UNIT V: NATURAL RESOURCES

CHAPTER 14

SOURCES OF ENERGY

Syllabus

Different forms of energy, conventional and non-conventional sources of energy: Fossil fuels, solar energy, biogas, wind, water, tidal energy and nuclear energy, Renewable versus non-renewable sources of energy.

Trend Analysis

List of Concepts	2018	2019	2020
Sources of Energy	1 Q (1 M)		
Alternative or Non-conventional Sources of Energy		1 Q (3 M)	1 Q (4 M)

TOPIC - 1
Conventional Sources of Energy

Revision Notes

- Any system from where energy can be trapped is called a source of energy. A good source of energy is capable of providing adequate amount of energy. It should be convenient to use and easy to store and transport.
- **Law of Conservation of Energy :** Energy can neither be created nor be destroyed, but can be transformed from one form to another.
- **Qualities of a Good Source of Energy :**
  - **(i)** Energy which could do a large amount of work per unit mass or volume.
  - **(ii)** Cheap and easily accessible and provides energy for the maximum period of time.
  - **(iii)** Easy to store and transport.
  - **(iv)** Safe to handle and use.
  - **(v)** Does not cause environmental pollution.
- **Fuel :** The material which is burnt to produce heat energy is known as fuel. *e.g.*, wood, coal, LPG, kerosene.
- **Characteristics of a Good Fuel :**
  - **(i)** High calorific value (gives more heat per unit mass).
  - **(ii)** Burn easily in air at a moderate rate without giving out any smoke or harmful gases.

(iii) Easy to handle, safe to transport.

(iv) Convenient to store.

(v) Burn smoothly and does not leave behind any undesirable substances.

(vi) Less expensive.

➢ **Conventional Sources of Energy :** Sources of energy which are used since a long time. e.g., fossil fuels, biomass, energy of moving water, wind energy etc.

I. Fossil Fuels :

- Fuels developed from the fossils *e.g.*, coal, petroleum.
- Take million of years to form.
- Available in very limited amount.
- Fossil fuels are non-renewable sources of energy.
- Burning of fossil fuels leads to air pollution and green-house effect.

II. Thermal power plants

- In thermal power plants, fossil fuels like coal are burnt to produce heat energy, which is converted into electrical energy. For example, fossil fuels are burnt to heat up water to produce steam which in turn runs turbine to generate electricity. The flow of energy is as listed below :
  Fossil fuels—Heat Energy—Mechanical Energy—Electrical Energy.

III. Hydro power plants :

- Hydropower plants, convert the potential energy of falling water into electricity. The energy of water flowing through rivers has been used for rotating the wheels of water-mills operating in remote hilly areas.
- **Dams :** High rise dams are constructed on the river to collect water in large reservoirs. This water is then carried through pipes to the turbines, at the bottom of the dam to generate electricity.

IV. Biomass

- The dead part of plants, trees and the waste materials of animals and man are called **Biomass.** Normally, biomass has low calorific value and produce lot of smoke when they are burnt.

(1) Wood : It is a biomass and used as a fuel for a long time.

Disadvantages :

- Produces a lot of smoke on burning.
- Do not produce much heat.

(2) Charcoal : When wood is burnt in limited supply of air, then water and other volatile materials gets removed and charcoal is formed.

$$\text{Wood} \xrightarrow{\text{Limited Supply of } O_2} \text{Charcoal}$$

Charcoal is better fuel than wood because :

(i) It has high heat generation capacity (or higher calorific value) than wood.

(ii) It does not produce smoke while burning.

(iii) Is is a compact fuel, easy to handle than wood and convenient to use.

(3) Cow dung : Cow dung is an efficient and cheap good fuel. However, it is not good to burn cow dung directly as fuel because,

- It produces a lot of smoke.
- It does not burn completely, produces lot of ash as a residue.
- It has low calorific value.

(4) Biogas : Biogas is produced by decomposing cow dung, various plant materials like the residue after harvesting the crops, vegetable waste and sewage in a biogas plant. Biogas is used for lighting, cooking in the rural areas while the slurry left behind is used as excellent manure, rich in nitrogen and phosphorus.

(5) Wind Energy : The kinetic energy of the wind can be used to generate electricity. The rotatory motion of the windmill is used to turn the turbine of the electric generator.

The output of a number of windmills in a farm is coupled together to get electricity on a commercial scale.

How is it done on the GREENBOARD?

Q. What is biogas? Describe the steps involved in obtaining biogas. 3

Solution:

Step I: Biogas is a mixture of methane, carbon dioxide, hydrogen, and hydrogen sulphide.

Following steps are involved in obtaining biogas:

Step II: Digesting (decomposition of cattle-dung by anaerobic bacteria).

Step III: Formation of biogas.

Step IV: Collecting the residue left after the formation of biogas.

Objective Type Questions — 1 mark each

A Multiple Choice Questions

Q. 1. Which of the following is a non-renewable source of energy?

(a) Wood **(b) Sun**
(c) Fossil fuels **(d) Wind**

[NCERT Exemp.]

Ans. Correct option : (c)

Explanation: Fossil fuels are non-renewable source of energy because their supplies are limited and can't be recycled once used.

Q. 2. The main constituent of biogas is

(a) methane. **(b) carbon dioxide.**
(c) hydrogen. **(d) hydrogen sulphide.**

[NCERT Exemp.]

Ans. Correct option : (a)

Explanation: Biogas contains upto 75% methane. It burns without smoke and leaves no residue like ash in wood, charcoal and coal burning.

Q. 3. 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.

[NCERT Exemp.]

Ans. Correct option : (a)

Explanation: Maximum wind power is harnessed in open space hence, option (a) is wrong.

Q. 4. Choose the incorrect statement :

(a) We are encouraged to plant more trees so as to ensure clean environment and also provide biomass fuel.
(b) Gobar gas is produced when crops, vegetable wastes, etc., decompose in the absence of oxygen.
(c) The main ingredient of biogas is ethane and it gives a lot of smoke and also produces a lot of residual ash.
(d) Biomass is a renewable source of energy.

[NCERT Exemp.]

Ans. Correct option : (c)

Explanation: The main ingredient of biogas is methane.

Q. 5. Fuel used in thermal power plants is :

(a) water. **(b) uranium.**
(c) biomass. **(d) fossil fuels.**

[NCERT Exemp.]

Ans. Correct option : (d)

Explanation : Large amount of fossil fuels such as coal, natural gas, or petroleum, are burnt every day in power stations to heat up water to produce steam which further runs the turbine to generate electricity.

B Assertions and Reasons Type Questions

Directions : In the following questions/a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as :

(a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).
(b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A).
(c) Assertion (A) is true but reason (R) is false.
(d) Assertion (A) is false but reason (R) is true.

