4 WATER : A PRECIOUS RESOURCE

THEORY

1.1 INTRODUCTION

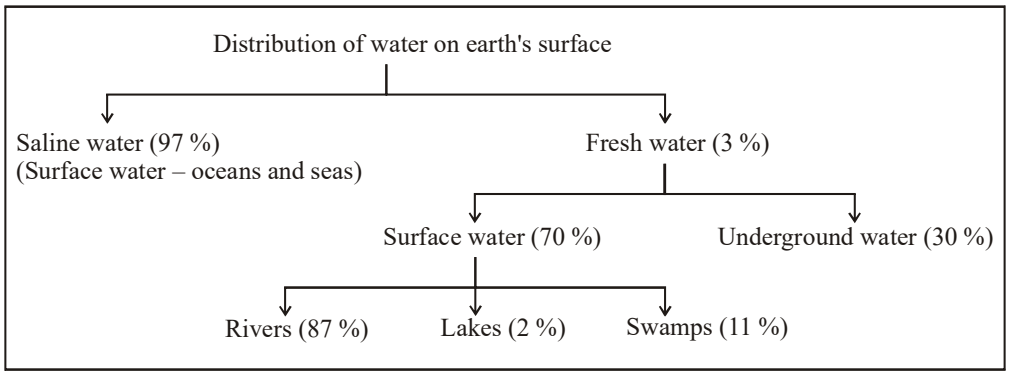
The uniqueness of the planet earth in the universe lies in it being inhabited by a wide variety of flora and fauna. Water is one of the most important abundant resource which is responsible for sustaining life on this planet alone.

The significance of water in the sustenance of the biosphere dates back to the evolution of aquatic life in oceans millions of years ago. It is believed that complex chemical reactions between the minerals in sea water took place in the presence of sunlight which resulted in the origin of unicellular organisms such as bacteria and fungi. The role of water is not confirmed to the evolution of life alone. Water is the essential constituent required for photosynthesis which is the only process that supports life. Being the major component in all living cells, water plays the most crucial role in all biological processes.

1.2 AVAILABILITY OF WATER

Water is available in plenty on earth. More than three-fourth of the earth's surface is covered with water in the form of seas, rivers and lakes. It is also found inside the earth's crust Most of the water that we get from the wells comes from this source.

About the 71 % of the earth's surface is covered with water.



1.3 PHYSICAL PROPERTIES OF WATER

Water possesses certain significant physical properties which are responsible for making it a vital liquid.

(i) **Nature** : It is a colourless, odourless and tasteless liquid.

(ii) **Freezing point** : Water freezes to ice at 0°C under normal atmospheric pressure that is 76 cm of Hg.

(iii) **Boiling point** : Water gets converted to steam at 100°C under normal atmospheric pressure that is 76 cm of Hg. The boiling point of water is proportional to external pressure.

(iv) **Density** : In general, solids possess greater densities than liquids. Therefore, for such liquids, the density decreases with an increase in temperature as the liquids expand on heating. However, in the case of water, it is different. Ice has lower density than water at the same temperature. As ice gets converted to water at 0°C its density increases and this trend continues till the temperature rises to 4°C. Beyond 4°C, water shows normal trend of decrease in density with increase in temperature. Therefore, density of water is maximum at 4°C (1 g /cc). From 4°C to 0°C, water undergoes expansion while all other liquids undergo contraction. Since this trend is opposite to the normal trend, this is called **anomalous expansion of water**.

Temperature	Density
0°C	0.91 g / cc (ice)
0°C	0.97 g / cc (water)
4°C	1 g / cc
> 4°C	<1g / cc

(v) **Specific heat** : The amount of heat energy required to raise the temperature of unit mass of a substance through 1°C is called the specific heat capacity of that substance. Specific heat capacity of pure water is 1 calorie / g / °C. Among all substances, water has the highest specific heat capacity.

(vi) **Latent heat** : When a substance changes from one state to the other, certain amount of heat is required to overcome the intermolecular force of attraction. For instance, when ice of certain mass at 0°C is converted to water of same mass at 0°C, the heat supplied brings about conversion of state without change in temperature. This is stored as potential energy in the water molecules and is called latent heat of fusion and is equal to 80 cal/g.

