour who led the movement of unification of Italy was a **(Haryana / NTSE Stage I/2013)**
 (A) Freedom Fighter (B) A revolutionary
 (C) A democrat (D) Neither a Revolutionary nor a Democrat
10. Germany was unified in - **[Haryana_NTSE Stage-1_ 2013-14]**
 (A) 1870 (B) 1871 (C) 1872 (D) 1873
11. The tactful diplomatic alliance between Sardinia-Piedmont and France was engineered by **(Rajasthan/NTSE Stage I/2015)**
 (A) Mazzini (B) Cavour (C) Garibaldi (D) Victor Emmanuel
12. Young Italy, a secret society was formed by **(Rajasthan/NTSE Stage I/2016)**
 (A) Metternich (B) Giuseppe Mazzini (C) Bismarck (D) Hitler.
13. Match the table-I with table -II and select the correct response from the options given thereafter. **(Haryana_NTSE_Stage-1_2015)**
- | Table-I
(symbols) | Table-II
(Meanings) |
|-----------------------------|--------------------------------|
| a. Broken chains | i. Beginning of the new era. |
| b. Crown of Oak leaves | ii. Being Freed |
| c. Olive branch around | iii. Heroism. |
| d. Rays of rising sun | iv. Willingness to make peace. |
- (A) a-i, b-iii, c-ii, d-iv (B) a-ii, b-iv, c-iii, d-i (C) a-iv, b-ii, c-i, d-iii (D) a-ii, b-iii, c-iv, d-i
14. Who became the king after the July Revolution of 1830? **(West Bengal_NTSE_Stage-1_2015)**
 (A) Louis Napoleon (B) Louis Philippe (C) Louis Blanc (D) Louis XVIII.
15. Otto Von Bismarck was the Chief Minister of **(Delhi_NTSE_Stage-1_2015)**
 (A) Germany (B) Italy (C) France (D) Britain
16. "Young Italy" an underground Society founded by: **(Delhi_NTSE_Stage-1_2015)**
 (A) Garibaldi (B) Wilhelm Wolff (C) Giuseppe Mazzini (D) Napoleon
17. Who hosted the Vienna Congress? **(Delhi_NTSE_Stage-1_2015)**
 (A) Duke Metternich (B) Napoleon (C) Bismarck (D) Mazzini
18. Which one of the following incidents happened first? **[Rajasthan_NTSE_Stage-1_2017]**
 (A) Convocation of Estates General (B) Overthrow of the Jacobin Republic
 (C) Debates over socialism in Russia (D) Proclamation of the Weimar Republic.
19. The German King in 1871 was **[Rajasthan_NTSE_Stage-1_2018]**
 (A) William I (B) Napoleon III (C) Frederik William IV (D) Emmanuel II.
20. The impact of the French revolution 1830 and 1848 in Europe was the emergence of- **[Bihar_NTSE_Stage-1_2018]**
 (A) Feudalism (B) Class Struggle (C) Nationalism (D) Autocracy
21. Architect of national unification of Prussia was **[Delhi/Haryana_NTSE_Stage-1_2018]**
 (A) Otto Von Bismarck (B) William I (C) Mazzini (D) Emmanuel II
22. Who among the following was described as the most dangerous enemy of social order by Duke Metternich? **[Haryana_NTSE_Stage-1_2018]**
 (A) Louis Philippe (B) Karol Kurpinski (C) Johan Gottfried (D) Guiseppe Mazzini



Answers

EXERCISE # 1

Fill in the Blank :

1. Absolutist 2. plebiscite 3. Polish 4. Constantinople
5. Giuseppe Mazzini

True /False:

1. True 2. True 3. False 4. True 5. True

Match the Column :

- 1.(A) (i)-(b), (ii)-(a), (iii)-(e), (iv)-(c), (v)-(d)

EXERCISE # 2

Ques	1	2	3	4	5	6	7	8	9	10
Ans.	B	A	D	B	A	B	A	B	A	A
Ques	11	12	13	14	15	16	17	18	19	20
Ans.	A	A	C	C	D	B	C	D	D	D
Ques	21	22	23	24	25	26	27	28	29	30
Ans.	A	B	C	D	C	B	A	A	A	C

EXERCISE # 3

Ques	1	2	3	4	5	6	7	8	9	10
Ans.	D	A	D	A	D	D	B	B	D	B
Ques	11	12	13	14	15	16	17	18	19	20
Ans.	B	B	D	B	A	C	A	A	A	C
Ques	21	22								
Ans.	A	D								





TENSE

Eng. G. - 1

DEFINITION

It is any form of the verb which may be used to show (i) the time of an action and (ii) the state of action or an event. The Tense of a verb shows the time when an action takes place.