Q. 1. Assertion (A) : Charcoal is better fuel than wood. Reason (R) : Wood is smokeless and leaves no residue.

Ans. Correct option : (c)

Explanation : Charcoal is better fuel than wood because it is smokeless and leaves no residue. It has higher heat of combustion.

Q. 2. Assertion (A) : Burning of coal or petroleum products lead to air pollution.
Reason (R) : Coal and petroleum are non renewable source of energy.

Ans. Correct option : (b)

Explanation : Coal and petroleum are non-renewable sources of energy as they take millions of years to form and are available in very limited amount. Burning of fuels releases gases like CO_2, SO_2, NO_2.

These gases cause air pollution. With rain, these pollutants fall as acid rain and cause soil pollution.

Q. 3. Assertion (A) : Biogas is a boon to the farmers.
Reason (R) : Spent slurry is used as manure and can be used to generate electricity.

Ans. Correct option : (a)

Explanation : Biogas is considered to be a boon to the farmers as the slurry left in the biogas plant is a good manure for fields.

C Very Short Answer Type Questions

Q. 1. Why is biogas considered an excellent fuel?

R [CBSE Board Delhi Set-I, 2019]

Ans. It burns completely/ burns without smoke / high calorific value.

[CBSE Marking Scheme, 2019] **1**

Detailed Answer:

Q. 2. Write the name of the main constituent of biogas. Also, state its percentage.

R [CBSE Board Delhi, Set- II, 2019]

Ans. Methane - 75%

[CBSE Marking Scheme, 2019] ½ + ½

Q. 3. Although coal and petroleum are produced by the degradation of biomass, yet we need to conserve these resources. Why?

A [Board Outside Delhi, Set- III, 2019]

Ans. They are non renewable / their formation takes millions of years / exhausted in the future. (any one point) [CBSE Marking Scheme, 2019] **1**

Detailed Answer:

Coal and petroleum take millions of years to form by the degradation of biomass. As these resources are being utilised at a much faster rate than their formation, they will be exhausted in the future very soon. Therefore, they need to be conserved.

AI **Q. 4. Name two constituents of biogas.**

R [CBSE Comptt. Set-I, II, III-2018]

Ans. Methane /CH_4, Hydrogen/H_2, Hydrogen Sulphide/ H_2S, Carbon Dioxide/CO_2. **(Any two)**

[CBSE Marking Scheme, 2018] ½ + ½

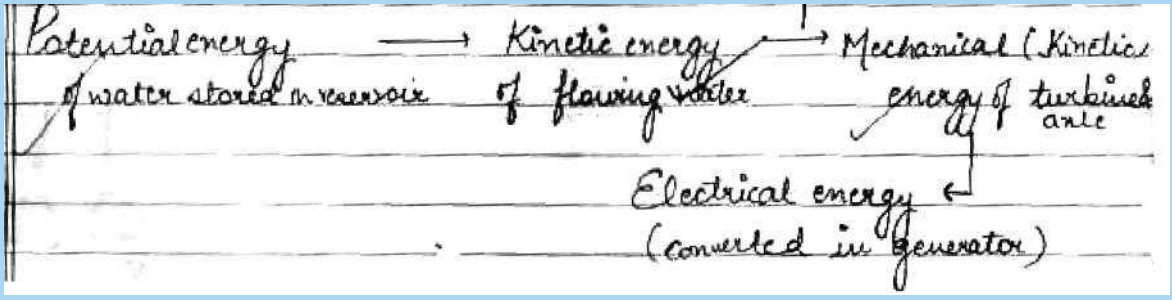
Q. 5. Write the energy conversion that takes place in hydropower plant.

U [CBSE Delhi/OD Set-2018]

Ans. Potential / Kinetic / Mechanical Energy into Electrical energy.

[CBSE Marking Scheme, 2018] **1**

Topper Answer, 2018



Q. 6. Name the part of a biogas plant where reactions take place in the absence of oxygen.

R [Board Term-I, 2016]

Ans. Digester tank. [CBSE Marking Scheme, 2016] **1**

Q. 7. Name two constituent of biogas, one should be chief constituent. R [Board Term-I, 2015]

Ans. Methane : 75%
CO_2 : 25%. [½ + ½

Short Answer Type Questions-I — 2 marks each

AI **Q. 1. List any four qualities of an ideal source of energy.** U

Ans. Qualities of an Ideal Source of Energy:

(i) More heat per unit mass. ½

(ii) Less pollution and smoke free. ½

(iii) Cheap and Economical. ½

(iv) Easily available and easily handled. ½

(v) Safe to transport. **(Any four)**

Q. 2. List any two disadvantages of using fossil fuels. U

Ans. (i) Burning of coal or petroleum products lead to air pollution.

(ii) The oxides of C, N and S are released on burning of fossil fuels as acidic oxides. It leads to acidic rain and affects water and soil. **1 + 1**

Q. 3. Name the major constituent of biogas. List three characteristics to prove it as an excellent fuel. R

Ans. Methane is the major constituent of biogas. ½

Three characteristics to prove it as an excellent fuel :

(i) Smokeless.

(ii) Leaves no residue.

(iii) Higher heat of combustion. **[½ + ½ + ½]**

Q. 4. Mention the main use of slurry left behind in the biogas plant. State the characteristics of the slurry on which this use is based. U

Ans. Slurry is used as a manure. **1**

Slurry is rich in nitrogen and phosphorus. **1**

AI **Q. 5. Give two advantages of using nuclear energy.** R

Ans. Two advantages of using nuclear energy are :

(i) Very small mass of Uranium yields tremendous energy.

(ii) The released energy can be used to produce steam and further generate electricity. **1 + 1**

Short Answer Type Questions-II — 3 marks each

AI **Q. 1. List three environmental consequences of using fossil fuels. Suggest three steps to minimise the pollution caused by various energy sources.**

R **[Board Outside Delhi, Set-II, 2019]**

Ans. Consequences :

(i) Cause air pollution

(ii) The acidic oxides lead to acid rain

(iii) High concentration of green house gas (CO_2) and its effect

(iv) Global warming **(any 3 points)** ½ × 3

Steps to minimize the pollution :

(i) Use of alternate source of energy

(ii) Use of various devices to reduce emission of harmful gases.