Similarly, the conversion of 1 g of water to steam at 100°C requires 540 cal heat and thus called as latent heat of vapourization.

At any temperature between 0°C and 100°C, conversion of water to water vapour takes place rather slowly. This process is called evaporation. The rate of evaporation increases with increase in temperature.

(vii) **Conductivity** : Pure water is a poor conductor of electricity. However, the presence of dissolved salts renders normal water a good conductor.

(viii) **Solvent property** : Water can dissolve most of the substances in it. Hence it is known as **universal solvent.**

1.4 COMPOSITION OF WATER

Water is essential for life. Water is made up of hydrogen (H_2) and oxygen (O_2) elements.

The molecular formula for water is H_2O. The ratio between hydrogen and oxygen in water is 1 : 8 by mass.

1.5 SOURCES OF WATER

The natural sources of water are rain, springs, wells, rivers and seas.

(a) **Surface water** : It is the water present on the surface of earth. The water present in oceans, seas, rivers, springs, etc. comes under surface water.

(i) **Rain water** : **Rain water** is considered to be the **purest form** of natural water (distilled water) free from impurities.

$$\underset{\text{water (rivers and seas)}}{H_2O_{(l)}} \xrightarrow[\text{Heat of sun}]{\text{Evaporation}} \underset{\text{water vapour}}{H_2O_{(v)}}$$

When the water vapours go high up in the air they condense to form clouds. The water drops come down as rain.

(ii) **River water** : Rivers are formed by melting of snow on the mountain, and also sometimes from the rain water. River water is also not a pure source.

(iii) **Sea water** : Sea water is the largest natural source of water. However, it is also the source of common salt and other important chemicals. It is the **most impure form of water**. All the impurities dissolved in river water are carried into the sea. Sea water cannot be used for drinking purpose because of high salinity and impurities.

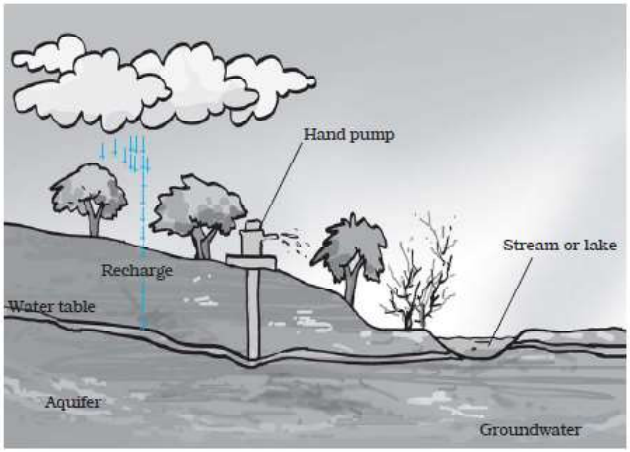
(b) **Groundwater as an important source of water**

If we dig a hole in the ground near a water body we may find that the soil is moist. The moisture in the soil indicates the presence of water underground. If we dig deeper and deeper, we would reach a level where all the space between particles of soil and gaps between rocks are filled with water . The upper limit of this layer is called the water table. The water table varies from place to place, and it may even change at a given place. The water table may be at a depth of less than a metre or may be several metres below the ground. The water found below the water table is called groundwater.

The rain water and water from other sources such as rivers and ponds seep through the soil and fills the empty spaces and cracks deep below the ground. **The process of seeping of water into the ground is called INFILTRATION**. The groundwater thus gets recharged by this process. **At places the groundwater is stored between layers of hard rock below the water table. This is known as an AQUIFER.**

Spring water : Springs are formed by percolation of rain water into soil. Springs supply water to wells and lakes.

Well Water : The rain water seeps through the soil and goes down and is stored over rocks or hard earth crust. On digging the well this underground water becomes available to us. This is known as well water. This water may not be pure and may contain impurities such as suspended particles, bacteria and other microorganisms.



