

CHAPTER 3 SOURCES OF ENERGY

Class 10 Solutions

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Solution 1:

Nuclear fuels (like uranium)

Solution 2:

The amount of heat produced by burning 1 gram of a fuel completely is known as its calorific value.

Solution 3:

Calorific value of LPG is 50kJ/gm means that if 1 gram of LPG is burnt completely, then it will produce 50kJ of heat energy.

Solution 4:

LPG, due to its higher calorific value.

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Solution 5:

Ignition temperature of fuel can be defined as the minimum temperature to which a fuel must be heated so that it may catch fire and start burning.

Solution 6:

If ignition temp of a fuel is 80°C, this means that minimum 80°C is required for the ignition of the fuel.

Solution 7:

calorific.

Solution 8:

A source of energy is one which can provide adequate amount of energy in a convenient form over a long period of time.

Two main categories of the source of energy are:

- i. Renewable source of energy
- ii. Non- renewable source of energy

Solution 9:

A good source of energy is one:

- (i) which would do a large amount of work per unit mass,
- (ii) which is cheap and easily available,
- (iii) which is easy to store and transport,
- (iv) which is safe to handle and use.

Solution 10:

A non-renewable source of energy is defined as the source of energy which has accumulated in nature over a very, very long time and cannot be quickly replaced when exhausted.

Ex. Coal, petroleum etc.

Solution 11:

A renewable source of energy is the one which is being produced continuously in nature and is inexhaustible.

Ex. wind energy, ocean thermal energy etc.

Solution 12:

Renewable source of energy can be used again and again endlessly, whereas non-renewable source of energy cannot be renewed once used.

Ex. Renewable sources of energy are wind energy, ocean energy.

Non-renewable sources of energy are coal, fossil fuel.

Solution 13:

Fossil fuels are known as non-renewable sources of energy because fossil fuels once used cannot be renewed or regained.

Solution 14:

Air and water, because both air and water can be used again and again endlessly, they never get exhausted.

Solution 15:

Petroleum and coal are non-renewable sources of energy because they cannot be used again once exhausted.

Solution 16:

(a) Renewable source of energy – wind, tides, wood

Non- Renewable source of energy – coal, petroleum, natural gas

(b) The above classification is based on the fact that renewable sources are inexhaustible, whereas non-renewable sources are exhaustible.

Solution 17:

Coal is a non-renewable source of energy because it has accumulated in the earth over a very. Very long time, and if all the coal gets exhausted, it cannot be produced quickly in nature.

Wood is considered as a renewable source of energy because if trees are cut to obtain wood, then more trees will grow in due course of time.

Solution 18:

(a) The material which is burnt to produce heat energy is known as a fuel.
Ex. Wood, coal, LPG, kerosene, diesel etc.

(b) Characteristics of ideal fuel:

- (i) It should have high calorific value.
- (ii) It should burn without giving out any smoke or harmful gases.
- (iii) It should have proper ignition temperature.
- (iv) It should be cheap and easily available.

(c) Fuel A:

- i. Lower calorific value of 55 kJ/g (Disadvantage)
- ii. Moderate ignition temperature of 80°C (Advantage)
- iii. No harmful gases produced (Advantage)

Fuel B:

- i. High calorific value of 80 kJ/g (Advantage)
- ii. Very low ignition temperature of 10°C (Disadvantage)
- iii. Harmful gases like CO and SO₂ produced (Disadvantage)

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Solution 30:

Fuel B is the most ideal fuel because.

- (i) it leaves no residue on burning.
- (ii) it has high calorific value of 48 kJ/g.
- (iii) it does not burn explosively.

Solution 31:

Fuel Y is a better fuel because

- (i) it has a moderate ignition temperature of 75°C.
- (ii) it produces no harmful gases like CO on burning.

Solution 32:

- (i) cooking gas – D

- (ii) alcohol – E
- (iii) wood – B
- (iv) hydrogen – C
- (v) kerosene – A

Solution 33:

Hydrogen gas>Methane>Petrol>Kerosene>Biogas>Wood

Solution 34:

Dung cakes<Coal<Alcohol<Diesel<LPG

Solution 35:

Hydrogen gas.

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Solution 1:

Diesel.

Solution 2:

LPG.

Solution 3:

Kerosene.

Solution 4:

Coal, oil or gas.

Solution 5:

Fractions obtained from petroleum:
Diesel, petrol, kerosene, petroleum gas etc.

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Solution 6:

LPG consists mainly of butane, along with smaller amounts of propane and ethane.

Solution 7:

Compressed Natural Gas (CNG)

Solution 8:

- (i) LPG-Liquefied Petroleum Gas.
- (ii) CNG-Compressed Natural Gas.

Solution 9:

- (i) Main constituent of petroleum gas is butane.
- (ii) Main constituent of natural gas is methane.

Solution 10:

Methane.

Solution 11:

Uses of natural gas:

- (i) As a fuel in thermal power plants.
- (ii) As a fuel in transport vehicles.

Solution 12:

CNG is used as a fuel in transport vehicles.

Solution 13:

butane.

Solution 14:

Natural gas is considered to be a good fuel because it has a high calorific value, burns with a smokeless flame, causes no air pollution and does not produce any poisonous gas.

