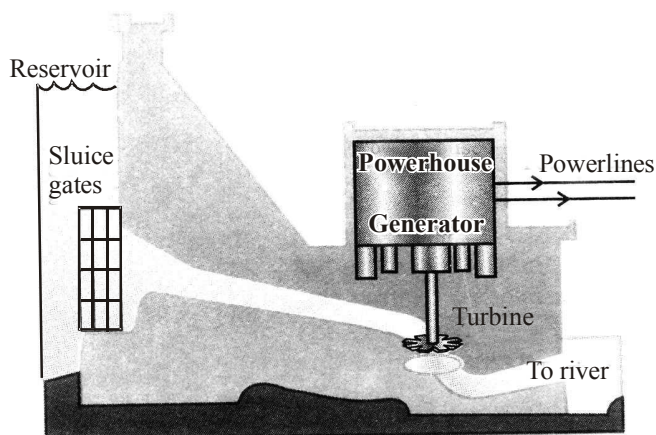


- Energy is an essential requirement of our life. No activity in our daily life can be undertaken without the use of energy. Energy in one or the other form has been used by man since long.
- **Sources of Energy :** Plants, wind, water, coal, petroleum, natural gas, gobar gas or bio-gas, etc.
Solar energy + Air → Wind energy
- **Types of Sources of Energy**
 - (i) Non-renewable or conventional sources of energy like coal, petroleum, natural gas, nuclear energy.
 - (ii) Renewable or non-conventional sources of energy like the wind, the sun, hydro power, ocean tidal energy, geothermal energy, biogas.
- **Requirements of good source of energy?**
A good source of energy would be one
 - (i) which would do a large amount of work per unit volume or mass,
 - (ii) be easily accessible,
 - (iii) be easy to store and transport, and
 - (iv) perhaps most importantly, be economical.
- **Fossil Fuels :** Fossil fuels are hydrocarbon based natural resources that were formed over 300 hundred millions of years ago by the fossilization of prehistoric plants and animals. There are three major forms of fossil fuels: coal, oil and natural gas. We have learned to harness the energy released from these fossil fuels during combustion in order to meet our energy needs. Fossil fuels are a common source of energy we use everyday. They are used to generate the electricity that runs our household appliances, fuel the motors of our cars, and heat our homes. Fossil fuels are currently essential for providing the energy needs of our everyday lives.
- The amount of heat energy produced by a fuel on burning is measured in terms of the calorific value of the fuel. A fuel having high calorific value is considered as a good fuel.
- **Thermal Power Plant :** In thermal power plants, fuel is burnt to produce heat energy which is further converted into electrical energy. Generally fossil fuels are used in thermal power plants. Therefore, many thermal power plants are set up near coal or oil fields.
- **Hydropower Plants :** In hydropower plants, the potential energy of falling water is converted into electricity. Since, there are very few water-falls which are suitable to be used as a source of potential energy, hydropower plants are associated with dams. A quarter of energy requirement in India is met by hydropower plants. In India, 25% of energy requirement is fulfilled by hydroelectric power plants.



A schematic view of a hydro power plant

High-rise dams are constructed on the river so as to obstruct the flow of water and thereby collect water in larger reservoirs. The water from the high level in the reservoir is made to fall on the turbine through pipes. In this way, the potential energy of water is converted into the electrical energy. Hydro power is a renewable source of energy, so we would not have to worry about hydro electricity sources getting used up the way fossil fuels would get finished.

- Biogas is a combustible mixture of gases produced by the decomposition of biomass, especially animal waste and sewage. Biogas can contain up to 75% methane (CH_4), 23% carbon dioxide and 2% other gases, including hydrogen and hydrogen sulphide.
- **Advantages of Biogas :** Biogas plants are simple and the dung from 3 to 4 heads of cattle can supply biogas for cooking for about 6 hours every day. Biogas is an excellent clean fuel that burns without smoke. It leaves no ash on burning. The spent slurry from a biogas plant is good manure. Biogas plants represent a safe and useful way of waste disposal. Use of biogas in rural areas leads to saving of fire wood and reduces deforestation.
- **Preparation of Biogas :** Biogas is prepared by anaerobic fermentation of biomass. Biomass contains complex molecules like carbohydrates, fats, cellulose, etc. When these complex molecules are allowed to undergo fermentation process by action of bacteria in absence of air but in the presence of water then these complex molecules get decomposed into simpler molecules like CH_4 , CO_2 , H_2 , H_2S which are collectively known as Biogas.

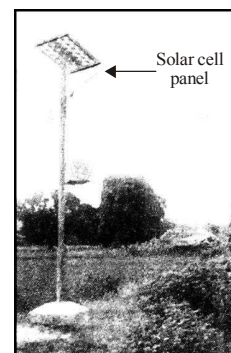
- **Biogas Plant** : It is a place or a device in which biogas is prepared by anaerobic formation of biomass. These are two types of biogas plant –
 - (a) Fixed dome shaped
 - (b) Floating gas holder
 Biogas is renewable source of energy if more and more plants are grown periodically.