1.6 FORMS OF WATER

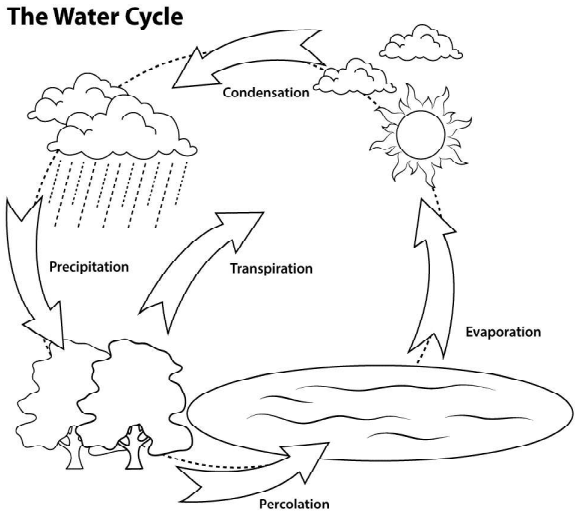
Water can be found in all the three forms, i.e., solid, liquid and gas.

(i) **Solid** : It occurs in the form of snow, ice crystal, ice caps at the poles of the earth, snow covered mountains and glaciers.

(ii) **Liquid** : It occurs in the form of rain, oceans, lakes rivers and even ground water.

(iii) **Gas** : The gaseous form is the water vapour i.e., present in the air around us.

1.7 WATER CYCLE



The supply of water in nature does not run out. This is because water is continuously recycled in the water cycle.

(i) Heat from the sun causes the water on the earth's surface to **evaporate**. The vapour rises, cools and **condenses** to form tiny water droplets. These droplets form **clouds**.

(ii) The clouds get carried along by air currents. They cool and the droplets join to form larger drops. These fall as **rain**.

(iii) If the temperature in the region is very low, these water droplets fall as hail, **sleet or snow**.

(iv) Some of the rain water flows along the ground as streams. Some soaks through the ground and then reappears as springs. Streams and springs join to form rivers. Rivers flow back into the sea. Thus, the water cycle is completed.

1.9 DEPLETION OF WATER TABLE

Increase in population, industrial and agricultural activities are some common factors affecting water table. Scanty rainfall is another factor that may deplete the water table.

(a) **Increasing population :** Increasing population creates demand for construction of houses, shops, offices, roads and pavements. This decreases the open areas like parks and playgrounds. This, in turn, decreases the seepage of rainwater into the ground. Moreover, a huge amount of water is required for the construction work. Often groundwater is used for this purpose.

So, on one hand we are consuming more groundwater, and on the other we are allowing lesser water to seep into the ground.

(b) **Increasing industries :** Water is used by all the industries. Almost everything that we use needs water somewhere in its production process. The number of industries is increasing continuously. Water used by most of the industries is drawn from the ground.

