

Chapter 6

Heat and Energy

Class 9 - Concise Physics Selina Solutions

Exercise 6(A) — Multiple Choice Type

Question 1

The energy which flows from a hot body to a cold body is called

1. mechanical energy
2. fuel energy
3. solar energy
4. heat energy

Answer

heat energy

Reason — Heat is the form of energy that is transferred between two bodies at two different temperatures when kept in contact.

Question 2

1 Joule is equal to :

-
1. 10^6 erg
 2. 10^5 erg
 3. 10^7 erg

4. 10^9 erg

Answer

10^7 erg

Reason — The S.I. unit of heat is joule and its C.G.S. unit is erg, where $1 \text{ Joule} = 10^7 \text{ erg}$

Question 3

..... determines the direction of flow of heat.

1. Heat
2. Temperature
3. Coldness
4. None of these

Answer

Temperature

Reason — Temperature is a quantity which indicates the thermal state of a body (i.e., the degree of hotness or coolness of the body). It determines the direction of flow of heat when two bodies at different temperatures are placed in contact.

The S.I. unit of temperature is Kelvin (K).

Question 4

The amount of heat energy contained by a body depends on :

1. the mass of the body
2. the temperature of the body
3. the nature of the material of the body
4. all of the above

Answer

all of the above

Reason — The amount of heat energy contained by a body depends on its mass, temperature and the nature of the material of the bdy.

Question 5

Celsius and Kelvin scales are related as :

1. $t \text{ K} = 273 + t^\circ \text{ C}$
2. $t \text{ K} = 273 - t^\circ \text{ C}$
3. $\frac{t \text{ K}}{t^\circ \text{ C}} = 273$
4. $\frac{273}{t^\circ \text{ C}} = T \text{ k}$

Answer

$$t \text{ K} = 273 + t^\circ \text{ C}$$

Reason — $t \text{ K} = 273 + t^\circ \text{ C}$

Thus, by adding 273 to the temperature in degree celsius, we get the temperature in Kelvin.

Question 6

The temperature of a body depends on the average of the molecules.

1. potential energy
2. kinetic energy
3. elastic energy
4. atomic energy

Answer

kinetic energy

Reason — The temperature rises when the kinetic energy of the molecules of the substance increases and vice versa. Hence, the temperature of a body depends on the average ***kinetic energy*** of the molecules.

Question 7

The temperature at which pressure and volume of a gas becomes zero is :

1. 0° C
2. 0 K
3. 0° F
4. 273 K

Answer

0 K

Reason — On Kelvin scale, 0 K is the temperature at which pressure and volume of a gas becomes zero. 0 K is called absolute zero. Thus, negative temperature is not possible on kelvin scale.

Question 8

The steam point on Fahrenheit scale is :

1. 273° F
2. 100° F
3. 213° F
4. 212° F

Answer

212° F

Reason — The steam point is 100 °C on Celsius scale, 212 on Fahrenheit scale and 373 K on Kelvin scale.

Question 9

Celsius and Fahrenheit scales are related as :

$$1. \frac{C}{5} = \frac{F - 32}{9}$$

$$2. \frac{C}{9} = \frac{F + 32}{5}$$

$$3. \frac{9}{5}C = \frac{F + 32}{9}$$

$$4. \frac{C}{5} = 9(F + 32)$$

Answer

$$\frac{C}{5} = \frac{F - 32}{9}$$

Reason — The temperature on Celsius and Fahrenheit scales are related as : $\frac{C}{5} = \frac{F - 32}{9}$

Question 10

The increase in the length of a solid on heating is called :

1. contraction
2. linear expansion
3. cubical expansion
4. superficial expansion

Answer

linear expansion

Reason — A solid has a definite shape, so when it is heated, it expands in all directions i.e., the length, area and volume all increase on heating. The increase in the length is called linear expansion.

Question 11

On heating, liquids expand than
solids and gases expand than
liquids.

1. more, less
2. less, more
3. more, much more
4. less, less

Answer

more, much more

Reason — Liquids and gases do not have have a definite shape, so they have only the cubical (or volumetric expansion). On heating, liquids expand more than solids and gases expand much more than liquids.

Question 12

Water is cooled from 4°C to 0°C . It :

1. contracts
2. expands
3. first contracts, then expands
4. first expands, then contracts.

Answer

expands

Reason — The expansion of water when it is cooled from 4°C to 0°C , is known as

anomalous expansion of water.

Question 13

The change in volume of water when it is cooled from°C to°C is known as anomalous expansion of water :

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

Answer

4,0

Reason — The expansion of water when it is cooled from 4°C to 0°C, is known as anomalous expansion of water.

Question 14

The property of ice which prevents the flow of heat from water of a pond (or lake) to the atmosphere is :

1. conduction
2. insulation
3. low specific heat
4. none of the above

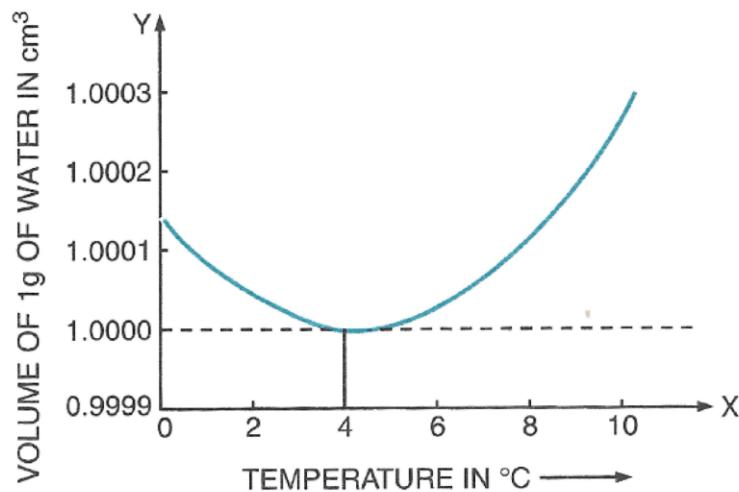
Answer

Reason — Ice is a poor conductor of heat. Hence, it acts as an insulator and prevents the flow of heat from water of a pond (or lake) to the atmosphere.

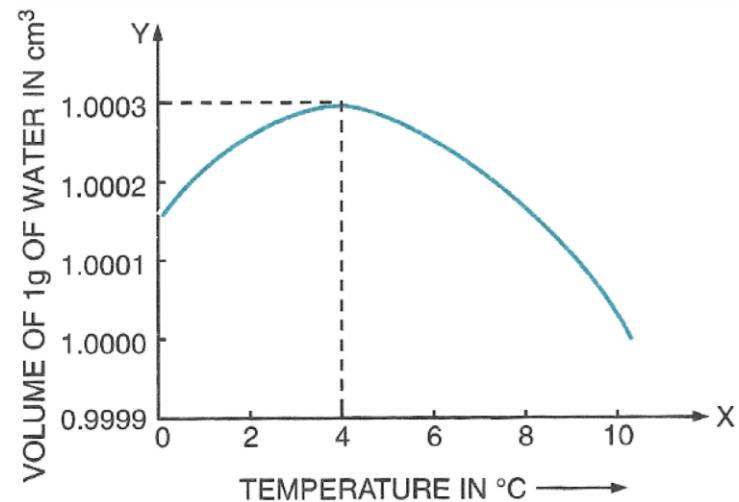
Question 15

Identify the correct graph showing the variation in the volume of water with temperature :

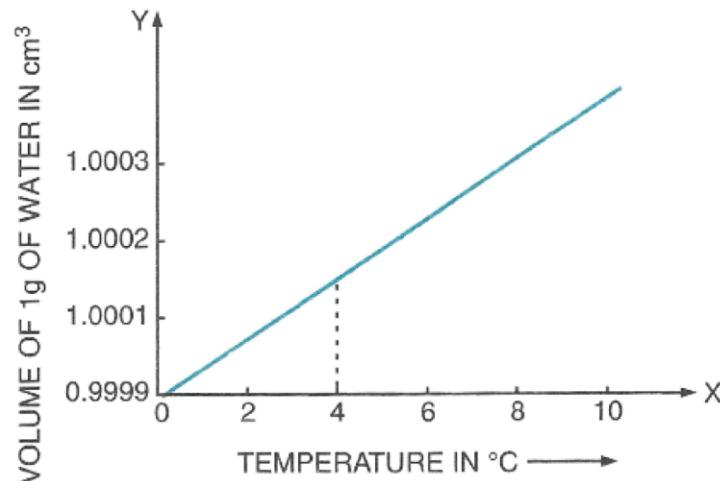
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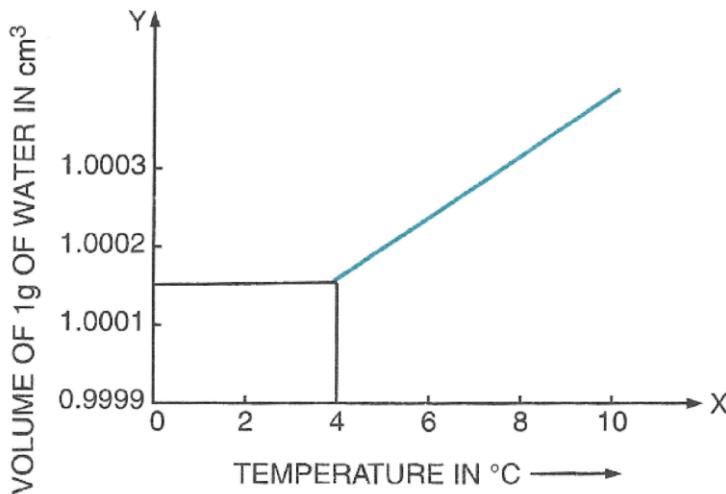
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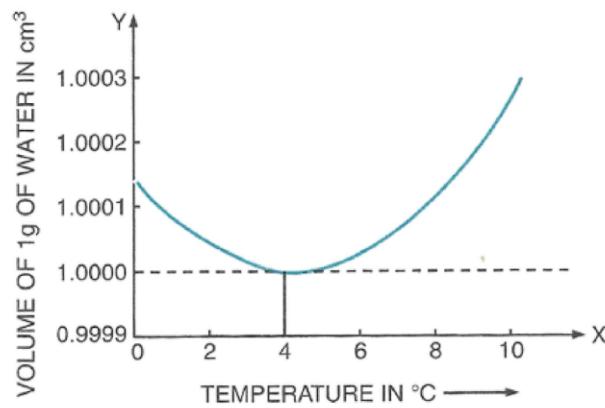
3.