- **Wind Energy** : Moving air is called wind. When wind blows with a sufficient speed, it gets ability to do some work, it means wind possesses energy called **wind energy**. It means wind energy is another form of kinetic energy. Sun's rays fall directly over equatorial region and at an angle in the polar region. It means air in the equatorial region is hotter than the air in polar region. The temperature difference supports the air to move. This movement of air causes wind to blow. Rotation and revolution of the earth also disturb the movement of air. Moreover local climatic conditions also affect the wind.

Uses of Wind Energy :

- (i) It is used to sail boats.
 - (ii) It is used to generate electricity.
 - (iii) It can be used to run wind mill which is further utilised
 - (a) to grind wheat and grains.
 - (b) to pump out water from the earth's crust.
 - (iv) It is used to fly gliders and moreover it is used for upward and downward movement of aeroplanes.
- **Wind Mill** : It is a device which is used to convert wind energy into useful mechanical work.
Sequence of energy conversion in a wind mill.
Wind energy → Mechanical energy → Electrical energy
 - **Wind Farms** : When large number of wind mills are installed over a large area to harness wind energy commercially, like to generate electricity commercially (large scale), they are called wind farms.
High wind energy level areas are available in Rajasthan, Gujarat, Tamil Nadu, coastal areas of Bay of Bengal, Maharashtra, etc.
 - **Wind Power Plants in India** : Wind energy is used to generate electricity on large scale in three places.
 - (i) Near Kanyakumari in Tamil Nadu.
 - (ii) Okha in Gujarat.
 - (iii) Lamba in Gujarat.
 One of these wind energy power plants, the one which is in Tamil Nadu is the biggest one. It produces 380 MW of electricity.
 - **Advantages of Wind Energy** :
 - (i) It is renewable sources of energy.
 - (ii) The wind energy is free of cost.
 - (iii) It doesn't create pollution.
 - **Disadvantages of Wind Energy (Wind Mill)** :
 - (i) It can not be used everywhere.
 - (ii) High cost of installation.
 - (iii) It has low efficiency.
 - (iv) It requires large area.

- **Solar Energy** : The energy coming with the rays of the sun is called solar energy. Electromagnetic radiations from the sun consists of ultraviolet, visible and infra-red radiations. Visible and IR radiation reach the earth's surface. UV radiation is absorbed by the ozone layer in the earth's atmosphere.
- **Solar Cookers** : Box type solar cookers can achieve temperatures of the order of 100-140°C. Frying and making chapattis are generally not possible in a box type solar cooker. These are possible in reflector type solar cookers in which temperature upto 200°C can be achieved.
A solar concentrator is a device that concentrates sunlight collected from a large area into a small region. Reflection type solar concentrators can be used for cooking, making steam to drive electrical generators, melting metals in solar furnaces, to dispose dead bodies 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 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**

(i) **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.

(ii) **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.

(iii) **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° 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.

(iv) **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.

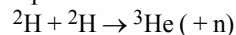
- **Nuclear Energy** : The energy released during nuclear reactions is called nuclear energy because it comes from the nuclei of atoms. Nuclear energy is generated by two types of nuclear reactions–

(i) **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, Δm , between the original nucleus and the product nuclei gets converted to energy E at a rate governed by the famous equation, $E = \Delta m c^2$, 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.

(ii) **Nuclear Fusion** : Fusion means joining lighter nuclei to make a heavier nucleus, most commonly hydrogen or hydrogen isotopes to create helium, such as



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.

Exercise

1

DIRECTIONS : This section contains multiple choice questions. Each question has 4 choices (1), (2), (3) and (4) out of which only one is correct.

