

ies in crematoriums, and so on. Reflection type solar concentrators can be used for concentrating sunlight on solar cells.

### **Advantages of Solar Cooker**

- (i) It doesn't create pollution.
- (ii) Its sources of energy is free of cost and renewable.
- (iii) Due to its slow cooking, essential nutrients are retained.

Solar cell is a device which converts solar energy into electricity.

### **Solar Panel**

When a large number of solar cells are put together to draw high voltage for commercial purposes then it's called solar panel. Electrical energy which is produced is stored in lead storage battery which can be further utilised whenever required.



### **Uses of Solar Cells**

- (i) Solar cells are used to provide energy to artificial satellites and space probes.
- (ii) Solar cells are used as a source of electricity on oil drilling platforms and light house.
- (iii) Solar cells are also used to provide energy to TV, radio transmission, relay towers.
- (iv) Solar cells also used in traffic lights and glow sign boards.

- (v) It is used in irrigation pumps.
- (vi) Solar cells are used to run small electrical devices like watches, calculators, etc.

## **ENERGY FROM THE SEA**

### **Tidal Energy**

It is a form of energy which is obtained from the ocean in the form of tidal waves. Water rises to a great height during tides due to gravitational pull of moon twice a day. Tidal energy can be harnessed by constructing tidal dams.

When water rises during tides, it is stored behind the tides dams and then it is allowed to fall down on turbines and when turbines rotate electricity is generated. Harnessing of tidal energy is not advisable or beneficial because the rise and fall of water during tides is not sufficient to produce electricity on a large scale and moreover tidal dams cannot be constructed everywhere. Due to these reasons, tidal energy is not likely to be a major source of energy.

### **Wave Energy**

It is another form of ocean energy which can be harnessed, wind blowing across the surface of ocean are converted into waves. These waves carry energy called wave energy. Kinetic energy possessed by waves can be harnessed to generate electricity. The total amount to wave energy available on the shore lines across the world is estimated to be 2 to 3 million mega watts i.e., why wide range of devices have been developed to trap wave energy to generate electricity.

### **Ocean Thermal Energy (O.T.E)**

Temperature difference between layers of water at different depth in the sea can also be used to produce electricity. The energy present

in this form is called ocean thermal energy. Generally, the difference in temperature is of about  $20^{\circ}\text{C}$  between the surface water and the water of a depth of 1 km. This temperature difference is required to operate an ocean thermal energy conversion (OTEC) plant. In a closed system plant, liquid ammonia (or CFC), heated by warm sea water, evaporates and expands to turn a turbine. The vapours are condensed back to liquid by cold sea water, and reused.

### **Geothermal Energy**

Geothermal energy is the energy stored as heat in the earth. It heats rocks and water below the ground. At certain places over hot spots in the crust, the water gets superheated. It may come out as steam or a mixture of steam and hot water in geysers. The steam from geysers can be used directly to turn turbines. At other places, pipes are sunk up to hot water sources close to the surface of the earth. As the water rises in the pipes, it gets converted to steam, which can be used to turn turbines.

## **NUCLEAR ENERGY**

The energy released during nuclear reactions is called nuclear energy because it comes from the nuclei of atoms. Nuclear energy is generated by two types of nuclear reactions—

### **Nuclear Fission**

In a process called nuclear fission, the nucleus of a heavy atom (such as uranium, plutonium or thorium), when bombarded with low-energy neutrons, can be split apart into lighter nuclei. When this is done, a tremendous amount of energy is released if the mass of the original nucleus is just a little more than the sum of the masses of the individual products. The fission

of an atom of uranium, for example, produces 10 million times the energy produced by the combustion of an atom of carbon from coal.

In nuclear fission, the difference in mass,  $Dm$ , between the original nucleus and the product nuclei gets converted to energy  $E$  at a rate governed by the famous equation,

$E = Dm c^2$ , first derived by Albert Einstein in 1905, where  $c$  is the speed of light in vacuum. In nuclear science, energy is often expressed in units of electron volts (eV):  $1 \text{ eV} = 1.602 \times 10^{-19}$  joules. It is easy to check from the above equation that 1 atomic mass unit (u) is equivalent to about 931 mega electron volts (MeV) of energy.