4.



Answer



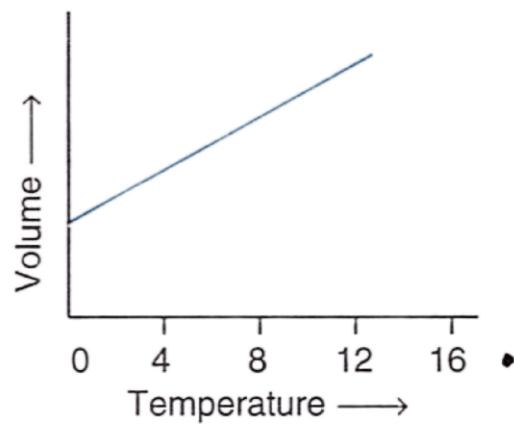
Reason — The volume of water first decreases on heating it from 0°C to 4°C and then increases on further heating it from 4°C

to 10°C . The volume of water is thus minimum at 4°C .

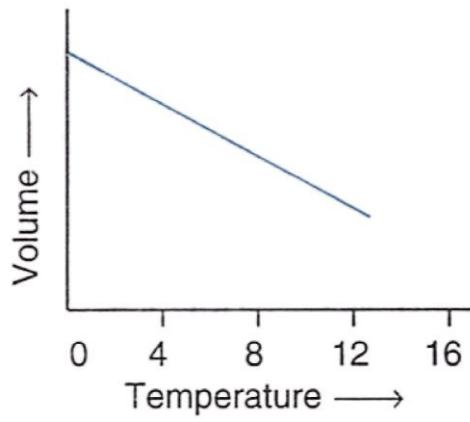
Question 16

Some quantity of water at 0°C is heated to 20°C . Identify the correct graph showing the variation of volume of water with temperature.

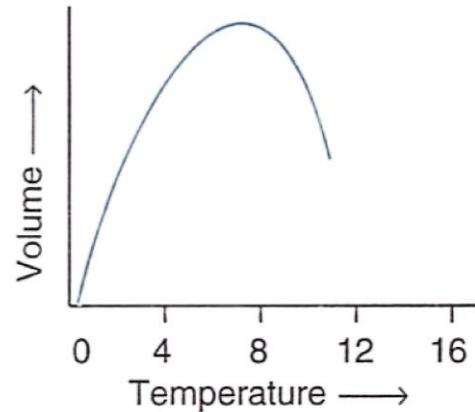
1.



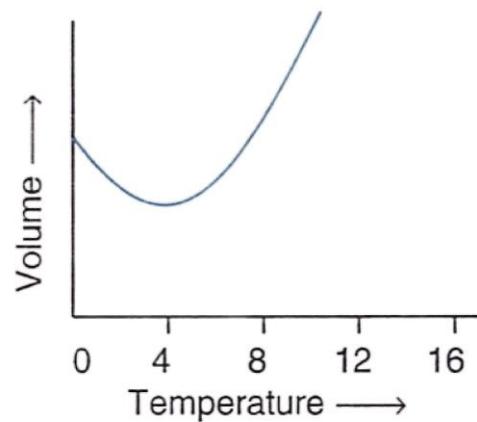
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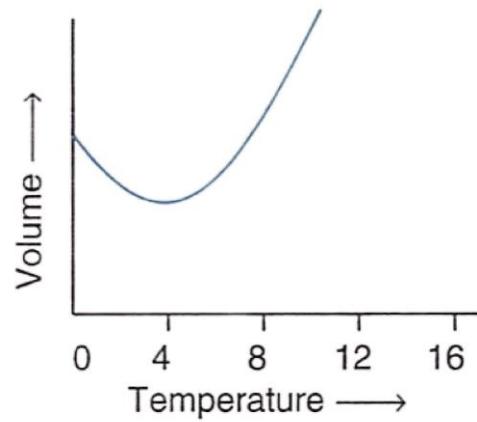
3.



4.



Answer



option 4

C

Reason — As from 0°C to 4°C , water contracts so its volume decreases as temperature increases, at 4°C water has maximum density and minimum volume and from 4°C to 20°C , water expands, i.e., volume increases as temperature increases.

So, the correct graph should show a decrease in volume from 0°C to 4°C and then an increase in volume from 4°C to 20°C . This forms a "U" shaped curve with the minimum point at 4°C .

Exercise 6(A) — Very Short Answer Type

Question 1

What is heat? Write its S.I. unit.

Answer

Heat is the form of energy that is transferred between two bodies at two different temperatures when kept in contact.

The S.I. unit of heat is **joule (J)**.

Question 2

Two bodies at different temperatures are placed in contact. State the direction in which heat will flow.

Answer

C

The **flow of heat is from the body at a higher temperature to a body at a lower temperature.** So, when a hot body is kept in contact with a cold body, the hot body becomes less hot and the cold body becomes less cold.

Question 3

Name the S.I. unit of heat. How is it related to the unit calorie?

Answer

The S.I. unit of heat is **joule (J).**

1 J = 0.24 cal (approximately).

Question 4

Define temperature and write its S.I. unit.

Answer

Temperature is a quantity which indicates the thermal state of a body (i.e., the degree of hotness or coolness of the body). It determines the direction of flow of heat when two bodies at different temperatures are placed in contact.

The S.I. unit of temperature is **Kelvin (K)**

Question 5

C

Why does a piece of ice when touched with hand, appear cool? Explain.

Answer

When we touch a piece of ice with our hand, heat passes from our hand to the ice. This happens because flow of heat is from a hot body to a cold body and as our hand is at a higher temperature than the ice cube therefore heat passes from our hand to the ice and we feel cold.

Question 6

Name two substances which expand on heating.

Answer

The two substances that expand on heating are **Brass and Iron**.

Question 7

Name two substances which contract on heating.

Answer

The two substances that contract on heating are —

1. Water from 0°C to 4°C
2. Silver iodide from 80°C to 141°C

Question 8

What do you mean by anomalous expansion of water?

Answer

The expansion of water when it is cooled from 4°C to 0°C , is known as anomalous expansion of water.

Question 9

At what temperature the density of water is maximum? State it's value.

Answer

The density of water is maximum at 4°C . It's value is 1000 kg m^{-3} .

Question 10

Deep pond of water has it's top layer frozen during winter. State the expected temperature of water layer (i) just in contact with ice, (ii) at the bottom of pond.

Answer

(i) The temperature of water layer just in contact with ice is 0°C .

(ii) The temperature of water layer at the bottom of pond is 4°C .

Exercise 6(A) — Short Answer Type

Question 1

Distinguish between heat and temperature.

Answer

Heat	Temperature
Heat is a form of energy obtained due to random motion of molecules in a system.	Temperature is a quality which tells the thermal state of a body (i.e., the degree of hotness or coolness of the body) and determines the direction of flow of heat on keeping the two bodies at different temperatures in contact.
S.I. unit of heat is Joule (J)	S.I. unit of temperature is Kelvin (K)

The amount of heat contained in a body depends on mass, temperature, material of the body	The temperature of a body depends on the average kinetic energy of its molecules due to their random motion.
Heat	Temperature
Heat is measured by the principle of calorimetry.	Temperature is measured by a thermometer.
Two bodies having same quantity of heat may differ in their temperature.	Two bodies at same temperature may differ in the quantities of heat contained in them.

When two bodies are placed in contact, the total amount of heat is equal to the sum of heat of the individual bodies.	When two bodies at different temperatures are placed in contact, the resultant temperature is a temperature in between the two temperatures .
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Question 2

What do you understand by thermal expansion of a substance?

Answer

The expansion of a substance on heating is called the thermal expansion of that substance.

Question 3

Name the three kinds of thermal expansion.
Out of solids, liquids and gases, which
expands more ?

Answer

The three kinds of thermal expansion are :

1. Linear expansion
2. Superficial expansion
3. Cubical expansion.

On heating, liquids expand more than solids
and gases expand much more than liquids.
Hence, expansion in gases is the most.

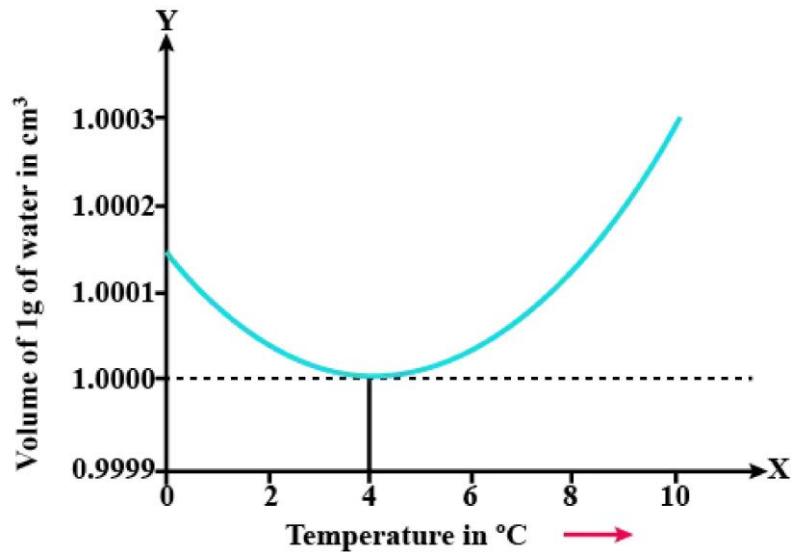
Question 4

State the volume changes observed when a
given mass of water is heated from 0°C to
10°C. Sketch a temperature-volume graph to
show the behavior.