- Which of the following is a false statement?
 - To overcome the energy crisis the use of solar cooker must be increased.
 - To overcome the energy crisis more amount of non-renewable sources of energy must be used.
 - The re-usage of waste material as a source of energy can be done to overcome the energy crisis.
 - To overcome the energy crisis water has to be saved.
- The main constituent of LPG is butane. Then
 - butane can be liquefied easily under high pressure.
 - butane is liquefied by chemically reacting with ethane and propane.
 - Only A is true
 - Only B is true
 - Both A and B are true
 - Both A and B are false
- Which element contained in a fuel contributes to its high calorific value?
 - Carbon
 - Hydrogen
 - Oxygen
 - Nitrogen
- 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
 - forms of energy keep changing
 - total energy before and after remains constant, but some of it is used to carry other functions
 - usable form of energy is dissipated to the surroundings in less usable forms
 - All of these
- Combustion, the process of burning a fuel, is _____.
 - an oxidation and an exothermic reaction.
 - a reduction and an endothermic reaction.
 - Only A is true
 - Only B is true
 - Both A and B are true
 - Both A and B are false
- _____ is used as a fuel in space ships.
 - Hydrogen
 - Alcohol
 - Petrol
 - Diesel
- 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.
 - The only purpose of bending copper pipe is to increase the capacity of water storage.
 - Bending copper pipe as a coil helps to increase the surface area for heating.
 - Both (1) and (2) are true
 - Both (1) and (2) are false
- Different forms of energy can be
 - mechanical energy
 - heat energy
 - muscular energy
 - chemical energy, electrical energy & others in addition to those mentioned above
- In the extraction of some metals from their ores, coke can be used as a/an _____.
 - oxidizing agent
 - reducing agent
 - catalyst
 - flux
- _____ are used to produce energy in OTEC.
 - Tidal energy
 - Temperature difference between the different layers of water in ocean
 - Ocean waves
 - None of the above
- The crude oil extracted from the earth is separated into its constituents by a process called _____.
 - disintegration distillation
 - compound distillation
 - destructive distillation
 - fractional distillation
- Characteristics of good source of energy are that
 - it would do large amount of work per unit volume or mass
 - it is accessible and economical
 - it is easy to store and transport
 - All of these
- The Sun's energy is due to
 - the nuclear fission of hydrogen
 - the nuclear fusion of hydrogen
 - the natural combustion of hydrogen.
 - the nuclear fission of uranium
- In a hydro power plant
 - potential energy possessed by stored water is converted into electricity
 - kinetic energy possessed by stored water is converted into potential energy
 - electricity is extracted from water
 - water is converted into steam to produce electricity
- Which part of the solar cooker is responsible for green house effect?
 - Coating with black colour inside the box
 - Mirror
 - Glass sheet
 - Outer cover of the solar cooker
- Wood, coal, energy of flowing water and wind are considered to be
 - conventional sources of energy
 - unconventional sources of energy
 - renewable sources of energy
 - non-renewable sources of energy
- The main constituent of biogas is
 - methane
 - carbon dioxide
 - hydrogen
 - hydrogen sulphide
- The power generated in a windmill
 - is more in rainy season since damp air would mean more air mass hitting the blades
 - depends on the height of the tower
 - depends on wind velocity
 - can be increased by planting tall trees close to the tower

19. Choose the correct statement
- (1) Sun can be taken as an inexhaustible source of energy
 - (2) There is infinite storage of fossil fuel inside the earth
 - (3) Hydro and wind energy plants are non polluting sources of energy
 - (4) Waste from a nuclear power plant can be easily disposed off
20. Global demand for energy has grown to tremendous levels because of
- (1) increasing industrialization
 - (2) zest for better quality of life
 - (3) transport
 - (4) many other reasons in addition to these
21. Choose the incorrect statement regarding wind power :
- (1) It is expected to harness wind power to minimum in open space.
 - (2) The potential energy content of wind blowing at high altitudes is the source of wind power.
 - (3) Wind hitting at the blades of a windmill causes them to rotate. The rotation thus achieved can be utilised further.
 - (4) 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
- (1) mechanical energy
 - (2) chemical energy
 - (3) radiant energy
 - (4) All of the above
23. Coal, petroleum, natural gas, and propane are fossil fuels. They are called fossil fuels because:
- (1) they are burned to release energy and they cause air pollution
 - (2) they were formed from the buried remains of plants and tiny animals that lived hundred of millions of years ago
 - (3) they are nonrenewable and will run out
 - (4) they are mixed with fossils to provide energy
24. Burning of fossil fuel gives lot of energy, but has disadvantages in the shape of
- (1) scarcity of fossil fuels
 - (2) increased pollution levels
 - (3) Both (1) and (2)
 - (4) 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?
- (1) It's safer
 - (2) It's portable
 - (3) It's cleaner
 - (4) It's cheaper
26. What sector of the Indian economy consumes most of the nation's petroleum?
- (1) Residential
 - (2) Commercial
 - (3) Industrial
 - (4) Transportation
27. Natural gas is transported mainly by
- (1) pipelines
 - (2) trucks
 - (3) barges
 - (4) all three equally
28. Oxides of carbon, nitrogen and sulphur released on burning of fossils fuels are harmful because
- (1) they are acidic oxides and can cause acid rains
 - (2) CO₂ is a green-house gas and can cause global warming
 - (3) some of them are toxic and cause respiratory disorders
 - (4) All of these
29. Solar, biomass, geothermal, wind, and hydropower energy are all renewable sources of energy. They are called renewable because they
- (1) are clean and free to use
 - (2) can be converted directly into heat and electricity
 - (3) can be replenished by nature in a short period of time
 - (4) do not produce air pollution
30. Today, which renewable energy source provides the India with the most energy?
- (1) wind
 - (2) solar
 - (3) geothermal
 - (4) hydropower
31. How much of the energy in burning coal reaches the consumer as electricity
- (1) 1/3 (one-third)
 - (2) 1/2 (one-half)
 - (3) 3/4 (three-quarters)
 - (4) 9/10 (nine-tenths)
32. Pollution caused by burning of fossil fuels can be controlled to some extent
- (1) by increasing the efficiency of the combustion process
 - (2) by using various techniques to reduce the escape of harmful gases and ash to surrounding
 - (3) both (1) and (2)
 - (4) banning the use of fossils fuels
33. In biogas, which gas is present in maximum amount
- (1) Carbon dioxide
 - (2) Methane
 - (3) Hydrogen
 - (4) Oxygen
34. A solar water heater cannot be used to get hot water on
- (1) a sunny day
 - (2) a cloudy day
 - (3) a hot day
 - (4) a windy day
35. Which of the following is not an example of a biomass energy source?
- (1) Wood
 - (2) Gobargas
 - (3) Nuclear energy
 - (4) Coal
36. Fossil fuels are considered to be non-renewable sources of energy because
- (1) they are produced underground and become costly to extract
 - (2) they take millions of years to be produced though used in a little time
 - (3) there are only a limited reservoirs
 - (4) Both (2) and (3)
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?
- (1) Geothermal energy
 - (2) Wind energy
 - (3) Nuclear energy
 - (4) Bio-mass
38. Producer gas is a mixture of
- (1) carbon monoxide and nitrogen gas
 - (2) carbon monoxide and hydrogen gas
 - (3) carbon monoxide and water vapour
 - (4) carbon monoxide and nitrous oxide
39. The fraction of the sun's energy received on earth is about
- (1) 12%
 - (2) 26%
 - (3) 38%
 - (4) 47%
40. Fossil fuels are being used in ways other than direct consumption in the form of
- (1) first changing the chemical energy of fossils to heat energy
 - (2) using heat energy to rotate turbines (mechanical energy)
 - (3) converting the mechanical energy to electrical energy
 - (4) All of the above in sequence