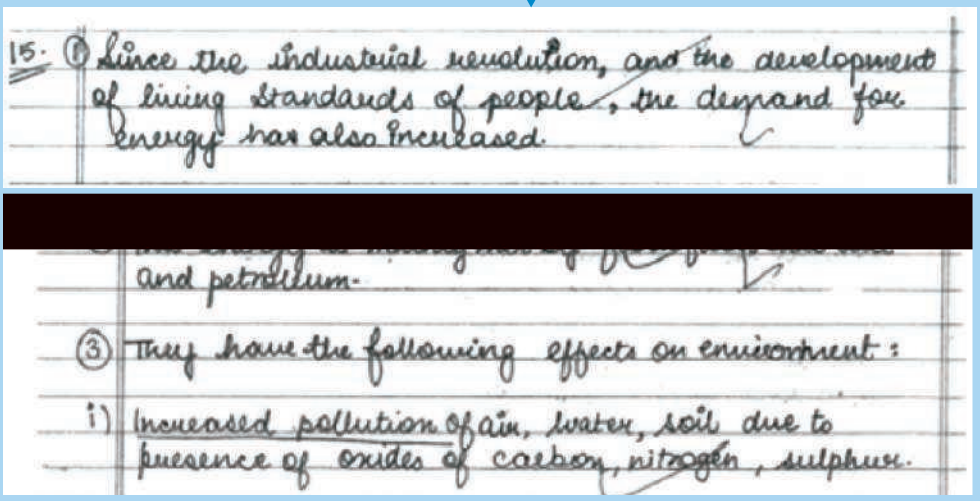
(iii) By increasing efficiency of combustion process

(or any other) ½ × 3

[CBSE Marking Scheme, 2019]

Detailed Answer:

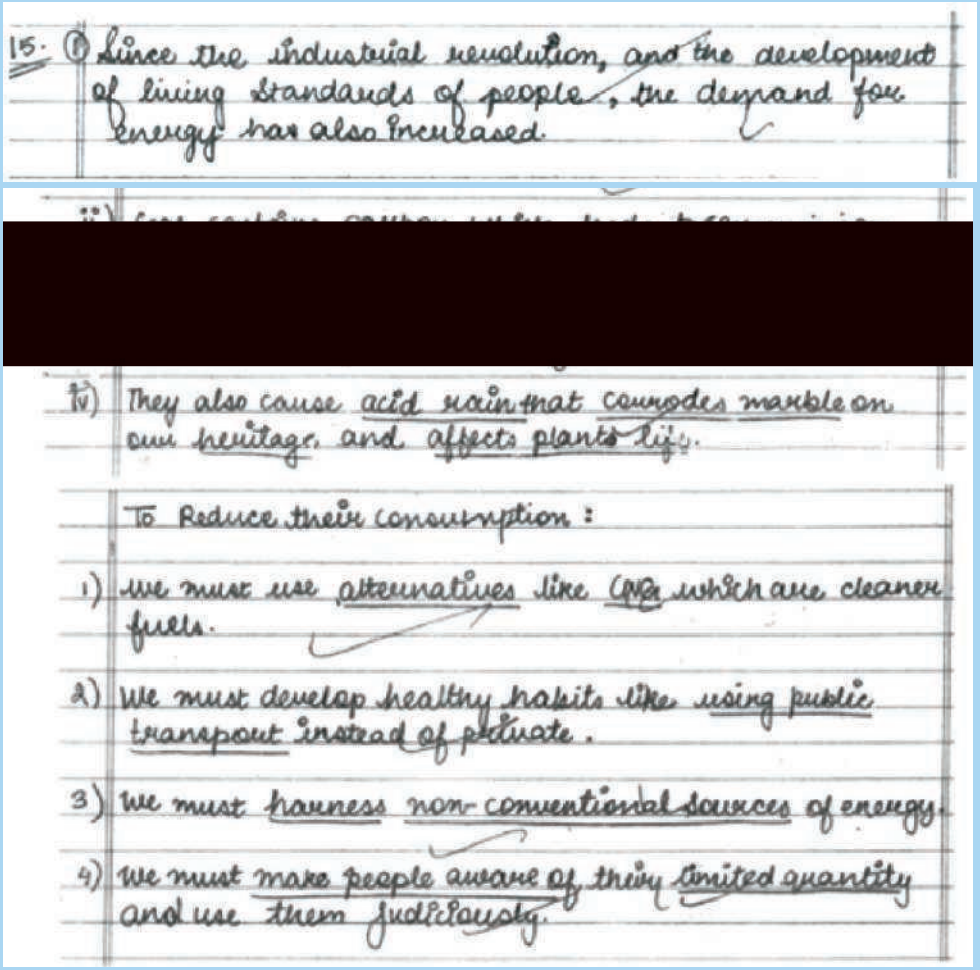
Topper Answer, 2019


15. (1) Since the industrial revolution, and the development of living standards of people, the demand for energy has also increased.

and petroleum.

(3) They have the following effects on environment :

i) Increased pollution of air, water, soil due to presence of oxides of carbon, nitrogen, sulphur.


15. (i) Since the industrial revolution, and the development of living standards of people, the demand for energy has also increased.

(iv) They also cause acid rain that corrodes marble on our heritage, and affects plants life.

To Reduce their consumption :

1) We must use alternatives like CNG which are cleaner fuels.

2) We must develop healthy habits like using public transport instead of private.

3) We must harness non-conventional sources of energy.

4) We must make people aware of their limited quantity and use them judiciously.

AI Q. 2. What is biogas? Describe the steps involved in obtaining biogas. U **[CBSE SQP 2018-19]**

Ans. Biogas is a mixture of methane, carbon dioxide, hydrogen, and hydrogen sulphide.

Following steps are involved in obtaining biogas:

(i) Mixing (Slurry of cattle-dung and water).

(ii) Digesting (decomposition of cattle-dung by anaerobic bacteria).

(iii) Formation of biogas.

(iv) Collecting the residue left after the formation of biogas. **[CBSE Marking Scheme, 2018-19] 3**

Q. 3. If energy can neither be created nor destroyed, explain with an example why we should worry about our energy resources? U **[CBSE Term I, 2016]**

Ans. The law of conservation of energy states that energy can neither be created nor be destroyed. But, it can only be converted from one form to another. Despite this fact, the world is facing energy crisis. The reason behind it is that energy is converted into non-usable forms.

Fossil fuels like coal, petroleum etc. are the sources of energy which have accumulated in nature over a long time and cannot be replaced. We should worry about such sources because these sources of energy are getting depleted and sooner or later, will no longer be available to us. **3**

Q. 4. Write two points of differences between renewable and non-renewable sources of energy. Give one example of each. U **[Board Term-I, 2016]**

Ans. Renewable - Supply can be renewed, environment friendly.

Eg : wind, sun, water **(Any one)**

Non-Renewable - Supply is limited, cause environment pollution.

Eg : coal, petroleum **(Any one)**

[CBSE Marking Scheme, 2016] 3

Detailed Answer :

S. No.	Renewable source of energy	Non-renewable source of energy
(i)	Produced continuously in nature and are inexhaustible.	Takes long time for production and may get exhausted.
(ii)	These sources of energy do not cause any pollution.	These sources are the major cause of environmental pollution.

(iii)	Example - Wind, Sun, Water.	Example - Coal, Petroleum.

COMMONLY MADE ERROR

- Students often write differences in paragraph form.

ANSWERING TIP

- Differences when asked should be written in tabular form and the points should be compatible.