## Nuclear Fusion

Fusion means joining lighter nuclei to make a heavier nucleus, most commonly hydrogen or hydrogen isotopes to create helium, such as

$${}_2^1\text{H} + {}_2^1\text{H} \rightarrow {}_3^4\text{He} (+ n)$$

It releases a tremendous amount of energy, according to the Einstein equation, as the mass of the product is little less than the sum of the masses of the original individual nuclei.

Such nuclear fusion reactions are the source of energy in the Sun and other stars. It takes considerable energy to force the nuclei to fuse. The conditions needed for this process are extreme – millions of degrees of temperature and millions of pascals of pressure.

The hydrogen bomb is based on thermonuclear fusion reaction. Nuclear fusion takes place at a very high temperature. So nuclear fusion reaction is also known as thermonuclear reaction.

## Nuclear Power Plants in India

Nuclear power reactors are located at Tarapur (Maharashtra), Rana Pratap Sagar (Rajasthan).

Kalpakkam (Tamil Nadu), Narora (UP), Kaprapar (Gujarat) and Kaiga (Karnataka)

### **Hazards of Nuclear Power Generation**

The major hazard of nuclear power generation is the storage and disposal of spent or used fuels – the uranium still decaying into harmful subatomic particles (radiations). Improper nuclear - waste storage and disposal result in environmental contamination. Further, there is a risk of accidental leakage of nuclear radiation. The high cost of installation of a nuclear power plant, high risk of environmental contamination and limited availability of uranium makes large-scale use of nuclear energy prohibitive.

### **Environmental Consequences**

Exploiting any source of energy disturbs the environment in some way or the other. In any given situation, the source we would choose depends on factors such as the ease of extracting energy from that source, the economics of extracting energy from the source, the efficiency of the technology available and the environmental damage that will be caused by using that source.

Research continues in these areas to produce longer lasting devices that will cause less damage throughout their life.



<b>Exercise</b>	
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**DIRECTIONS :** This section contains multiple choice questions. Each question has 4 choices (a), (b), (c) and (d) out of which only one is correct.

1. Which of the following is a false statement?
  - (a) To overcome the energy crisis the use of solar cooker must be increased.
  - (b) To overcome the energy crisis more amount of non-renewable sources of energy must be used.
  - (c) The re-usage of waste material as a source of energy can be done to overcome the energy crisis.
  - (d) To overcome the energy crisis water has to be saved.
2. The main constituent of LPG is butane. Then
  - (A) butane can be liquefied easily under high pressure.
  - (B) butane is liquefied by chemically reacting with ethane and propane.
  - (a) Only A is true
  - (b) Only B is true
  - (c) Both A and B are true
  - (d) Both A and B are false
3. Which element contained in a fuel contributes to its high calorific value?
  - (a) Carbon
  - (b) Hydrogen
  - (c) Oxygen
  - (d) Nitrogen
4. It is a well known fact that energy can neither be created nor be destroyed, but still we say that there is an energy crisis because
  - (a) forms of energy keep changing
  - (b) total energy before and after remains constant, but some of it is used to carry other functions

- (c) usable form of energy is dissipated to the surroundings in less usable forms
- (d) All of these
5. Combustion, the process of burning a fuel, is \_\_\_\_\_.
- (A) an oxidation and an exothermic reaction.
- (B) a reduction and an endothermic reaction.
- (a) Only A is true
- (b) Only B is true
- (c) Both A and B are true
- (d) Both A and B are false
6. \_\_\_\_\_ is used as a fuel in space ships.
- (a) Hydrogen
- (b) Alcohol
- (b) Petrol
- (d) Diesel
7. In solar water heater, a copper pipe with its outer surface painted in black is fixed in the form of a coil in a box.
- (a) The only purpose of bending copper pipe is to increase the capacity of water storage.
- (b) Bending copper pipe as a coil helps to increase the surface area for heating.
- (c) Both (a) and (b) are true
- (d) Both (a) and (b) are false
8. Different forms of energy can be
- (a) mechanical energy
- (b) heat energy
- (c) muscular energy
- (d) chemical energy, electrical energy & others in addition to those mentioned above
9. In the extraction of some metals from their ores, coke can be used as a/an \_\_\_\_\_.
- (a) oxidizing agent
- (b) reducing agent
- (c) catalyst
- (d) flux