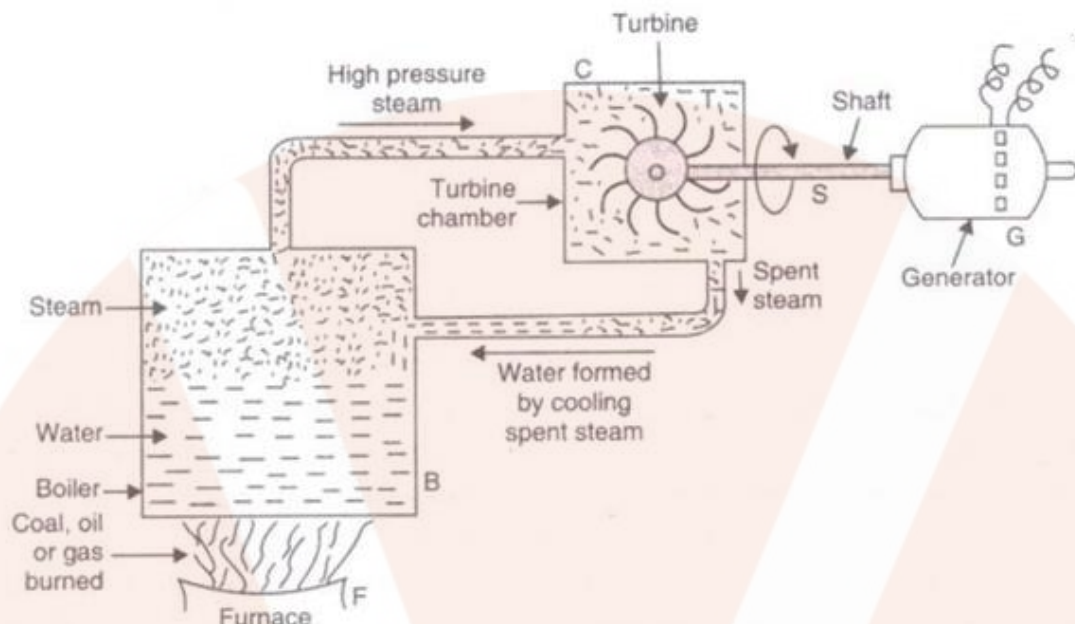
Solution 15:

The traditional sources of energy which are familiar to most people are called conventional source of energy.

Ex. Wood, coal etc.

Solution 16:

In a thermal power plant, heat produced by burning coal is used to boil water to form steam. The steam, at high temperature and pressure, rotates the turbine and its shaft, which drives the generator to produce electricity.



Solution 17:

Disadvantages of burning the fossil fuels are:

- (i) The burning of fossil fuels produce acidic gases.
- (ii) The burning of fossil fuels produce large amount of CO₂ gas, which increases greenhouse effect.
- (iii) The burning of fossil fuels produce smoke and leaves behind a lot of ash.

Solution 18:

Burning of fossil fuels leads to the production of many acidic gases like Sulphur-dioxide and nitrogen dioxides. These gases causes acid rain which damages trees, plants and buildings, reduces fertility of soil, and poses danger to aquatic life. The burning of fossil fuels puts a poisonous gas carbon monoxide in air. It also produces large amount of CO₂ gas which damages the environment in the long run by increasing the greenhouse effect. Also, burning of fossil fuels produces smoke and a lot of ash.

Solution 19:

Pollution caused by the burning of fossil fuels can be controlled by the increasing the efficiency of combustion process and by using various techniques to reduce the escape of harmful gases and ash into the surrounding air.

Solution 20:

We will use LPG due to its high calorific value and smokeless flame.

Solution 21:

LPG is considered as good fuel because it has a high calorific value gives a smokeless flame.

Solution 22:

LPG is considered as a better fuel than coal because it has a higher calorific value, while burning it does not produce any smoke.

Solution 23:

For the detection of leakage, a foul smelling substance called ethyl mercaptan is added to the LPG.

In case of LPG leakage in the kitchen, following steps must be taken:

1. The door and windows should be opened at once to allow the gas to escape.
2. The source of gas leakage should be checked and then set right with the help of a gas mechanic.

Solution 24:

(a) Natural fuels formed deep under the earth from the pre-historic remains of the organisms (like plants and animals) are called fossil fuels.

Ex. Coal, petroleum and natural gas.

(b) The plants and animals which died millions of years ago and got buried deep in the earth, away from the reach of oxygen, got converted into fossil fuels due to the chemical effects of pressure, heat and bacteria.

(c) Sun is considered to be the ultimate source of fossil fuels because it was the sunlight of long ago that made plants grow and the animals which got buried in the earth also ate plants. So, plants and animals which were originally made by sun's energy only have been converted into fossil fuels.

(d) Petroleum and natural gas.

(e) Coal.

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Solution 37:

(a) X = Carbon

(b) Another element which is usually found in combination with carbon in fossil fuels is hydrogen.

Question 38:

The energy in petrol originally came from the sun. Explain how it got into petrol.

Solution 38:

Petrol is obtained from petroleum, which is a fossil fuel. Fossil fuels were originally made by sun's energy because it was the sunlight of long ago that made plants and animals grow. So, the energy in petrol originally came from the sun.

Solution 39:

(a) X is ethyl mercaptan

(b) Ethyl mercaptan has a foul smell that can be detected easily.

Solution 40:

- (a) Catalytic converter
- (b) It converts poisonous carbon monoxide into non-poisonous carbon dioxide and harmful nitrogen oxides into harmless nitrogen gas.

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Solution 1:

Potential energy into electrical energy.

Solution 2:

Kinetic energy.

Solution 3:

Kinetic energy of water.

Solution 4:

Sun.

Solution 5:

15 km/hr.

Solution 6:

Use of wind energy

(a) in the past – in flour mills

(b) at present – for generating the electricity through wind-powered generators.

Solution 7:

Copper tube of solar water heater is painted black because black colour is good absorber of heat.

Solution 8:

Nuclear fusion.

Solution 9:

Solar water heater.

Solar cooker.

Solar cell.

Solution 10:

Plane mirror reflector.

Solution 11:

About 100°C to 140°C

Solution 12:

Solar cell.

Solution 13:

Solar constant is 1.4kW/m² or 1.4 kJ/s/m².

Solar energy received by 1 m² area in 1 s = 1.4 kJ

Solar energy received by 1 m² area in one hour (or 3600 s) = 1.4 x 3600 = 5040 kJ

Solution 14:

sunlight; electrical.

Solution 15:

(a) Difference between thermal power plant and hydro power plant:

Thermal power plant uses non-renewable sources of energy like coal, oil or gas; whereas hydro power plant uses renewable source of energy i.e. water.

Thermal power plant causes pollution due to the burning of fossil fuels; whereas hydro power plant is environment friendly.

(b) Thermal power plant causes serious air pollution because it emits harmful gases and fly-ash into the air.

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Solution 16:

Sun is a renewable source of energy, whereas fossil fuels are non-renewable sources of energy.

Solution 17:

Concave and plane mirrors are used for making solar cooker because concave mirror converges a large amount of sun's rays at a point that is required for high heating and plane mirror reflects the rays of light in the form of a strong beam of sunlight on the top of the box that is required for moderate heating.