There can be no sentence without a verb.

(a) **There are Three Main Tenses in English :**

The Present Tense	_____	(i) Mr. Sharma teaches us English.
The Past Tense	_____	(ii) Mr. Sharma taught us English.
The Future Tense	_____	(iii) Mr. Sharma will teach us English.

The three main tenses are subdivided into four heads. They are

(a) Indefinite or Simple (b) Continuous (c) Perfect (d) Perfect Continuous.

(b) **Tense at a Glance :**

Tense at a Glance				
Tense	Indefinite/Simple	Continuous	Perfect	Perfect Continuous
Present	writes	am writing is writing are writing	has written have written	has been writing have been writing
Past	wrote	was writing were writing	had written	had been writing
Future	shall write will write	shall be writing will be writing	shall have written will have written	shall have been writing will have been writing

(c) **Examine the Following Sentences :**

- I write a letter.
- I am writing a letter.
- I have written a letter.
- I have been writing a letter.

The verbs in all these four sentences refer to the Present Time and are therefore said to be in the Present Tense.

- In sentence (i) :** the verb 'write' simply expresses the action done in the present time, without indicating the state of action. It does not tell us anything about the completeness or incompleteness of the action. Hence the verb is said to be in the **Simple Present Tense or Present Indefinite Tense**.
- In sentence (ii) :** the verb 'am writing' is still going on or continuing. Hence the verb is said to be in the

PRESENT CONTINUOUS TENSE

- In sentence (iii) :** the verb 'have written' shows that the action is completed, finished or perfect. Hence the verb is said to be in the **Present Perfect Tense**.
- In sentence (iv) :** the verb 'have been writing' shows that the action is going on continuously up to the present time. Hence the verb is said to be in the **Present Perfect Continuous Tense**.





(d) Similarly the Past Tense and the Future Tense have four forms:

- **Simple Past Tense or Past Indefinite Tense** (i) I wrote a letter.
- **Past Continuous Tense** (ii) I was writing a letter.
- **Past Perfect Tense** (iii) I had written a letter.
- **Past Perfect Continuous Tense** (iv) I had been writing a letter.

- **Simple Future or Future Indefinite Tense** (i) I shall write a letter.
- **Future Continuous Tense** (ii) I shall be writing a letter.
- **Future Perfect Tense** (iii) I shall have written a letter.
- **Future Perfect Continuous Tense** (iv) I shall have been writing a letter.

PRESENT TENSE

(a) **Simple Present Tense:** When a tense is used to show the present time it is known as the simple present tense.

SUBJECT	VERB BASE FORM (first form of the verb)
Rohan	writes English well
Fatima	sings very beautifully
You	wait here

We use the Present Simple Tense to describe

- (i) Things that are always true i.e. universal fact. **E.g.** The Sun rises in the East.
- (ii) Situations that exist now and will go on indefinitely. **E.g.** Teachers teach the students.
- (iii) Habits or things that happen regularly. **E.g.** We go to school everyday.

(b) **Present Continuous :** When a tense is used to show what is happening now, it is known as the present continuous tense.

SUBJECT	AM / IS / ARE	PRESENT PARTICIPLE (verb + ing)
I	am	reading a letter from my parents
Mary	is	writing a novel.
It	is	snowing heavily

(c) **Present Perfect Tense :** When a tense is used to show that an action has just been completed, or an action has finished at the moment of speaking, it is known as the present perfect tense.

SUBJECT	HAVE / HAS	PAST PARTICIPLE (verb third form)
Sushil	has	completed his work.
Priyanka	has	written a story for children.
They	have	vacated the house.

(d) **Present Perfect Continuous Tense :** When a tense is used to show that an action has been taking place for some time in the past and is in progress up to now, it is known as the present perfect continuous tense.

SUBJECT	HAVE BEEN / HAS BEEN	PRESENT PARTICIPLE (verb + ing)
I	have been	writing a letter.
We	have been	looking for Manjeet
It	has been	snowing heavily.