41. Find the false statement from the following statements given below:
- (1) Geothermal power plants cannot operate round the clock.
 - (2) The initial cost in setting up this plant will be high.
 - (3) This type of source is free and renewable.
 - (4) 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
- (1) Hydroelectric power plant
 - (2) Ocean Thermal Energy Conversion (OTEC)
 - (3) Tidal energy
 - (4) Biomass
43. A good fuel should
- (1) be safe to store and transport
 - (2) be able to provide desired quantity of energy at a steady rate over a long period of time
 - (3) have low content of non-combustibles and no combustion products that are poisonous or environmental pollutants
 - (4) All the above
44. Hydro Power Plants utilize the potential energy of water stored at a height by
- (1) changing potential energy to kinetic energy of flowing (falling) water
 - (2) utilising this kinetic energy to rotate the turbine of a generator and producing electricity
 - (3) Both of these
 - (4) None of these
45. All forms of energy come from
- (1) heat energy (2) light energy
 - (3) solar energy (4) hydro energy
46. Energy crisis is due to
- (1) depletion of the sources
 - (2) excessive use
 - (3) problem in unearthing the resources
 - (4) All of these
47. Wind is caused due to
- (1) uneven heating of earth's surface
 - (2) rotation of earth
 - (3) local conditions
 - (4) All of these
48. Storage of water in reservoirs for hydro power plants cause socio-economic problems besides
- (1) destruction of agricultural land and habitation
 - (2) destruction of large eco systems
 - (3) rotting of vegetation under anaerobic conditions to harmful greenhouse methane gas
 - (4) All of these
49. Chain reaction is a
- (1) fission reaction (2) sustainable reaction
 - (3) fusion reaction (4) both (1) and (2)
50. Energy equivalent of 1 amu is
- (1) 139 Me V (2) 931 Me V
 - (3) 235 Me V (4) 92 Me V
51. The complex compounds are broke down by which of the following organisms?
- (1) Aquatic (2) Aerobic
 - (3) Anaerobic (4) Terrestrial
52. Hydrogen bomb and a Nuclear bomb are based on (respectively)
- (1) fission and fusion (2) fusion and fission
 - (3) fission only (4) fusion only
53. Improvement in the technology for using conventional sources of energy is becoming popular
- (1) more of energy is being extracted in the usable form
 - (2) pollution is being restricted
 - (3) sewage is also getting disposed
 - (4) All of these
54. Destructive distillation of wood produces.
- (1) charcoal that burns without flames and is smokeless
 - (2) volatile substances that can be used for manufacture of other products
 - (3) harmless water
 - (4) All of these
55. Biogas plants are gaining popularity in Indian villages because
- (1) they produce manures in addition to a clean fuel
 - (2) provide a clean and cheap method of disposing animal and agricultural waste
 - (3) both of these
 - (4) 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
- (1) wind mills (2) generators
 - (3) electric motors (4) 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.
- (1) Oceans
 - (2) Sun
 - (3) Earth's atmosphere
 - (4) Melting snow
58. Construction of solar cookers or solar heaters is based on the fact that
- (1) black surface absorb more heat as compared to white objects
 - (2) spherical reflecting surfaces can be utilized to concentrate solar energy
 - (3) covering with a glass plate cause increase in temperature by green house effect
 - (4) All of these
59. A typical solar cell develops
- (1) a potential difference of 0.5 – 1 V and 0.7 W of electricity
 - (2) a potential difference of 0.7 V and 0.5 W of electricity
 - (3) a potential difference of 0.7 V and 1.0 W of electricity
 - (4) None of these
60. Solar cells generate little amount of electricity, but are becoming popular because
- (1) its raw material Silicon is available in large quantities in India
 - (2) it can be set up in remote and inaccessible hamlets without laying transmission lines
 - (3) electricity generated from solar cells can be stored and used when required
 - (4) All of these
61. The phenomenon of high and low tides and the difference in sea levels give _____.
- (1) Hydel energy (2) Tidal energy
 - (3) Wave energy (4) Thermal energy