Solution 18:

(a) Glass sheet cover

(b) A plane mirror reflector is used in a box type solar cooker so as to get a strong beam of sunlight after reflection from the mirror.

Solution 19:

(a) Advantages of using solar cooker

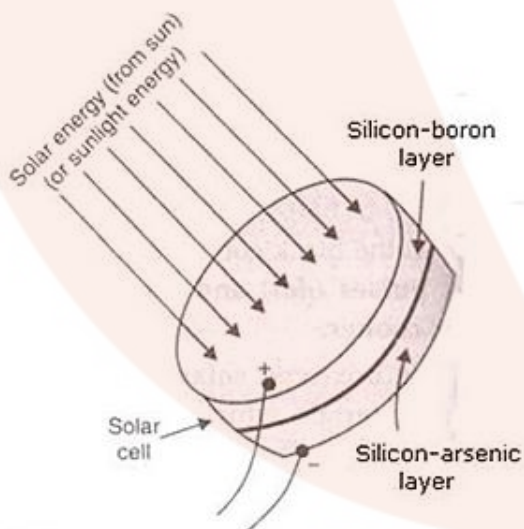
- (i) It saves precious fuels like coal, kerosene etc.
- (ii) It does not produce any smoke or ash.
- (iii) The food cooked in a solar cooker has all its nutrients intact.

(b) Disadvantages of using solar cooker

- (i) solar cooker cannot be used during night time.
- (ii) If the day-sky is covered with clouds, it will not be possible to cook the food using solar cooker.
- (iii) Direction of reflector has to be changed from time to time to keep it facing the sun.

Solution 20:

(a) Solar cell is a device which converts solar energy directly into electrical energy.



(b) Silicon

(c) Use of solar cell:

- i. To provide electricity in artificial satellites and space probes.
- ii. To provide electricity to remote areas where normal electricity transmission lines do not exist.
- iii. To provide electricity to light houses
- iv. To operate traffic signals, watches, calculators and toys.

Solution 21:

(a) Advantage of solar cell

- (i) They have no moving parts and require no maintenance.
- (ii) They can be set up in remote and inaccessible areas

(b) Disadvantage of solar cell

- (i) they are very expensive.
- (ii) They are less efficient. They can convert only about 25 % of light falling on them into electricity.
- (iii) They cannot work during night time.

Solution 22:

Solar cell panel consists of a large number of solar cells joined together in a definite pattern. It is used to convert solar energy into electricity.

Advantages of solar cell panel are:-

1. It provides much more electric power than a single solar cell.
2. It is used to provide electricity in remote and inaccessible rural areas.

Solution 23:

(a) The amount of solar energy received per second by one meter square area of the near earth space (exposed perpendicularly to the sun rays) at an average distance between the sun and the earth, is known as solar constant. Its value is 1.4 kJ/s/m^2 .

(b) Area, $A=5\text{m}^2$; time, $t=10 \text{ min}=600\text{sec}$; $E=4200 \text{ kJ}$.

Solar constant $=E/(Axt)$

$$=4200/(5 \times 600)$$

$$=1.4 \text{ kJ/s/m}^2$$

Solution 24:

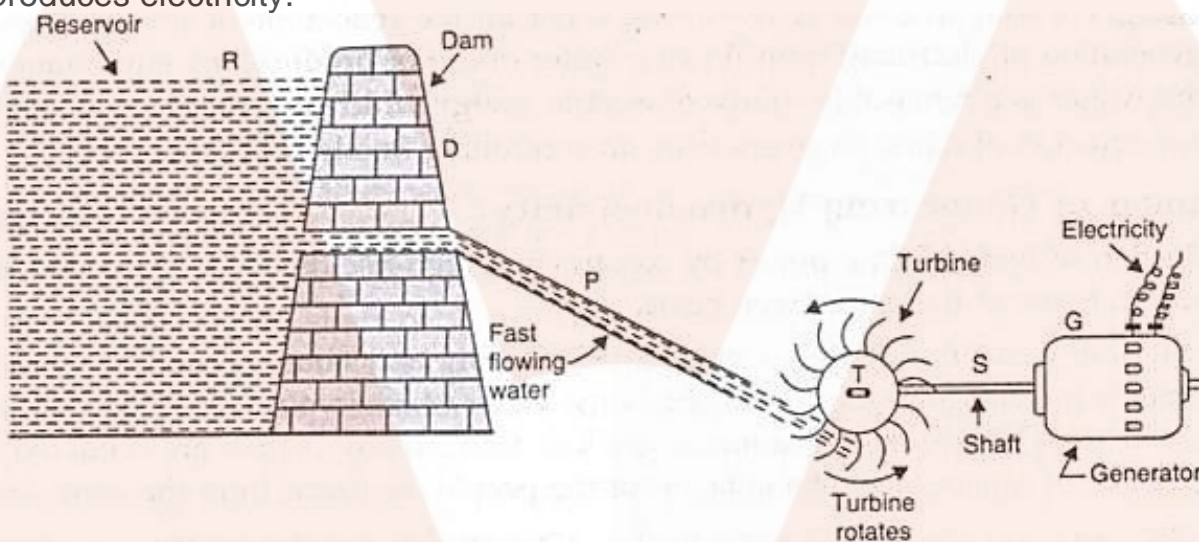
Traditionally, the energy of flowing water has been used for rotating the water-wheels and for driving water-mills to grind wheat to make flour. The traditional use of energy of flowing water has been modified by improvements in technology and it is now used to generate electricity.

Solution 25:

Traditionally, wind energy was used through windmills to pump water from a well and to grind wheat into flour. But the traditional use has been modified and now it is used for the generation of electricity.

Solution 26:

(a) The electricity generated from hydropower plant is known as hydroelectricity. Water is collected in a reservoir at a height, so the water has potential energy stored in it. When the water flows down through this large height, its potential energy gets converted into kinetic energy. The fast flowing water rotates the turbine which is connected to generator through its shaft. The generator produces electricity.



(b) Advantage of producing hydroelectricity:

- (i) It does not cause any environmental pollution.
- (ii) It uses the energy of flowing water, which is a renewable source of energy

(c) Disadvantage of producing hydroelectricity

- (i) Large areas of land are required.
- (ii) Large eco-systems get destroyed.

