Water

EXERCISE

Question 1.
Name a 'pure form' and an,'impure form' of water in the natural state.

Answer:
Rain water – pure natural water.
Sea water, lake water – impure form of natural water.

Question 2.
State what is potable water. Give its qualities or characteristics which make it fit for human consumption.

Answer:
Potable water : "That water which is fit for human consumption and for drinking purposes."

Characteristics of potable water :

1. Water should be free from harmful bacteria, germs, suspended impurities and harmful salts.
2. Should be clear, colourless and odourless.
3. Should contain small amounts of dissolved gases and minerals for good taste.
4. Should have dissolved air and salts of (Na, Ca, Mg) which impart taste to the water and are useful for metabolic functions of the human body.

Question 3.
Give a reason why water is called a 'universal solvent' but, an alkali is not.

Answer:
Water is a polar covalent compound. When it comes in contact with any substance it breaks the electrostatic forces holding the molecules of that substance. Thus, the molecules break loose from the substance and hence dissolve in water. Thus, water is called a universal solvent and an alkali is not.

Question 4.
Name the solute, solvent & solution in the statement – 'sodium chloride dissolves in water to give sodium chloride solution'. Define each of the terms in italics.

Answer:

- **Solute (sodium chloride) :** The substance which dissolves or disappears in solvent, i.e. liquid to form a solution.
  Mostly solvent is which is in less quantity.
- **Solvent (water) :** The substance which allows the solute to dissolve in it. It is the substance which is in more quantity.
- **Solution (sodium chloride solution) :** The homogenous mixture of solute and solvent is called solution.

Question 5.
Explain how each of the following factors affects the formation of a solution

(a) Proportion of the solute & the solvent
(b) Particle size of the solute
(c) Temperature of the solvent

Answer:
Factors effecting the formation of solution :

(a) Proportion of solute & the solvent : The solute must be in a small amount compared to the solvent which must be in much greater amount to dissolve the solute.
(b) Particle size of the solute : Smaller the size of solute, quickly and completely they will dissolve and form solution.
(c) Temperature of the solvent : Sometime increase in temperature makes the solution quicker.

Question 6.
Define the term 'solubility ' of a solute in water. If 10 g. of a solute is added to 100 g. of water at 50°C and stirred, it is seen that the total solute dissolves at that temperature giving an unsaturated solution. Is 10 g, the solubility of the solute in water. Give reasons.

Answer:
Solubility is the maximum amount of solute in grams – that will saturate 100 g of water at 0°C.
OR
Maximum amount of solute that can be dissolved in 100 g of solvent at specific temperature.
No, 10 g is not solubility as the solution is unsaturated and not saturated solution. This means more of solute can be added to make it saturated solution.

Question 7.
Give a reason why – **(a)** Alcohol and water form a miscible mixture while oil & water do not. **(b)** Boiled water tastes flat, **(c)** On opening a bottle of soda [carbon dioxide dissolved in water] the gas escapes out with a 'fizz'.

Answer:

(a) Alcohol and water form miscible mixture as alcohol is soluble in water. Oil does not dissolve in water form immiscible mixture.
(b) Boiled water loses the gases and mineral and the water tastes flat.
(c) Solubility of gases in liquid decreases on decreasing the pressure and CO_2 come out of water with a 'fizz' when pressure decreases on opening the bottle.

Question 8.
Give the importance of

(a) Dissolved minerals & salts
(b) Dissolved air – in water.

Answer:
Importance in water of:

(a) Dissolved minerals & salts : Provide taste to water and are useful for metabolic functions of the human body.
(b) Air : Air containing various gases gives taste to water.

Question 9.
How are solutions generally classified. What is the basis of this classification.

Answer:
Solutions are classified into :

(a) True solutions.
(b) Colloidal solution.
(c) Suspensions.

The basis of classification is the size of dissolved or dispersed particles in the medium.