62. Ocean-Thermal-Energy Conversion plants operate if
 (1) water on the surface of oceans is hot enough to boil a volatile liquid like ammonia
 (2) temperature difference between the water at surface and water at depths up to 2 km is at least 293 K or 20° C
 (3) Both (1) and (2)
 (4) Neither (1) nor (2)
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
 (1) nuclear fission, which is a chain reaction
 (2) nuclear fusion, which requires large energy to initiate the reaction
 (3) nuclear warfare
 (4) biotechnological processes
64. Joining of lighter nuclei to make a heavier nucleus, most commonly hydrogen isotopes to helium such as $2\text{H} + 2\text{H} \rightarrow 3\text{He} + n$ with release of large amount of energy is
 (1) nuclear fusion that is the source of energy in the Sun and other stars
 (2) nuclear fission
 (3) Both (1) and (2)
 (4) None of these
65. Many of the sources of energy ultimately their energy from
 (1) the Earth (2) the Sun
 (3) the environment (4) the plants

Exercise

2

Matching Based MCQ

DIRECTIONS (Qs. 1 to 7) : Match Column-I with Column-II and select the correct answer using the codes given below the columns.

1. **Column-I** **Column-II**
 (A) Peat (p) Liquid fuel
 (B) Alcohol (q) 27% of carbon
 (C) Decay of biomass (r) Biogas
 (D) Rise and fall of water levels in oceans (s) Tidal energy
 (1) A – (q); B – (p); C – (s); D – (r)
 (2) A – (q); B – (r); C – (p); D – (s)
 (3) A – (q); B – (p); C – (r); D – (s)
 (4) A – (p); B – (q); C – (r); D – (s)
2. **Column-I** **Column-II**
 (A) OTEC (p) Bioenergy
 (B) Ultimate source of energy (q) Difference in temperature between warm surface waters and colder waters
 (C) Solar to electrical energy (r) Solar cell
 (D) Stored in food grains (s) Sun
 (1) A – (q); B – (s); C – (r); D – (p)
 (2) A – (s); B – (q); C – (r); D – (p)
 (3) A – (q); B – (r); C – (s); D – (p)
 (4) A – (q); B – (s); C – (p); D – (r)
3. **Column-I** **Column-II**
 (A) Ramagundam Thermal Plant is in (p) Andhra Pradesh
 (B) Raichur Thermal Plant is in (q) Karnataka
 (C) Korba Thermal Plant is in (r) Madhya Pradesh
 (D) Farraka Thermal Plant is in (s) West Bengal
 (1) A – (q); B – (p); C – (r); D – (s)
 (2) A – (p); B – (q); C – (r); D – (s)
 (3) A – (p); B – (r); C – (q); D – (s)
 (4) A – (p); B – (q); C – (s); D – (r)
4. **Column-I** **Column-II**
 (A) Natural gas (p) It is produced in marshy areas by the action of bacteria feeding on dead vegetation
 (B) L.P.G (q) Contains mainly methane
 (C) Kerosene (r) Used as a domestic fuel
 (D) Bio-gas (s) Obtained as a liquid fraction of refining of petroleum
 (1) A – (p); B – (r); C – (s); D – (q)
 (2) A – (q); B – (s); C – (r); D – (p)
 (3) A – (q); B – (r); C – (s); D – (p)
 (4) A – (r); B – (q); C – (s); D – (p)
5. **Column-I** **Column-II**
 (A) Paraffin wax (p) Lubrication
 (B) Lubricating oil (q) Candles
 (C) LPG (r) Electric generators
 (D) Diesel (s) Fuel for home and industry
 (1) A – (p); B – (q); C – (s); D – (r)
 (2) A – (q); B – (p); C – (r); D – (s)
 (3) A – (q); B – (s); C – (p); D – (r)
 (4) A – (q); B – (p); C – (s); D – (r)
6. **Column-I** **Column-II**
 (A) Carbon dioxide (p) Oxides of sulphur and nitrogen
 (B) Acid rain (q) Smoke less fuel
 (C) Coke (r) Product of combustion
 (D) Petrol (s) Inflammable substance
 (1) A – (r); B – (p); C – (q); D – (s)
 (2) A – (s); B – (p); C – (q); D – (r)
 (3) A – (p); B – (r); C – (q); D – (s)
 (4) A – (p); B – (r); C – (s); D – (q)

7. **Column-I** **Column-II**
- (1) Coal gas (p) $(C_2H_6 + C_3H_8 + C_4H_{10})$
- (2) Petroleum gas (q) $(CH_4 + C_2H_6 + C_3H_8 + C_4H_{10})$
- (3) Producer gas (r) $(H_2 + CH_4 + CO)$
- (4) Natural gas (s) $(CO + N_2)$
- (1) A – (r); B – (p); C – (s); D – (q)
- (2) A – (p); B – (r); C – (s); D – (q)
- (3) A – (q); B – (p); C – (s); D – (r)
- (4) A – (r); B – (p); C – (q); D – (s)

Statement Based MCQ

8. Consider the following statements :
- (a) Atom bomb is based upon the principle of uncontrolled nuclear fusion.
- (b) Hydrogen bomb is based upon the principle of uncontrolled nuclear fission.
- (c) Nuclear reactor is based upon the principle of controlled nuclear fission.