Q. 5. Make a list of three features due to which LPG is considered to be a good fuel?

U [CBSE Term-I, 2016]

Ans. (i) Releases large amount of energy on burning.
(ii) Easy to store.
(iii) Easy to transport.
(iv) Does not produce smoke.
(v) Environment friendly. **(Any three)**

[CBSE Marking Scheme, 2016] **[1×3]**

Q. 6. List three advantages of harnessing wind energy.

U [CBSE Term I, 2016]

Ans. The advantages of harnessing wind energy are :
(i) It is an environment-friendly and efficient source of renewable energy.
(ii) It requires no recurring expenses for the production of electricity.
(iii) It does not cause any pollution. **1 + 1 + 1**

[CBSE Marking Scheme, 2016]

Q. 7.Explain generation of electricity in a thermal power plant. A [CBSE Term I, 2015]

OR

Mention the transformation of energy that takes place in a thermal power plant. Briefly.

C [CBSE Term I, 2015]

Ans. In thermal power plant, heat energy is transformed into electrical energy. Chemical energy of coal is used as a fuel in thermal power plant. Large amount of fossil fuels are burnt everyday in power stations to heat up water to produce steam which further runs the turbine to generate electricity. Many thermal plants are set up near coal or oil fields. In these plants fuel is burnt to produce heat energy which is converted into electrical energy. **3**

Long Answer Type Questions — 5 marks each

AI **Q. 1. What are the environmental consequences of using fossil fuels? Suggest the steps to minimise the pollution caused by various sources of energy including non-conventional sources of energy causing global warming.** A [NCERT Exemp.]

Ans. Following are the environmental consequences of using fossil fuels :
(i) Increased level of carbon dioxide is resulting in global warming. Global warming is causing drastic changes in weather patterns across the world. ½
(ii) Oxides of sulphur and nitrogen cause acid rain. Acid rain is harmful for buildings and monuments and also for living beings. ½
(iii) The burning of fossil fuels produces greenhouse effect of gases like carbon dioxide and results in global warming. ½
(iv) Increase in air pollution is causing more cases of respiratory diseases. ½
(v) The burning of fossil fuels also releases oxides of nitrogen and sulphur that are acidic oxides. These lead to acid rain which affects our water and soil resources. ½

Steps to minimise pollution caused by various sources of energy :
(i) Increased use of public transport. ½
(ii) Increased use of bicycle. ½
(iii) Follow the principles of 3R of conservation (*i.e.*, Reduce, Reuse and Recycle). By doing this, we can minimise the demand for energy. This will help in reducing pollution. **1**
(vi) The effect of greenhouse gases released by burning of fossil fuels and biogas can be minimised by planting more trees. ½

COMMONLY MADE ERROR

- Students write irrelevant stories. Be specific. Read question carefully and write only what is asked.

ANSWERING TIP

- Always write the answer pointwise and each point must reflect a separate idea. Do not repeat the same point in different words.

Q. 2. On what basis would you classify energy sources as
(a) renewable and non-renewable?
(b) exhaustible and inexhaustible?
Are the options given in (a) and (b) the same?

AE [NCERT Ex.]

Ans. (a) The source of energy that is regenerated in nature is known as renewable source of energy.

Sun, wind, moving water and biomass are some of the examples of renewable sources of energy.

The source of energy that does not regenerate in nature is known as non-renewable source of energy.

Coal, petroleum and natural gas are some of the examples of non-renewable sources of energy. **2½**

(b) Exhaustible sources are those sources of energy, which will deplete and exhaust after a few hundred years. Coal and petroleum are the exhaustible sources of energy.

Inexhaustible resources of energy are those sources, which will not exhaust in future. These are unlimited. Biomass is one of the inexhaustible sources of energy.

So, the options given in (a) and (b) are the same.

2½

TOPIC - 2
Alternative or Non-Conventional Sources of Energy

Revision Notes

Alternative or Non-conventional Sources of Energy

- Non-conventional energy sources are energy sources that are infinite, natural and restorable. e.g., tidal energy, solar energy.
- **Reasons for alternate source of energy :**

  (i) To reduce the pressure on fossil fuels making them last for a much longer time.

  (ii) To reduce the pollution level and to save the environment.

I. Solar Energy :

- Sun is the ultimate source of energy.
- Energy obtained from the sun is called solar energy. A large number of devices like solar cooker, solar furnaces, solar cells and solar water heaters utilizes solar energy directly.
- **Solar Cooker :** A black surface absorbs more heat than a white surface. Solar cookers and solar heaters use this property. A solar cooker is covered with a glass plate and have a mirror to focus sun rays.
- **Solar cell :** It is a device which converts solar energy *i.e.*, light energy directly into electricity. They are made up of semi-conductors like–silicon, germanium and selenium. A solar cell can develop a voltage of 0.5–1 V and can produce only about 0.7 W of electricity. However a number of solar cells are combined to form solar panel to produce enough amount of electricity.
- **Solar cell panel :** It absorbs sunlight as a source of energy to generate electricity. It comprises a large number of photo voltaic solar cells and can provide much higher power for many uses.

II. Energy from the Sea :

- **Ocean Thermal Energy (OTE)** : There is always a temperature difference between water at the surface and at deeper level up to 20°C. This form of energy is called ocean thermal energy which can be converted into electricity.
- **Wave Energy :** Energy from oceans is also available in the form of sea-waves. Due to blowing of wind on the surface of ocean, huge sea-waves move on its surface. It has lot of kinetic energy due to high speed. Energy possessed by huge waves near the seashore can be trapped to generate electricity.
- **Tidal Energy :** The rise of ocean water due to attraction of moon is called '**high tides**' whereas fall of ocean water is called '**low tides**'. The difference in sea-levels gives us tidal energy. A turbine fixed at the opening of the dam constructed across narrow opening of the sea converts tidal energy to electricity.
- **Geothermal Energy :** The heat from inside the earth heats up the water below the surface. This hot water can be used under favourable conditions as a source of energy. This energy with hot water below the earth is called geothermal energy. This energy is used to run a turbine to produce electricity.

III. Nuclear energy :

- 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. This reaction is called nuclear fission. In this reaction, a tremendous amount of energy is released. This energy is called nuclear energy. The released energy can be used to produce steam and

further generate electricity. When nuclear fission reaction takes place, neutrons that are released are made to bombard other uranium nuclei to produce more fission. Such self-sustained reactions are called chain reactions.

- Disadvantages of nuclear power generation are complexity in storage and disposable of fuel, environmental contamination and risk of accidental leakage of radiations.

How is it done on the GREENBOARD?

Q. What are solar cells ? Explain the structure of solar panel. List two principal advantages associated with solar cells. 3

Solution:

Step I: A device that converts solar energy directly into electrical energy.

