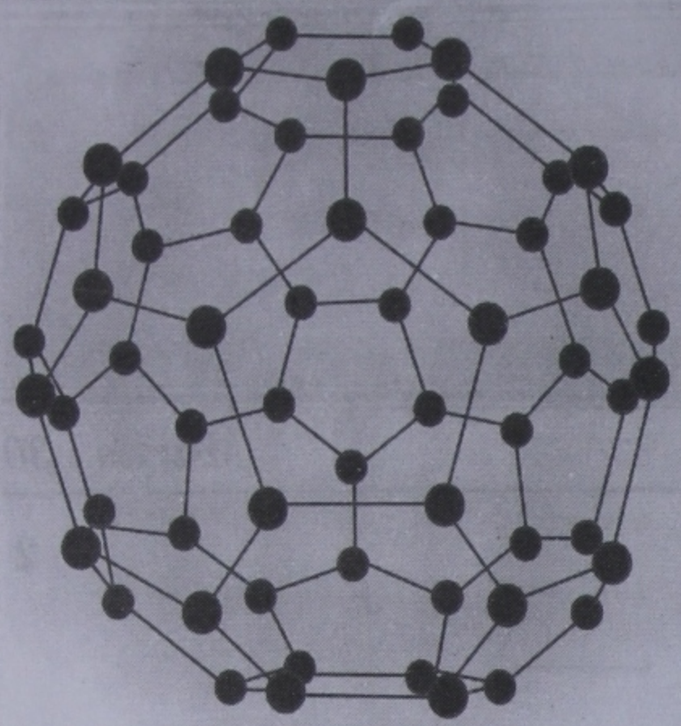


6

WATER

SCOPE OF SYLLABUS

Water as a compound and as a universal solvent; its physical and chemical properties.

Why is water considered a compound ? Chief physical properties should include: density, boiling point, melting point. Experiment to show that the water we drink, contains dissolved solids and dissolved gases (air): their significance. Solution as 'mixtures' of solids in water; saturated solutions; qualitative effect of temperature on solubility (*e.g.*, solutions of calcium sulphate, potassium nitrate, sodium chloride in water).

Chemical Properties : The action of cold water on sodium and calcium; the action of hot water on magnesium and steam on iron; reversibility of reaction between iron and steam.

Students can be shown the action of sodium and calcium on water in the laboratory; they must be asked to make observations (equations for the above reactions) and form reactivity series based on reactions.

IMPORTANT POINTS TO REMEMBER

1. **Water** is **indispensible** for the **survival** of **life** on the earth. Approximately **80%** of the **earth's surface** is covered by **water**. **Water** is the **main part** of all the **living matter**.
2. **Water** exists in all the **three states** of **matter**. In all three states water occurs in **free form**.
   - (*i*) **Solid :** Large amount of water is found in the form of ice or snow.
   - (*ii*) **Liquid :** In liquid state most of the water is present in sea, rivers, lake, ocean, ponds, streams, spring, etc. Water also occurs under the surface of earth called as ground water.
   - (*iii*) **Gas :** Mist, fog are examples of water in its gaseous form. It is also present as water vapours in the atmosphere.
3. In **combined state** water is present in **carbohydrates**, **proteins**, etc. as well as in the **salts** in the form of **water of crystallisation**. It is the **definite number** of **water molecules** which enters into **loose chemical combination** when the **salt crystallises** out of its **saturated solution**.