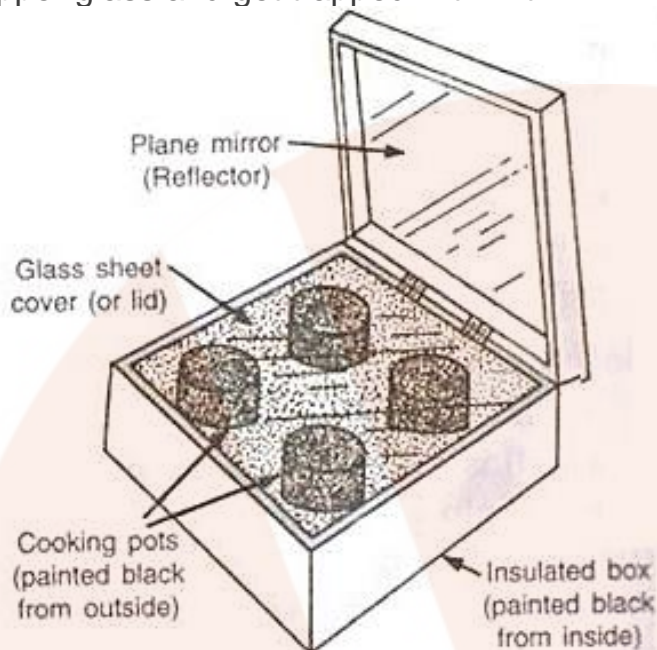
Solution 27:

(a) Construction and working of solar cooker

A solar cooker consists of an insulated metal box or wooden box which is painted all black from inside. There is a thick glass sheet cover over the box and a plane mirror reflector is also attached to the box.

The food to be cooked is put in metal containers which are painted black from outside. These metal containers are then placed inside the solar cooker box

covered with the glass sheet. The sun's rays fall on the reflector, get reflected into the box through the upper glass and get trapped within it.



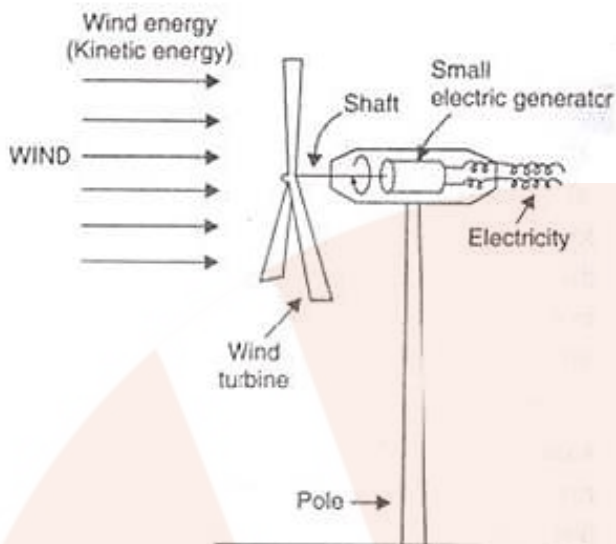
(b) Solar cooker inner body is painted black because black color is a good absorber of heat, so it traps the maximum rays from the sun.

(c) Solar cooker is covered with a glass sheet so as to trap the heat rays in the interior of the box of the cooker.

Solution 28:

(a) Moving air is known as wind. Wind possess kinetic energy.

(b) The fast moving wind strikes the wind turbine which starts rotating. The shaft of the wind turbine also rotates and drives the generator which produces electricity.



(c) Advantages of using wind energy for generating electricity:

- (i) It does not cause any pollution.
- (ii) It is available free of cost.

(d) Limitations of wind energy:

- (i) Wind energy farms cannot be established everywhere. They can be established only at those places where wind blows for most part of the year.
- (ii) Wind energy farms require large area of land for their establishment.

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Solution 39:

(a) Electrical energy produced by coal-fired plant = $2000\text{MW} = 2000 \times 10^6\text{W}$
 Electrical energy produced by wind turbine = $300\text{kW} = 300 \times 10^3\text{W}$
 No. of wind turbine required = $\frac{2000 \times 10^6}{300 \times 10^3} = 6666.6$
 So, 6667 wind turbines would be needed to replace the power station.

(b) In actual practice, this no. of wind turbines could not replace the coal-fired power plant because the efficiency of wind turbines keeps changing due to changes in wind speed but the efficiency of steam turbines used in coal-fired power stations remains the same.

Solution 40:

This is because hot water, being lighter and less denser, rises to the top.

Solution 41:

The electricity made by the solar cells during day time is stored in rechargeable batteries so that it can be used later on, for example, at night.

Solution 42:

(a) Solar cells convert solar energy into electrical energy.

While charging the batteries, electrical energy is converted into chemical energy.

During the use of batteries, chemical energy is converted into electrical energy; then electric motor converts electrical energy into kinetic energy (which drives the car).

(b) (i) Batteries are charged quickly.

(ii) Batteries are charged very slowly.

(iii) Batteries are not charged at all.

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Solution 1:

Charcoal.

Solution 2:

Geothermal energy.

Solution 3:

Geothermal energy.

Solution 4:

Anaerobic bacteria.

Solution 5:

Methane.

Solution 6:

Bio gas consists of methane, carbon dioxide, hydrogen and hydrogen sulphide.

Solution 7:

Needed:- water.

Not needed:- oxygen.

Solution 8:

Biogas.

Solution 9:

Apart from cattle dung, human excreta, agriculture wastes, vegetable wastes, poultry droppings, paper scrap etc. can also be added to a biogas plant.

Solution 10:

Three forms of energy which could be harnessed from the sea are:

- (i) Tidal energy
- (ii) Wave energy
- (iii) Ocean thermal energy.

Solution 11:

- (i) Sea-waves energy.
- (ii) Ocean thermal energy.

Solution 12:

OTE stands for Ocean Thermal Energy.

Solution 13:

Anaerobic bacteria help in the degradation of cow-dung in the presence of water but in the absence of oxygen.

Solution 14:

False

Solution 15:

- (a) solar.
- (b) Twice.

Solution 16:

(a) The dead parts of plants and trees, and the waste material of animals are called biomass. It is the organic matter which is used as a fuel to produce energy. E.g., wood, agricultural wastes and cow dung.

(b) Wood.