10. \_\_\_\_\_ are used to produce energy in OTEC.
  - (a) Tidal energy
  - (b) Temperature difference between the different layers of water in ocean
  - (c) Ocean waves
  - (d) None of the above
11. The crude oil extracted from the earth is separated into its constituents by a process called \_\_\_\_\_.
  - (a) disintegration distillation
  - (b) compound distillation
  - (c) destructive distillation
  - (d) fractional distillation
12. Characteristics of good source of energy are that
  - (a) it would do large amount of work per unit volume or mass
  - (b) it is accessible and economical
  - (c) it is easy to store and transport
  - (d) All of these
13. The Sun's energy is due to
  - (a) the nuclear fission of hydrogen
  - (b) the nuclear fusion of hydrogen
  - (c) the natural combustion of hydrogen.
  - (d) the nuclear fission of uranium
14. In a hydro power plant
  - (a) potential energy possessed by stored water is converted into electricity
  - (b) kinetic energy possessed by stored water is converted into potential energy
  - (c) electricity is extracted from water
  - (d) water is converted into steam to produce electricity
15. Which part of the solar cooker is responsible for green house effect?
  - (a) Coating with black colour inside the box
  - (b) Mirror



- (c) Glass sheet
  - (d) Outer cover of the solar cooker
16. Wood, coal, energy of flowing water and wind are considered to be
- (a) conventional sources of energy
  - (b) unconventional sources of energy
  - (c) renewable sources of energy
  - (d) non-renewable sources of energy
17. The main constituent of biogas is
- (a) methane
  - (b) carbon dioxide
  - (c) hydrogen
  - (d) hydrogen sulphide
18. The power generated in a windmill
- (a) is more in rainy season since damp air would mean more air mass hitting the blades
  - (b) depends on the height of the tower
  - (c) depends on wind velocity
  - (d) can be increased by planting tall trees close to the tower
19. Choose the correct statement
- (a) Sun can be taken as an inexhaustible source of energy
  - (b) There is infinite storage of fossil fuel inside the earth
  - (c) Hydro and wind energy plants are non polluting sources of energy
  - (d) Waste from a nuclear power plant can be easily disposed off
20. Global demand for energy has grown to tremendous levels because of
- (a) increasing industrialization
  - (b) zest for better quality of life
  - (c) transport
  - (d) many other reasons in addition to these

21. Choose the incorrect statement regarding wind power :
- (a) It is expected to harness wind power to minimum in open space.
  - (b) The potential energy content of wind blowing at high altitudes is the source of wind power.
  - (c) Wind hitting at the blades of a windmill causes them to rotate. The rotation thus achieved can be utilised further.
  - (d) One possible method of utilising the energy of rotational motion of the blades of a windmill is to run the turbine of an electric generator.
22. Electrical energy can be produced from
- (a) mechanical energy
  - (b) chemical energy
  - (c) radiant energy
  - (d) All of the above
23. Coal, petroleum, natural gas, and propane are fossil fuels. They are called fossil fuels because:
- (a) they are burned to release energy and they cause air pollution
  - (b) they were formed from the buried remains of plants and tiny animals that lived hundred of millions of years ago
  - (c) they are nonrenewable and will run out
  - (d) they are mixed with fossils to provide energy
24. Burning of fossil fuel gives lot of energy, but has disadvantages in the shape of
- (a) scarcity of fossil fuels
  - (b) increased pollution levels
  - (c) Both (a) and (b)
  - (d) None of these

25. Propane is used instead of natural gas on many farms and in rural areas. Why is propane often used instead of natural gas?
- (a) It's safer
  - (b) It's portable
  - (c) It's cleaner
  - (d) It's cheaper
26. What sector of the Indian economy consumes most of the nation's petroleum?
- (a) Residential
  - (b) Commercial
  - (c) Industrial
  - (d) Transportation
27. Natural gas is transported mainly by
- (a) pipelines
  - (b) trucks
  - (c) barges
  - (d) all three equally
28. 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)  $\text{CO}_2$  is a green-house gas and can cause global warming
  - (c) some of them are toxic and cause respiratory disorders
  - (d) All of these
29. Solar, biomass, geothermal, wind, and hydropower energy are all renewable sources of energy. They are called renewable because they
- (a) are clean and free to use
  - (b) can be converted directly into heat and electricity
  - (c) can be replenished by nature in a short period of time
  - (d) do not produce air pollution