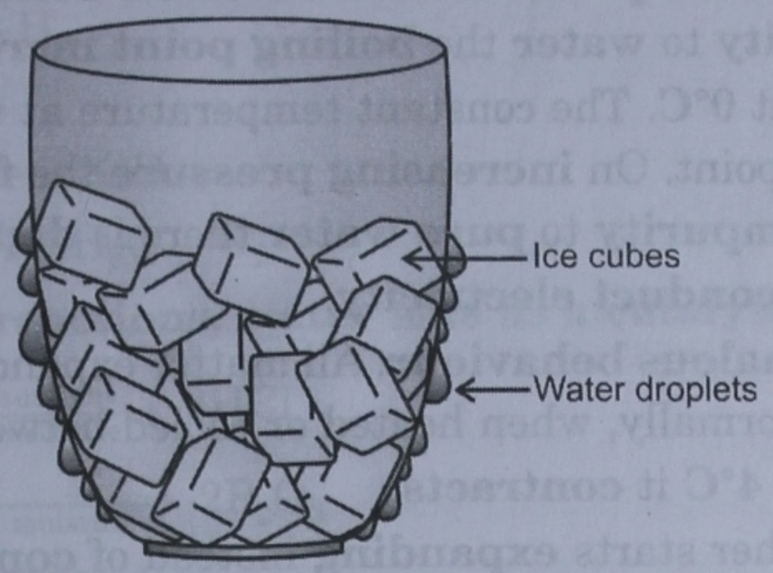
   For example,

   $CuSO_4 . 5 H_2O$ – Blue vitriol (Hydrated copper sulphate)

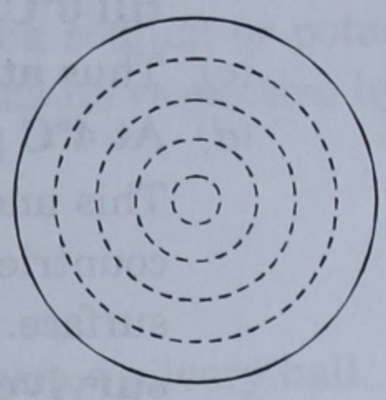
   $FeSO_4 . 7 H_2O$ – Green vitriol (Hydrated ferrous sulphate)
4. The **salts** containing **water of crystallisation** are called **hydrated salts**.
5. **Hydrated salts** on **heating lose** their **water of crystallisation** and become **anhydrous**.
6. **Hydrated salts** on **heating lose** their **crystalline shape** and **colour**. For example, **hydrated copper sulphate** on **heating** changes from **blue** to **white** and its **crystalline shape** changes to **amorphous**.

$$\underset{\text{Blue}}{CuSO_4 . 5H_2O} \xrightarrow{\Delta} \underset{\text{White}}{CuSO_4 + 5H_2O}$$

7. On **heating** a **hydrated salt**, **water of crystallisation** are given out in the form of **steam** and they **condense** on the **upper cooler portion** of the test-tube.
8. If **water** is added to an **anhydrous compound**, the **anhydrous compound regains** its **original colour**. For example, if **water** is allowed to drop over the **white anhydrous copper sulphate**, then it changes to **blue**.
9. A **glass** filled with **ice** is kept in atmosphere, **water droplets condense** on the **outer cooler surface** of glass. This experiment shows that **water is present in our atmosphere**.



10. In a beaker of 100 c.c, add 50 c.c of water. Over the beaker place the watch glass containing tap water and set the experiment as shown in the figure. Heat the contents of the beaker, the water starts boiling, the steam produced evaporates the water in the watch glass slowly. Continue heating till all the water in the watch glass completely evaporates. The watch glass is removed from the beaker, the **concentric rings** of **solid material** are seen on the watch glass. The **rings** are of **salts** which are present in **dissolved form** in **water**.



Concentric rings on the watch glass

11. **Water** is a **compound** of **hydrogen** and **oxygen**. It can be produced

(*i*) **By burning of hydrogen in air :**

Pure hydrogen burns in **pure oxygen** with **pale blue flame** to form the droplets of **colourless liquid (water).**

$$2H_2 + O_2 \longrightarrow 2H_2O$$

(*ii*) **By burning of hydrocarbon in air :**

Hydrocarbons burn in free supply of **air** or **oxygen** to form **carbon dioxide** and **water vapour.**

$$CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$$

$$C_2H_4 + 3O_2 \longrightarrow 2CO_2 + 2H_2O$$

$$2C_2H_2 + 5O_2 \longrightarrow 4CO_2 + 2H_2O$$

$$2C_2H_6 + 7O_2 \longrightarrow 4CO_2 + 6H_2O$$

(*iii*) **By the reduction of metallic oxides by hydrogen :**

During these reactions, **hydrogen** gets **oxidized** to form **water.**

$$CuO + H_2 \longrightarrow Cu + H_2O$$

$$PbO + H_2 \longrightarrow Pb + H_2O$$

(*iv*) **During the process of respiration :**

Carbohydrates burn in the presence of **oxygen** to form **carbon dioxide** and **water vapour** with the **liberation** of **energy.**

$$C_6H_{12}O_6 + 6O_2 \longrightarrow 6CO_2 + 6H_2O + Heat$$

12. The physical properties of water are :

(*i*) Water is **colourless liquid.**

(*ii*) **Pure water** has **flat taste**. However, the **drinking water** has the **characteristic taste** because of the presence of **dissolved salts**.