Structure of solar panel:

Step II: Large number of solar cells combine in an arrangement called solar cell panel.

Advantages associated with solar cells are :

Step III: They have no moving parts.

Step IV: They require little maintenance and work quite satisfactorily without the use of any focusing device.

Objective Type Questions — 1 mark each

A Multiple Choice Questions

Q. 1. 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) Biomass**

[NCERT]

Ans. Correct option : (c)

Explanation: Nuclear energy is released during nuclear fission or fusion. These reactions produce tremendous amount of energy. The energy released during these reactions comes from the mass of elements (mass converts into energy). There is no role of sunlight on these reactions. Hence, nuclear energy is not ultimately derived from Sun's energy. Geothermal energy, wind energy and biomass are all ultimately derived from solar energy.

Q. 2. Ocean thermal energy is due to

(a) energy stored by waves in the ocean.
(b) temperature difference at different levels in the ocean.
(c) pressure difference at different levels in the ocean.
(d) tides arising out in the ocean. [NCERT Exemp.]

Ans. Correct option : (b)

Explanation: Ocean thermal energy conversion (OTEC) uses the principle of a heat engine. It works by converting a temperature difference into energy. This means the difference in temperature between the warmer water on the surface and the cooler water in the depths of the ocean can be converted into electricity.

Q. 3. Which part of the solar cooker is responsible for greenhouse effect?

(a) Coating with black colour inside the box
(b) Mirror
(c) Glass sheet
(d) Outer cover of the solar cooker [NCERT Exemp.]

Ans. Correct option : (c)

Explanation: Solar cookers are covered with a glass plate which traps infra-red radiations (heat) from sunlight and does not allow them to escape. In other words, we can say that it provides greenhouse effect.

Q. 4. 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.**

[NCERT Ex.]

Ans. Correct option : (b)

Explanation: A solar water heater uses solar energy to heat water. It requires day light (intense sunlight) to function properly. On a cloudy day, the sunlight reflects back in the sky from the clouds and is unable to reach the ground. Therefore, solar energy is not available for the solar heater to work properly. Hence, solar water heater does not function on a cloudy day.

B Assertions and Reasons Type Questions

Directions : In the following questions, a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as :

(a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).

(b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A).

(c) Assertion (A) is true but reason (R) is false.

(d) Assertion (A) is false but reason (R) is true.

Q. 1 Assertion (A) : Solar heating devices are painted black.

Reason (R) : Black bodies are good absorbers of heat, so temperature rises quickly.

Ans. Correct option : (a)

Explanation : Solar heating devices are painted black as black bodies are good absorbers of heat.

Q. 2. Assertion (A) : Dam is a barrier that is built across a river or a stream

Reason (R) : Large dam can ensure the storage of adequate water for irrigation and also for generating electricity.

Ans. Correct option : (b)

Explanation : Dam is a barrier that stops or restricts the flow of water or underground streams. A dam is built to control water through placement of a blockage of earth, rock across a stream or river. They usually store water in a reservoir, which is then used for a variety of applications such as irrigation and municipal water supplies.

Q. 3. Assertion (A) : Solar cell is a device which converts solar energy *i.e.*, light energy directly into electricity.

Reason (R) : They are made up of semi-conductors like-silicon, germanium and selenium.

Ans. Correct option : (b)

Explanation : Solar cell panel absorb sunlight as a source of energy to generate electricity. It comprises of a large number of photo voltaic solar cells and can provide much higher power for many uses.

C Very Short Answer Type Questions

Q. 1. If you could use any source of energy for heating your food, which one would you prefer? State one reason for your choice. A [CBSE Delhi, Set- III, 2019]

Ans. Fuel energy / microwave / hot plate / solar energy. Easily available **(Or any other source of energy with reason)** [CBSE Marking Scheme, 2019] **1**

AI **Q. 2. Name the component of a solar cooker that produces a green house effect inside it.** R [CBSE Term-I, 2016]

Ans. Glass plate / sheet that covers the box. **1** [CBSE Marking Scheme, 2016]

Q. 3. Name any one material used to make a solar cell and also mention the range of voltage produced by a typical cell. C [CBSE Term-I, 2016]

Ans. Silicon, Germanium. **(Any one) 1**
(Each solar cell produces a voltage of 0.5 volt.)
[CBSE Marking Scheme, 2016]

Q. 4. List two forms of energy in which solar energy manifests itself in oceans. U **[Board Term I, 2012]**

Ans. Ocean thermal energy and Sea-wave energy.
½ + ½

Q. 5. Why is a solar cooker painted black from outside? U [CBSE Term-I, 2016]

Ans. A black surface absorbs more heat as compared to white or a reflecting surface. **1**
[CBSE Marking Scheme, 2016]

Short Answer Type Questions-I — 2 marks each

Q. 1. (i) What is solar cell panel?

(ii) Name any two elements that are used for making solar cell panels. R

Ans. (i) A combined arrangement of a large number of solar cells which can generate sufficient electricity through photovoltaic effect for practical use is known as solar cell panel.

(ii) Silver, Silicon. **1**

Q. 2. (a) Hydrogen is used as a rocket fuel. Why?

(b) List two limitations of using solar cookers. U

Ans. (a) Hydrogen is comparatively a cleaner fuel than any other gaseous fuel, as on its burning only water is produced which does not pollute the environment. **1**

(b) (i) Cannot be used in night/cloudy days.

(ii) Direction of reflector has to be changed from time to time. ½ + ½

AI **Q. 3. List two reasons which limit the usage of solar cells for harnessing energy for domestic use.** U

Ans. (i) Availability of the special grade silicon for making solar cells is limited.

(ii) The process of manufacturing is expensive, silver used for interconnections of the cells in the panel further adds to the cost. **1+1**

Short Answer Type Questions-II — 3 marks each

Q. 1. What are solar cells? Explain the structure of solar panel. List two principal advantages associated with solar cells.

R [Board Outside Delhi, Set-I, 2019]

Ans. A device that converts solar energy directly into electrical energy. **1**

Large number of solar cells are combined in an arrangement called Solar Cell Panel. **1**

Advantages :

(i) They have no moving parts.

(ii) Require little maintenance and work quite satisfactorily without the use of any focusing device.

(iii) These cells can be set up in remote & inaccessible areas where laying of a power transmission may be expensive. **(Any two)** ½ + ½

[CBSE Marking Scheme, 2019]

AI **Q. 2. Explain the term, geothermal energy. How can it be exploited? Though it is economical yet it is not harnessed in most of the countries. Why?**

U [Board Term-I, 2016]

Ans. Geothermal energy is heat energy trapped in hot regions called hot spots when molten rocks are pushed upwards.

When underground water comes in contact with hot spots, steam is generated. Steam trapped in rocks is routed through a pipe to a turbine to generate electricity.