30. Today, which renewable energy source provides the India with the most energy?
- (a) wind
  - (b) solar
  - (c) geothermal
  - (d) hydropower
31. How much of the energy in burning coal reaches the consumer as electricity
- (a)  $1/3$  (one-third)
  - (b)  $1/2$  (one-half)
  - (c)  $3/4$  (three-quarters)
  - (d)  $9/10$  (nine-tenths)
32. Pollution caused by burning of fossil fuels can be controlled to some extent
- (a) by increasing the efficiency of the combustion process
  - (b) by using various techniques to reduce the escape of harmful gases and ash to surrounding
  - (c) both (a) and (b)
  - (d) banning the use of fossils fuels
33. In biogas, which gas is present in maximum amount
- (a) Carbon dioxide
  - (b) Methane
  - (c) Hydrogen
  - (d) Oxygen
34. A solar water heater cannot be used to get hot water on
- (a) a sunny day
  - (b) a cloudy day
  - (c) a hot day
  - (d) a windy day
35. Which of the following is not an example of a biomass energy source?
- (a) Wood
  - (b) Gobargas
  - (c) Nuclear energy
  - (d) Coal

36. Fossil fuels are considered to be non-renewable sources of energy because
  - (a) they are produced underground and become costly to extract
  - (b) they take millions of years to be produced though used in a little time
  - (c) there are only a limited reservoirs
  - (d) Both (b) and (c)
37. Most of the sources of energy we use represent stored solar energy. Which of the following is not ultimately derived from the Sun's energy?
  - (a) Geothermal energy
  - (b) Wind energy
  - (c) Nuclear energy
  - (d) Bio-mass
38. Producer gas is a mixture of
  - (a) carbon monoxide and nitrogen gas
  - (b) carbon monoxide and hydrogen gas
  - (c) carbon monoxide and water vapour
  - (d) carbon monoxide and nitrous oxide
39. The fraction of the sun's energy received on earth is about
  - (a) 12%
  - (b) 26%
  - (c) 38%
  - (d) 47%
40. Fossil fuels are being used in ways other than direct consumption in the form of
  - (a) first changing the chemical energy of fossils to heat energy
  - (b) using heat energy to rotate turbines (mechanical energy)
  - (c) converting the mechanical energy to electrical energy
  - (d) All of the above in sequence
41. Find the false statement from the following statements given below:

- (a) Geothermal power plants cannot operate round the clock.
  - (b) The initial cost in setting up this plant will be high.
  - (c) This type of source is free and renewable.
  - (d) Operating cost involved in a geothermal plant is less.
42. Among the following the sources of energy for which source sun is not a chief source of energy is
- (a) Hydroelectric power plant
  - (b) Ocean Thermal Energy Conversion (OTEC)
  - (c) Tidal energy
  - (d) Biomass
43. A good fuel should
- (a) be safe to store and transport
  - (b) be able to provide desired quantity of energy at a steady rate over a long period of time
  - (c) have low content of non-combustibles and no combustion products that are poisonous or environmental pollutants
  - (d) All the above
44. Hydro Power Plants utilize the potential energy of water stored at a height by
- (a) changing potential energy to kinetic energy of flowing (falling) water
  - (b) utilising this kinetic energy to rotate the turbine of a generator and producing electricity
  - (c) Both of these
  - (d) None of these
45. All forms of energy come from
- (a) heat energy
  - (b) light energy
  - (c) solar energy
  - (d) hydro energy
46. Energy crisis is due to



- (a) depletion of the sources
  - (b) excessive use
  - (c) problem in unearthing the resources
  - (d) All of these
47. Wind is caused due to
- (a) uneven heating of earth's surface
  - (b) rotation of earth
  - (c) local conditions
  - (d) All of these
48. Storage of water in reservoirs for hydro power plants cause socio-economic problems besides
- (a) destruction of agricultural land and habitation
  - (b) destruction of large eco systems
  - (c) rotting of vegetation under anaerobic conditions to harmful greenhouse methane gas
  - (d) All of these
49. Chain reaction is a
- (a) fission reaction
  - (b) sustainable reaction
  - (c) fusion reaction
  - (d) both (a) and (b)
50. Energy equivalent of 1 amu is
- (a) 139 Me V
  - (b) 931 Me V
  - (c) 235 Me V
  - (d) 92 Me V
51. The complex compounds are broke down by which of the following organisms?
- (a) Aquatic
  - (b) Aerobic
  - (c) Anaerobic
  - (d) Terrestrial
52. Hydrogen bomb and a Nuclear bomb are based on (respectively)
- (a) fission and fusion
  - (b) fusion and fission