(*iii*) **Boiling point** of **pure water** is **100°C**. The constant temperature at which the liquid gets converted into its vapour state is called boiling point. If the **pressure increases**, then the **boiling point** also **increases**. If the **pressure decreases** the **boiling point** of water **decreases**. With an **addition** of **impurity** to **water** the **boiling point increases**.

(*iv*) **Pure water freezes** at **0°C**. The constant temperature at which the liquid gets converted into solid is called freezing point. On **increasing pressure** the **freezing point** of water **decreases**. With an **addition of impurity** to **pure water** there is **depression** in **its freezing point**.

(*v*) **Pure water** does **not conduct electricity**.

(*vi*) **Water** shows the **anomalous behaviour**. All matter expand on heating and contract on cooling, but water behaves abnormally, when heated or cooled between 0°C to 4°C.

(*a*) When **cooled** upto **4°C** it **contracts.**

(*b*) **On cooling** it further starts **expanding** instead of **contracting** and keeps on **expanding till 0°C.**

(*c*) Thus **at 0°C** water has **maximum volume** but **minimum density.**

(*d*) **At 4°C** pure water has **minimum volume** and **maximum density.**

This anomalous behaviour of water is important for the **existence** of **aquatic life** in cold countries. As **water freezes** into **ice at 0°C, ice** being **lighter** than **water floats** on the surface. **Water** is present **below ice** where **fish** and **other aquatic animals** can easily **survive.**

(*e*) Water is a **universal solvent** as it has the **capacity** to **dissolve** the **number** of **solute particles in it**. Water is a **polar covalent compound**. It has a unique property of **weakening** the **electrostatic forces** of **attraction** in **ionic compounds** thus they rapidly dissolve in water.

(*vii*) The **specific heat capacity** of **water** is **1 calorie / (gram°C)**. It is the **amount** of **heat** (measured in calories) **required** to **raise** the **temperature** of **one gram** of a substance by **one degree celsius**.

(*viii*) The **specific latent heat** of **fusion** is the **amount** of **heat needed** to **convert 1 kg** of **ice** to **water** at its **melting point** without change in its temperature. The **specific latent heat** of **fusion** for **ice** is **80 kcal/kg** or **333.55 J/g**.

(*ix*) The **specific latent heat** of **vaporization** of **water** is **540 cal/g** or **2268 J/g** (1 cal = 4.2 J). It is the **amount** of **heat required** to **change 1g** of **water** to **steam** at its **boiling point** without change in its temperature.

13. The **solubility** of **gases** in a **liquid decreases** with **rise** in **temperature** and **increases** with the **fall** in **temperature**.

14. On **increasing** the **pressure** on the **surface of liquid** at any temperature, the **solubility** of gas **increases** which is in accordance with **Henry's law**. It states that **"At any given temperature, the mass of gas dissolved in fixed volume of liquid is directly proportional to the pressure of the surface of the liquid".**

15. The chemical properties of water are

(*i*) **Action towards litmus :** Pure water is **neutral** towards **litmus**, *i.e.*, it neither turns red litmus to blue nor blue litmus to red.

(*ii*) **Stability :** Water is a **stable compound**. It **does not break** into **its elements** when heated in ordinary conditions. However if **electric current** is passed through **acidified water**, it

decomposes to give **hydrogen** at **cathode** and **oxygen** at **anode** in the ratio of **2 : 1** respectively by **volume**.

$$H_2O \rightleftharpoons H^+ + OH^-$$

$$HCl \rightleftharpoons H^+ + Cl^-$$

At Cathode

$$H^+ + e^- \longrightarrow [H]$$

$$2[H] \longrightarrow H_2$$

At Anode

$$OH^- - e^- \longrightarrow OH$$

$$4[OH] \longrightarrow 2H_2O + O_2$$

***(iii)* In many chemical reactions, water acts as a catalyst like**

$$H_2 + Cl_2 \xrightarrow[\text{moisture}]{\text{sunlight}} 2HCl$$

$$4P + 5O_2 \xrightarrow[\text{moisture}]{\Delta} 2P_2O_5$$

***(iv)* Reaction with metals :**

***(a)* Reaction of cold water with sodium and potassium.** When sodium or potassium is dropped into a trough of cold water it reacts explosively and forms its respective hydroxide with the liberation of hydrogen gas.