PAST TENSE

The past tense refers to actions and events that happened in the past or in an earlier time.

- (a) **Simple Past Tense** : When a verb shows that an action has been completed in the past, it is known as the simple past tense.

SUBJECT	VERB SECOND FORM
I	wrote a novel when I was 15 years old.
We	looked for Manjeet everywhere.
They	built the bridge.

- (b) **Past Continuous Tense** : When a tense is used to show that an action was in progress or incomplete in the past, it is known as the past continuous tense.

SUBJECT	WAS / WERE	PRESENT PARTICIPLE (verb + ing form)
I	was	reading the newspaper
We	were	looking for Manjeet
You	were	dancing all evening

- (c) **Past Perfect Tense** : When a tense is used to show that an action had been completed in the past before another action began, it is known as the past perfect tense.

SUBJECT	HAD	PAST PARTICIPLE
I	had	read the letter
Devesh	had	finished his work
They	had	built the house

- (d) **Past Perfect Continuous Tense** : When a tense is used to show that an action had been in progress when another past action began, it is known as the past perfect continuous tense.

SUBJECT	HAD BEEN	PRESENT PARTICIPLE (verb + ing form)
I	had been	teaching here
We	had been	praying for Manasi
You	had been	helping us.

THE FUTURE TENSE

- (a) **Simple Future Tense**: When a tense is used to show that some action will take place in the future, it is known as the simple future tense.

SUBJECT	SHALL / WILL	VERB BASE FORM (first form)
I	shall	write a story for the newspaper
We	shall	sing for the queen.
It	will	snow heavily

- (b) **Future Continuous Tense** : When a tense is used to show that some action will be in progress in the future, it is known as the future continuous tense.

SUBJECT	SHALL/WILL BE	PRESENT PARTICIPLE
I	shall be	writing the letter soon.
We	shall be	going to Mussoorie in March.
It	will be	snowing heavily at this time of the year.



- (c) **Future Perfect Tense** : When a tense is used to show that some action will be finished in the future, it is known as the future perfect tense.

SUBJECT	SHALL/WILL HAVE	PAST PARTICIPLE
I	shall have	written the letter.
We	shall have	built the house by August next year.
It	will have	snowed heavily.

- (d) **Future Perfect Continuous Tense** : When a tense is used to show that some action will have been in progress in the future, it is known as the future perfect continuous tense.

SUBJECT	SHALL/WILL HAVE BEEN	PRESENT PARTICIPLE
I	shall have been	writing the letter
We	shall have been	seeing the film.
Robert	will have been	helping Shaila.

Solved Examples

- (i) In the passage given below, one word has been omitted in each line. Write the missing word along with the word that comes before and the word that comes after it. Ensure that the word that forms your answer is underlined.
- (a) Pollution not a new problem. In the
 (b) middle ages most towns dirty, water
 (c) supply foul and diseases spread
 quickly. Much has been done to improve
 sanitation and public health. But since
 (d) Industrial Revolution disposal of waste become
 more complicated. As factories produce new
 (e) goods old ones thrown out with the
 (f) rubbish. These rubbish heaps an unpleasant
 (g) sight to watch. Getting rid of plastics particularly
 difficult. Plastics never decay,
 (h) the more we throw, the more litter produced.
 So scientists are trying to make plastics which can be easily broken.

- Ans.** Pollution not a new problem. In the middle ages most towns dirty, water supply foul and diseases spread quickly. Much has been done to improve sanitation and public health. But since Industrial Revolution disposal of waste become more complicated. As factories produce new goods old ones thrown out with the rubbish. These rubbish heaps an unpleasant sight to watch. Getting rid of plastics particularly difficult. Plastics never decay, the more we throw, the more litter produced. So scientists are trying to make plastics which can be easily broken.
- (a) pollution is not
 (b) towns were dirty
 (c) supply was foul
 (d) waste has become
 (e) ones are thrown
 (f) heaps are an
 (g) plastics is particularly
 (h) litter is produced





Exercise-1

Direction (1 to 15): Fill in the blanks with the correct forms of the verbs given in the bracket.