- (c) fission only
  - (d) fusion only
53. Improvement in the technology for using conventional sources of energy is becoming popular
- (a) more of energy is being extracted in the usable form
  - (b) pollution is being restricted
  - (c) sewage is also getting disposed
  - (d) All of these
54. Destructive distillation of wood produces.
- (a) charcoal that burns without flames and is smokeless
  - (b) volatile substances that can be used for manufacture of other products
  - (c) harmless water
  - (d) All of these
55. Biogas plants are gaining popularity in Indian villages because
- (a) they produce manures in addition to a clean fuel
  - (b) provide a clean and cheap method of disposing animal and agricultural waste
  - (c) both of these
  - (d) it is being encouraged by the government
56. 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
57. An enormous amount of energy is being received by the Earth from \_\_\_\_\_ for 5 billion years and will continue to do so for another 5 billion years.
- (a) Oceans
  - (b) Sun

- (c) Earth's atmosphere
  - (d) Melting snow
58. Construction of solar cookers or solar heaters is based on the fact that
- (a) black surface absorb more heat as compared to white objects
  - (b) spherical reflecting surfaces can be utilized to concentrate solar energy
  - (c) covering with a glass plate cause increase in temperature by green house effect
  - (d) All of these
59. A typical solar cell develops
- (a) a potential difference of 0.5 – 1 V and 0.7 W of electricity
  - (b) a potential difference of 0.7 V and 0.5 W of electricity
  - (c) a potential difference of 0.7 V and 1.0 W of electricity
  - (d) None of these
60. Solar cells generate little amount of electricity, but are becoming popular because
- (a) its raw material Silicon is available in large quantities in India
  - (b) it can be set up in remote and inaccessible hamlets without laying transmission lines
  - (c) electricity generated from solar cells can be stored and used when required
  - (d) All of these
61. The phenomenon of high and low tides and the difference in sea levels give\_\_\_\_\_.
- (a) Hydel energy
  - (b) Tidal energy
  - (c) Wave energy
  - (d) Thermal energy
62. Ocean-Thermal-Energy Conversion plants operate if

- (a) water on the surface of oceans is hot enough to boil a volatile liquid like ammonia
  - (b) temperature difference between the water at surface and water at depths up to 2 km is at least 293 K or 20° C
  - (c) Both (a) and (b)
  - (d) Neither (a) nor (b)
63. The nucleus of a heavy atom such as uranium, plutonium or thorium when bombarded with low-energy neutrons, can be split into lighter nuclei and a tremendous amount of energy in
- (a) nuclear fission, which is a chain reaction
  - (b) nuclear fusion, which requires large energy to initiate the reaction
  - (c) nuclear warfare
  - (d) biotechnological processes
64. Joining of lighter nuclei to make a heavier nucleus, most commonly hydrogen isotopes to helium such as
- $${}^2\text{H} + {}^2\text{H} \rightarrow {}^3\text{He} + n \text{ with release of large amount of energy is}$$
- (a) nuclear fusion that is the source of energy in the Sun and other stars
  - (b) nuclear fission
  - (c) Both (a) and (b)
  - (d) None of these
65. Many of the sources of energy ultimately their energy from
- (a) the Earth
  - (b) the Sun
  - (c) the environment
  - (d) the plants

## Hints & SOLUTIONS —

1. (b)
2. (a)
3. (b)
4. (d) Energy can neither be created nor be destroyed, but usable form of energy is dissipated to the surroundings in less usable forms.
5. (a)
6. (a)
7. (b)
8. (d) Different forms of energy can be solar energy, mechanical energy, heat energy, muscular energy, chemical energy, electrical energy & others.
9. (b)
10. (b)
11. (d)
12. (d) Characteristics of good source of energy are: Good calorific value, easily accessible and economical, easy to store and transport.
13. (b)
14. (a)
15. (c)
16. (a) Wood, coal, energy of flowing water and wind are being used for several thousands of years.
17. (a)
18. (c)
19. (a)
20. (d) All round development has grown global demand for energy.
21. (b)
22. (d)
23. (b)
24. (c) Fossil fuels take several thousand years to be produced. Their stock is depleting fast due to increased consumption. Presence of S and N along with C leads to increased pollution levels.