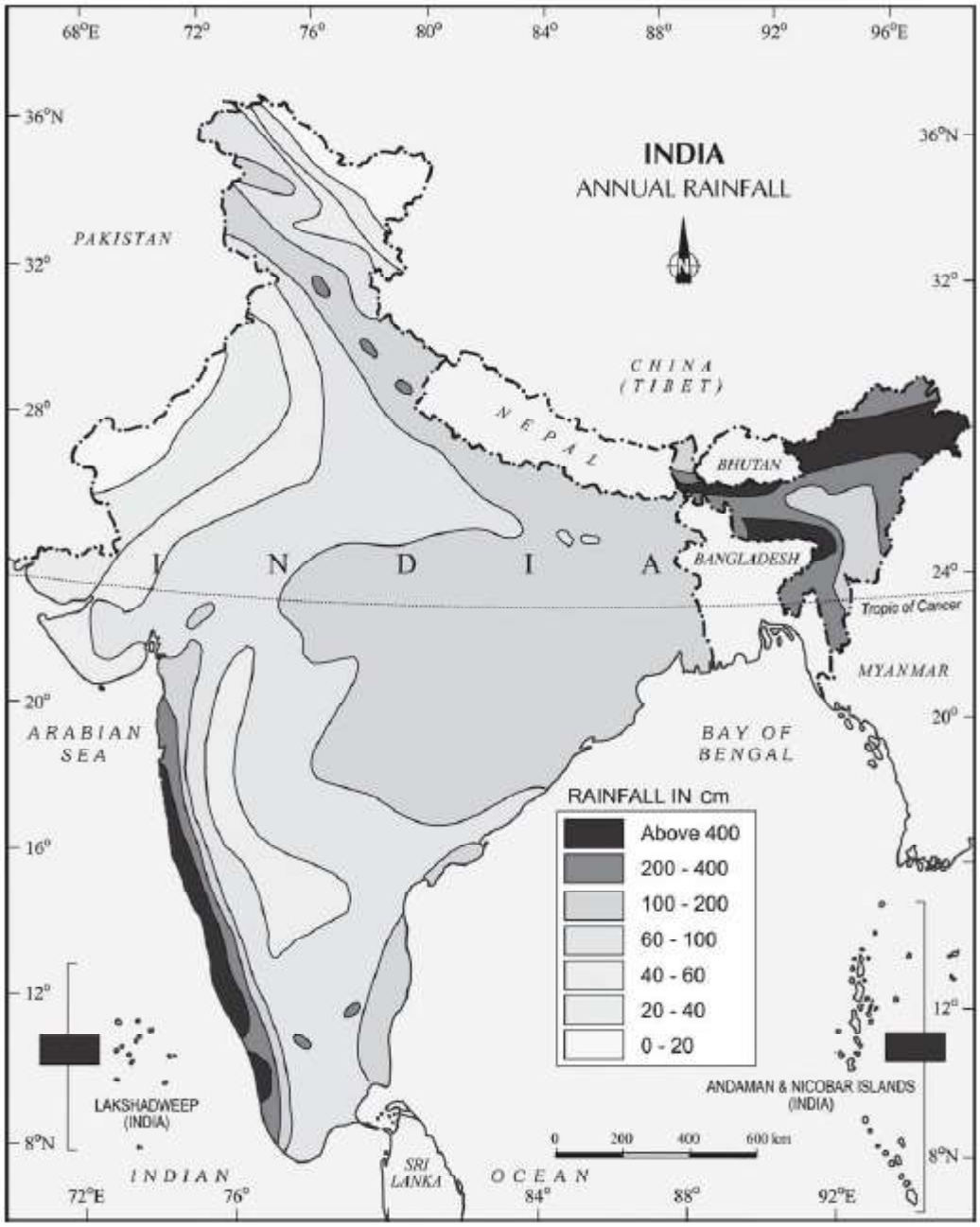
(c) **Agricultural activities :** A majority of farmers in India depend upon rains for irrigating their crops. Irrigation systems such as canals are there only in a few places. Even these systems may suffer from lack of water due to erratic rainfall. Therefore, farmers have to use groundwater for irrigation. Population pressure on agriculture forces increasing use of groundwater day by day. This results in depletion of water table.

(d) **Scanty rainfall or draught conditions :** During long periods of scanty rainfall or in the absence of rainfall, this balance is disturbed. Usage of underground water continues more or less at the same level while its replenishment becomes very less or almost nil. This results in the depletion of water table.

(e) **Deforestation** : Deforestation results in the reduction of forest area which allows the rain water flow rapidly into large water bodies. Seepage becomes less thereby leading to imbalance in the replenishment of underground water.

1.10 DISTRIBUTION OF WATER

India is a vast country and the rainfall is not the same everywhere. Some regions have excessive rain while some others have very little rainfall. Excessive rain cause floods, whereas the absence of rain results in drought. Therefore, some regions in our country may have floods while others may suffer from drought at the same time.



RAIN MAP OF INDIA

1.11 WATER MANAGEMENT

We have seen that most of the water that we get as rainfall just flows away. This is a waste of precious natural resource. The rainwater can be used to recharge the groundwater. This is called as **water harvesting or rainwater harvesting**.

Find out if the buildings in your neighbourhood have water harvesting systems installed.

We have at many places in India an age old practice of water storage and water recharge like the bawris. Bawri was the traditional way of collecting water. With time the bawris fell into disuse and garbage started piling in these reservoirs. However, because of the acute water shortage, people in these areas have had to rethink. The bawris are being revived. Today the situation is that inspite of scanty rains these places are managing their water needs well.

Water in the fields can use be used water economically. Maybe you have heard of **drip irrigation**. Drip irrigation is a technique of watering plants by making use of narrow tubings which deliver water directly at the base of the plant.

1.12 USES OF WATER

(i) Essential constituent for the reaction of photosynthesis which is the process supporting life as well as making food for plants and animals.