1. Raman _____ in the ground since morning. (has been playing , is playing)
2. The stars _____ at night. (twinkles , twinkle)
3. We _____ the Taj Mahal last year. (visited , had visited)
4. My brother will go to watch a movie when his friend _____. (will come , comes)
5. And still the little dog blinked at the lights and the conductor _____ to and fro on the pavement. (walked , walks)
6. You _____ the rule and broken its spirit. (have kept , keep)
7. My fater had to _____ the whole thing from the beginning. (explained, explain)
8. As the days passed, I _____ his shadow. (have become , became)
9. It _____ difficult to be a good parent and a good friend at the same time. (is , have been)
10. I continued _____ at that shoe store until it was time to leave for college. (to work , for woking)
11. We _____ games in the evening everyday. (play , plays)
12. She usually _____ at the back of the class. (sit , sits)
13. The sun rises in the east and _____ in the west. (sets , set)
14. The students _____ cricket match on every Sunday. (play , plays)
15. An honest person usually _____ the truth. (speak , speaks)
16. I _____ my lunch before my friend comes to my house. (will have taken , will took)
17. That fool always _____ a mistake. (make , makes)
18. The baby _____ hungry since morning. (has been , has being)
19. I _____ in London for six years. (have been , has been)

20. **Samaira wrote a short story but forgot to edit it. There is an error in each line. Write the incorrect word/phrase and the correction.**

- | | Incorrect | Correct |
|---|------------------|----------------|
| (a) There was living a farmer named Mohan, | _____ | _____ |
| (b) who is very hardworking and honest. He | _____ | _____ |
| (c) has known across the village as a man | _____ | _____ |
| (d) of principles and thus loving by all. His | _____ | _____ |
| (e) fields been always green and he never | _____ | _____ |
| (f) sleeping with an empty stomach | _____ | _____ |
| (g) After a drought, all the farmers was leaving, | _____ | _____ |
| (h) but Mohan was not ready to left his | _____ | _____ |
| (i) fields. The news was reaching the press and | _____ | _____ |
| (j) a reporter come to the village to | _____ | _____ |
| (k) got his side of the story | _____ | _____ |





21. In the passage given below, one word has been omitted in each line. Write the missing word along with the word that comes before and the word that comes after it.

	Before	Missing	After
Experiments at the world's biggest			
(a) particle smasher confirmed the existence of two subatomic particles.	_____	_____	_____
(b) The discoveries part of the baryon	_____	_____	_____
(c) family of particles. Baryons composite particles composed of three quarks. The	_____	_____	_____
(d) work carried out in 2011 and 2012. A	_____	_____	_____
(e) paper reporting the finding been submitted	_____	_____	_____
(f) The facility going through an upgrade	_____	_____	_____
(g) now. A related baryonic particle found by an experiment in 2012.	_____	_____	_____

22. Read the following notes carefully and complete the paragraph.

RK NARAYAN

Birth : 10th October, 1906, Chennai

Occupation : Novelist, short story writer

Father : Headmaster

Brother, : Famous cartoonist RK Laxman

The famous novelist and short story writer, RK Narayan (a) _____ His father _____ (b) and his brother, RK Laxman (c) _____

- (a) (A) was born at Chennai on 10th October, 1906 (B) was born in Chennai on 10th October, 1906
(C) born on Chennai on 10th October, 1906 (D) were born in Chennai on 10th October, 1906
- (b) (A) was a Headmaster (B) was the Headmaster
(C) was Headmaster (D) is the Headmaster
- (c) (A) is a famous cartoonist (B) were a famous cartoonist
(C) is this famous cartoonist (D) is famous cartoonist

23. Fill in the blanks using correct form of tenses.

Medileaks, a website that (a) _____ (allow) stakeholders to register complaints and point out irregularities in healthcare, (b) _____ (launch) in the capital yesterday. The website, (c) _____ (inspire) by Wikileaks, (d) _____ (allow) whistleblowers to (e) _____ (post) information anonymously. This (f) _____ (check) by a team of volunteers before (g) _____ (share) on the portal. However, concerns are already (h) _____ (raise) about how it (i) _____ (address) the issue of medical negligence.

Exercise-2

Direction : (1 to 31) Tick the correct option in the following to form a grammatically correct sentence.