## Hints & SOLUTIONS —

1. (b)
2. (a)
3. (b)
4. (d) Energy can neither be created nor be destroyed, but usable form of energy is dissipated to the surroundings in less usable forms.
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6. (a)
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22. (d)
23. (b)
24. (c) Fossil fuels take several thousand years to be produced. Their stock is depleting fast due to increased consumption. Presence of S and N along with C leads to increased pollution levels.



25. (b)
26. (d)
27. (a)
28. (d) Oxides of carbon, nitrogen and sulphur released on burning of fossils fuels are toxic and acidic oxides and can cause acid rains.  $\text{CO}_2$  a green-house gas causes global warming.
29. (c)
30. (d)
31. (a)
32. (c) Efficiency of the combustion process can be increased by making technical changes in the techniques to reduce the escape of harmful gases and ash to surrounding. Banning will slow the development process.
33. (b)
34. (b)
35. (c)
36. (d) Fossil fuels are considered to be non-renewable sources of energy because they take millions of years to be produced though used in a little time and there are only limited reservoirs.
37. (c)
38. (a)
39. (d)
40. (d) Many thermal power houses are still using coal to generate steam for rotating the turbines.
41. (b)
42. (b)
43. (a)
44. (c) Hydro Power Plants utilize the potential energy of water stored at a height. Kinetic energy of flowing (falling) water is utilised to rotate the turbine of a generator.
45. (c)
46. (d)
47. (d)
48. (d) Large amount of agricultural land, habitation and eco-systems get submerged in the stored water. Rotting of vegetation under water, in anaerobic conditions, lead to formation of harm-

ful greenhouse methane gas. Movement of local people without compensation add to their miseries.

49. (d)
50. (b)
51. (c)
52. (b)
53. (d) Improvement in the technology for using conventional sources of energy is aimed to extract energy with minimum wastage. Pollution is checked and the sewage also gets disposed as the raw material to biogas plants.
54. (d) Destructive distillation of wood removes all the volatile substances leaving charcoal that burns without flames and is smokeless.
55. (c) Biogas plants produce manures in addition to a clean fuel and provide a clean and cheap method of disposing animal and agricultural waste.
56. (a) Wind mills utilize the kinetic energy of moving air or winds in coastal or hilly areas, where the winds are strong for most part of the year.
57. (b) Radiations from the Sun are falling on the Earth for 5 billion years and will continue to do so for another 5 billion years.
58. (d) Absorption of radiations by black surfaces, reflection of light by shining surfaces and green house effect are the principles used in designing solar cookers or solar heaters.
59. (a) A typical silicon-germanium solar cell develops a potential difference of 0.5 - 1 V and 0.7 W of electricity.
60. (d) Silicon is available in large quantities in India. Setting up of solar panels does not require laying of transmission lines, so can be set up in remote and inaccessible hamlets. Storing of electricity has become possible by using inverters.
61. (b) The phenomenon of high and low tides and the difference in sea levels give tidal energy.

- 62. (c)** OTEC plants utilise the difference in temperature of water at surface of oceans and water at depths to evaporate a volatile substance like ammonia and use it for rotating turbine.
- 63. (a)** A chain reaction of nuclear fission is triggered when the nucleus of a heavy atom such as uranium, plutonium or thorium is bombarded with low-energy neutrons to split into lighter nuclei, three neutrons and a tremendous amount of energy.
- 64. (a)** Nuclear fusion is joining of lighter nuclei to make a heavier nucleus and a neutron. For example two hydrogen isotopes join to give helium such as  ${}^2\text{H} + {}^2\text{H} \rightarrow {}^3\text{He} + \text{n}$  with release of large amount of energy. That is the source of energy in the Sun and other stars.
- 65. (b)** Many of the sources of energy ultimately their energy from the Sun as the producers get their energy from the Sun.

## Section : CHEMISTRY

### Chapter 1

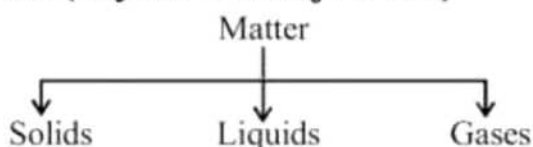
## Matter and Its Classification

### MATTER

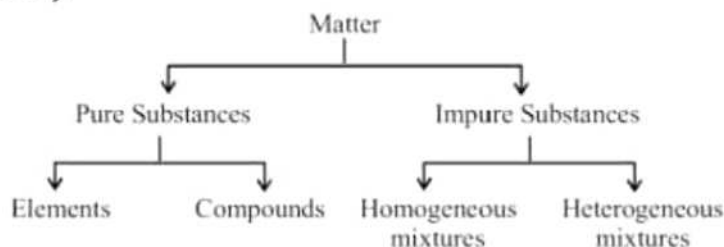
Any thing that has weight and occupies space and can be felt by one of our senses is called matter e.g., air, water, wood, chalk, table, chair etc.