Question 10.
Draw a table to differentiate – True solutions, colloidal solutions & suspensions – with respect to

1. Type of mixture
2. Solute particles in the mixture.

Answer:
True solution :

1. Homogeneous mixture.
2. Particles are extremely small less than 1 nm in diameter = 10^{-9} m.

Colloidal :

1. Appears to be homogeneous actually it is heterogeneous
2. Between 1 nm and 100 nm in diameter.

Suspension :

1. Heterogeneous mixture.
2. Size larger than 100 nm in diameter. Quite large size.

Question 11.
Give four examples of each of the above types of solutions i.e. true solution, colloidal solution & suspension. Give a reason why a true solution does not exhibit 'Tyndall effect'.

Answer:
Examples of :

(a) True solution : Salt solution, vinegar, copper sulphate solution, sugar in water solution, air, brass.
(b) Colloidal solution : Milk, ink, blood, soap solution, starch sol.
(c) Suspension : Milk of magnesia, flour in water, chalk- water solution, muddy water. A true

solution cannot exhibit 'Tyndall effect' because 'the size of particles is very small and cannot reflect light falling on them."

Question 12.
If 5 g. of a solute is added to 50 ml. of a solvent at a particular temperature and the solution can dissolve more of the solute at that temperature – is the solution obtained a saturated or an unsaturated solution. Give reasons.

Answer:
As more of solute can be dissolved at that temperature, it is unsaturated solution because saturated solution cannot dissolve any more quantity of solute at a particular temperature.

Question 13.
Explain the meaning of the term 'saturated solution'. State two methods to convert a saturated solution to an unsaturated solution.

Answer:
Saturated solution : "A solution in which no more solute can be dissolved at that temperature, is called saturated solution."
Two methods to convert a saturated solution into unsaturated solution are :

1. By increasing temperature
2. By increasing the amount of solvent.

Question 14.
State how a 'supersaturated' solution differs from a 'saturated solution'. State briefly how you would prepare a supersaturated solution using potassium chloride and water.

Answer:
Super saturated solution contains more amount of solute than saturated solution in hot solution. On cooling, it gives out excess salt which separate out.
Preparation of supersaturated solution of potassium chloride in water : Take 100 g of water and add little by little of KCl salt and stir it, if it gets dissolved, add a little more and stir it. We find that 35 g of KCl can make the solution saturated at 20°C. Now heat the saturated solution and add more of KCl. At 40°C it will dissolve 40 g and 46 g at 60°C and 54 g at 80°C. This super saturated solution at 80°C. On cooling this super saturated solution excess of solute [KCl] crystals separates out.

Question 15.
The process of separation or deposition of crystals from a hot saturated solution on gentle cooling of the solution is called 'crystallisation'. With reference to the statement explain what is meant by 'water of crystallisation'. State which physical properties of a crystal are correlated with the water of crystallisation.

Answer:
Water of crystallisation is the number of water molecules that combine chemically – in definite proportion with the – concerned salt in the crystalline state.
OR
Some salts, while crystallising out from their solutions unite with a definite quantity of water, which

is known as water of crystallisation.
Physical properties are that crystals are solid, definite regular shapes.

Question 16.
Differentiate between 'hydrated' & 'anhydrous' crystals. Give the chemical formula of – the following hydrated crystals –

(a) Washing soda
(b) Gypsum
(c) Blue vitriol
(d) Epsom salt
(e) Glauber's salt. State

which crystal from (a) to (e) is a pentahydrate.

Answer:

Hydrated crystals : Contain definite number of water molecules in loose chemical combination with the crystals.
Anhydrous crystals : Do not contain any definite number of water molecules – in loose chemical combination with the crystals.

Formula of hydrated crystals :

(a) Washing soda : $CaCO_3 10H_2O$
(b) Gypsum : $CaSO_4.2H_20$
(c) Blue vitriol : $CuSO_4.5H_20$
(d) Epsom salt : $MgSO_4.7H_20$
(c) blue vitriol [$CuSO_4.5H_20$] is a pentahydrate.