Answer

The volume of water first decreases on
heating it from 0°C to 4°C and then increases
on further heating it from 4°C to 10°C. The
volume of water is thus minimum at 4°C.

Temperature-Volume graph showing the
variation in volume of water from 0°C to 10°C
is shown below:



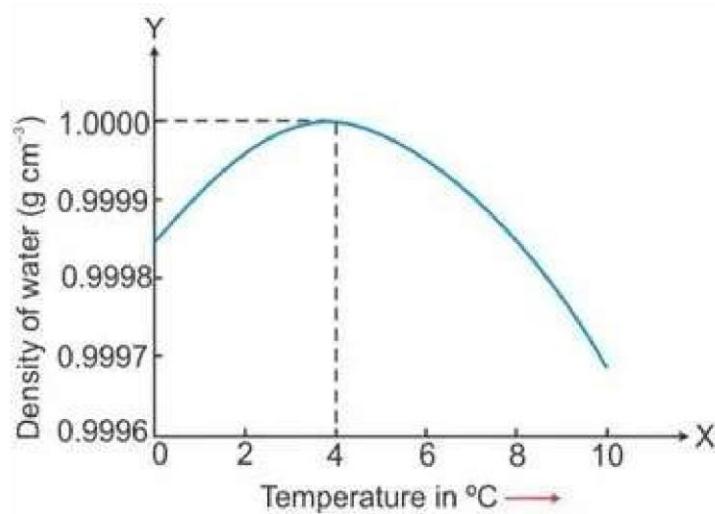
Question 6

Question 5

Draw a graph to show the variation in density of water with temperature in the temperature range from 0°C to 10°C.

Answer

The following graph shows the variation in density of water with temperature in the range of 0°C to 10°C.



A given mass of water is cooled from 10°C to 0°C . State the volume changes observed.

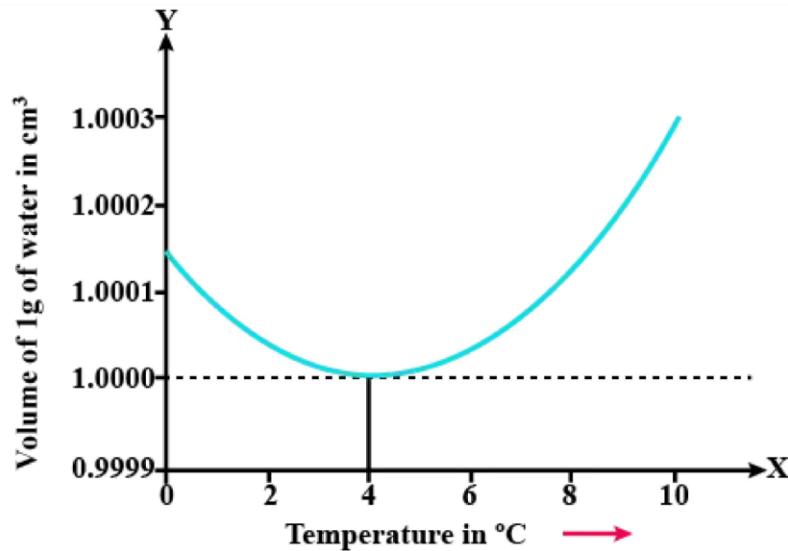
Represent these changes on a temperature-volume graph.

Answer

On cooling water from 10°C , the density of water first increases up to 4°C and then decreases on cooling further below 4°C to 0°C .

Hence, the density of water is maximum at 4°C which is equal to 1 g cm^{-3} (or 1000 kg m^{-3})

Temperature-Volume graph showing these changes is given below:



Question 7(a)

Explain the following:

Water pipes in colder countries often burst in winter.

Answer

In colder countries, during winter nights, as the temperature starts falling below 4°C , water in pipe lines expand and it exerts large pressure on the pipes, causing them to burst.

Question 7(b)

Explain the following:

In winter, water tank (or ocean) starts freezing from the surface and not from the bottom.

Answer

In winter, when the atmospheric temperature drops below 0°C , the surface water of a tank or ocean initially above 4°C starts losing heat to the air. As the surface water temperature falls below 4°C , it contracts and becomes denser, causing it to sink to the bottom. This process continues until the entire water mass reaches 4°C . As the top layers cool below 4°C , the water expands, reducing its density. Consequently, the water does not sink further but remains at the surface. When the air temperature falls below 0°C , the surface water gradually freezes into ice, while the water below the ice layer stays at 4°C . This is

why the freezing of a water tank (or ocean) begins from the top and not the bottom.

Question 7(c)

Explain the following:

Fishes survive in ponds even when the atmospheric temperature is below 0°C .

Answer

In winter, when the atmospheric temperature drops below 0°C , the surface water of a pond cools and contracts. It continues to sink until the entire water mass reaches a temperature of 4°C . Further cooling causes the top layers to expand and become less dense, preventing them from sinking. When the air temperature falls below 0°C , the surface water loses heat and gradually freezes into ice. However, the water beneath the ice layer remains at 4°C . The layer of water in contact with the ice is at 0°C , while the layers below gradually increase in temperature up to 4°C . Fish can survive in the pond because the ice acts as an insulator, preventing heat transfer from the water to the atmosphere.

Question 7(d)

Explain the following:

A hollow glass sphere which floats with its entire volume submerged in water at 4°C , sinks when water is heated above 4°C .

Answer

As we know that, the density of water decreases on heating water above 4°C . Hence, the upthrust acting on the glass sphere decreases and becomes less than the weight of the glass sphere, hence **the glass sphere sinks.**

Question 7(e)

Explain the following:

A glass bottle completely filled with water and tightly closed at room temperature, is likely to burst when kept in the freezer of a refrigerator.

Answer

Due to the anomalous nature of water it expands when the temperature goes below 4°C inside the freezer. As the glass bottle is completely filled with water and tightly closed, so there is no space for the water to expand and hence the **bottle bursts.**

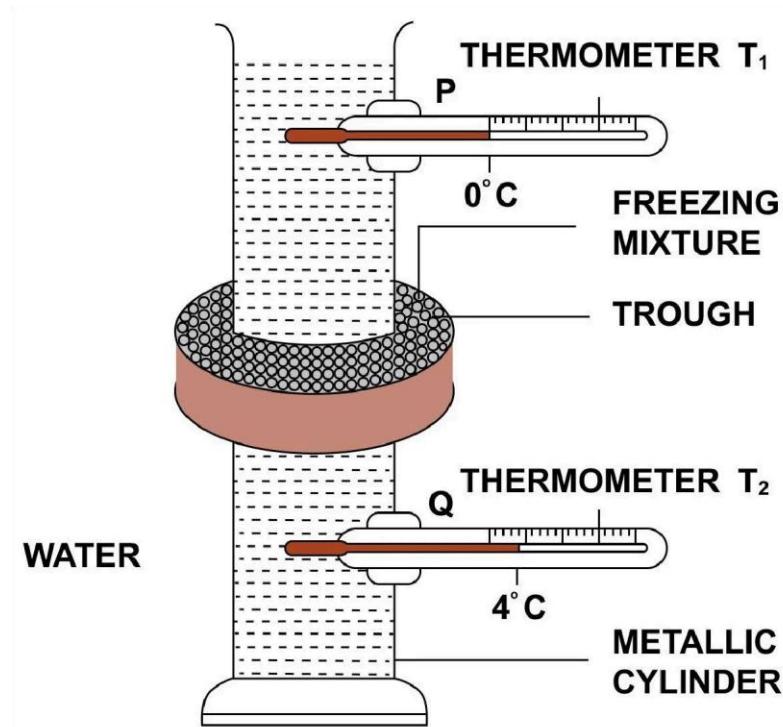
Exercise 6(A) — Long Answer type

Question 1

Describe an experiment to show that water has maximum density at 4°C. What important consequences follow from this peculiar property of water? Discuss the importance of this phenomenon in nature.

Answer

Hope's apparatus can be used for demonstrating that water has maximum density at 4°C. The apparatus consists of a tall metallic cylinder with two side openings P, near the top and Q near the bottom, fitted with thermometers T₁ and T₂ respectively.



The central part of the cylinder is surrounded by a cylindrical trough containing a freezing mixture of ice and salt. The cylinder is filled with pure water at room temperature. The

temperature recorded by both the thermometers is observed at regular intervals of time.

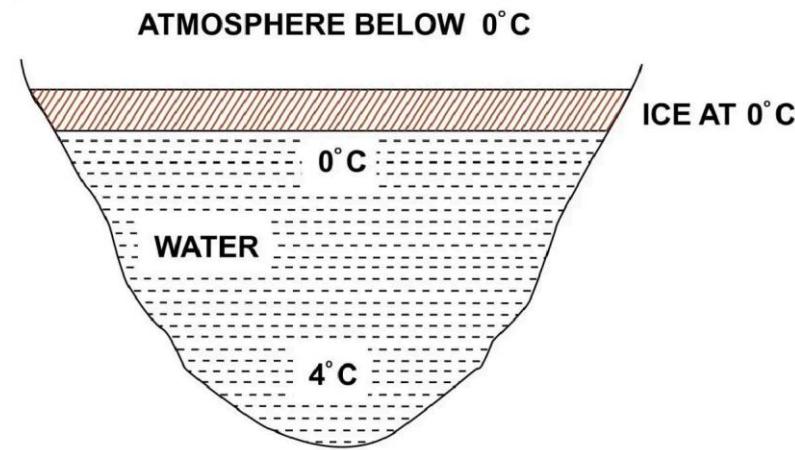
Observations —

1. Initially both thermometers T_1 and T_2 show same temperature (i.e., room temperature).
2. First the temperature recorded by lower thermometer T_2 , starts decreasing and finally it becomes steady at 4°C , while the temperature recorded in upper thermometer T_1 remains almost unchanged during this time.
3. While the temperature recorded by lower thermometer T_2 remains constant at 4°C , the upper thermometer T_1 shows a continuous fall in temperature up to 0°C and then it also becomes steady.
4. At this stage, the lower thermometer T_2 shows the temperature 4°C at which water has the maximum density while the upper thermometer T_1 shows the temperature of water and ice at 0°C .