Solution 17:

Two ways in which cow-dung can be used as a fuel are:

1. In the form of cow-dung cakes, which can be used directly as a fuel.
2. by preparing biogas from cow-dung.

Biogas is better than cow-dung cakes because it gives a cleaner than cow-dung cakes and after extracting biogas, the spent cow-dung can be used as a manure.

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Solution 18:

Charcoal is prepared by burning wood in a limited supply of air, so that water and other volatile materials present in it get removed.

Charcoal is a better fuel than wood because it has a higher calorific value than wood, and it burns without producing smoke whereas wood produces a lot of smoke on burning.

Solution 19:

(i) Biomass is a renewable source of energy and hydroelectricity is also a renewable source of energy.

(ii) The use of biomass by burning cause's air pollution but the use of hydroelectricity does not cause any pollution.

(iii) Biomass gives heat energy which can be used for cooking and heating only. On the other hand, hydroelectricity can run all types of electrical appliances.

(iv) Biomass energy can be obtained without using any special device but hydroelectricity can be produced only by establishing hydro-power plants.

Solution 20:

Biogas is considered an ideal fuel for domestic use because:

(a) Biogas burns without smoke and hence does not cause air pollution.

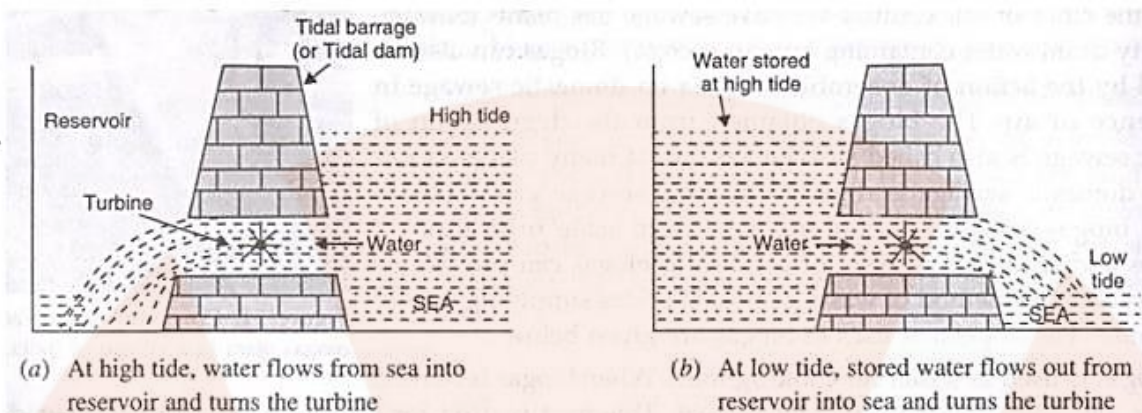
(b) Biogas has a high calorific value. That is, biogas produces a large amount of heat per unit mass.

(c) Biogas is cheaper than most common fuels.

(d) Biogas is a clean fuel since it burns completely without leaving any residue behind.

Solution 21:

(a)



During high tide, when the level of water in the sea is high, sea-water flows into the reservoir of the barrage and turns the turbines. The turbines then turn the generator to produce the electricity. And during the low tide, when the level of sea-water is low, the sea-water stored in the barrage reservoir is allowed to flow out into the sea. This flowing water also turns the turbines and generates electricity.

(b) Tidal energy is not likely to be a potential source of energy because there are very few sites around the world which are suitable for building tidal barrages, and the rise and fall of sea-water during high and low tides is not enough to generate electricity on a large scale.

Solution 22:

Sea-waves energy can be harnessed by the following ways:

1. By setting up floating generators in the sea which would move up and down with the sea-waves and their movement would drive the generators to produce electricity.
2. By letting the sea-waves move up and down inside large tubes so that when the waves move up, the air in the tubes is compressed and this compressed air can then be used to turn a turbine of a generator to produce electricity.

Solution 23:

The energy available due to the difference in the temperature of water at the upper surface and the deeper layers of ocean is known as ocean thermal energy. Ocean thermal energy is used to generate electricity in an Ocean Thermal Energy Conversion power plant (OTEC power plant). A temperature difference of 20°C or more between the surface water and deeper water is needed for the operation of these plants. The warm surface water of ocean is used to boil a

liquid like ammonia or chlorofluorocarbon. The high pressure of liquid vapours is used to turn the turbine of a generator and produce electricity.

Solution 24:

Limitations of energy that can be harnessed from the sea:

1. There are very few sites around the world which are suitable for building tidal barrage for harnessing tidal energy. Moreover, the rise and fall of sea-water during high and low tides is not enough to generate electricity on a large scale.
2. The harnessing of sea-waves energy is a viable proposition only at those places where sea-waves are very strong.
3. Though the energy potential from the sea is very large but its large scale exploitation is difficult at the moment.

Solution 25:

A safe and efficient method for the disposal of bio wastes and sewage materials is to utilize them for producing biogas. This method is advantageous to us for getting energy and manure without polluting the environment.

Solution 26:

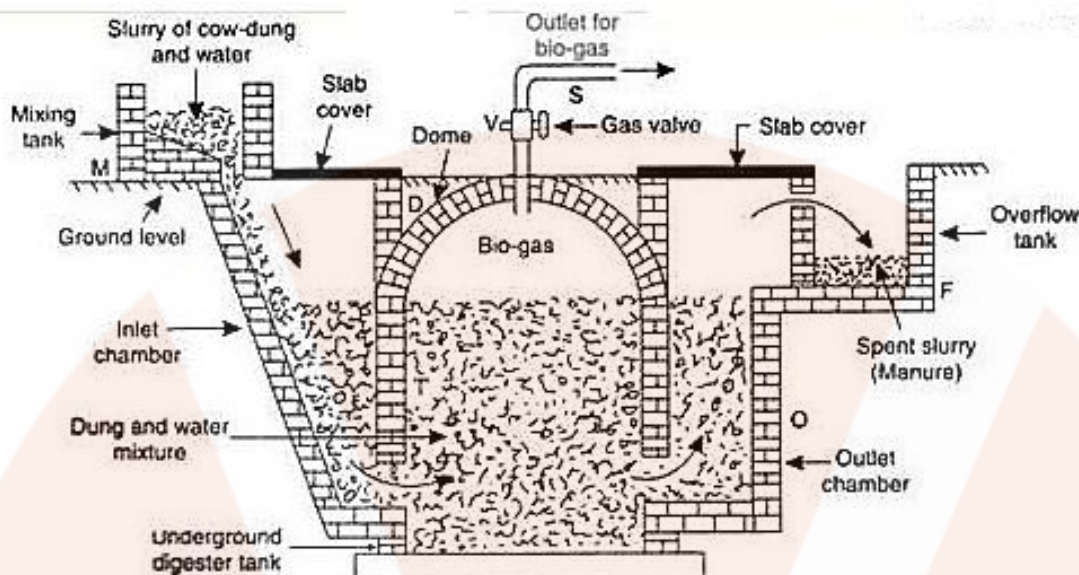
Following sources of energy are not derived from the sun:
Geothermal energy, nuclear fuels, tidal energy.