(ii) Medium for all biochemical processes taking place in plants and animals

(iii) Medium for transport of nutrients and minerals to the living cells in living beings.

(iv) Exchange of gases through blood by the process of respiration.

(v) Germination of seeds.

(vi) Growth of plants

(vii) Regulation of body temperature.

KEY WORDS

1. **Aquifer :** A water trap where groundwater is trapped between the layers of hard rock below water table.
2. **Depletion of water table :** We are consuming more ground water for industrial, agricultural activities as human wastes and on the other hand, we are allowing lesser water to seep into the ground. Due to this reason, depletion of water table occurs.
3. **Drip irrigation :** Drip irrigation is a technique of watering the plants by making use of narrow tubings which deliver water drop by drop directly at the base of the plant.
4. **Groundwater :** The water that seeps into the earth, gets collected between the layers of rocks and found below the water table, is called groundwater.
5. **Infiltration :** The process of seeping of water into the ground is called infiltration. The groundwater gets recharged by this process.
6. **rainwater harvesting :** The rainwater can be used to recharge the groundwater. This is referred as water harvesting or rainwater harvesting.
7. **Water recharged :** The groundwater is recharged by the seepage of rainwater. The rainwater and water from other sources such as rivers and ponds seeps through soil and fills the empty spaces and cracks deep below the ground.
8. **Water table :** The top most level of the groundwater, where all the space between soil particles is filled with water is called water table.

CONCEPT APPLICATION LEVEL - I [NCERT Questions]

Q.1 Mark 'T' if the statement is true and 'F' if it is false:
(a) The freshwater stored in the ground is much more than that present in the rivers and lakes of the world. (T/F)
(b) Water shortage is a problem faced only by people living in rural areas. (T/F)
(e) Water from rivers is the only source for irrigation in the fields. (T/F)
(d) Rain is the ultimate source of water. (T/F)

Ans. (a) T (b) F (c) F (d) T

Q.2 Explain, how groundwater is recharged?

Ans. The rainwater and water from other sources such as rivers and ponds etc., seeps through the soil and fills the empty spaces and cracks deep below the ground. The process of seeping of water into the ground is called infiltration. The groundwater is recharged through this process.

Q.3 There are ten tubewells in a lane of fifty houses. What could be the long term impact on the water table?

Ans. A huge amount of water will be pumped out from these ten tubewells and it will result in the depletion of the groundwater. Consequently, the water table will go deeper and deeper with the time and in longer term it will affect the availability of water in that area.

Q.4 You have been asked to maintain a garden. How will you minimise the use of water?

Ans. The use of water can be minimised by:
(i) using drip irrigation.
(ii) preventing the leakage in the drains in the delivery pipes.
(iii) filling the burrows of snakes and rats.
(iv) protect the boundaries of the field from breakage.

Q.5 Explain the factors responsible for the depletion of water table.

Ans. Following factors are responsible for the depletion of water table:
(i) Increasing population: Increasing population creates more demand of water for the construction of houses, shops, offices, roads and pavements. It decreases the open areas like parks and playgrounds. This in turn decreases the seepage of rainwater into the ground. Moreover, a huge amount of water is required for the construction work. Often groundwater is used for this.
(ii) Increasing industries: Water is used by all the industries. Water used by most of the industries is drawn from the ground.
(iii) Agricultural activities: Farmers have to use groundwater for irrigation. Population pressure on agriculture forces increasing use of groundwater day by day. This results in depletion of water table.

Q.6 Fill in the blanks with the appropriate answers:
(a) People obtain groundwater through ..... and .....
(b) Three forms of water are ..... , ... and .....
(c) The water bearing layer of the earth is ..... .
(d) The process of water seepage into the ground is called ..... .