Important consequences that follow due to this peculiar property of water (i.e., anomalous expansion of water) are:

1. It is responsible for bursting of water pipelines and destruction of crops during very cold nights.
2. It helps in preserving aquatic life during very cold weather.

In nature, during winter when the atmospheric temperature starts falling below 0°C , water at the surface of a pond initially at temperature above 4°C , begins to radiate heat to the atmosphere, so the temperature of water near the surface starts falling.



When temperature of water at the surface falls below 4°C , water contracts and its density increases and therefore, it sinks to the bottom.

This continues till temperature of entire water reaches to 4°C . Now, further cooling of top layers below 4°C results in expansion of water and so its density decreases.

As a result, water does not sink further, but it remains on the surface. When the temperature of atmosphere falls below 0°C , water on the surface loses further heat to the atmosphere and gradually freezes into ice, but water below the ice layer remains at 4°C .

The water layer just below the ice in contact with it will be at 0°C , as shown in figure. Since, ice is a poor conductor of heat, so ice now prevents the flow of heat from water of the pond to the atmosphere.

Thus, temperature of water in contact with ice is at 0°C and that of layers below the ice gradually increases to 4°C . As a result, fish and other aquatic creatures remain alive in water of the pond (or lake), though water on the surface has frozen into ice. Nature thus protects the aquatic life during the winter season.

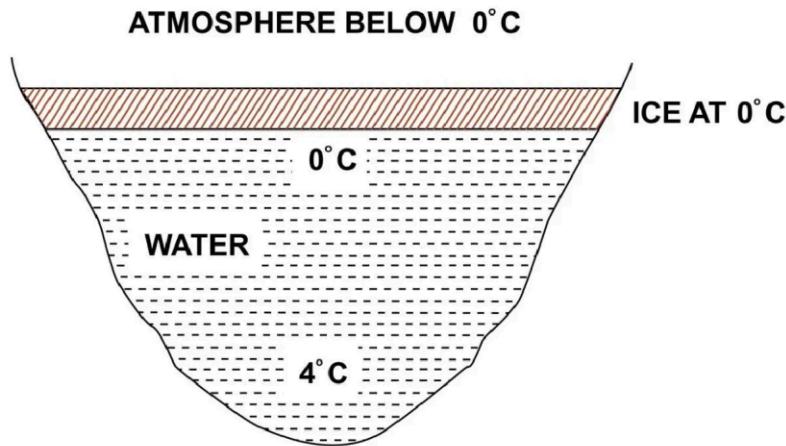
Question 2

Draw a diagram showing the temperature of various layers of water in an ice covered pond.

Answer

Below diagram shows the temperature of various layers of water in an ice covered

pond:



Exercise 6(B) — Multiple Choice Type

Question 1

Out of the following components, which one is not abiotic ?

1. trees
2. light
3. heat
4. rain

Answer

trees

Reason — Biotic components in an ecosystem are the living organisms (i.e., producers, consumers and decomposers) and abiotic components are the non-living factors. Hence, in the options above, trees are biotic whereas light, heat, rain are abiotic.

Question 2

Plants use of the total energy absorbed by them in photosynthesis for producing their food.

1. 40%
2. 50%
3. 5%
4. 0.02%

Answer

0.02%

Reason — Out of the 8% heat energy falling on plants, they use only 0.02% in photosynthesis for producing their food.

Question 3

Food chain begins with :

1. respiration
2. photosynthesis
3. decomposition
4. decay

Answer

photosynthesis

Reason — In a food chain, the first level are the producers (photosynthetic plants). They synthesize organic substances by the process

of photosynthesis (i.e., they combine simple compounds with the help of solar energy into complex organic substances).

Question 4

The source of energy in an ecosystem is :

1. sun
2. decayed bodies
3. green plants
4. sugar

Answer

sun

Reason — The most significant source of energy for all ecosystems is the **sun..**

Question 5

Energy enters in a food chain through:

1. primary consumers
2. secondary consumers
3. tertiary consumers
4. producers

Answer

producers

Reason — In a food chain, the first level are the **producers (photosynthetic plants)**. They

utilize the energy received from the sun to synthesize organic substances by the process of photosynthesis (i.e., they combine simple compounds with the help of solar energy into complex organic substances).

Question 6

The place of human being in food chain in an ecosystem is as:

1. producer
2. consumer
3. decomposer
4. both (a) & (b)

Answer

consumer

Reason — Human beings are consumers in the food chain.

Question 7

Secondary consumers are :

1. Herbivores
2. Carnivores
3. Krill
4. All of the above

Answer

Reason — Secondary consumers are organisms that feed on primary consumers (herbivores). Hence, they are carnivores. For example, Krill can act as secondary consumers in marine ecosystems by feeding on phytoplankton (primary producers)

Question 8

In an aquatic ecosystem, act as producers:

1. small fishes
2. plants
3. krill
4. large fishes

Answer

plants

Reason — Plants are the primary producers in aquatic ecosystems. They convert sunlight and nutrients into energy through photosynthesis, serving as the foundation of the food chain. Other organisms, such as small fishes, krill, and large fishes, typically act as consumers rather than producers in the aquatic ecosystem.

Question 9

First law of thermodynamics is also known as

1. conservation of mass
2. conservation of energy
3. conservation of force
4. conservation of momentum

Answer

conservation of energy

Reason — According to the first law of thermodynamics — Energy can be transformed from one form to another form, but it can neither be created nor destroyed. Hence, energy is always conserved.

Question 10

Choose the correct statement(s):

- A. According to the first law of thermodynamics, when energy is put to work, a part of it is always converted to non-useful form such as heat, mainly due to friction and radiation.
 - B. According to the second law of thermodynamics, energy can be transformed from one form to another, but it can neither be created nor destroyed.
1. Both (A) and (B)
 2. only (B)
 3. only (A)

4 None of these

Answer

None of these

Reason — The laws of thermodynamics are stated below:

1. First law of thermodynamics (Law of conservation of energy) — Energy can be transformed from one form to another form, but it can neither be created nor destroyed.

2. Second law of thermodynamics — When energy is put to work, a part of it is always converted in unuseful form mainly as heat, due to friction and radiation.

Exercise 6(B) — Very Short Answer Type

Question 1

What is an ecosystem? Name its two components.

Answer

A unit composed of **biotic components** (i.e., **producers, consumers and decomposers**) and **abiotic components** (**heat, rain, humidity, inorganic and organic substances**) is called an ecosystem.

- 1 Biotic component,
2. Abiotic component.

Question 2

What is a food chain?

Answer

A series of organisms linked by the process of eating and being eaten which shows linear flow of energy through different trophic levels is called Food chain.

Question 3

State the law which governs the energy flow in an ecosystem.

Answer

Energy flow in an ecosystem is governed by the laws of thermodynamics that are stated below:

1. **First law of thermodynamics (Law of conservation of energy)** — Energy can be transformed from one form to another form, but it can neither be created nor destroyed.
2. **Second law of thermodynamics** — When energy is put to work, a part of it is always converted in unuseful form mainly as heat due to friction and radiation.

Question 4

Give two examples each of biotic and abiotic components ?

Answer

Examples of :

1. biotic components : trees, animals
2. abiotic components : heat, rain

Question 5

From where do the tertiary consumers obtain their energy ?

Answer

The tertiary consumers (such as large fish) eat the small fish (secondary consumers) and get energy.

Exercise 6(B) — Short Answer Type

Question 1

What is the source of energy for all ecosystems?

Answer

The most significant source of energy for all ecosystems is the **Sun**.

Question 2

State the importance of green plants in an ecosystem.

Answer

Green plants absorb most of the energy that is incident on them and by the process of photosynthesis they produce food for the consumers. Thus, they serve as the primary producers in the ecosystem. They also help in maintaining the balance of Oxygen and Carbon dioxide on earth.

Question 3

Differentiate between the producers and consumers.

Answer

Producers	Consumers
Producers produce their own food using energy from the Sun.	Consumers do not produce their own food and obtain their food from producers.
Example — Green plants	Example — Herbivores

Question 4

State the functions of decomposers in an ecosystem.

Answer

The role of a decomposer in an ecosystem is to break down dead organisms and then feed on them. The nutrients created by the dead organisms are returned to the soil to be later used by the producers. Once these deceased organisms are returned to the soil, they are used as food by bacteria and fungi by transforming the complex organic materials into simpler nutrients. The simpler products can then be used by producers to restart the cycle.

Question 5

What are primary, secondary and tertiary consumers ? Explain briefly by giving examples.

Answer

Primary consumers obtain their food from producers (plants). Example - krill eats grass.

Secondary consumers obtain energy by eating primary consumers (herbivores).
Example - Small fish eats krill.

Tertiary consumers obtain energy as food from secondary consumers (large predators).
Example, Large fish eats small fish.

Question 6

The energy transfer in an ecosystem is not 100% efficient. Why ?

Answer

According to the second law of thermodynamics, when energy is put to work, a part of it is always converted in unuseful form mainly as heat, due to friction and radiation. In all such cases the total sum of useful and unuseful energy remains constant. So, similar to machines, in ecosystems also the energy transfer is not 100% efficient. The energy used in respiration and in decay (or death) appears as unuseful heat energy because this energy does not reach to the consumer of next stage. This aligns with the second law of thermodynamics.