#### Classification of Matter

(i) *Based on state (Physical Classification)*



(ii) *Based on purity/composition (Chemical Classification)*



### Physical Nature of Matter

Every substance has a unique set of property. The properties of matter can be categorised as physical or chemical. Physical properties can be measured without changing the identity and composition of the substance. These properties include colour, odour, density, melting point, boiling point and hardness. Chemical properties describe the way of substance which may change or react to form other substances.

### Characteristics of Particles of Matter

- (i) Particles of matter have space between them.
- (ii) Particles of matter are continuously moving.
- (iii) As temperature rises particles of matter move faster.

### Kinetic Theory of Matter

The main postulates of kinetic Theory of matter are following :

- (i) Matter consists of molecules. These are the smallest particles, which are capable of free existence and retain all the chemical properties of the parent substance.
- (ii) The molecules are always in a state of random continuous motion.
- (iii) The molecules exert forces on one another. These forces depend upon intermolecular distance
- (iv) All collision between the particles of matter are perfectly elastic.

## STATES OF MATTER

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Matter can exist in three states

### Solid State

In solids, particles are bound together by forces strong enough to prevent movement of translation. So that a **solid** has a *definite shape* which remains fixed (in constant conditions) unless sufficient force is supplied to shatter or distort the mass. Particles in a solid may however, show a certain amount of movement of vibration.

#### Characteristics of solids

- (i) solids have a fixed shape.
- (ii) solids occupy a fixed volume.
- (iii) solids can not be compressed.
- (iv) solids have a higher density as compared to liquids and gases.

### Liquid State

Liquid state of matter is the intermediate state between the gaseous and the solid state. This state arises when the molecules of the matter are held together by strong intermolecular forces in comparison to those in gases.

#### Characteristics of liquids :

- (i) This state is characterised as having *fluidity, low compressibility*.
- (ii) Liquids have *no definite shape or boundaries*. They take the shape of container. Liquids have a *definite volume*.
- (iii) Liquids generally have lower densities as compared to solids.

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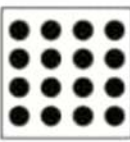
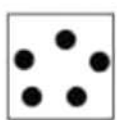

- (iv) Liquids are more compressible as compared to solids.
- (v) Liquid shows the property of diffusion.
- (vi) Particles of liquids have more kinetic energy than those of solids.

## Gaseous State

Gaseous state is the simplest state of matter which is observed when the boiling point of the substance is below the room temperature at atmospheric pressure. The forces of attraction between the molecules is minimum and hence the molecules are far apart from each other and thus their position is not fixed in gaseous state.

### Characteristics of gases

- (i) Gases have neither a definite shape nor a definite volume.
- (ii) They take the shape of the container in which they are stored and fill the container fully. i.e., the volume of a gas is the same as that of the container.
- (iii) Gases can be compressed easily.
- (iv) The kinetic energy of particles in gaseous state is maximum.
- (v) Gaseous particles move randomly at high speed. They hit each other and also the wall of the container.
- (vi) Applying pressure and reducing temperature can liquify gases.

Solids	Liquids	Gas
 <ul style="list-style-type: none"> <li>• Particles are very closely packed thus rigid in nature</li> <li>• Voids are extremely small therefore incompressible</li> <li>• Particle motion is restricted to vibratory motion</li> <li>• Inter-particle force is very large thus very dense</li> </ul>	 <ul style="list-style-type: none"> <li>• Particles are loosely packed thus can flow</li> <li>• Voids are relatively larger thus slightly compressible</li> <li>• Particle motion is very slow</li> <li>• Inter-particle forces are intermediate resulting in low density</li> </ul>	 <ul style="list-style-type: none"> <li>• Particles are very loosely packed and expand to large volume</li> <li>• Voids are very larger thus highly compressible</li> <li>• Particle motion is very rapid and also random</li> <li>• Inter-particle forces are negligible thus imparting very low density</li> </ul>

## Plasma

Plasmas are a lot like gases, but the atoms are different because they are made up of free electrons and ions of the element. Example of plasma

is a neon sign. Just like a fluorescent light, neon signs are glass tubes filled with gas.