Which of the statement(s) given above is /are correct ?

- (1) (c) only (2) (a) and (b)
- (3) (b) and (c) (4) (a), (b) and (c)

9. Consider the following statements :
- (a) Solar energy is a non-renewable source of energy.
- (b) The solar energy is always available uniformly all the time at all places.

Which of these statement(s) is/are correct ?

- (1) (a) only (2) (b) only
- (3) Both (a) and (b) (4) Neither (a) nor (b)

10. Consider the following statements :
- (a) The renewable sources of energy are also called non-conventional sources of energy.
- (b) Petroleum and uranium are renewable sources of energy.

Which of these statement(s) is/are correct ?

- (1) (a) only (2) (b) only
- (3) Both (a) and (b) (4) Neither (a) nor (b)

11. Consider the following statements :
- (a) The efficiency of solar heating devices is much lower than the efficiency of electric heating devices.
- (b) The excessive use of solar energy will pollute the air.

Which of these statement(s) is/are correct ?

- (1) (a) only (2) (b) only
- (3) Both (a) and (b) (4) Neither (a) nor (b)

12. Consider the following statements :
- (a) The value of solar constant is 1.4 kJ/sec m^2 .
- (b) The elements which can be used to make solar cells are carbon, silver, etc.
- (c) Solar heating devices can be used during night.

Which of these statement(s) is/are correct ?

- (1) (a) and (b) (2) Only (a)
- (3) (b) and (c) (4) Only (b)

13. Consider the following statements :
- (a) Heavy water is used as a coolant in nuclear reactors.
- (b) The energy produced in a nuclear fusion reaction is much more than that produced during fission.

Which of these statement(s) is/are correct ?

- (1) (a) only (2) (b) only
- (3) Both (a) and (b) (4) Neither (a) nor (b)

14. Consider the following statements :
- (a) Hydro electricity is the indirect application of solar energy.
- (b) Exploiting any source of energy disturbs the environment in some way or the other.

Which of these statement(s) is/are correct ?

- (1) (a) only (2) (b) only
- (3) Both (a) and (b) (4) Neither (a) nor (b)

15. Consider the following statements :
- (a) Wave energy would be a viable proportion only where wave are very strong.
- (b) T.V. relay stations in remote locations use solar cell panels.

Which of these statement(s) is/are correct ?

- (1) (a) only (2) (b) only
- (3) Both (a) and (b) (4) Neither (a) nor (b)

16. Consider the following statements :
- (a) Charcoal is formed by the burning of wood in the presence of oxygen.
- (b) Tidal energy is made available by the gravitational pull of the moon on the earth.

Which of these statement(s) is/are correct ?

- (1) (a) only (2) (b) only
- (3) Both (a) and (b) (4) Neither (a) nor (b)

17. Consider the following statements :
- (a) The use of turbine is essential for the production of electrical energy.
- (b) The approximate percentage of energy met by India with the use of hydel energy is 25%.
- (c) Windmills require giant structural erection and vast space.
- (d) New Zealand is called as “Country of Winds”.

Which of these statement(s) is/are correct ?

- (1) (a) and (b) (2) (b) and (c)
- (3) (b), (c) and (d) (4) (a), (b) and (c)

Passage Based MCQ

DIRECTIONS (Qs. 18 to 24) : Read the passage(s) given below and answer the questions that follow.

PASSAGE - 1

The term “Conventional” means “not unusual or extreme or ordinary.” Conventional energy sources are the traditional sources of energy like coal and petroleum. In terms of being “usual”, however, the impact on society by these sources is something extra-ordinary and have actually been quite serious. Conventional energy sources are finite. They will not last for ever. What if all the petroleum reserves in the world come to an end? What if all the coal gets exhausted? It takes hundreds of years for a coal bed to get formed. It takes less than a month for the same to get extracted for use. Excessive use of these sources of energy result in global warming. Statistics tell that the average daily temperature of earth and the rainfall pattern has changed drastically. Ocean temperatures have increased. Number of days of rain, an important parameter in monsoon countries, have come down. Burning of coal produces harmful chemical emissions - Sulphur, Nitrogen Oxide and Mercury. All of these are known to have disastrous environmental and health effects on this fragile earth. Another form of pollution caused by the conventional sources is the “thermal pollution” or letting out of heat into the environment.

When these fuels are burnt to be converted into other forms of energy, a lot of heat is produced and let out into the environment. This has resulted in climate changes-unseasonal rains, excessive rains, floods and drought in several parts of the world. The answer is “Non-Conventional” sources of energy, which are naturally replenished.

18. What is the meaning of word conventional?
 - (1) Not unusual
 - (2) Not extreme
 - (3) Ordinary
 - (4) All of these
19. What are the conventional sources of energy?
 - (1) Traditional sources of energy
 - (2) Coal and petroleum
 - (3) Nuclear energy
 - (4) Both (1) and (2)
20. Give two examples of conventional sources of energy.
 - (1) Coal and petroleum
 - (2) Uranium and plutonium
 - (3) Both (1) and (2)
 - (4) Neither (1) nor (2)
21. How many years it takes for a coal bed to get formed?
 - (1) Thousands of years
 - (2) Hundreds of years
 - (3) Both (1) and (2)
 - (4) Neither (1) and (2)

PASSAGE - 2

Carefully observe the following table and answer the questions that follows.