1. I shall wait here until you _____ (NTSE Stage-I / Raj./ 2014)
(A) would be ready. (B) are ready.
(C) are not ready. (D) will be ready.
2. While she _____ (NTSE Stage-I / Raj./ 2014)
(A) read the milk boiled over. (B) has read the milk boiled over.
(C) reads the milk boiled over. (D) was reading the milk boiled over.
3. I _____ (NTSE Stage-I / Raj./ 2014)
(A) go to the cinema last night. (B) went to the cinema last night.
(C) am going to the cinema last night. (D) shall go to the cinema last night.
4. Woollen clothes _____ (NTSE Stage-I / Raj./ 2014)
(A) are worn in winter. (B) worn in winter.
(C) wear in winter. (D) have been worn in winter.
5. The truck _____ (NTSE Stage-I / Raj./ 2014)
(A) will be loaded at present. (B) is being loaded at present.
(C) is loaded at present (D) was loading at present





6. Heat (NTSE Stage-I / Raj./ 2014)
 (A) expands gas. (B) expanded gas. (C) expand gas. (D) has expanded gas.
7. Smoking (NTSE Stage-I / Raj./ 2014)
 (A) is prohibited here. (B) was prohibited here.
 (C) will prohibited here. (D) prohibit here.
8. America (NTSE Stage-I / Raj./ 2014)
 (A) is discovered by Columbus. (B) will be discovered by Columbus.
 (C) was discovered by Columbus. (D) is being discovered by Columbus.
9. It (NTSE Stage-I / Raj./ 2014)
 (A) rained since yesterday afternoon. (B) rain since yesterday afternoon.
 (C) rains since yesterday afternoon. (D) has been raining since yesterday afternoon.
10. We reached the theatre after the film (NTSE Stage-I / Raj./ 2014)
 (A) started (B) starts (C) will start (D) had started
11. English (NTSE Stage-I / Raj./ 2014)
 (A) speak all over the world. (B) was spoken all over the world.
 (C) is spoken all over the world. (D) has been spoken all over the world.
12. Himani..... this test recently. (NTSE Stage-I / Raj./ 2015)
 (A) pass (B) passed (C) have passed (D) has passed.
13. Earlier Vivekon 17th floor of a multi-storeyed building. So, he knows how to use a lift. (NTSE Stage-I / Raj./ 2015)
 (A) live (B) lived (C) lives (D) is living.
14. Raghu had better..... at a boarding school. (NTSE Stage-I / Raj./ 2015)
 (A) study (B) to study (C) studying (D) studied.
15. She went to the village market..... the necessary commodities . (NTSE Stage-I / Raj./ 2015)
 (A) for buy (B) to buy (C) buying (D) to be bought
16. I (catch) only one fish by five o'clock yesterday. (NTSE Stage-I / Delhi / 2015)
 (A) caught (B) has caught (C) had caught (D) would have caught
17. I have not seen her since she (leave) the hospital. (NTSE Stage-I / Delhi / 2015)
 (A) left (B) has left (C) had left (D) would leave
18. The plane (take) off for London by tomorrow afternoon. (NTSE Stage-I / Delhi / 2015)
 (A) will take (B) will have taken (C) will be taking (D) will have been taking
19. The news of his death (declare) so far. (NTSE Stage-I / Delhi / 2015)
 (A) was not declared (B) has not declared (C) has not been delcared (D) had not been declared
20. The farmers (reap) the crops before the rainy season set in. (NTSE Stage-I / Delhi / 2015)
 (A) reaped (B) have reaped (C) will have reaped (D) had reaped
21. The doctor found that she (bite) by a snake. (NTSE Stage-I / Delhi / 2015)
 (A) was bitten (B) had been bitten (C) bit (D) has been bitten
22. Mayank always newspaper in the morning. (NTSE Stage-I / Raj./ 2017)
 (A) read (B) reads (C) was reading (D) is reading.
23. Listen! Someone at the door. (NTSE Stage-I / Raj./ 2017)
 (A) is knocking (B) are knocking (C) knocks (D) knocked.