Very few commercially viable sites are available where such energy can be exploited. **3**

Q. 3. Explain ocean-thermal energy and how can it be harnessed. Mention any two limitations in obtaining the energy from the oceans? AE

Ans. The difference in temperature between warm surface water heated by the sun and colder water found at ocean depth is a source of energy called Ocean thermal energy. The difference in temperature is exploited in OTE conversion plants.

The warm surface water is used to boil a volatile liquid like ammonia. The vapours are used to run the turbine of a generator. **2**

Limitations :

(i) Efficient commercial exploitation is difficult. ½

(ii) Expensive set up. ½

Q. 4. What is geothermal energy? How can it be used commercially? List in tabular form three distinguishing features between a thermal power plant and a geothermal power plant. R

Ans. The underground water comes in contact with 'hot spots' present in the earth's crust and steam is generated. This energy possessed by the hot water below the earth is called Geothermal energy. **1**

It can be used to produce electricity. ½

S. No.	Thermal Power Plant	Geothermal Power Plant
(i)	Uses coal as fuel.	Uses underground hot water.
(ii)	Causes pollution.	Does not cause pollution.
(iii)	The fuel used is very expensive.	The fuel is free of cost.

½ × 3 = 1½

Q. 5. (i) Name the device used to convert :

(a) Solar energy into heat.

(b) Solar energy into electricity.

(ii) Mention two limitations of solar energy. R

Ans. (i) (a) Solar cooker. **(b)** Solar cell. ½ + ½

(ii) Two Limitations :

(a) Solar heating devices are useful only at certain times during the day. **1**

(b) High cost and low efficiency of solar cell panels. **1**

Long Answer Type Questions — 5 marks each

Q. 1. Make a list of conventional and non-conventional sources of energy. Give a brief description of harnessing one non-conventional source of energy.

R [NCERT Exemp.]

Ans. Conventional Sources of Energy

(i) Fossil fuels

(ii) Hydro-electric power plant

(iii) Thermal power plant

(iv) Biomass **1**

Non-conventional Sources of Energy

(i) Solar energy **(ii)** Tidal energy

(iii) Nuclear energy **(iv)** Ocean thermal energy **1**

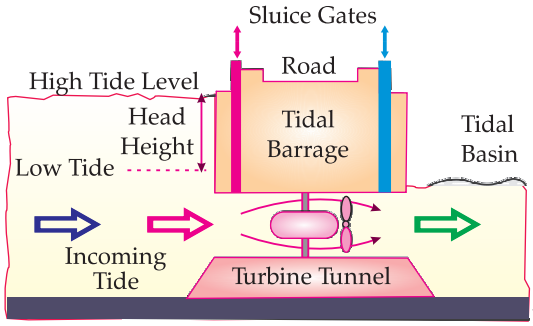
Harnessing Tidal Energy :

(i) For this, a cylindrical structure is vertically placed in coastal areas where tides come. ½

(ii) A turbine is fitted at the top of this cylinder. ½

(iii) When the tide comes, air gushes through the cylinder. This turns the turbine and electricity is generated. ½

(iv) When the tide goes, air moves in opposite direction. This also turns the turbine and electricity is generated. ½



1

Q. 2. Why is there a need for harnessing non-conventional sources of energy? How can energy be harnessed from the sea in different ways?

A [NCERT Exemp.]

Ans. The population of world is increasing at a very rapid rate due to which demands for energy is increasing day by day. Following are the main reasons because of which there is a need to harness non-conventional sources of energy :

(i) Limited non-renewable fuels : Today, fossil fuels are the main energy sources for us. But it takes millions of years for the formation. The rate at which we are using them means they are not going to last many years from now. They would be definitely exhausted sooner rather than later.

1

(ii) Polluting fuels : Burning of fossil fuels releases greenhouse gas. Carbon monoxide can be poisonous even in low concentration. Oxides of sulphur and nitrogen cause acid rain. Air pollution also results in increased cases of respiratory problems. **1**

The energy from the sea energy can be harnessed from the sea in following ways :

(a) Tidal energy : Tidal energy or tidal power can be defined as the energy that is the result of the Moon and the Sun's gravitational influence on the ocean. Height differences between high and low tides create tidal currents in coastal areas, and these currents can be strong enough to drive turbines. The turbine fixed at the opening of the dam converts tidal energy to electricity. **1**

(b) Ocean thermal energy : OTEC uses the principle of a heat engine. It works by converting a temperature difference into energy. This means the difference in temperature between the warmer water on the surface and the cooler water in the depths of the ocean can be converted into electricity. **1**

(c) Wave energy : The kinetic energy possessed by huge waves near the seashore can be trapped to generate electricity. The waves are generated by strong winds blowing across the sea. Wave energy would be a viable proposition only where waves are very strong. A wide variety of devices has been developed to trap wave energy for rotation of turbine and production of electricity. **1**

AI **Q. 3. How can solar energy be harnessed? Mention any two limitations in using solar energy. How are these limitations overcome?** AE **[NCERT Exemp.]**

Ans. Solar cooker : Solar cooker is a device which is composed of a rectangular box with a mirror at the top. The box has a glass cover. Mirror is kept in erect position so that reflected sunlight can go inside the box. Utensils are kept in the box. Glass cover on the top prevents heat from escaping the box. **1**

Solar cell : A solar cell is also called photo-voltaic cell. It converts solar energy into electrical energy. Electrical energy, thus produced needs to be stored in inverters so that it can be used even during night. **1**

Solar furnace : Solar furnace is made of concave mirror. The heating device is kept at the focus of this furnace. Heat from sun is concentrated at the focus which helps in generating lot of heat. Solar furnace can be used to heat water and steam generated by this process can be used to generate electricity. **1**

Limitations of solar energy :

(i) Access to direct sunlight is needed for solar panels to perform at their best. Solar energy is not available in night or when the sun is hidden under clouds. ½

(ii) The domestic use of solar cells for production of electricity is not possible due to high cost. ½

Ways to overcome the limitations of solar energy :

(iii) First limitation can be overcome by converting solar energy into electrical energy and storing them for future use. ½

(iv) Second limitations can be overcome by taking certain steps by government to reduce price of solar cells. ½

COMMONLY MADE ERROR

➲ Students often write irrelevant stories. Instead of pointwise, they write answer in the form of essay.

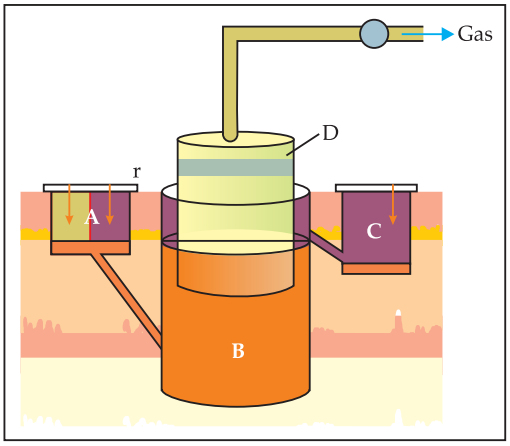
ANSWERING TIP

➲ Always write the answer point wise and each point must reflect a separate idea. Do not repeat the same point in different words.