Ans. (a) tubewells, hand pumps (b) solid, liquid, gas
(c) aquifer (d) infiltration

Q.7 Which one of the following is not responsible for water shortage?
(i) Rapid growth of industries
(ii) Increasing population
(iii) Heavy rainfall
(iv) Mismanagement of water resources

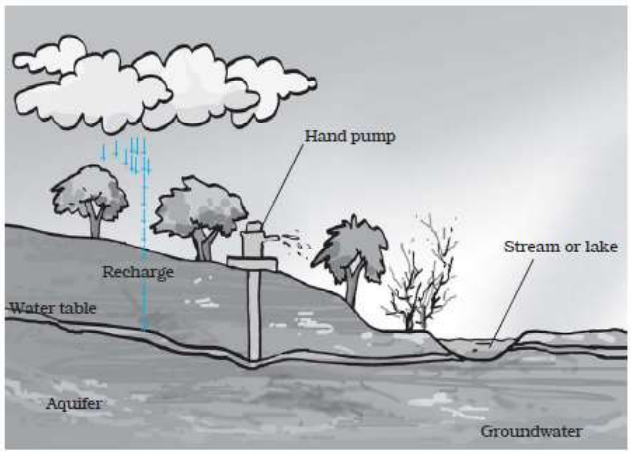
Ans. (iii) Heavy rainfall.

Q.8 Choose the correct option.
The total water
(i) in the lakes and rivers of the world remains constant
(ii) under the ground remains constant
(iii) in the seas and the oceans of the world remains constant
(iv) of the world remains constant.

Ans. (iv) of the world remains constant.

Q.9 Make a sketch showing groundwater and water table. Label it.

Ans.



CONCEPT APPLICATION LEVEL - II

VERY SHORT ANSWER TYPE QUESTIONS :

Q.1 What does the slogan 'Jal Hai to Kal Hai' means?

Ans. This slogan means, "If there is water, you can think of the future, i.e., no life is possible without water".

Q.2 What percentage of earth's surface is covered with water?

Ans. Approx 71%.

Q.3 What is fresh water?

Ans. The water that is fit for human consumption is called fresh water.

Q.4 What content of water does human body contain?

Ans. 75%.

Q.5 What will be the effect on a plant if it is not watered for a few days ?

Ans. It will wilt i.e. droping of the plant parts and ultimately drying-up.

SHORT ANSWER TYPE QUESTIONS :

Q.6 Where do we find water on earth in solid form?

Ans. Water can be found in solid form as snow and ice present as ice caps at the poles of the earth and on snow covered mountains and glaciers.

Q.7 Explain the terms water table and groundwater.

Ans. If we dig a hole in the ground and dig deeper and deeper, we would reach a level where all the space between particles of soil and gaps between rocks are filled with water. The upper limit of this layer is called the water table. The water found below the water table is called groundwater.

Q.8 What is meant by an aquifer?

Ans. The place where groundwater is stored between the layers of hard rock, i.e., right below the water table is called aquifer.

Q.9 When does the water table get depleted?

Ans. Water drawn from under ground gets replenished by seepage of rainwater. The water table does not gets affected as long as we draw as much water as is replenished by natural processes. However, water table may go down if the water is not replenished sufficiently. This may happen due to many reasons. Increase in population, industrial and agricultural activities are some common factors which cause depletion in water table.

Q.10 List various reasons for depletion of water table.

Ans. Various causes for the depletion of water table are:

(i) Increase in population (ii) Industrialisation

(iii) Agricultural activities (iv) Scanty rainfall

(v) Deforestation (vi) Decrease in the effective area for seepage of water.

Q.11 What do you mean by water shortage?

Ans. The amount of water recommended by the United Nations for drinking, washing, cooking and maintaining proper hygiene is a minimum of 50 litres per person per day. Millions of people in our country do not get enough water. In some places there is an acute shortage of water. Taps running dry, long queues for water, fights, marches and protests for demand of water have become a common sight especially during summers.

Water shortage has become a matter of concern throughout the world. It is estimated that in a few years from now more than one-third of the people in the world could face water scarcity.

Q.12 What is rainwater harvesting?

Ans. Most of the water that we get as rainfall just flows away. This is a waste of precious natural resource. The rainwater can be used to recharge the groundwater. This is referred to as water harvesting or rainwater harvesting.

Q.13 What are bawris?

Ans. Bawris are the old age practices of water storage and water recharge. It is a step well in which a person can go down by using steps to fetch water. Bawris were mainly set up in cities and towns for collecting water for drought periods.

Q.14 What is drip irrigation?

Ans. A farmer using water in the field can also use water economically. Drip irrigation is a technique of watering plants by making use of narrow tubings system which deliver water drop by drop directly at the base of the plant.

Q.15 What role can you play to overcome water problem?