Solution 27:

(a) Biogas is a mixture of gases produced by anaerobic degradation of biomass in the presence of water but in the absence of oxygen. Methane is the major component of biogas.

(b) Cow-dung and water.

(c) Construction and working of biogas plant:



A biogas plant consists of a wall-shaped, underground tank called digester, which is made of bricks, and has a dome shaped roof D. The dome acts as a gas-holder. There is a gas outlet S at the top of the dome having a valve V. There is a sloping inlet chamber I connected to a mixing tank M and a rectangular outlet chamber O connected to the overflow tank F.

Cow dung and water are mixed in equal proportions in the mixing tank M to prepare the slurry. This slurry is fed into the digester tank through the inlet chamber I to fill the tank up to the cylindrical level. Then, the cow-dung undergoes anaerobic degradation with the evolution of biogas which collects in the dome. The pressure of biogas on the slurry forces the spent slurry to go into the overflow tank F through outlet chamber O, from where it is removed.

(d) Two uses of bio gas:

- (i) For cooking purpose
- (ii) For lightning purpose

(e) Two advantages of biogas:

- (i) Smoke-free cooking
- (ii) High calorific value

Solution 28:

(a) Geothermal energy is the heat energy from hot rocks present inside the earth.

(b) Hot rocks present inside the earth are the source of heat contained in geothermal energy.

(c) 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. This high pressure steam is brought up through pipes and is used to run the turbine of a generator to produce electricity.

(d) Advantage of geothermal energy:

(i) It is very economical to use.

(ii) It does not cause any pollution.

(e) Disadvantage of geothermal energy:-

(i) It is not available everywhere.

(ii) Deep drilling in the earth is required, which is technically very difficult and expensive.

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Solution 42:

(a) Ocean thermal energy

(b) No

(c) Ocean thermal energy is used to generate electricity in an Ocean Thermal Energy Conversion power plant (OTEC power plant). A temperature difference of 20°C or more between the surface water and deeper water is needed for the operation of these plants. The warm surface water of ocean is used to boil a liquid like ammonia or chlorofluorocarbon. The high pressure of liquid vapours is used to turn the turbine of a generator and produce electricity.

(d) 200C

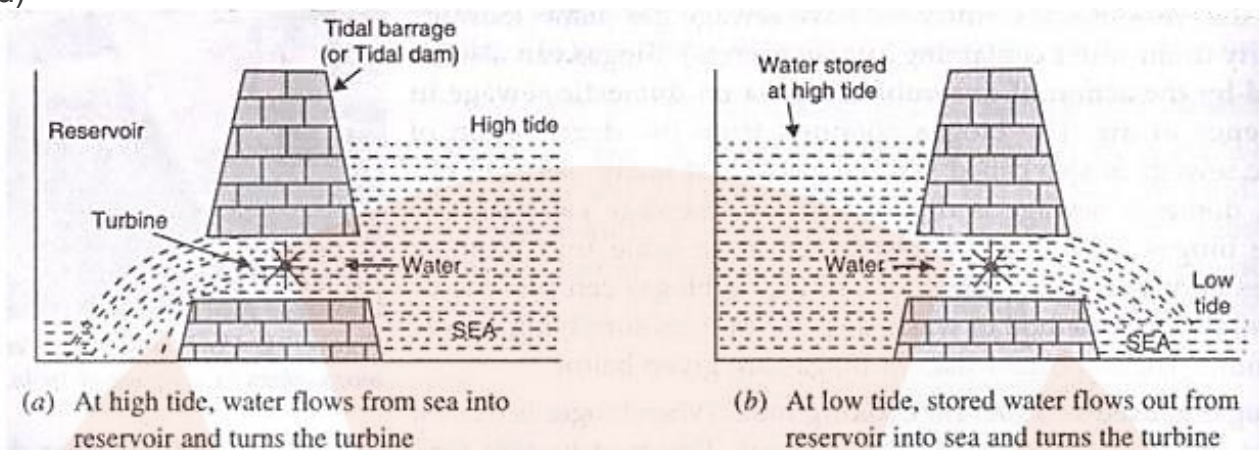
Solution 43:

(a) High tide

(b) Low tide

(c) Tidal energy

(d)



Solution 44:

A is coal; B is coke; C is wood; D is charcoal

Solution 45:

Geothermal energy.

Class 10 Solutions

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Solution 1:

(a) Nuclear fission

(b) Nuclear fusion

Solution 2:

Neutrons.

Solution 3:

Neutrons.

Solution 4:

By the low energy neutrons.

Solution 5:

- (a) Nuclear fusion.
- (b) Nuclear fission.

Solution 6:

Graphite.

Solution 7:

Boron.

Solution 8:

Thick concrete chamber is required to prevent the radioactive rays to travel outside.

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Solution 9:

Uranium is used up in the reactor.

Solution 10:

Nuclear fission reactions are used for generating electricity at a nuclear power plant.

Solution 11:

Million electron volt (MeV)

Solution 12:

1 atomic mass unit=931 MeV

Solution 13:

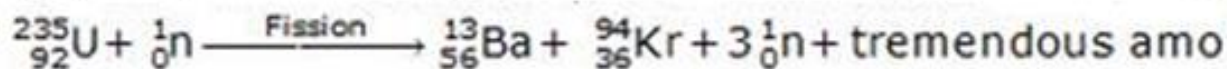
- (a) nuclear fission
- (b) neutrons; nuclear fission
- (c) fission
- (d) reactor

Solution 14:

The process in which the heavy nucleus of a radioactive atom (such as uranium) splits up into smaller nuclei when bombarded with low energy neutrons, is called nuclear fission.