Visual Case-based Questions — 4 marks each

Q. 1. Read the following and answer any four questions from (a) to (e) that follow on the basis of information provided and studied concepts.

A biogas plant is where biogas is produced by fermenting biomass. [CBSE–QB 2021]



(a) In which of the parts would you find anaerobic bacteria

(i) A **(ii)** B
(iii) C **(iv)** D

(b) Which one of the following is NOT correct for biogas

(i) its carbon neutral
(ii) its non-renewable
(iii) it depends on micro-organisms
(iv) yields rich manure

(c) Which of the following best indicates the steps of

(i) Waste water feed → biogas storage → generator → biogas
(ii) Waste water feed → digester → biogas → biogas storage → generator
(iii) Generator → waste water feed → digester → biogas → biogas storage
(iv) Waste water feed → biogas → digester → biogas storage → generator

(d) Biogas is a better fuel than animal dung cake because

(i) Biogas is a renewable source of energy
(ii) Animal dung cake has higher calorific value
(iii) Biogas has high heating capacity
(iv) Biogas burns without smoke.

(1) (i) only **(2)** (ii) only
(3) (iii) and (iv) **(4)** (i) and (ii)

(e) Biogas is formed in the

(i) presence of air only
(ii) presence of water only
(iii) presence of air and absence of water
(iv) presence of water and absence of air.

Ans. (a) (ii) B
(b) (ii) its non-renewable
(c) (ii) Waste water feed → digester → biogas → biogas storage → generator
(d) (iii) (3) and (4)
(e) (iv) presence of water and absence of air

Q. 2. Read the following and answer any four questions from (a) to (e) that follow on the basis of information provided and studied concepts.

In Kunjpura village, located in Karnal district, Haryana, Aditya Aggarwal and his older brother Amit Aggarwal run Tee Cee Industries, a steel plant set up by their ancestors in 1984. Along with this, they also run a gaushala that houses 1,200 cows that can no longer produce milk.

The cow shelter was manageable but running the steel plant was turning out to be expensive because they spent a whopping Rs 5 lakh every month on electricity.

The brothers struck upon an idea. Why not run the factory with the biogas produced from cow dung from the shelter and other gaushalas, along with bio and agri-waste like sewage, farm waste, etc. This led Aditya and Amit to start Amrit Fertilisers, a biogas project, in 2014, without any government support.

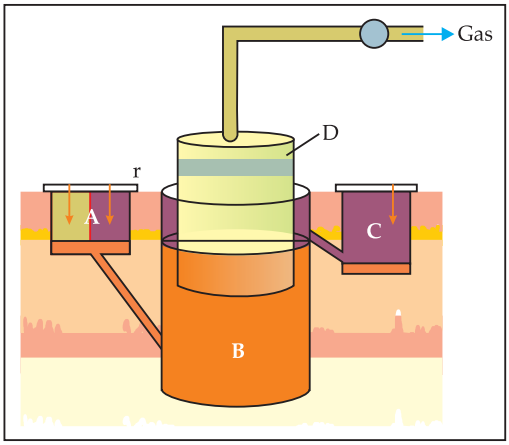
(a) Biogas is a mixture of the following gases.

(i) Ethane, Carbon monoxide, Nitrogen and Butane
(ii) Methane, Hydrogen, Carbon dioxide and Nitrogen
(iii) Butane, Carbon monoxide, Propane and Hydrogen
(iv) Carbon monoxide, Sulphur dioxide and Hydrogen

(b) Raw material used in bio gas plant is

(i) Animal dung **(ii)** crop residue
(iii) Food waste **(iv)** All of the above

(c) The correct labelling in a biogas plant is given in



(i) A-Manure B-Slurry C-Gas tank D-Digester
(ii) A-Slurry B-Digester C-Manure D-Gas tank
(iii) A-Gas tank B-Manure C-Digester D-Slurry
(iv) A-Digester B-Gas tank C-Slurry D-Manure.

(d) Biogas is a better fuel than animal dung cake because

(1) Biogas has lower calorific value.

(2) Animal dung cake has higher calorific value.

(3) Biogas has high heating capacity.

(4) Biogas burns without smoke.

(i) (1) only **(ii) (2) only**

(iii) (3) and (4) **(iv) (1) and (2)**

(e) Biogas is formed in the

(i) presence of air only.

(ii) presence of water only.

(iii) absence of air only.

(iv) presence of water and absence of air.

Ans. (a) (ii)

(b) (iv)

(c) (ii)

(d) (iii)

(e) (iv)

Q. 3. Read the following passage and answer any four questions from (a) to (e):

Fossil fuels are at the verge of getting exhausted. It is because of their non-replenishment, increasing demand, increasing population and more energy dependent technologies. Therefore, one has to look upto the sources which can be regenerated and cause the minimum possible environmental damage.

(a) "I" am a fossil fuel that is very important for daily use. I am non-renewable source and regarded as the cleanest source of energy. I am found deep inside the earth in the gaseous state. Who am "I"?

(i) Petroleum

(ii) Gasoline

(iii) Geothermal Energy

(iv) Natural Gas

(b) If the temperature of the earth keeps increasing due to the burning of fossil fuels and all other reasons that cause the Global Warming, then what all can happen to the earth?

I. Changes in weather.

II. Melting of all the glaciers into water. This will cause an increase in the sea level and widespread decrease in the snow and ice.

III. Deforestation

(i) I and III only

(ii) All of these

(iii) I and II only

(iv) II and III only

(c) Seema and Meena are good friends. Both live in the same colony and work in the same company. They both use their cars to go to office which runs on petrol. As petrol is a non-renewable resource it cannot be replenished within a short duration of time. As a common friend of both what best advise will you give them to save petrol.

(d) Does burning of fossil fuel causes water pollution. Explain.

(e) Which of the given problems is associated with the burning of coal?

(i) It causes acid rain.

(ii) Carbon dioxide is released.

(iii) Ash with toxic metal impurities are produced.

(iv) All of the above

Ans. (a) (iv) Natural gas.