Ans. There are a number of ways we can adopt to minimize the wastage of water. For example:

1. Turn off taps while brushing.
2. Mop the' floors instead of washing.

LONG ANSWER TYPE QUESTIONS :

Q.16 Briefly describe the water cycle.

Ans. The sun heats up and evaporates the water from oceans, ponds, lakes and rivers. These water vapours being lighter are carried up by the air. These water vapours get cooled at height and water droplets are formed. These water droplets form the clouds. When these water droplets in the cloud come close together, they form drops of water. These drops of water may fall on the earth as rain. The rainwater is absorbed by the soil. A part of rainwater collected in the rivers flows into the sea, where again the evaporation occurs. This completes the water cycle (Fig.).

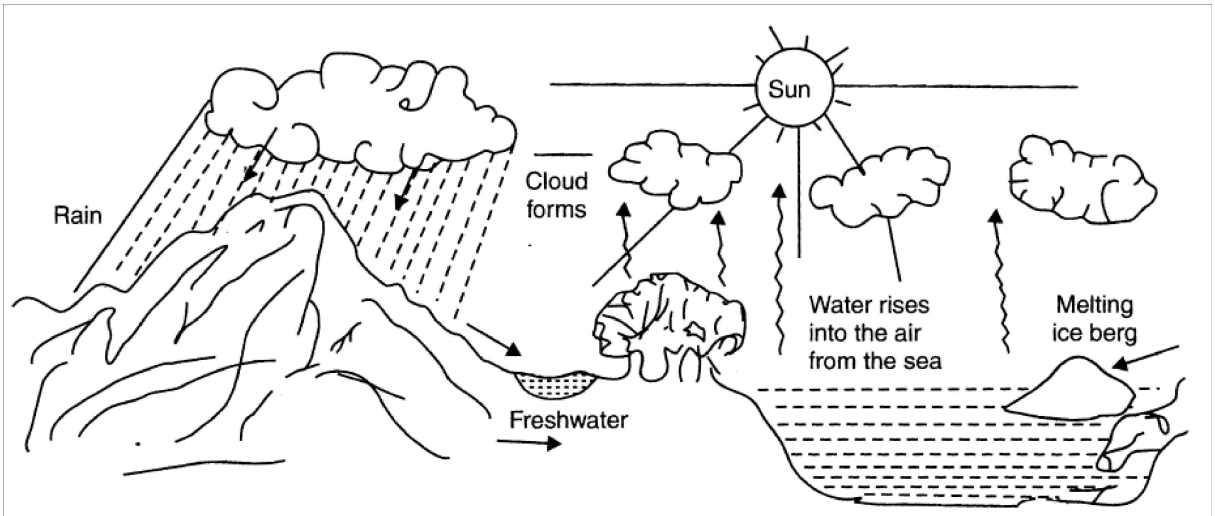


Fig. Water cycle in nature

Q.17 How is increasing population affecting water table? Explain.

Ans. Increasing population creates demand for construction of houses, shops, offices, roads and pavements. This decreases the open areas like parks and playgrounds. This in turn decreases the seepage of rainwater into the ground. Moreover, a huge amount of water is required for construction work. Often groundwater is used for this purpose. So, on the one hand, we are consuming more groundwater, and on the other hand, we are allowing lesser water to seep into the ground. This results in the depletion of water table. In fact, the water table in some parts of many cities has gone down to alarmingly low levels.

CONCEPT APPLICATION LEVEL - III

SECTION–A

FILL IN THE BLANKS :

(i) Water on the earth has been maintained for millions of years by various processes which make ..... .

(ii) The ..... form of water is the water vapour.

(iii) The .... in the soil indicates the presence of undergroundwater.

(iv) The process of ..... of water into the ground is called infiltration.

(v) Water in the ..... can be easily pumped out with the help of tube wells or handpumps.

(vi) .... was the traditional way of collecting water.

Ans. (i) water cycle (ii) gaseous (iii) moisture
(iv) seeping (v) aquifer (vi) Bawri

TRUE (T) OR FALSE (F) :

(i) The water that is fit for use is called fresh water.

(ii) The water table varies from place to place and it may even change at a given place.

(iii) The water found above the water table is called groundwater.

(iv) Drip irrigation has a disadvantage that it is associated with huge loss of water.