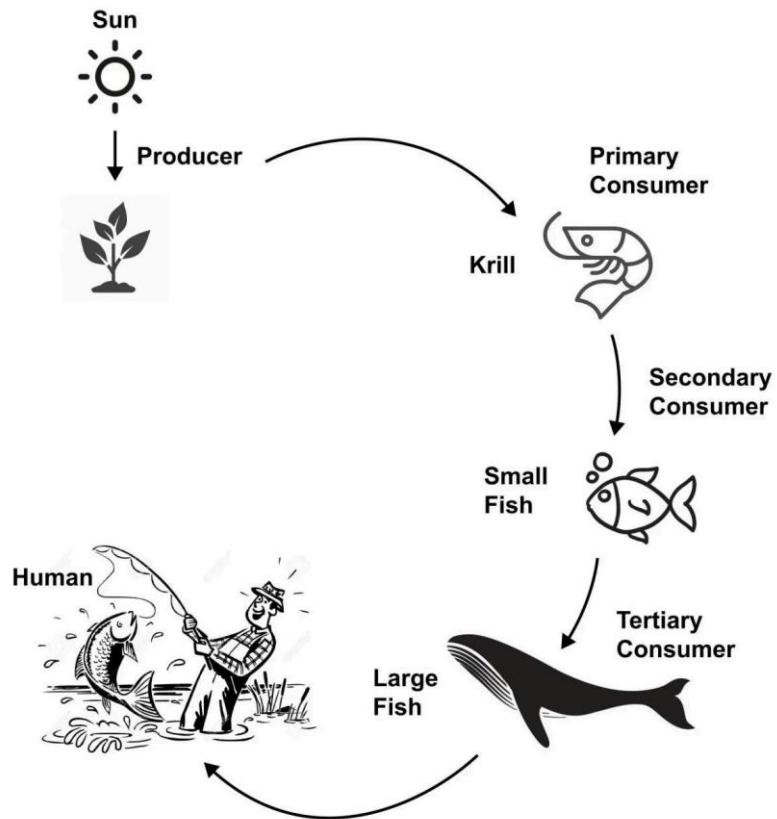
Exercise 6(B) — Long Answer Type

Question 1

Draw a simple diagram showing a food chain.

Answer

Below diagram shows a food chain:

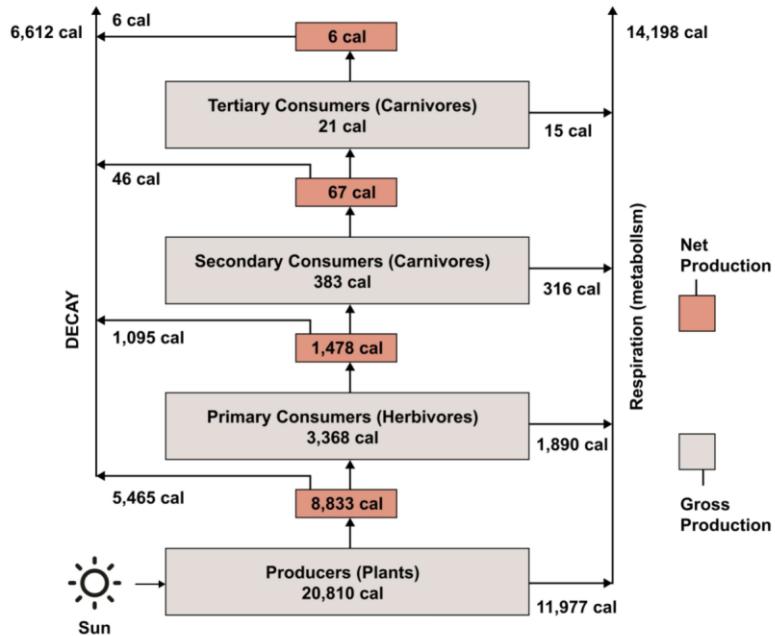


Question 2

Describe the energy flow in an ecosystem.

Answer

The diagram below shows the energy flow in the ecosystem.



The producers (photo-synthetic plants) synthesize organic substances by the process of photosynthesis. The chemical energy so stored in plants is called gross primary production. The producers themselves first use the synthesized organic substances in the process of respiration in which some energy is used in oxidation of organic substances. The rest of the energy, called the net primary production, is stored for the growth, development and important metabolic processes.

Next the primary consumers (herbivores) obtain their food from the producers, so they obtain only a small part of energy from the producers and the rest is wasted in decay of producers. A small part of the energy obtained by the primary consumers is utilized

in respiration and the remaining part is stored in them as food.

Afterwards, a small part of the energy stored as food in the primary consumers is obtained by the secondary consumers (carnivores).

They again make use of a part of the energy in respiration and rest is stored in them as food.

By repeating the sequence, the tertiary consumers (carnivores) obtain energy as food from the secondary consumers and utilise a small part of it in respiration and remaining energy is wasted in their decay and decomposition.

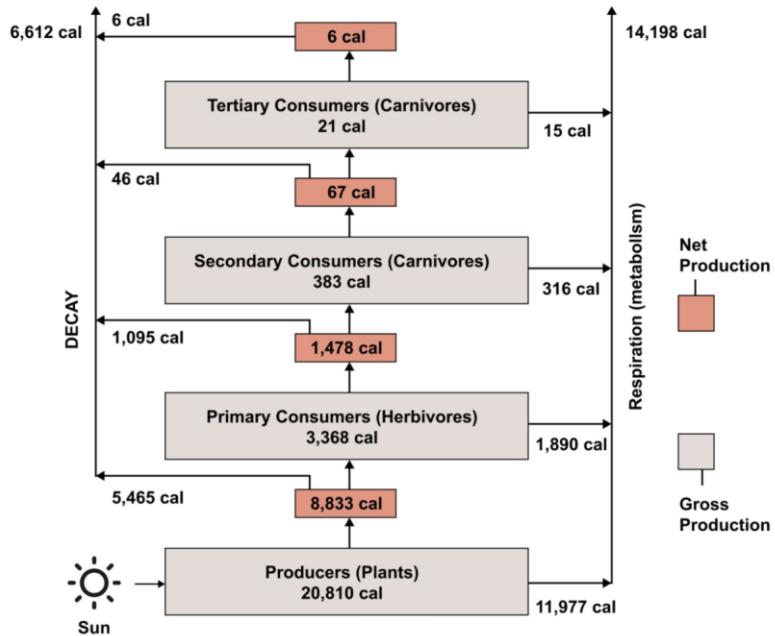
The energy flow in ecosystems is thus linear i.e., it moves in a fixed direction. At the end, the energy reaches to the degraded (or unuseful) state. It does not return to the sun to make the process cyclic.

Question 3

Show that the energy flow in an ecosystem is linear.

Answer

The diagram below shows the energy flow in the ecosystem.



Plants being primary producers, absorb solar energy to prepare food. This food is then used up by primary consumers, so they obtain only a small part of energy from the producers and rest is wasted in decay of producers.

Afterwards, a small part of energy stored as food in primary consumers is obtained by secondary consumers (carnivores). They again use a part of energy in respiration and rest is stored in them as food.

Now, the tertiary consumers (carnivores) obtain energy as food from the secondary consumers and utilise a small part in respiration and rest is wasted in their decay and decomposition.

The energy flow in ecosystems is thus linear

i.e., it moves in a fixed direction. At the end

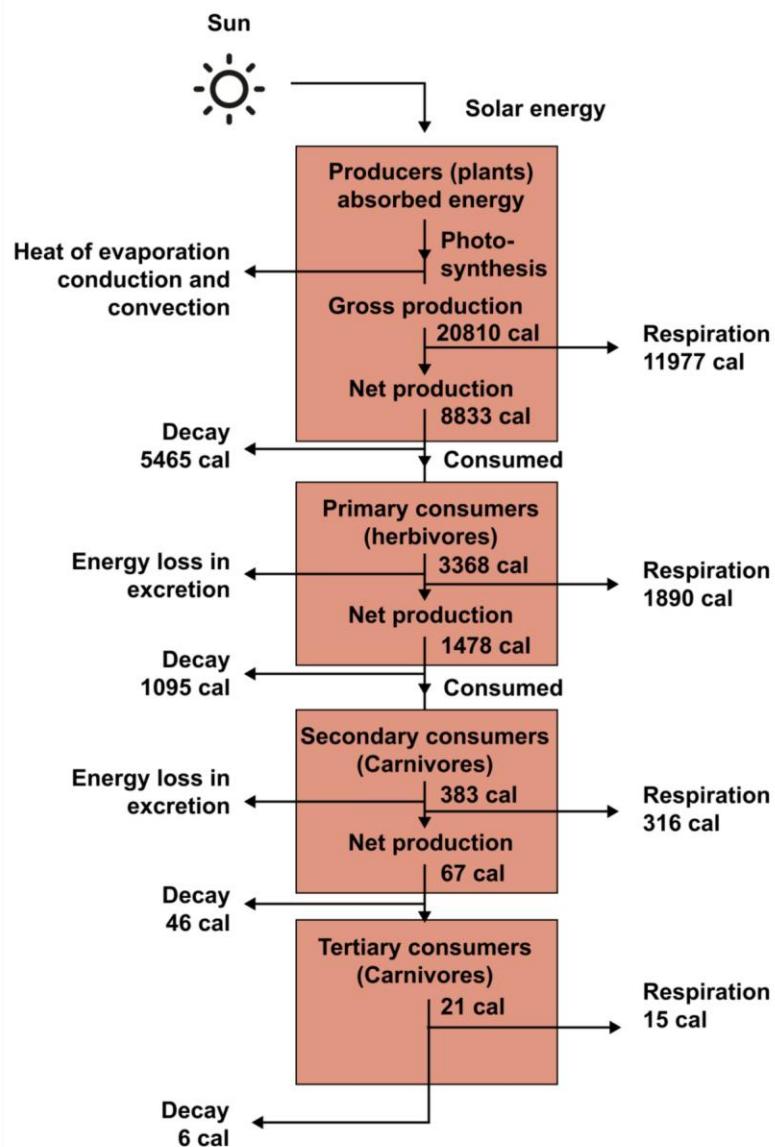
the energy reaches to the degraded (or unuseful) state. It does not return to the sun to make the process cyclic.

Question 4

Draw a simple diagram showing the energy flow in a food chain.