Fraction	Composition	Temperature Range (K)	Uses
Gaseous	$C_1 - C_4$	Below 298	As a fuel
Petroleum ether	$C_5 - C_7$	298 – 333	As solvent in dry cleaning
Petrol/gasoline	$C_7 - C_{10}$	333 – 473	Motor fuel
Kerosene	$C_{12} - C_{16}$	448 – 550	Fuel in jet engines and for domestic purposes
Fuel oil or diesel oil	$C_{16} - C_{20}$	525 – 670	In diesel engines, in industries
Lubricating oil	$C_{15} - C_{18}$	above 623	Lubrication, vaseline,
greases			
Petroleum wax	C_{20} and above	above 623	Candles,
electrodes		waterproofers,	
fabrics, fuel			
Petroleum coke			Fuel

22. What are candles and water proofers made of ?
 - (1) Petroleum wax
 - (2) Petroleum coke
 - (3) Both (1) and (2)
 - (4) Neither (1) nor (2)
23. What is the composition of the fraction which is used as a solvent in dry cleaning ?
 - (1) $C_7 - C_{10}$
 - (2) $C_{15} - C_{18}$
 - (3) $C_5 - C_7$
 - (4) $C_{16} - C_{20}$
24. What is composition and use of diesel oil ?
 - (1) $C_{16} - C_{20}$, In diesel engines
 - (2) $C_{15} - C_{18}$, In diesel engines
 - (3) $C_{16} - C_{20}$, Lubrication
 - (4) $C_7 - C_{10}$, Motor fuel

Assertion Reason Based MCQ

DIRECTIONS (Qs. 25 to 31) : Following questions consist of two statements, one labelled as the ‘**Assertion**’ and the other as ‘**Reason**’. You are to examine these two statements carefully and select the answer to these items using the code given below.

Code :

- (1) Both A and R are individually true and R is the correct explanation of A:
 - (2) Both A and R are individually true but R is not the correct explanation of A.
 - (3) A is true but R is false
 - (4) A is false but R is true.
-
25. **Assertion :** Nuclear fusion is safer than fission.
Reason : Energy released is comparatively higher in nuclear fission.
 26. **Assertion :** Fossil fuels do not cause pollution.
Reason : Acid rain is formed by the acidic oxides of carbon, sulphur and nitrogen.
 27. **Assertion :** The main constituent of LPG is butane.
Reason : A small quantity of mercaptans is added to cooking gas cylinders supplied for domestic use.
 28. **Assertion :** Coal gas is a mixture of methane, hydrogen and carbon monoxide.
Reason : It is obtained when coal is burnt in excess of air.
 29. **Assertion :** Nuclear forces are independent of charges.
Reason : Nuclear force is not a central force.
 30. **Assertion :** U^{235} nucleus, by absorbing a slow neutron undergoes nuclear fission with the evolution of a significant quantity of heat.
Reason : During nuclear fission a part of the original mass of U^{235} is lost and gets converted into heat.
 31. **Assertion :** In street light circuits, photo-cells are used to switch on and off the lights automatically at dusk and dawn.
Reason : A photocell can convert a change in intensity of illumination into a change in photocurrent that can be used to control lighting system.
-
- ### **Correct Definition Based MCQ**
32. Geothermal energy is
 - (1) energy of magma inside the earth crust
 - (2) energy stored as heat in the earth
 - (3) amount of energy obtained from coal and petroleum inside earth crust.
 - (4) amount of minerals obtained from earth crust
 33. Energy in nuclear fission
 - (1) $E = \Delta m \times c^2$
 - (2) $E = m \times (\Delta c)^2$
 - (3) $E = (\Delta m)^2 \times c$
 - (4) $E = \Delta m \times c$
 34. Ocean thermal energy is
 - (1) temperature difference between layers of water at different depth in river
 - (2) temperature difference between layers of water at different depth in sea
 - (3) temperature difference between layers of water at different depth in pond
 - (4) temperature difference between layers of water at different depth in lake

35. Tidal energy is a
- (1) form of energy obtained from kinetic energy of moving ocean water
 - (2) form of energy which is obtained from the river in the form of tidal waves
 - (3) form of energy which is obtained from the lake in the form of tidal waves
 - (4) form of energy which is obtained from the ocean in the form of tidal waves.
- Feature Based MCQ**
36. On the basis of following features identify the correct option.
- (I) It is used to convert solar energy into electrical energy
 - (II) These are made up of substance which conduct current partially.
- (1) Solar cooker (2) Solar panel
 - (3) Solar cells (4) None of these
37. On the basis of following features identify the correct option.
- (I) Cooks food without any pollution.
 - (II) Temperature of the order 100 – 140°C is achieved in this cooker.
- (1) Pressure cooker (2) Solar cooker
 - (3) Both (1) and (2) (4) Neither (1) nor (2)
38. On the basis of following features identify the correct option.
- (I) This reaction occurs in Sun.
 - (II) This reaction also occurs in hydrogen bomb.
- (1) Nuclear fission (2) Nuclear fusion
 - (3) Both (1) and (2) (4) Neither (1) nor (2)
39. On the basis of following features identify the correct option.
- (I) This fuel majorly contains methane.
 - (II) It is produced by anaerobic digestion of biomass
- (1) Biogas (2) CNG
 - (3) Coal gas (4) Producer gas