Question 17.
Differentiate between an efflorescent, deliquescent & ' hygroscopic substance with suitable examples.

Answer:
Efflorescent substances :

1. Lose wholly or partially their water of crystallisation when exposed to air.
2. Become powdery.
3. Washing soda $CaCO_3.10H_2O$, Gauber's salt
   $Na_2SO_4.10H_2O$, epsom salt $MgSO_4.7H_2O$

   $$Na_2CO.10H_2O \xrightarrow{\text{dry air}} Na_2CO_3.H_2O + 9H_2O$$
4. Crystalline when hydrated.

Deliquescent substances :

1. Absorb moisture from atmosphere, absorb water and dissolve in it forming a saturated solution.
2. Deliquescence is maximized in dry conditions,
3. NaOH, KOH, $CaCl_2$, $MgCl_2$, $FeCl_3$ are the examples.
4. They are crystalline water soluble.
   $FeCl_3 \rightarrow FeCl_3$ [Crystal changes to Solution]

Hygroscopic substances :

1. They are amorphous solids or liquids.
2. Absorb moisture from the air of atmosphere.
3. Do not change their original state.
   CaO (quick lime), cone. H_2SO_4, P_2O_5 and silica gel are the examples.

$$\underset{\text{Conc.}}{H_2SO_4} \longrightarrow \underset{\text{Conc.}}{H_2SO_4}$$

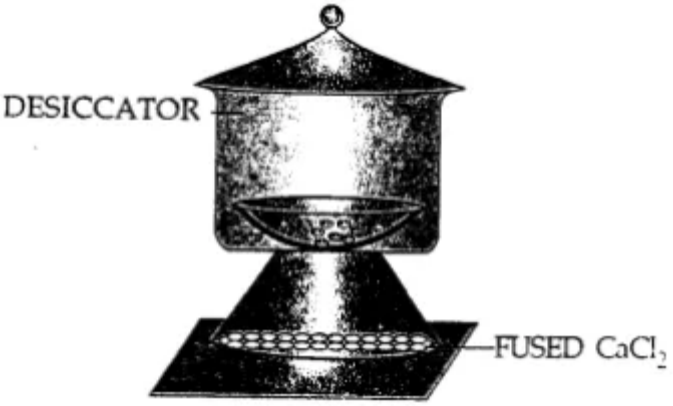
(State not changed)
is used for drying gases in laboratory.

Question 18.
Differentiate the function of concentrated sulphuric acid as a drying agent & as a dehydrating agent. Is fused calcium chloride a dehydrating or a desiccating agent. Give reasons.

Answer:
Sulphuric acid (cone.) acts as drying agent when it removes water from other substances i.e. for drying gases.
Cone, sulphuric acid acts as dehydrating agent when it removes chemically combined water from compounds due to it strong affinity for water.

$$\underset{\text{ethanol}}{C_2H_5OH} + \xrightarrow[\text{dehydrating agent}]{\text{Conc. } H_2SO_4} \underset{\text{ethene}}{C_2H_4} + \underset{\text{water}}{H_2O}$$

Cone. H_2SO_4 has removed H_20 from ethanol and changed it to ethene. Fused calcium chloride [$CaCl_2$] is desiccating agent as it is drying the substance.



Question 19.
Give a reason why metals are arranged in a series called – 'activity series of metals'. Name a metal which reacts
with

(a) Cold water
(b) Boiling water
(c) Steam to liberate hydrogen in each case.

Answer:
Metals arranged in series is called 'activity series of metals' because metals differ in tendency to lose valence electrons and can be arranged in a series, i.e. metals are arranged in decreasing order of their reactivity. The most reactive metal at top of the series and then with decreasing reactivity.
Metal that react with

(a) Cold water – Sodium

$$2Na + 2H_2O \longrightarrow 2NaOH + H_2$$

(b) Boiling water – Magnesium [Mg]

(c) Steam – Iron [Fe]

Question 20.
Differentiate between – **(a)** Hard & soft water **(b)** Temporary & permanent hard water – with suitable examples.