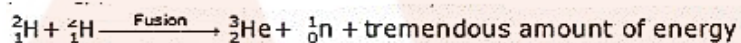
E.g., when uranium-235 atoms are bombarded with slow moving neutrons, the heavy uranium nucleus breaks up to produce two medium-weighted atoms and 3

neutrons, with the emission of tremendous amount of energy.



Solution 15:

(a) The process in which two nuclei of light elements (like that of hydrogen) combine to form a heavy nucleus (like that of helium), is called nuclear fusion. When deuterium atoms are heated to an extremely high temperature under extremely high pressure, then two deuterium nuclei combine together to form a heavy nucleus of helium, and a neutron is emitted. A tremendous amount of energy is liberated in the process.



(b) Because very high energy is required to force the lighter nuclei (which repel each other) to fuse together to form a bigger nuclei.

(b) Because very high energy is required to force the lighter nuclei (which repel each other) to fuse together to form a bigger nuclei.

Solution 16:

The nuclear fuel in the sun is hydrogen gas.

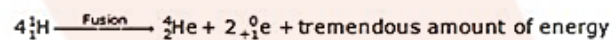
The sun can be considered as a big thermonuclear furnace where hydrogen atoms continuously get fused into helium atoms. Mass gets lost during these fusion reactions and energy is being produced.

Nuclear reaction:

The nuclear fuel in the sun is hydrogen gas.

The sun can be considered as a big thermonuclear furnace where hydrogen atoms continuously get fused into helium atoms. Mass gets lost during these fusion reactions and energy is being produced.

Nuclear reaction:



Solution 17:

(a) Einstein's equation: $E=mc^2$

where E is the amount of energy produced if mass m is destroyed, and c is the speed of light in vacuum.

(b) 1 atomic mass unit = 931 MeV

25 atomic mass unit = 931 x 25 MeV = 23275 MeV

23275 MeV of energy is released.

Solution 18:

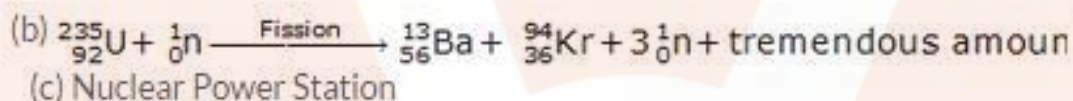
(a) Nuclear fusion reactions Of hydrogen.

(b) The hydrogen bomb consists of heavy isotopes of hydrogen (deuterium and tritium) along with lithium-6. The explosion of hydrogen bomb is done by using an atom bomb. When the atom bomb is exploded, its fission reaction produces a lot of heat which raises the temperature of deuterium and tritium to 107oC in a few microseconds. Then fusion reactions of deuterium and tritium take place producing a tremendous amount of energy. This explodes the hydrogen bomb. Lithium-6 is used to produce more tritium needed for fusion.

(c) The source of energy is same for both the sun and the hydrogen atom, i.e. nuclear fusion.

Solution 19:

(a) When slow moving neutrons are made to strike the atoms of a heavy element uranium-235, the heavy uranium nucleus breaks up to produce two medium-weighted atoms and 3 neutrons, with the emission of tremendous amount of energy. This process is called nuclear fission.



(c) Nuclear Power Station

Solution 20:

(a) Advantages of nuclear energy:

(i) It produces a large amount of useful energy from a very small amount of a nuclear fuel.

(ii) Once the nuclear fuel is loaded into the reactor, the nuclear power plant can go on producing electricity for two to three years at a stretch. There is no need of feeding the fuel again and again.

(iii) It does not produce gases like CO₂ or SO₂.

(b) Disadvantages of nuclear energy:

(i) The waste products of nuclear fission reactions are radioactive which keep on emitting harmful radiations for thousands of years and are difficult to store or dispose safely.

(ii) Very high cost of installation is required.

(iii) There is a limited availability of uranium fuel.

Solution 21:

- (a) Uranium-235
- (b) No

(c) Nuclear fission

(d) Moderator slows down the speed of neutrons to make them fit for causing fission.

(e) Boron rods are used to absorb excess neutrons and prevent the fission reaction from going out of control.

(f) Liquid sodium or carbon dioxide gas is used as a 'coolant' to transfer the heat produced to heat exchanger for converting water into steam.

Solution 22:

- (a) Graphite
- (b) Concrete
- (c) Uranium-235
- (d) Boron
- (e) Liquid sodium

Solution 23:

(a) Control rods control the rate of fission by absorbing the excess neutrons and preventing the fission reaction from going out of control.

(b) Heat is removed from the nuclear reactor core with the help of liquid sodium, which absorbs the heat and transfers it to the heat exchanger. This heat is used for converting water in the heat exchanger into steam, which is then used to produce electricity by rotating a turbine and its shaft connected to a generator.

Solution 24:

On inserting the control rods in the graphite core, the rods start absorbing the excess neutrons and maintain the rate of reaction as per requirement. The rods can be raised or lowered in the reactor from outside. The part which is inside the reactor absorbs neutrons.

Solution 25:

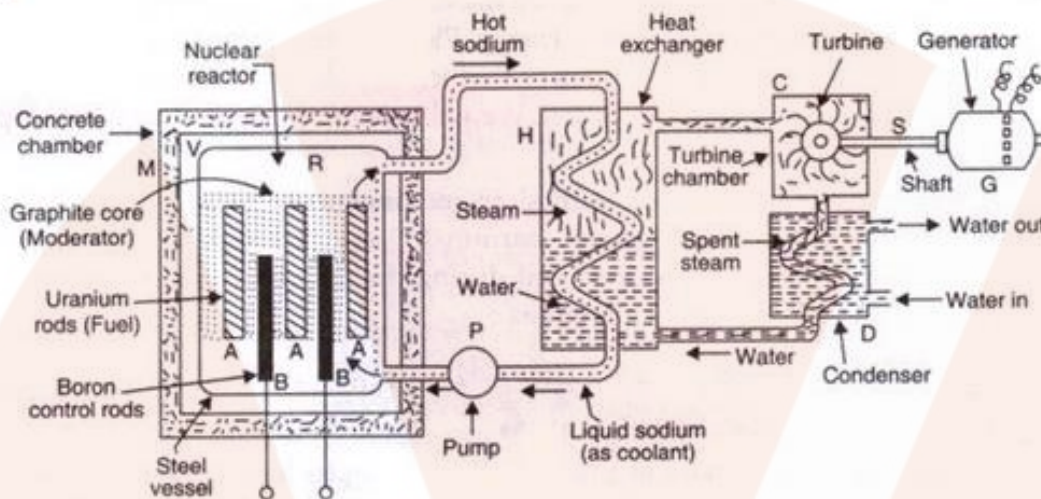
Advantages of using nuclear fuel: Electricity can be produced for almost two to three years with the same uranium fuel in a nuclear power plant.