### Bose-Einstein Condensates

Condensation happens when several gas molecules come together and form a liquid. It all happens because of a loss of energy. Gases are really excited atoms. When they lose energy, they slow down and begin to collect.

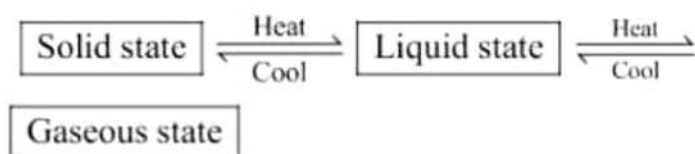
### Vapour

It is used to describe those gases that usually exist as liquid at room temperature e.g., water that exists as liquid at room temperature is called water vapour when it is in gaseous state.

### Latent heat of vapourisation

The amount of heat energy that is required to change 1 kg of a liquid into gaseous state at atmospheric pressure without any change of temperature at its boiling point is known as **Latent heat of vapourization**.

## INTERCHANGE OF STATES OF MATTER



**Note:** The state of a matter can change into another state by changing the temperature.

### Sublimation

- + Change of state direct from solid to gas without changing into liquid state (or vice versa) is called sublimation.
- + Any substance that shows the property of sublimation is known as sublime substance. Some such substances are Ammonium chloride, Iodine, Benzoic acid, Naphthalene, Camphor etc.

- ✦ The solid formed when a sublime substance cools from its gaseous state is called **sublimate**.

### Evaporation

It is the phenomenon of change of a liquid into gas at any temperature below its boiling point. It is a surface phenomenon. The particles of a liquid present on the surface gain energy and leave the surface.

- ✦ The process of evaporation is always accompanied by a cooling effect. For example, when a liquid evaporates from the skin, a cooling sensation results. The reason for this is that only the most energetic molecules of liquid are lost by evaporation, so that the average energy of the remaining molecules decreases.

### Factors affecting evaporation

- Increase in surface area* increases the rate of evaporation.
- Decrease in humidity* increases the rate of evaporation.
- Increase in wind speed* increases the rate of evaporation.
- Increase of temperature* increases the rate of evaporation.

### Fusion/Melting

It is the change of solid into liquid state.

- **Latent heat of fusion** : The amount of heat energy that is required to change 1 kg of a solid into a liquid at atmospheric pressure without any change of temperature at its melting point is known as **Latent heat of fusion**.
- Melting point of a solid also depends upon the surrounding pressure. More will be the pressure more lower will be the melting point. Thus solid melts easily at higher pressure.

### Solidification

It is the change of liquid state to the solid state.

- When the pressure surrounding a substance goes up, the freezing point also goes up. That means it's easier to freeze the substance at higher pressures.

## Boiling

It is a bulk phenomenon. Particles from bulk (whole) of the liquid change into vapour state.

**Boiling point :** The constant temperature at which a liquid changes into gas/vapour is known as its boiling point. Boiling point of water is  $100^{\circ}\text{C}$  or  $(273 + 100) = 373 \text{ K}$ .

- Condensation point of gas also depends upon the surrounding pressure. More will be the pressure more closer will be molecules and thus greater will be the intermolecular forces of attraction. Thus more will be the surrounding pressure more easily gas gets condensed in to liquid.
- **Difference between Boiling and Evaporation**
  - (1) Boiling takes place only at a particular temperature for a liquid. Whereas evaporation occurs at all temperatures.
  - (2) Boiling is Bulk phenomena i.e., the bubble formation occurs even below the surface. Whereas evaporation is surface phenomena, i.e., bubble formation occurs only on the surface of liquid.

## SUBSTANCE

A "**substance**" is a kind of matter that can not be separated into other kinds of matter by any physical process. e.g. gold, silver, iron, sodium chloride, calcium carbonate etc.

### Pure Substance

It is one that is a *single substance* and has a *uniform composition*. Such a substance always have the *same texture* and *taste*. e.g. water, salt, sugar etc. Thus, those substances, which always have the same *colour*, taste or texture at a given temperature and pressure are pure substances.

- The purity of substance can easily be checked by checking its melting points in case of a solid sub-