Answer:
(a) Hard water : It does not lather readily with soap and soap is wasted.
Soft water : Soft water form lather easily with soap.

(b) Temporary hard water : contains bicarbonate of calcium or magnesium. Hardness can be removed by boiling water.
Permanent hard water : contains sulphates or chlorides of calcium and magnesium. Hardness cannot be removed by boiling water.

Question 21.
Give balanced equations to show how – **(a)** Temporary hardness enters into water, **(b)** Temporary hardness in water can be removed by boiling, **(c)** Permanent hardness in water can be removed by addition of washing soda.

Answer:

(a) Temporary hardness : Enters in water when rain water containing CO_2 falls on earth and combines with limestone [$CaCO_3$] & magnesite [$MgCO_3$] layers forming respective soluble bicarbonates.

$$CaCO_3 + H_2 + CO_2 \longrightarrow \underset{\text{Cal. bicarbonate}}{Ca[HCO_3]_2}$$

$$MgCO_3 + H_2O + CO_2 \longrightarrow \underset{\text{Magnesium bicarbonate}}{Mg[HCO_3]_2}$$

(b) To remove temporary hardness by boiling : Bicarbonate changes to insoluble carbonate and water becomes soft.

$$Ca[HCO_3]_2 \xrightarrow{\text{Boil}} \underset{\text{Cal. carbonate}}{CaCO_3\downarrow} + CO_2 + H_2O$$

$$\underset{\text{Magnesium bicarbonate}}{Mg[HCO_3]_2} \xrightarrow{\text{Boil}} \underset{\text{Magnesium bicarbonate}}{MgCO_3\downarrow} + CO_2 + H_2O$$

(c) Removal of permanent hardness in water by adding washing soda : $CaCl_2$ or $CaSO_4$ present in permanent hard water exchanges the ions and forms $CaCO_3$ which being in soluble can be filtered.

$$\underset{\text{Washing soda}}{Na_2CO_3} + \underset{\text{Present in hard water}}{CaSO_4} \longrightarrow CaCO_3\downarrow + Na_2SO_4$$

$$Na_2CO_3 + CaCl_2 \longrightarrow CaCO_3\downarrow + 2NaCl$$

OBJECTIVE TYPE QUESTIONS

Q.1. Select the correct answer from A, B, C, D & E for each statement given below :
A : Colloidal
B : Fused calcium chloride
C : Solvent
D : Suspension
E : Washing soda

Question 1.
The medium of dissolution which allows the solute to dissolve in it.
Answer:
C : Solvent

Question 2.
A solution which can pass through a filter paper but not through a semipermeable membrane.
Answer:
A : Colloidal

Question 3.
A decahydrate crystal.

Answer:
E : Washing soda

Question 4.
A drying agent placed in desiccator.
Answer:
B : Fused calcium chloride

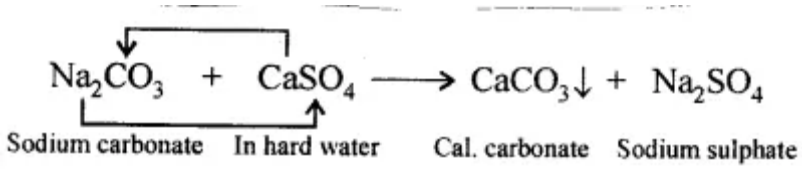
Question 5.
A heterogenous mixture of undissolved particles in dispersion medium, visible to the naked eye.

Answer:
D : Suspension

Q.2. Give a balanced equation for the following conversions :

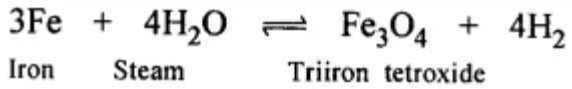
Question 1.
Calcium sulphate in permanent hard water to calcium carbonate using sodium carbonate.