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

$$2K + 2H_2O \longrightarrow 2KOH + H_2$$

When both of these metals are placed in water, they melt and form a silvery ball. As these metals are lighter than water therefore they float on the surface of water and starts moving in a zig-zag manner. Tiny bubbles of hydrogen gas are evolved and the metals catch fire. If it is **sodium**, then it burns with **golden yellow flame** and if it is **potassium** it burns with **violet** or **lilac colouration**. The solution left behind after the reaction is soapy to touch and turns red litmus to blue showing that it is **alkaline** in nature.

***(b)* Reaction with magnesium, zinc and aluminium.**

$$Mg + \underset{\text{steam}}{H_2O} \longrightarrow MgO + H_2$$

$$Zn + \underset{\text{steam}}{H_2O} \longrightarrow ZnO + H_2$$

$$2Al + \underset{\text{steam}}{3H_2O} \longrightarrow Al_2O_3 + 3H_2$$

***(c)* Reaction with iron.**

$$\underset{\text{heated}}{3Fe} + \underset{\text{steam}}{4H_2O} \rightleftharpoons Fe_3O_4 + 4H_2$$

***(d)* Metals** present **below hydrogen** in the **metal activity series do not displace hydrogen** from **water**, *e.g.*, **copper**, **silver**, **gold**, etc. **Mercury does not react** with **water** even under drastic conditions.

***(v)* Reaction with soluble basic oxides :**

Soluble basic oxides dissolve in water to give respective soluble bases called alkalies which turn red litmus blue.

$$Na_2O + H_2O \longrightarrow 2NaOH$$

$$K_2O + H_2O \longrightarrow 2KOH$$

$$CaO + H_2O \longrightarrow \underset{\text{sparingly soluble in water}}{Ca(OH)_2}$$

(*vi*) Reaction with acidic oxides :

Acidic oxides are also called **acid anhydrides.** On dissolving in water they produce acids which turn blue litmus red.

$$CO_2 + H_2O \longrightarrow \underset{\text{Carbonic acid}}{H_2CO_3}$$

$$SO_2 + H_2O \longrightarrow \underset{\text{Sulphurous acid}}{H_2SO_3}$$

$$SO_3 + H_2O \longrightarrow \underset{\text{Sulphuric acid}}{H_2SO_4}$$

$$P_2O_5 + 3H_2O \longrightarrow \underset{\text{Phosphoric acid}}{2H_3PO_4}$$

$$\underset{\text{Mixed anhydride}}{2NO_2} + H_2O \longrightarrow \underset{\text{Nitrous acid}}{HNO_2} + \underset{\text{Nitric acid}}{HNO_3}$$

(*vii*) Reaction with non-metals :

(*a*) Reaction with carbon.

When superheated steam is passed over white hot coke, an endothermic reaction takes place with the formation of equi-volume mixture of carbon monoxide and hydrogen called water gas is obtained.

$$\underset{\text{White hot coke}}{C} + \underset{\text{Superheated steam}}{H_2O} \longrightarrow \underbrace{CO + H_2}_{\text{Water gas}}$$

(*b*) Reaction with chlorine.

When chlorine is passed through water in dark, it forms a greenish yellow solution called chlorine water. When chlorine water is exposed to sunlight, the following changes occur—

(*i*) Greenish yellow chlorine water decolourises.