Answer

Below diagram shows the energy flow in a food chain:

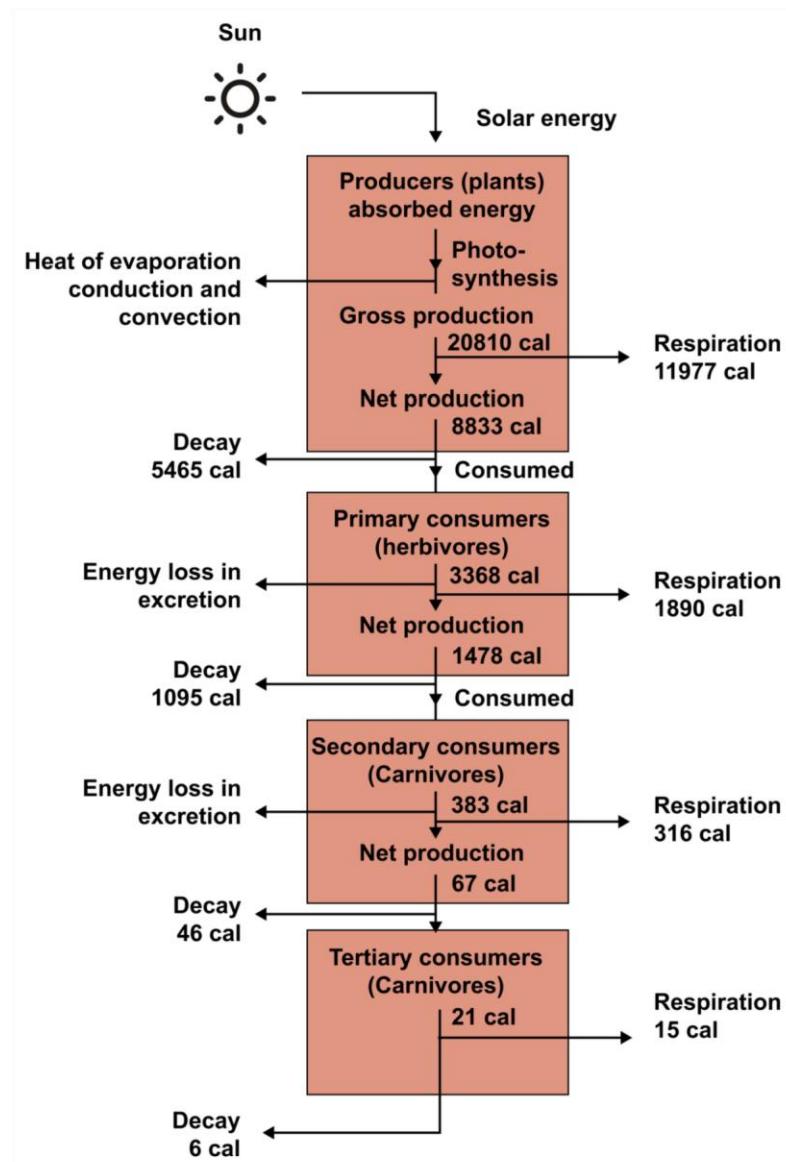


Question 5

Draw a diagram to show that the energy flow in an ecosystem is governed by the law of conservation of energy.

Answer

Below diagram shows that the energy flow in an ecosystem is governed by the law of conservation of energy:



Exercise 6(C) – Multiple Choice

Type

Question 1

The ultimate source of energy is —

1. wood
2. wind
3. water
4. sun

Answer

sun

Reason — The most significant source of energy for all ecosystems is the **sun**.

Question 2

A natural source providing us energy continuously is called -

1. non-renewable
2. conventional
3. renewable
4. none of the above

Answer

renewable

Reason — From the point of view of availability, the various sources of energy are classified into the following two groups —

1. Renewable or non-conventional sources of energy — are sources from which energy can be obtained continuously over a long period of time.
2. Non-renewable or conventional sources of energy — sources from which energy cannot be continuously obtained over a long period of time.

Question 3

The energy of wind is called wind energy.

1. potential
2. chemical
3. electric
4. kinetic

Answer

kinetic

Reason — The large mass of moving air is called wind. Due to motion, it has kinetic energy. The **kinetic energy of wind is called wind energy**.

Question 4

The energy obtained from the sun is called -

1. solar
2. renewable

3. non-renewable
4. both (a) and (b)

Answer

both (a) and (b)

Reason — Sun is the main source of various types of energy. The energy obtained from the sun is called **solar energy**. It is a renewable source of energy.

Question 5

The correct renewable sources of energy are

:

- (i) Biomass
 - (ii) Nuclear fuel
 - (iii) Coal
 - (iv) Petroleum
1. (i)
 2. (iii)
 3. (ii) and (iv)
 4. (i) and (ii)

Answer

(i) and (ii)

Reason — Coal and petroleum are **non-renewable sources** whereas, biomass and

nuclear fuel are **renewable sources**.

Question 6

Geothermal energy is the energy possessed by the:

1. Sun
2. Wind
3. Biomass
4. Rocks

Answer

Rocks

Reason — At some places, rocks below the surface of the earth are very hot. Such places are known as hot spots. The heat energy possessed by rocks inside the earth is called geothermal energy.

Question 7

The main constituent of biogas is :

1. oxygen
2. carbon dioxide
3. nitrogen
4. methane

Answer

methane

Reason — The main constituent of biogas is methane (65%) and the rest is a mixture of carbon dioxide, hydrogen and hydrogen sulphide.

Question 8

The chemical formula of the strong-smelling substance that is mixed in LPG is :

1. $\text{C}_2\text{H}_2\text{SH}$
2. $\text{C}_2\text{H}_5\text{SH}$
3. CH_5SH
4. C_2SH_3

Answer

$\text{C}_2\text{H}_5\text{SH}$

Reason — LPG is stored in gas cylinders after mixing a strong smelling substance called ethyl mercaptan ($\text{C}_2\text{H}_5\text{SH}$) so that the gas leakage, if any, from the cylinder can easily be detected.

Question 9

The process used for refining of petroleum is known as:

1. evaporation
2. filtration
3. distillation

4 fractional distillation

Answer

fractional distillation

Reason — The process of separating useful components from crude petroleum is called refining which is done by fractional distillation in big oil refiners set up for this purpose.

Question 10

Identify the incorrect statement/s about solar panels.

- (i) The running costs of solar panels is very high.
 - (ii) They do not cause any pollution.
 - (iii) They last over a long period of time.
1. (i)
2. (ii)
3. (iii)
4. (i) and (iii)

Answer

(i)

Reason — The solar panels :

- 1. do not require maintenance

2. last over a long period of time

3. running cost is almost nil
4. do not cause any pollution.
5. do not cause pollution.

Question 11

The non-renewable sources of energy are :

1. Coal
2. Petroleum
3. Natural gas
4. All of the above

Answer

All of the above

Reason — Coal, petroleum, and natural gas are non-renewable sources of energy. These resources are finite and take millions of years to form. Once they are depleted, they cannot be replenished within a human timescale.

Question 12

In a hydroelectric plant :

1. Water is converted to steam to turn turbines and produce electrical energy.
2. Potential energy of stored water is converted into electrical energy.
3. Kinetic energy of stored water is converted into electrical energy.

4 All of the above.

Answer

Potential energy of stored water is converted into electrical energy.

Reason — In a hydroelectric plant, water is stored at a height in a dam. When it flows down, its potential energy is converted into kinetic energy, which then drives turbines to produce electricity.

Exercise 6(C) — Very Short Answer Type

Question 1

State two characteristics which a source of energy must have.

Answer

The characteristics that a source of energy must have are —

1. A source of energy should be such that it can provide an adequate amount of useful energy at a steady rate over a long period of time.
2. It should be safe and convenient to use.

Question 2

Select the renewable and non-renewable sources of energy from the following —

- (a) Coal
- (b) Wood
- (c) Water
- (d) Diesel
- (e) Wind
- (f) Oil

Answer

- (a) Coal — **non-renewable source**
- (b) Wood — **renewable source**
- (c) Water — **renewable source**
- (d) Diesel — **non-renewable source**
- (e) Wind — **renewable source**
- (f) Oil — **non-renewable source**

Question 3

What is the main source of energy for the earth?

Answer

The main source of energy for the earth is the **Sun.**

Question 4

State the energy transformation in the following —

1. electricity is obtained from solar energy.
2. electricity is obtained from wind energy.
3. electricity is obtained from hydro energy.
4. electricity is obtained from nuclear energy.

Answer

1. Light energy is transformed into electrical energy when electricity is obtained from solar energy.
2. Mechanical energy is transformed into electrical energy when electricity is obtained from wind energy.
3. Mechanical energy is transformed into electrical energy when electricity is obtained from hydro energy.
4. Nuclear energy is transformed into electrical energy when electricity is obtained from nuclear energy.

Question 5

The conversion of part of energy into an unuseful form of energy is called

Answer

The conversion of part of energy into an unuseful form of energy is called **degradation**

of energy.

Exercise 6(C) — Short Answer Type

Question 1

Name the two groups in which various sources of energy are classified. State on what basis are they classified.

Answer

From the point of view of availability, the various sources of energy are classified into the following two groups —

1. Renewable or non-conventional sources of energy
2. Non-renewable or conventional sources of energy

Question 2

What is meant by renewable and non-renewable sources of energy? State two differences between them, giving two examples of each.

Answer

Renewable sources of energy or non-conventional source are sources from which energy can be obtained continuously over a long period of time.

Non-renewable source of energy or conventional source are sources from which energy cannot be continuously obtained over a long period of time.

Difference between renewable and non-renewable sources of energy are as follows

Renewable sources of energy or non-conventional source	Non-renewable sources of energy or conventional source
These sources can be regenerated.	These sources cannot be regenerated.
These are natural sources which will not get exhausted.	These are natural sources which will get exhausted with time.
Example — Sun, wind, water etc.	Example — Coal, petroleum, natural gas .