Answer:



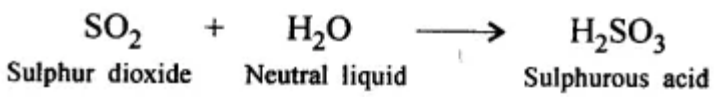
Question 2.
Iron to triiron tetroxide using steam.

Answer:



Question 3.
Sulphur dioxide to sulphurous acid using a neutral liquid.

Answer:



Question 4.
Potassium oxide to a strong alkali.
Answer:

$$K_2O + H_2O \longrightarrow 2KOH$$

Potassium oxide (base) — Strong alkali

dissolved in water to give alkali

Question 5.
Magnesium bicarbonate in temporary hard water to magnesium carbonate by boiling.
Answer:

$$Mg[HCO_3]_2 \xrightarrow{\text{Boiling}} MgCO_3\downarrow + CO_2 + H_2O$$

Magnesium carbonate

Q.3. Complete the statements by filling the blanks with the correct word from the bracket.

Question 1.
Solubility of most solids ___ [decreases/increases] with rise in temperature.
Answer:
Solubility of most solids **increases** with rise in temperature.

Question 2.
Kerosene & water form a ___ [miscible / immiscible] mixture.
Answer:
Kerosene & water form a **immiscible** mixture.

Question 3.
Solubility of a solute is the ___ [minimum/maximum] amount of solute that will saturate 100 g. of water at t°C.
Answer:
Solubility of a solute is the **maximum** amount of solute that will saturate 100 g. of water at t°C.

Question 4.
Hygroscopic substance absorb moisture from the atmosphere & ___ [do not change/change] their original state.
Answer:
Hygroscopic substance absorb moisture from the atmosphere & **do not change** their original state.

Question 5.
The ratio of hydrogen & oxygen in water is ___ [2 : 1/ 1 : 2].
Answer:
The ratio of hydrogen & oxygen in water is **2 : 1.**

Q.4. Give reasons for the following :

Question 1.
All solutions are homogenous mixtures of a solute in a solvent.

Answer:
Because solute dissapears in solvent and uniform composition throughout.

Question 2.
Hardness in temporary water can be removed by boiling, but hardness in permanent hard water cannot.
Answer:
Temporary hardness is due to the presence of bicarbonate of calcium or magnesium, on boiling bicarbonate decomposes to CO_2, carbonate which is in soluble and can be filtered out. Where as permanent hard water contains $[SO_2]^{2-}$ or Cl^{-}– of calcium and magnesium, cannot be removed by boiling.

Question 3.
Colloidal solutions exhibit brownian movement.
Answer:
Particles in colloidal solutions do not settle down and are always in motion.

Question 4.
The percentage of oxygen, in air dissolved in water, is higher than the percentage of oxygen in ordinary air.
Answer:
Oxygen dissolves in water and in air there are some other gases also which make the bulk of air. Some gases dissolve in water.

Question 5.
Washing soda can be used to remove both temporary and permanent hardness in water.
Answer:
Washing soda Na_2CO_3 exchanges ions $[SO_4]^{-}$ and Cl^{-} and do not make water hard.

Q.5. Match the substances in List I with the appropriate answer in List II.

List I	List II
1. Green vitriol	A: Permanent hardness in water
2. Paint	B: Hygroscopic
3. Magnesium chloride	C: Temporary hardness in water
4. Magnesium bicarbonate	D: Heptahydrate
5. Calcium oxide	E: Colloidal

Answer:

List I	List II
1. Green vitriol	D: Heptahydrate
2. Paint	E: Colloidal
3. Magnesium chloride	A: Permanent hardness in water
4. Magnesium bicarbonate	C: Temporary hardness in water
5. Calcium oxide	B: Hygroscopic