(*ii*) A colourless and odourless gas evolves which relights the glowing splinter.

$$\underset{\text{Chlorine}}{Cl_2} + \underset{\text{Water}}{H_2O} \xrightarrow{\text{dark}} \underbrace{Cl_2 + H_2O}_{\substack{\text{Chlorine water} \\ \text{(Greenish yellow solution)}}}$$

$$\underbrace{Cl_2 + H_2O}_{\substack{\text{Chlorine water} \\ \text{(Greenish yellow solution)}}} \xrightarrow[\text{sunlight}]{\text{diffused}} \underset{\text{Hydrochloric acid}}{HCl} + \underset{\text{Hypochlorous acid}}{HOCl}$$

$$HOCl \xrightarrow{h\nu} HCl + [O]$$

$$2[O] \longrightarrow O_2$$

$$2Cl_2 + 2H_2O \xrightarrow[\text{sunlight}]{\text{direct}} 4HCl + O_2$$

16. Water is a **colourless liquid** which can be **tested** as follows :

(*i*) It turns **anhydrous copper sulphate** from **white** to **blue**.

$$\underset{\text{White}}{CuSO_4} + 5H_2O \longrightarrow \underset{\text{Blue}}{CuSO_4 \,.\, 5H_2O}$$

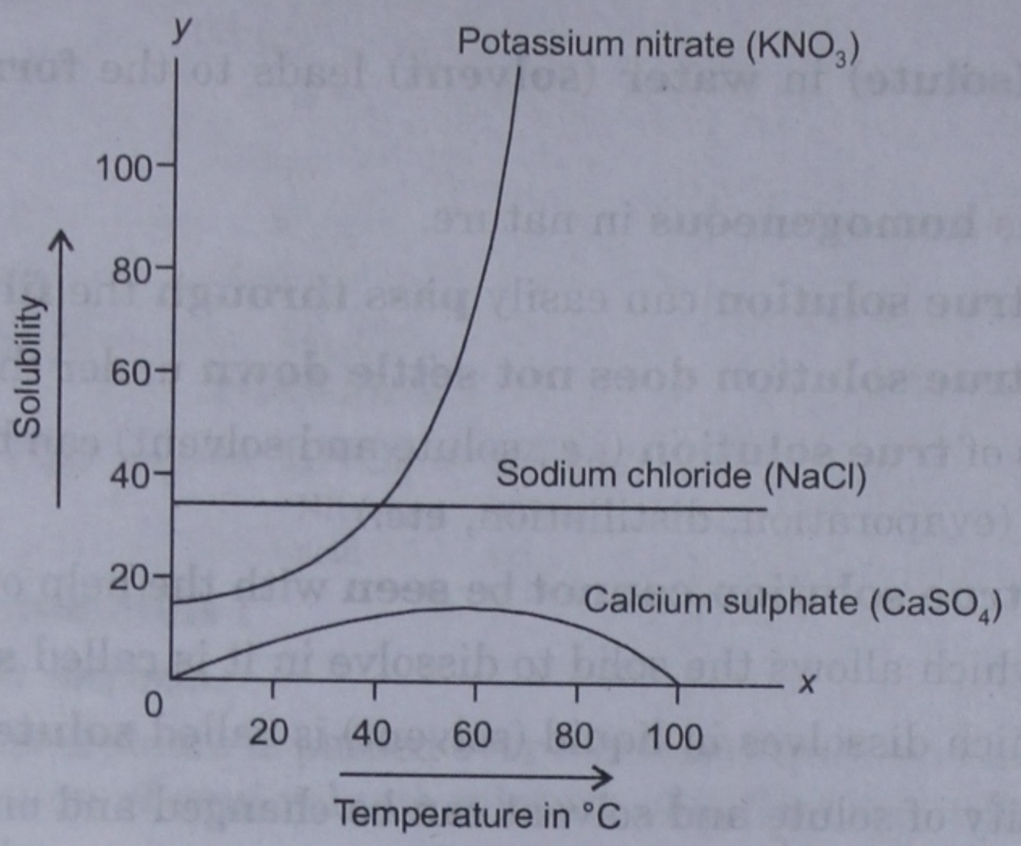
(*ii*) It turns **anhydrous cobalt chloride** from **blue** to **pink**.

$$\underset{\text{Blue}}{CoCl_2} + 6H_2O \longrightarrow \underset{\text{Pink}}{CoCl_2 \,.\, 6H_2O}$$