Question 3

Why is the use of wood as a fuel not advisable although wood is a renewable source of energy?

Answer

Although wood, obtained from trees, is also considered a renewable source of energy, trees usually takes more than 15 years to grow fully, therefore, renewable of wood as source of energy takes a long time.

Further, cutting of trees on a large scale causes depletion of forests which results in global warming and environmental imbalance. Hence, use of wood as a source of energy must be avoided

Question 4

Name five renewable and three non-renewable sources of energy.

Answer

The five renewable sources of energy are:

1. Sun
2. Wind
3. Flowing water
4. Bio mass and bio fuels from waste
5. Tides

The three non-renewable sources of energy are:

1. Coal
2. Petroleum

3. Natural gas

Question 5

What is (i) tidal, (ii) ocean and (iii) geothermal energy? Explain in brief.

Answer

(i) **Tidal energy** — the energy possessed by rising and falling water in tides is known as tidal energy.

But this is not a major source of energy because of the following two reasons —

1. The rise and fall of sea water during tides is not enough to generate electricity on a large scale.
2. There are very few sites which are suitable for building tidal dams.

(ii) **Ocean** — Water in oceans possesses energy in two forms:

1. Ocean thermal energy — The energy available due to the difference in temperature of water at the surface and at deeper levels of ocean.
2. Oceanic (or sea) waves energy — the kinetic energy possessed by fast moving oceanic (or sea) waves.

(iii) **Geothermal energy** — The heat energy possessed by rocks inside the earth is called geothermal energy.

It is harnessed to produce electricity. The rocks present at hot spots, heat the underground water and turn it into steam, which gets compressed at high pressure between the rocks.

By drilling holes into the earth up to the hot spots, steam is extracted through pipes which is utilized to rotate the turbine connected to the armature of an electric generator to produce electricity.

Question 6

State two advantages and two limitations of producing electricity from solar energy.

Answer

Advantages of producing electricity from solar energy —

1. They do not cause any pollution in the environment. They are the cleanest source of energy.
2. They are most suitable for the remote, inaccessible and isolated places where electric power lines cannot be laid.

Limitations of producing electricity from solar energy —

1. Initial cost of solar panel is sufficiently high.
2. The efficiency of conversion of solar energy to electricity is low.

Question 7

State two advantages and two limitations of using wind energy for generating electricity.

Answer

Advantages of using wind energy for generating electricity —

1. Does not cause any kind of pollution.
2. It is an everlasting (renewable) source of energy.

Limitations of using wind energy for generating electricity —

1. The wind farms can be established only at places near the coastal areas where wind blows around the year steadily with a speed not less than 15 km h^{-1} .
2. A large area of land is needed for the establishment of a wind farm.

Question 8

What is nuclear energy? Name the process used for producing electricity using the nuclear energy.

Answer

Nuclear energy is the energy released in nuclear fission and nuclear fusion reactions.

In both these processes, the origin of energy is the loss in mass i.e., the sum of masses of the products of reaction is less than the sum of masses of reactants and this loss in mass is converted into energy E according to Einstein's mass-energy equivalence relation

$E = mc^2$, where $c (= 3 \times 10^8 \text{ m s}^{-1})$ is the speed of light and m is the loss in mass.

Nuclear fission with controlled chain reaction in a nuclear reactor is used for producing electricity using the nuclear energy.

Exercise 6(C) — Long Answer Type

Question 1

What is solar energy? How is solar energy used to generate electricity in a solar power plant?

Answer

The **energy obtained from the sun is called solar energy.**

To obtain electricity from solar energy two devices are used — **a solar cell** and **a solar power plant.**

The device which converts solar energy directly into electricity is called a solar cell.

On the other hand, a **solar heating device used to generate electricity from solar energy, is called a solar power plant.**

The sun's rays after reflection from a large concave reflector gets concentrated at its focus. The rays have sufficient heat energy which can boil water, if it is placed at the focus of the reflector. This **principle is used in a solar power plant.**

A solar power plant consists of a number of big concave reflectors, at the focus of which, there are black painted water pipes. The reflectors concentrate the heat energy of the sun rays on the pipes due to which water inside the pipes starts boiling and produces steam.

The steam thus produced is used to rotate a steam turbine which drives a generator producing electricity.

Question 2

What is a solar cell? State two uses of solar cells. State whether a solar cell produces a.c. or d.c. Give one disadvantage of using a solar cell.

Answer

Solar cell — The device which converts solar energy directly into electricity is called solar cell.

Uses of solar cells are as follows —

1. A large number of solar cells are arranged over a large area to form a solar panel. They are made to collect a large amount of solar energy to produce sufficient electricity.
2. Small solar cells are used in watches and calculators.

A solar cell produces d.c. electricity which cannot be used for many household purposes.

One disadvantage of solar cell is that the **initial cost of a solar cell is sufficiently high**

Question 3

State two advantages and two disadvantages of producing hydro-electricity.

Answer

Advantages of producing hydro-electricity are:

1. It does not produce any environmental pollution.

2. It is a renewable source of energy.

Disadvantages of producing hydro-electricity are:

1. The flowing water is not available everywhere.
2. Due to the construction of dams over rivers, plants and animals of that place gets destroyed or killed.

Question 4

What percentage of total electrical power generated in India is obtained from nuclear power plants? Name two places in India where electricity is generated from nuclear power plants.

Answer

At present, only about 3% of the total electrical power generated in India is obtained from nuclear power plants.

The two places in India from where electricity is generated from nuclear power plants are —

1. Tarapur in Maharashtra
2. Narora in Uttar Pradesh

Question 5

State two advantages and two disadvantages of using nuclear energy for producing

electricity.

Answer

Advantages of using nuclear energy to produce electricity are as follows —

1. A very small amount of nuclear fuel (such as uranium-235) can produce a tremendous amount of energy.
2. Once the nuclear fuel is loaded into the nuclear power plant, it continues to release energy over a long period of time.

Limitations of using nuclear energy to produce electricity are as follows —

1. It is not a clean source of energy because very harmful nuclear radiations are produced in the process which are highly energetic and penetrating.
2. The waste obtained from the nuclear power plants causes a high degree of environmental pollution.

Question 6

State four ways for the judicious use of energy.

Answer

The four ways for the judicious use of energy are —

1. The fossil fuels such as coal, petroleum, etc. should be used only for a limited purpose when no other alternative source of energy is available.
2. Wastage of energy should be avoided.
3. Cutting of trees must be banned and more and more trees should be planted.
4. Efforts must be made to make judicious use of energy in the community.

Question 7

What do you mean by degradation of energy? Explain it by taking two examples of your daily life.

Answer

The gradual decrease of useful energy due to radiation loss, friction, etc. is called degradation of energy.

Examples of degradation of energy —

1. In transmission of electricity from a power generating station, a lot of electrical energy is wasted in the form of heat energy in the line wires used for transmission.

2. When we cook food over a fire, the major part of heat energy obtained from the fuel is radiated out in the atmosphere. This radiated energy is of no use to us. It is thus a degraded form of energy.

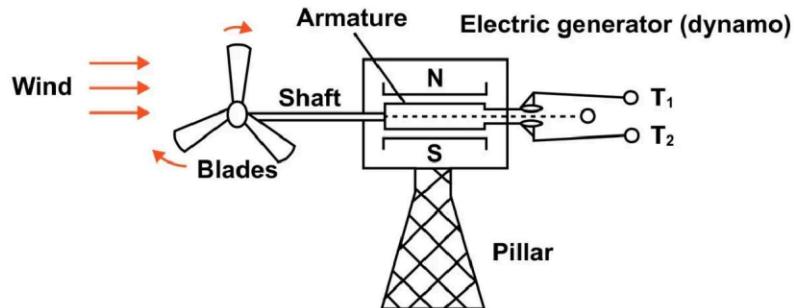
Question 8

What is wind energy? How is wind energy used to produce electricity? How much electric power is generated in India using wind energy?

Answer

The large mass of moving air is called wind. Due to motion, it has kinetic energy. The **kinetic energy of wind is called wind energy.**

Wind energy is used in a wind generator to produce electricity by making use of a wind mill (or wind turbine) to drive a wind generator.



The figure above shows the arrangement of a **wind generator in which a small electric**

generator (or dynamo) is placed at the top of a pillar. The armature of the dynamo is connected to the shaft attached with the blades of a wind mill. When the blowing wind strikes the blades of the wind mill, the kinetic energy of wind changes into rotational kinetic energy of the blades.

The rotation of blades of the turbine rotates the armature of the dynamo in the magnetic field between the pole pieces N and S of a strong magnet, thus an alternating e.m.f is produced between the terminals T_1 and T_2 and hence electric power is generated.

The electric power generated by a single wind mill generator is small. So to generate a sufficient amount of electric power, a large number of such wind generators are arranged over a big area called a wind farm, and then the electric power generated by each generator is combined together for supply to the consumers.

At present in India, we are generating more than 10,000 MW electric power by this technique in coastal areas of Gujarat and Tamil Nadu.

Exercise 6(D) — Multiple Choice Type

The gases which are good of long wavelength infrared radiations are called greenhouse gases.

1. emitters
2. reflectors
3. absorbers
4. none of the above

Answer

absorbers

Reason — Green house effect is the process of warming of the earth's surface and it's lower atmosphere, by **absorption** of infrared radiations of long wavelength emitted out from the surface of the earth by greenhouse gases such as carbon dioxide, methane, nitrous oxide, ozone, chlorofluorocarbon (CFCs), etc.

Question 1(ii)

Which of the following is a green house gas?

1. oxygen
2. nitrogen
3. chlorine
4. carbon dioxide

Answer

Reason — Carbon dioxide is a green house gas. Other green house gases are methane, nitrous oxide, ozone and chlorofluorocarbon.

Question 1(iii)

The increase of carbon dioxide gas in atmosphere will cause —

1. decrease in temperature
2. increase in temperature
3. decrease in humidity
4. increase in humidity

Answer

increase in temperature

Reason — The increase of carbon dioxide gas in atmosphere will cause an increase in green house effect hence increasing global warming and **increase in temperature**.