24. Kezia's father home just now. (NTSE Stage-I / Raj./ 2017)
 (A) come (B) came (C) has come (D) had come
25. First prize by Wanda last year. (NTSE Stage-I / Raj./ 2017)
 (A) were won (B) was won (C) are won (D) is won
26. Prizes by the chief guest in the annual function next week. (NTSE Stage-I / Raj./ 2017)
 (A) give away (B) has been given away
 (C) will be given away (D) was given away.
27. Have you ever abroad? (NTSE Stage-I / Telangana/ 2016)
 (A) went (B) been (C) go (D) to
28. Has your lost car been located? It was foundon the highway. (NTSE Stage-I / Andhra pradesh/ 2016)
 (A) to be abandoned (B) to be abandoning
 (C) abandoned (D) abandon
29. The window was alreadywhen I got here. (NTSE Stage-I / Andhra pradesh/ 2016)
 (A) breaking (B) broken (C) broke (D) break
30. He is wet. He of the sea. (NTSE Stage-I / Maharashtra/ 2016)
 (A) has just come out (B) just comes out
 (C) had just come out (D) was just coming out
31. If it snows this weekend, weskiing. (NTSE Stage-I / Maharashtra/ 2016)
 (A) go (B) will go (C) could going (D) are going

Answers

Exercise-1

- | | | | |
|---------------------|--------------|----------------------|---------------------|
| 1. has been playing | 2. twinkle | 3. visited | 4. comes |
| 5. walked | 6. have kept | 7. explain | 8. became |
| 9. is | 10. to work | 11. play | 12. sits |
| 13. sets | 14. play | 15. speaks | 16. will have taken |
| 17. makes | 18. has been | 19. have been living | |
20. **Incorrect**
 (a) was living
 (b) is
 (c) has
 (d) loving
 (e) been
 (f) sleeping
 (g) was leaving
 (h) left
 (i) was reaching
 (j) come
 (k) got
- Correct**
 lived
 was
 was
 loved
 were
 slept
 left
 leave
 reached
 came
 get
21. **Before** **Missing** **After**
 (a) smasher have confirmed
 (b) discoveries are part
 (c) Baryons are composite
 (d) work was carried
 (e) finding has been
 (f) facility is going
 (g) particle was found





22. (a) (ii) was born in Chennai on 10th October, 1906
 (b) (i) was a Headmaster
 (c) (i) was a famous cartoonist
23. (a) allows (b) was launched (c) inspired (d) allows (e) post
 (f) is checked (g) being shared (h) being raised (l) would address

Exercise-2

Q.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A.	B	D	B	A	B	A	A	C	D	D	C	D	B	A	B
Q.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
A.	C	A	B	C	C	B	B	A	C	B	C	B	C	B	A
Q.	31														
A.	B														





ALPHABET -TEST

A. ALPHABETICAL ORDER

You have to arrange the given words in order in which they are arranged in a dictionary. In a dictionary the words are placed in alphabetical order w.r.t. the second alphabet of the words and so on (that is, third alphabet, fourth alphabet....).

Example.1

Arrange the given words in the correct alphabetical order.

Late, Long, Liver, Last, Load, Luminous, Loan, Lock.

Solution :

The given words can be arranged in the alphabetical order as

Last, Late, Liver, Load, Loan, Lock, Long, Luminous.

Example. 2

Arrange the given words in alphabetical order and tick the one that comes last.

Heavy, Heredity, Hesitate, Hedge, Hero, Haste, History, Hinderance

Solution :

The given words can be arranged in the alphabetical order as

Haste, Heavy, Hedge, Heredity, Hero, Hesitate, Hinderance, History

Clearly, **History** comes last.

Example. 3

Arrange the given words in the order they occur in dictionary.

1. SIGN 2. SOLID 3. SCENE 4. SIMPLE

(A) 3, 1, 2, 4

(B) 3, 1, 4, 2

(C) 3, 4, 1, 2

(D) 3, 4, 2, 1

Solution :

(B) The correct alphabetical order of the given words is : SCENE, SIGN, SIMPLE, SOLID. Thus, the correct sequence is **3, 1, 4, 2**.

B. LETTER-WORD PROBLEMS

Example. 4

How many pairs of letter in the word **DABBLE** have as many letters between them as in the Alphabet series ?

(A) Nil

(B) One

(C) Two

(D) More than three

Solution :

(D) Letters in the given Word : Letters in the Alphabet

A B

A B

D A B

D C B

B B L E

B C D E

A B B L E

A B C D E

**Example. 5**

In the word **PARADISE** how many pairs of letters are there which have as many letters between them in the word as in the alphabet ?

- (A) None (B) One (C) Two (D) Three

Solution :

(D) Letter in the given word : Letter in the alphabet

- | | |
|---|---|
| (i) P <u>A</u> R | P <u>Q</u> R |
| (ii) A <u>R</u> A D | A <u>B</u> C D |
| (iii) A <u>D</u> I S E | A <u>B</u> C D E |

Example. 6

Number of letters skipped in between adjacent letters in the series are increased by one. Which of the following alternatives observes this rule ?