(v) Water is essential for all living beings.

(vi) Plants wilt and ultimately dry up if they are not watered for a few days.

Ans. (i) True (ii) True (iii) False (iv) False (v) True (vi) True

MATCH THE COLUMNS :

Column–I		**Column–II**
(i) Solid	(a)	Water under water table
(ii) Liquid	(b)	Traditional way of collecting water
(iii) Gas	(c)	Water between the hard rocks
(iv) Groundwater	(d)	sleet, snow
(v) Aquifer	(e)	Water in ponds, rivers, oceans
(vi) Bawri	(f)	Water vapour

Ans. (i)–(d), (ii)–(e),(iii)–(f), (iv)–(a), (v)–(c), (vi)–(b),

SECTION–B

MULTIPLE CHOICE QUESTIONS :

Q.1 On which day the world water day is celebrated?
(A) 23rd March (B*) 22nd March (C) 21st March (D) None of these

Q.2 Which year was observed as International Year of Fresh Water?
(A*) 2003 (B) 2004 (C) 2006 (D) 2002

Q.3 How much surface of the earth is covered with water?
(A) 80% (B) 90% (C*) 70% (D) 60%

Q.4 What portion of our body is water?
(A*) 75% (B) 65% (C) 85% (D) 95%

Q.5 Water is found in
(A) solid form (B) liquid form (C) gaseous form (D*) all of these

Q.6 Which one of the following is the cause of the depletion of water table?
(A) Increasing population (B) Increasing industries
(C) Agricultural activities (D*) All of these

Q.7 The groundwater when collects between the layers of hard rocks is called
(A*) aquifer (B) water table (C) bawri (D) none of these

Q.8 Which of the following sources of water is not used for drinking purpose due to dissolved salts present in them?
(A) Rain water (B*) Sea water (C) Spring water (D) River water

Q.9 Density of water is maximum
(A) at 0°C (B*) at 4°C (C) above 4°C (D) below 4°C

Q.10 Which among the following liquids has the highest specific heat?
(A) Petrol (B) Mercury (C) Oil (D*) Water

Q.11 Which among the following types of water is poor conductor of electricity?
(A) Saline water (B) Tap water (C) River water (D*) Distilled water

Q.12 Which of the following is not the control measure of water pollution?
(A) Usage of natural manure (B) Usage of drip irrigation
(C*) Usage of fertilizers (D) Usage of natural pesticides

Q.13 Spring water usually contains
(A) dissolved salts (B) minerals
(C) suspended impurities (D*) both (A) and (B)

Q.14 When the temperature of water rises from 0°C to 10°C, the density of water
(A) decreases gradually (B) decreases up to 4 °C and then increases
(C*) increases up to 4°C and then decreases (D) increases gradually.

Q.15 The mass composition of water is
(A) 1 : 2 ratio of hydrogen and oxygen respectively
(B*) 1 : 8 ratio of hydrogen and oxygen respectively
(C) 1 : 1 ratio of hydrogen and oxygen
(D) 2 : 1 ratio of hydrogen and oxygen respectively

Q.16 What is the latent heat of fusion and latent heat of vapourisation of 10 g of ice and water respectively?
(A) 800 cal, 800 cal (B) 540 cal, 540 cal (C*) 800 cal, 5400 cal (D) 540 cal, 800 cal

Q.17 Which of the following properties of iceberg led to the sinking of the titanic ship?
(A) Heavy water currents
(B) Relatively higher density of ice
(C*) 9 / 10 of iceberg submerged below sea water and 1/10 above the sea water
(D) None of the above

Q.18 The amount of heat energy required to increase the temperature of 20 g of water by 1°C is _____.
(A) 10 cal (B*) 20 cal (C) 15 cal (D) 2 cal

Q.19 Two persons A and B got burns one with boiling water at 100°C and other due to steam at 100°C respectively. Which person is affected more ?
(A) A (B*) B
(C) Both (A) and (B) to the same extent (D) None of the above

Q.20 Aquatic animals are able to survive in water bodies like rivers and oceans during winter when the atomospheric temperature is –10°C. This is because
(A) density of ice is less than water (B) density of water is minimum at 4°C
(C) ice is a poor conductor of heat (D*) both (A) and (C).