Hints & SOLUTIONS

Exercise 1

1. (2) 2. (1) 3. (2)
4. (4) Energy can neither be created nor be destroyed, but usable form of energy is dissipated to the surroundings in less usable forms.
5. (1) 6. (1) 7. (2)
8. (4) Different forms of energy can be solar energy, mechanical energy, heat energy, muscular energy, chemical energy, electrical energy & others.
9. (2) 10. (2) 11. (4)
12. (4) Characteristics of good source of energy are: Good calorific value, easily accessible and economical, easy to store and transport.
13. (2) 14. (1) 15. (3)
16. (1) Wood, coal, energy of flowing water and wind are being used for several thousands of years.
17. (1) 18. (3) 19. (1)
20. (4) All round development has grown global demand for energy.
21. (2) 22. (4) 23. (2)
24. (3) 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. (2) 26. (4) 27. (1)
28. (4) Oxides of carbon, nitrogen and sulphur released on burning of fossils fuels are toxic and acidic oxides and can cause acid rains. CO₂ a green-house gas causes global warning.
29. (3) 30. (4) 31. (1)
32. (3) 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. (2) 34. (2) 35. (3)
36. (4) 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. (3) 38. (1) 39. (4)
40. (4) Many thermal power houses are still using coal to generate steam for rotating the turbines.
41. (2) 42. (2) 43. (1)
44. (3) 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. (3) 46. (4) 47. (4)
48. (4) 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 harmful greenhouse methane gas. Movement of local people without compensation add to their miseries.
49. (4) 50. (2) 51. (3) 52. (2)
53. (4) 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. (4) Destructive distillation of wood removes all the volatile substances leaving charcoal that burns without flames and is smokeless.

55. (3) Biogas plants produce manures in addition to a clean fuel and provide a clean and cheap method of disposing animal and agricultural waste.
56. (1) 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. (2) 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. (4) 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. (1) A typical silicon-germanium solar cell develops a potential difference of 0.5 - 1 V and 0.7 W of electricity.
60. (4) 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. (2) The phenomenon of high and low tides and the difference in sea levels give tidal energy.
62. (3) 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. (1) 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. (1) 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. (2) Many of the sources of energy ultimately their energy from the Sun as the producers get their energy from the Sun.

Exercise 2

1. (3) 2. (1) 3. (2) 4. (3) 5. (4)
6. (1) 7. (1)
8. (1) Atom bomb is based upon the principle of uncontrolled nuclear fission, hydrogen bomb is based upon the principle of nuclear fusion and nuclear reactor is based upon the principle of controlled nuclear fission. This fission is controlled by absorbing neutrons by using cadmium rods.
9. (4)
10. (1) A non-renewable resource is a natural resource which cannot be reproduced, grown, generated, or used on a scale which can sustain its consumption rate, once depleted there is no more available for future needs. Fossil fuels (such as coal, petroleum, and natural gas), nuclear power (uranium) and certain aquifers are examples.
11. (1) Solar energy is pollution free and an easy source of renewable energy to harness for home use. There are many residential solar power systems of different sizes which absorb and store different levels of energy. Solar energy is also often used to heat water.
12. (2) A solar cell (also called a photovoltaic cell) is an electrical device that converts the energy of light directly into electricity by the photovoltaic effect. Mostly silicon is used to make solar. As solar cell convert light energy in to electrical energy thus during night it can not be used.
13. (2) 14. (2) 15. (3)
16. (2) Charcoal is the dark grey residue consisting of carbon, and remaining ash, obtained by removing water and other volatile constituents from animal and vegetation substances. When wood is heated in the absence of air above 270°C , water and other materials will be driven from the wood without burning. Charcoal is the substance that remains.
17. (4) Denmark is called the country of wind.
18. (4) 19. (4) 20. (1) 21. (2) 22. (1)
23. (3) 24. (2)
25. (3) The main difference between these two processes is that fission is the splitting of an atom into two or more smaller ones while fusion is the fusing of two or more smaller atoms into a larger one. The energy released by fission is a million times greater than that released in chemical reactions; but lower than the energy released by nuclear fusion.
26. (4) Fossil fuels, even when burned perfectly (natural gas, or methane, burns the best) release carbon dioxide which is a greenhouse gas thought to be involved in dangerous global warming. Most fossil fuels also release smoke (leading to smog), and they may also release sulfur oxides and nitrogen oxides which contribute to acid rain.
27. (2)
28. (3) Coal gas is obtained by destructive distillation of coal.
29. (2) 30. (1) 31. (1) 32. (2) 33. (1)
34. (2) 35. (4) 36. (3) 37. (2) 38. (2)
39. (1)