(b) (iii) If the temperature of the earth keeps increasing due to the burning of fossil fuels and all other reasons that causes the Global Warming, then there could be serious changes in the weather- the cold days and night can decrease and also due to high temperature all the glaciers will melt which means the ice and snow will convert in water, thus increasing the sea level. Deforestation is not caused by change in temperature

(c) (i) Go to office by bus/public transport

(ii) Use cycle

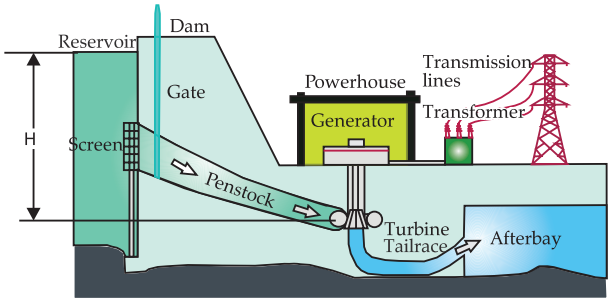
(iii) They can do car pool **(Any two)**

(d) Burning of fossil fuels releases gases like SO_2, NO_2, CO_2 etc, which mix up with water on raining and causes acid rain.

(e) (iv) On burning coal, carbon dioxide is released. Coal also releases acidic oxides, which combine with water vapour to form acid rain. Ash with toxic metal impurities are also produced.

(Any four) 1 + 1 + 1 + 1

Q. 4. Study the given diagram and answer any of the four questions from (a) to (e) :



(a) The given picture is of :

(i) Geothermal plant

(ii) Hydropower plant

(iii) Thermal power station

(iv) None of these

(b) In a hydro-power plant :

(i) potential energy possessed by stored water is converted into electricity.

(ii) kinetic energy possessed by stored water is converted into potential energy.

(iii) electricity is extracted from water.

(iv) water is converted into steam to produce electricity.

(c) Why this plant is considered as renewable source of energy?

(d) List two negative impacts of this plant on the ecosystem.

(e) Which one of the following forms of energy leads to least environmental pollution in the process of its harnessing and utilisation?

(i) Nuclear energy

(ii) Solar energy

(iii) Thermal energy

(iv) Geothermal energy

Ans. (a) (ii) The given picture represents the hydropower plant.

(b) (i) The water in a reservoir behind a hydro-power dam is an example of gravitational potential energy. The stored energy in the reservoir is converted into kinetic energy (motion) as the water flows down a large pipe called a penstock and spins a turbine, to generate electricity.

(c) It is because water can be replenished by water cycle.

(d) Negative impacts of hydropower plant on ecosystem are :

(i) A large variety of plants, animals and their habitats get submerged in water.

(ii) It decreases the fertility of the soil in the downstream area and affect crops.

(e) (ii) Solar energy leads to least environmental pollution in the process of its harnessing and utilisation. **(Any four) 1 + 1 + 1 + 1**

Q. 5. Read the passage and answer any of the four questions from (a) to (e) :

All of our energy comes from the sun, which is our nearest star. The sun sends out huge amounts of energy through its rays every day. We call this energy solar energy or radiant energy. Without the sun, life on earth would not exist, since our planet would be totally frozen. The sun's energy is stored in coal, natural gas, water and wind. Coal, oil, and natural gas are known as fossil fuels. Fossil fuels were formed over millions of years ago when the remains and fossils of prehistoric plants and animals sank to the bottom of swamps and oceans. These animal and plant remains were slowly covered and crushed by layers of rock, mud, sand, and water. The pressure of all those layers caused the plants and animals to break down and change into coal, oil and natural gas. We use the energy in these fossil fuels to make electricity. As of the year 2019, most of the energy we use comes from fossil fuels. However, fossil fuels are known as non-renewable sources of energy. They cannot be used over and over again. This means that one day they will run out!

(a) Geothermal and nuclear energy is not derived from the Sun's energy.

(i) True

(ii) False.

(b) Which among the following is not a renewable source of energy?

(i) Solar energy

(ii) Biomass energy

(iii) Hydro-power

(iv) Geothermal energy

(c) The energy source that uses collectors to heat water or air in buildings is

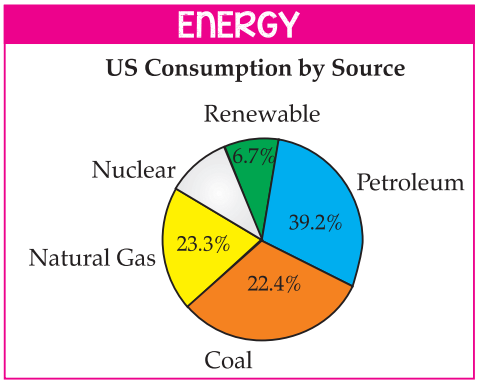
(i) Wind energy

(ii) Solar energy

(iii) Electrical energy

(iv) Water energy

(d) The pie chart below shows the consumption of various energy sources in the USA. Depending on the data given, if we consider that the quantity of all these sources are equal, then which source of energy is most likely to exhaust first?



(e) Choose the correct statement.

(i) Sun can be taken as an inexhaustible source of energy.

(ii) There is infinite storage of fossil fuel inside the Earth.

(iii) Hydro energy and wind energy plants are non polluting sources of energy.

(iv) Waste from a nuclear power plant can be easily disposed off.

Ans. (a) (i) True

(b) (ii) Biomass is not a renewable source among the options. Biomass is produced by the burning of the wood.

(c) (ii) The energy source that uses collectors to heat water or air in buildings is solar energy. These collectors are called as solar cells.

(d) According to the data given, if all the sources of energy at present are in equal quantities then petroleum is most likely to exhaust first as it is being used the most *i. e.* 39.2 % of all the energy sources.

(e) (i) The Sun has an enormous amount of energy at the present rate for nearly 5 billion years and will continue radiating at that rate for about 5 billion years more. So, it can be taken as an inexhaustible source of energy. **(Any four) 1 + 1 + 1 + 1**

Know the Terms

- **Conventional or Non-Renewable Sources** : Energy sources which are used traditionally for many years and deplete over a period of time are called conventional or non-renewable sources. *e.g.*, coal, petroleum, natural gas etc.
- **Non-Conventional or Renewable Sources :** Energy sources which do not deplete and are scarcely used by the population are called non-conventional or renewable sources *e.g.*, Solar energy, wind energy, tidal energy etc.
- **Solar constant :** The amount of solar energy received per square meter per second on the surface of earth is called **solar constant**. It is approximately 1.4 (kJ/m^2s).
- **Wavelength :** Length of a wave or separation between two points in successive waves which are in same phase is called wavelength. It is expressed in meter.
- **Frequency :** The number of wave motions in one second is called frequency. It is expressed in Hertz (Hz).
- **Nuclear fission reaction :** The action in which a heavy nucleus of an atom splits into two or more smaller nuclei as fission product, with the evolution of large amount of energy when it is bombarded with slow moving neutron is called **nuclear fission**.
- **Chain reaction :** A nuclear reaction in which the bombarding particle is obtained as one of the product, due to which the reaction once initiated proceeds on its own is called a **chain reaction**.
- **Nuclear fusion reaction :** A reaction in which two or more lighter nuclei fuse to form a heavy nucleus and large amount of energy is given out is called **nuclear fusion reaction**.

❑❑❑