- (A) KMPTY (B) IJKOT (C) HJMQT (D) DFIJK

Solution :

- (A) K L M N O P Q R S T U V W X Y
- 1 2 3 4

Clearly, in letter series KMPTY, the number of letters skipped in between adjacent letters in the series are increased by one.

C. ALPHABETICAL QUIBBLE

In this type of questions, generally a letter-series is given, be it the English alphabets from A to Z or Z to A. The candidate is then required to trace the letters satisfying certain given conditions as regards their position in the given sequence or the sequence obtained by performing certain given operations on the given sequence.

Example. 7

If the alphabet series is written in a reverse order, which of the following will be the seventh letter to the left of eighth letter from your right ?

- (A) L (B) M (C) O (D) P

Solution :

(C) The new alphabet series is :
ZYXWVUTSRQPONMLKJIHG FEDCBA
The eight letter from the right is H.
The seventh letter to the left of H is O.

Example. 8

If the first four letters of the word 'ANTHROPOMORPHISM' are rewritten in the reverse order followed by the next four rewritten in the reverse order followed by the next four letters in the reverse order and so on, which letter will be twelfth from the left end in the rewritten order ?

- (A) O (B) H (C) M (D) P

Solution :

(C) The new arrangement is as follows: HTNAOPORPROMMSIH.

D. WORD FORMATION BY UNSCRAMBLING LETTERS

In this type of questions, a set of English letters is given in a jumbled order. The candidate is required to arrange these letters to form a meaningful word.

Example. 9

Arrange the following group of letters such that when arranged in a specific order, meaningful word is formed.

V A H Y E
1 2 3 4 5

- (A) 2, 3, 4, 5, 1 (B) 3, 2, 5, 1, 4 (C) 3, 5, 2, 1, 4 (D) 1, 5, 2, 3, 4

Solution :

(C) The given letter, when arranged in the order **3, 5, 2, 1, 4**. form the word **HEAVY**.



E. WORD FORMATION USING LETTERS OF A GIVEN WORD

Example. 10

A meaningful word starting with A is made from the first, the second, the fourth, the fifth and the sixth letters of the word **CONTRACT**, which of the following is the middle letter of the word ?

- (A) C (B) T (C) O (D) R

Solution :

(B) The first, the second, the fourth, the fifth and sixth letters of the word **CONTRACT** are C, O, T, R and A respectively. The meaningful word will be **ACTOR** and **T** will be the required letter.

Example. 11

Find which one word can not be made from the letters of the given word.

TEMPERAMENT

- (A) METER (B) PETER (C) TENTER (D) TESTER

Solution :

(D) The word **TEMPERAMENT** contains all the letters of the word **TESTER** except S. So, the word **TESTER** cannot be formed.



Exercise-1

Directions : (1 to 2) Arrange the given words in alphabetical order and tick the one that comes first.

- (A) Grammar (B) Granary (C) Gradient (D) Grand
- (A) Mahender (B) Mahendra (C) Maninder (D) Mahindra
- If the following words are arranged in an alphabetical order, which word will appear in the second ?
(A) Principal (B) Principle (C) Principia (D) Principled
- If the following words are arranged as found in the dictionary, then what will be the fourth letter from the left in the last word ?
INTIMATION, INFORMATION, INTEREST, INTERROGATION, INSTIGATION
(A) R (B) O (C) T (D) I
- How many pairs of letters are there in the word **CARROT** which have as many letters between them in the word as in the alphabet ?
(A) 1 (B) 2 (C) 3 (D) 4
- How many pairs of letters are there in the word **HORIZON** which have as many letters between them in the word as in the English alphabet ?
(A) One (B) Two (C) Three (D) More than three
- Number of letters skipped in between adjacent letters in the series decreases by two. Which of the following series observes this rule ?
(A) FQWBG (B) HQXCF (C) TBINO (D) XFMQU
- Number of letters skipped in between adjacent letters in the series increases by one. Which of the following series observes this rule ?
(A) DBPUY (B) DBUYP (C) DBYPU (D) DBYUP



9. Which letter will be the midway between the fourteenth letter from the left end and nineteenth letter from the right end of the following alphabet?
A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
(A) I (B) K (C) M (D) G
10. Which letter will be the sixth to the left of the eleventh letter from the right end of the alphabet?
(A) K (B) V (C) J (D) U
11. If the positions of the first and sixth letters of the word **BENEFICIAL** are interchanged; similarly the positions of the second and seventh letters are interchanged and so on, which letter will be third from the right end after rearrangement?
(A) C (B) E (C) F (D) N

Directions : (12 to 14) In each of the following questions, a group of letters is given which are numbered 1, 2, 3, 4, 5 and 6. Below are given four alternatives containing combinations of these numbers. Select that combination of numbers so that letters arranged accordingly, form a meaningful word.