Question 1(iv)

Without green house effect, the average temperature of earth's surface would have been —

1. -18°C
2. 33°C
3. 0°C
4. 15°C

Answer

-18°C

Reason — In the absence of green house gases from the atmosphere, entire heat energy radiated from the earth's surface and objects on it, would escape out into space and then average temperature on earth would be **-18°C** instead of 15.5°C .

Question 1(v)

Global warming means a in average effective temperature near the earth's surface due to an in the amount of greenhouse gases in its atmosphere.

1. decrease, increase
2. decreases, decrease
3. increase, decrease
4. increase, increase

Answer

increase, increase

Reason — Global warming means a **increase** in average effective temperature near the earth's surface due to an **increase** in the amount of green house gases in its atmosphere.

Question 1(vi)

The global warming has resulted in —

1. the increase in yield of crops
2. the decrease in sea levels
3. the decrease in human deaths
4. the increase in sea levels.

Answer

the increase in sea levels

Reason — Due to global warming melting of ice is more and the area of sea ice around the poles is shrinking. It is expected that in the next 50 years, the ice at both the poles will melt completely and therefore **the sea levels will rise.**

Exercise 6(D) — Assertion Reason Type

Question 2(i)

Assertion (A) : Fishes survive in ponds even when the atmospheric temperature is below 0°C.

Reason (R) : The anomalous expansion of water helps in preserving aquatic life.

1. both A and R are true and R is the correct explanation of A

2. both A and R are true and R is not the correct explanation of A
3. assertion is false but reason is true
4. assertion is true but reason is false

Answer

both A and R are true and R is the correct explanation of A

Explanation

Assertion (A) is true because this happens in cold regions during winter, even when the air freezes, fish can survive underwater.

Reason (R) is true because of water's anomalous expansion, it is densest at 4°C , so water at 4°C stays at the bottom, while water above 4°C (and eventually ice) remains at the top. This keeps the lower layers liquid and habitable for aquatic life. Hence, the anomalous expansion of water explains why the bottom of the pond remains unfrozen, allowing fish to survive.

Exercise 6(D) — Very Short Answer Type

Question 1

What do you mean by green house effect?

Answer

Green house effect is the process of warming of the earth's surface and it's lower atmosphere, by absorption of infrared radiations of long wavelength emitted out from the surface of the earth by greenhouse gases such as carbon dioxide, methane, nitrous oxide, ozone, chlorofluorocarbon (CFCs), etc.

Question 2

Name three green house gases.

Answer

Three green house gases are — carbon dioxide, methane, nitrous oxide.

Question 3

Which of the following solar radiations pass through the atmosphere of the earth?

X-rays, ultraviolet rays, visible light rays, infrared radiation.

Answer

The solar radiations that pass through the atmosphere of the earth are visible light rays and infrared radiation.

Question 4

Name the radiations which are absorbed by the green house gases.

Answer

The radiations which are absorbed by the green house gases are **infrared radiation of long wavelength**.

Question 5

What would have been the temperature of earth's atmosphere in absence of green house gases in it?

Answer

In the absence of green house gases the average temperature on earth would be **-18°C instead of 15.5°C**.

Exercise 6(D) — Short Answer Type

Question 1

What results in the increase of carbon dioxide contents of earth's atmosphere?

Answer

The main human activities responsible for increase of the carbon dioxide gas in the earth's atmosphere are —

1. The burning of fuels, deforestation, transportation and industrial production (particularly cement factories).
2. Increase of population (human beings emit nearly 32 gigatonnes of carbon

dioxide each year).

3. Imbalance of carbon dioxide cycle (the ocean does not absorb full amount of carbon dioxide and plants are not able to change all the carbon dioxide into oxygen).

The increase in concentration of carbon dioxide due to the above human activities is responsible for **60% increase in green house effect.**

Question 2

State the effect of green house gases on the temperature of earth's atmosphere.

Answer

The green house gases have an average warming effect of nearly 33°C so that the average temperature on earth's surface is about 15.5°C .

Question 3

What do you mean by global warming?

Answer

Global warming means the increase in average effective temperature near the earth's surface due to an increase in the amount of green house gases in its atmosphere

Question 4

What causes the rise in atmospheric temperature?

Answer

The reason for rise in atmospheric temperature is the increase in amount of green house gases present in the atmosphere.

As the green house gases increase they trap more and more of heat radiated from the earth's surface. Thereby increasing the temperature of the earth.

Question 5

State the cause of increase of green house effect.

Answer

The reason for the increase in green house effect is the increase in green house gases like carbon dioxide and methane.

Human activities responsible for increase of the carbon dioxide gas in the earth's atmosphere are —

1. The burning of fuels, deforestation, transportation and industrial production (particularly cement factories).

2. Increase of population (human beings emit nearly 32 gigatonnes of carbon dioxide each year).
3. Imbalance of carbon dioxide cycle (the ocean does not absorb full amount of carbon dioxide and plants are not able to change all the carbon dioxide into oxygen).

The increase in concentration of carbon dioxide due to the above human activities is responsible for **60% increase in green house effect.**

Apart from this, **rice cultivation, animal husbandry, natural gas exploration, burning of bio mass in clearing of forests and leakage in natural gas pipe line** have doubled the concentration of methane which is also responsible for the increase in green house effect.

Question 6

What will be the effect of global warming at the poles?

Answer

Due to global warming, melting of ice is more and the area of sea ice around the poles is shrinking. It is expected that in the next 50 years, the ice at both the poles will melt

completely and therefore the sea level will rise.

Question 7

State the effect of global warming in coastal regions.

Answer

As more ice is melting due to the effect of global warming, so, buildings and roads in the coastal areas will get flooded and they could suffer damage from hurricanes and tropical storms.

Question 8

How will global warming affect the sea level?

Answer

Due to global warming, melting of ice is more and the area of sea ice around the poles is shrinking. It is expected that in the next 50 years, the ice at both the poles will melt completely and therefore the **sea level will rise.**

Buildings and roads in the coastal areas will get flooded and they could suffer damage from hurricanes and tropical storms.

Question 9

How will global warming affect agriculture?

Answer

In the near future, warming of nearly 3°C will result in poor yield in farms in low latitude regions and will increase the rise of malnutrition. The crop yield is expected to increase in middle and high latitude regions.

Therefore, the farmers will have to shift their farming region from low latitudes to high latitudes.

Question 10

State two ways to minimize the impact of global warming.

Answer

Ways to minimize the impact of global warming are —

- 1. Use of renewable source of energy** for generation of electricity instead of electricity from fossil fuel-based power plants.
- 2. Use of battery-operated vehicles** such as electric cars, bikes and scooters.

Question 11

What is carbon tax? Who will pay it?

Answer

S

Since, industries emit carbon dioxide to a great extent, to check them, they must be asked to pay carbon tax.

This tax can be calculated on the basis of carbon emission from the industry, number of employee hours and turn over of the industry.

This will encourage the industry to use energy efficient offices and to avoid the travelling of its employees by having tele-conferencing.

Exercise 6(D) — Long Answer Type

Question 1

State in detail the causes of global warming.

Answer

The cause of global warming is the increase in concentration of greenhouse gases present in the atmosphere of the earth due to human activities. The increase in different greenhouse gases is as follows:

1. The concentration of carbon dioxide has increased up to 25% due to industrial growth, combustion of fossil fuels, clearing of forests, etc.
2. The concentration of methane has doubled due to agricultural sources such as rice cultivation and animal husbandry, natural gas exploration, burning of

S

biomas, clearing of forests and leakage in natural gas pipelines.

3. The concentration of chlorofluorocarbons has increased at a rate of 5% per year.

Question 2

What technological measures are necessary to minimise the impact of global warming

Answer

Three technological measures are necessary to minimise the impact of global warming :

- 1. Use of renewable sources of energy for generation of electricity instead of generating electricity from fossil fuel-based power plants** — Fossil fuel-based power plants are major contributors to greenhouse gas emissions, accounting for around 21.3% of total emissions. To mitigate this impact, it is essential to shift towards alternative energy sources like wind, solar, tidal, and geothermal energy for electricity generation. Thus, it is necessary to phase out fossil fuel-based power plants and encourage the adoption of cleaner energy sources.

- 2. Use of battery operated vehicles such as electric cars, bikes and scooters** —

Traditional vehicles powered by internal

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combustion engines contribute approximately 14% of the total greenhouse gas emission. Switching to battery-operated vehicles and charging them with electricity from renewable sources will greatly decrease carbon dioxide emissions. These vehicles must be used in full capacity and size of the vehicles must be reduced.

3. Use of bio-char stoves for cooking —

In developing countries, biomass is commonly used for cooking, leading to a significant increase in greenhouse gas emissions. To address this issue, it is crucial to employ new technology that utilizes specially designed bio-char stoves. These stoves burn biomass in the absence of air, resulting in the production of smokeless combustible gases like methane and hydrogen, leaving a charcoal residue which can be buried in soil.

Question 3

What policy measures should the government enforce in order to minimise global warming ?

Answer

The policy measures that the government

should enforce in order to minimise global

warming are:

1. Educating children to live a sustainable lifestyle — We need to educate the children that genuine happiness lies in a less competitive and more cooperative society. Consuming more and buying more must not be the aim of life. For a sustainable life, we must make full use of what we have. The materialistic gains give only temporary happiness.

2. Controlling population through family planning, welfare reforms and empowerment of women — The world population is expected to increase from 7.1 billion in 2012 to 9.15 billion by the year 2050, with most of the growth taking place in developing countries. This needs to be controlled. Following measures can be taken:

- i. free and easy access to family planning
- ii. welfare provisions to encourage smaller families
- iii. empowerment of women and freedom to choose their career (because educated women are more conscious about family planning due to their career commitments.)

[Upthrust in Fluids, Archimedes' ...](#)[Reflection of Light](#)



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