Disadvantages of using nuclear fuel: The nuclear wastes produced by the fission of uranium-235 during the generation of electricity are radioactive and extremely harmful.

Solution 26:

(a) Nuclear reactor is a device designed to maintain a chain reaction producing a steady flow of neutrons generated by the fission of heavy nuclei. Uranium-235 is used as a fuel in a nuclear reactor.

(D)



In a nuclear power plant, the fission of uranium-235 is carried out in a reactor R. Uranium-235 rods are inserted in a graphite core which acts as a moderator to slow down the neutrons. Boron rods B absorb excess neutrons and controls the rate of reaction. Liquid sodium or carbon dioxide gas, which is pumped continuously through pipes embedded in reactor by using a pump P, is used as a 'coolant' to transfer the heat produced to heat exchanger for converting water into steam. The hot steam at high pressure goes into a turbine chamber and makes the turbine rotate. The shaft of the generator also rotates and drives a generator connected to it.

(c) By inserting the boron control rods fully into the reactor.

(d) Five places in India where nuclear power plants are located are:

- (i) Tarapur.
- (ii) Kalpakkam.
- (iii) Narora.
- (iv) Kaprapur.
- (vi) kaiga.

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Solution 27:

	Nuclear Fission	Nuclear Fusion
Natural occurrence of the process:	Fission reaction does not normally occur in nature.	Fusion occurs in stars, such as the sun.
Byproducts of the reaction:	Fission produces many highly radioactive particles.	Few radioactive particles are produced by fusion reaction, but if a fission "trigger" is used, radioactive particles will result from that.
Energy Ratios:	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.	The energy released by fusion is three to four times greater than the energy released by fission.
Nuclear weapon:	One class of nuclear weapon is a fission bomb, also known as an atomic bomb or atom bomb.	One class of nuclear weapon is the hydrogen bomb, which uses a fission reaction to "trigger" a fusion reaction.
Energy requirement:	Takes little energy to split two atoms in a fission reaction.	Extremely high energy is required to bring two or more protons close enough that nuclear forces overcome their electrostatic repulsion.

(b) (i) Nuclear fission

(ii) Nuclear fusion

(c) Nuclear fusion

(d) Mass, $m = 5\text{g} = 0.005\text{kg}$, Speed of light, $c = 3 \times 10^8\text{m/s}$

We know that, $E = mc^2$

$$E = 0.005 \times (3 \times 10^8)^2$$

$$E = 4.5 \times 10^{14}\text{J}$$

(e)

$$1\text{MeV} = 1.602 \times 10^{-13}\text{J}$$

$$1\text{J} = \frac{1}{1.602 \times 10^{-13}}\text{MeV}$$

$$4.5 \times 10^{14}\text{J} = \frac{4.5 \times 10^{14}}{1.602 \times 10^{-13}} = 2.808 \times 10^{27}\text{MeV}$$

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Solution 46:

(a) Nuclear fission; a large nucleus splits into two smaller nuclei with the release of energy, brought about by the absorption of a neutron.

(b) Particles c is neutron; $x=3$

(c) Energy liberated

(d) Nuclear power station

(e) Atom bomb

Solution 47:

(a) Nuclear fusion; two smaller nuclei combine to form a bigger nucleus with the release of energy, brought about under the conditions of high temperature and

pressure.

(b) Particle c is neutron; $x=1$

(c) Energy liberated

(d) Millions of degree of temperature and millions of pascals of pressure.

(e) Hydrogen bomb.

Solution 48:

(i) D(mass number 235)

(ii) A(mass number 2)

Solution 49:

We will insert the control rods of boron a little more into the reactor to reduce the rate of nuclear fission process.

Solution 50:

The control rods should be withdrawn a little more from inside the reactor. This will increase the rate of nuclear fission process and hence more heat.

Solution 51:

The control rods absorb all the neutrons, stopping the nuclear chain reaction.

Class 10 Solutions

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Solution 1:

Hydrogen is a cleaner fuel because burning of hydrogen produces only water. Which is harmless; but burning of CNG produces CO₂ and water. CO₂ produces greenhouse effect.

Solution 2:

CFL is more energy efficient because it wastes much less energy as heat than filament type electric bulb.

Solution 3:

Coal – 200 years

Petroleum – 40 years

Natural Gas – 60 years

Solution 4:

Solar cooker; pressure cooker

Solution 5:

Various factors to be kept in mind while choosing a source of energy are:

1. the ease of extracting energy from that source
2. the cost of extracting energy from that source
3. the efficiency of technology available for extracting energy from that source
4. the damage to environment caused by using that source

Solution 6:

No. No source of energy is pollution free.

For e.g., the use of wind generators is pollution-free but the processes involved in making it must have damaged the

Solution 7:

The environmental consequences of the increasing the demand for energy are:

- (i) The combustion of fossil fuels is producing acid rain and damaging plants, soil and aquatic life.
- (ii) The combustion of fossil fuels is increasing the greenhouse effect.
- (iii) Nuclear power plants are increasing radioactivity in the environment.
- (iv) Construction of hydro-power plants is disturbing the ecological balance.

Solution 8:

Steps for reducing the energy consumption:-

- (i) Switch off all the lights, fans, TV and other appliances when not needed.
- (ii) Use of biogas as cooking fuel should be encouraged.
- (iii) Bicycles should be used for short distances to save precious fuels like petrol.
- (iv) Solar cookers should be used to cook food.