12. R A C E T
1 2 3 4 5
(A) 1, 2, 3, 4, 5 (B) 3, 2, 1, 4, 5 (C) 5, 2, 3, 4, 1 (D) 5, 1, 2, 3, 4
13. R U S G A
1 2 3 4 5
(A) 1, 5, 4, 2, 3 (B) 5, 3, 4, 1, 2 (C) 3, 2, 4, 5, 1 (D) 4, 5, 3, 2, 1
14. R T A O U H
1 2 3 4 5 6
(A) 1, 3, 4, 5, 6, 2 (B) 2, 3, 6, 4, 5, 1 (C) 6, 3, 2, 4, 5, 1 (D) 3, 5, 2, 6, 4, 1
15. If a meaningful word can be formed by rearranging the letters **USCALA**, the first letter of the word so formed is the answer. If no such word can be formed the answer is X.
(A) C (B) S (C) A (D) L
16. A word given in Capital Letters is followed by four answer words. Out of these only one can be formed by using the letters of the given words. Find out that word. **SOMNAMBULISM**
(A) NAMES (B) BASAL (C) SOUL (D) BIOME

Directions : (17 to 18) In each of the following questions, find which one word can not be made from the letters of the given word.

17. KALEIDOSCOPE
(A) SCALE (B) PADLOCK (C) PACKET (D) DIESEL
18. SUPERIMPOSABLE
(A) SPIRE (B) REPTILE (C) POSSIBLE (D) REPOSE
19. If Letters of alphabets are written in reverse way then which letter will be seventh letter right to Q?
(NTSE Stage-I / Raj./2007)
(A) K (B) U (C) J (D) W
20. Select the word from given alternatives which can not be written from the letters of **EDUCATED** word-
(NTSE Stage-I / Raj./2007)
(A) DUCK (B) CUTE (C) TADE (D) ACTE
21. Which name will come at 3rd place in a telephone directory from the following given names?
(NTSE Stage-I / Raj./2014)
(A) AMIT (B) AMINA (C) ALOK (D) ABHIMAN



Exercise-2

- How many pairs of letters in the word **BRIGHTER** have as many letters between them in the word as in the alphabet ?
(A) 2 (B) 3 (C) 4 (D) more than 4
- If the alphabets were written in the reverse order, which letter will be the fifth letter to the left of the fourteenth letter from the left.
(A) R (B) I (C) S (D) H
- Which letter should be ninth letter to the left of ninth letter from the right, if the first half of the alphabet series is reversed ?
(A) D (B) E (C) F (D) I
- A meaningful nine-letter English word is formed using all the alphabets given in the grid below, starting with alphabet of a corner block, moving in clockwise direction and ending at the alphabet in the central grid. What is the fourth alphabet of the word ?

m	m	o
o	y	d
c	t	i

- (A) o (B) d (C) t (D) m
- If it is possible to make a meaningful word with the third, the fourth and the eleventh letters of the word **CONTROVERSIAL**, which of the following will be the last letter of that word ? If more than one such words can be made, give **M** as the answer and if no such word is there, give **X** as the answer.
(A) N (B) I (C) X (D) M
 - If it is possible to make a meaningful word with the second, the sixth, the ninth and the twelfth letters of the word **CONTRIBUTION**, which of the following will be the last letter of that word ? If more than one such words can be made, give **M** as the answer and if no such word is there, give **X** as the answer.
(A) N (B) O (C) X (D) M

Answers

EXERCISE - 1

Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	C	A	C	D	A	D	B	D	B	C	D	D	C	D	A
Que.	16	17	18	19	20	21									
Ans.	C	C	B	C	A	B									

EXERCISE - 2

Que.	1	2	3	4	5	6
Ans.	B	A	B	D	D	B