17. A **solution** is a **homogeneous mixture** of **solute** and **solvent**.

18. **Homogeneous mixture** has **uniform composition** and **properties** in its **every part**.
19. During the **formation** of the **solution**, the **solute** and **solvent do not** undergo any **chemical reaction**. Only a **physical change** takes place and the **process** of the **disappearance** of **solute** in a **solvent** is called **dissolution.**
20. **Dissolution** of **sugar (solute)** in **water (solvent)** leads to the **formation** of **true solution**. Its properties are
    (*i*) A **true solution** is **homogeneous** in nature.
    (*ii*) The **particles** of **true solution** can easily **pass through** the **filter paper**.
    (*iii*) The **particles** of **true solution does not settle down** under the influence of gravity.
    (*iv*) The **components** of **true solution** (*i.e.*, solute and solvent) can be easily **separated** by **simple physical means** (evaporation, distillation, etc.)
    (*v*) The **particles** of **true solution cannot** be **seen** with the help of **microscope**.
21. A **liquid component** which allows the solid to dissolve in it is called **solvent**.
22. A **solid component** which dissolves in liquid (solvent) is called **solute**.
23. In a solution, the quantity of solute and solvent can be changed and on the basis of this the solutions are divided in two categories.
    (*i*) **Dilute solution :** If the proportion of solute is relatively very small as compared to the quantity of the solvent, then the solution is called dilute solution.
    (*ii*) **Concentrated solution :** If the proportion of solute is relatively large as compared to the quantity of solvent, then it is called concentrated solution.
24. Solution can also be classified on the basis of their solubility, *i.e.*, depending upon the amount of solute that dissolves in a given solvent.
    (*i*) **Unsaturated solution :** If more solute can be dissolved in a solvent at a particular temperature, then the solution is called unsaturated solution.
    (*ii*) **Saturated solution :** If no more solute can be dissolved in a solvent at a particular temperature, then the solution is called saturated solution.
    (*iii*) **Supersaturated solution :** If the solution contains more of the solute, then the saturated solution at a particular temperature is called supersaturated solution.
25. The **amount** of **solute** that **dissolves** in **100 g** of **solvent** to form **saturated solution** at a particular temperature is called **solubility.**
26. The **solubility** of a **substance** depends upon the following **factors** :
    (*i*) **Temperature :** Generally the **solubility** of a substance **increases** with the **increase** in **temperature**.
    (*ii*) **Size of solute particle : Smaller** the **size** of solute particle **greater** is the **solubility**.
    (*iii*) **Nature of solvent : Ionic compounds** easily **dissolve** in **water** whereas **organic compounds** are **insoluble** in **water** but **soluble** in **organic solvents** like benzene, ether etc (like dissolves like).
27. A **graph** between **solubility** of a solid and **temperature** is called as **solubility curve**.
    The **uses** of **solubility curves** are :
    (*i*) Solubilities of different substances at a particular temperature can be recorded and compared.
    (*ii*) To find the solubility of a given substance at a particular temperature.

28. The **solubility curves** of **calcium sulphate**, **potassium nitrate** and **sodium chloride** are given below in graph. The curves indicates



(*i*) **Calcium sulphate :** There is a **decrease** in **solubility** (after a certain temperature) with further **rise** in **temperature**.

(*ii*) **Sodium chloride :** There is a **negligible increase** in the **solubility** of **sodium chloride** with **rise** in **temperature**.

(*iii*) **Potassium nitrate : Solubility increases** with the **rise** in **temperature**.

29. **Hydrated salts** when left exposed to atmosphere **lose** their **water of crystallisation** and **crumble down** to form **powder** such salts are called **efflorescent salts** and the property as **efflorescence**, *e.g.*,

Washing soda $Na_2CO_3 . 10H_2O$ Glauber's salt $Na_2SO_4 . 10H_2O$.

30. **Certain salts** when left exposed to atmosphere **absorb moisture** and get converted into their **saturated solution**. Such salts are called **deliquescent salts** and the property as **deliquescence**, *e.g.*, ferric chloride, magnesium chloride.

31. **Certain substances** when left exposed to atmosphere **absorb moisture** from the air and become **wet**. Such substances are called **hygroscopic substances** and the property is known as **hygroscopy**. **Hygroscopic substances** are also called **drying agents**.

e.g., phosphorus pentaoxide, conc. sulphuric acid, anhydrous calcium chloride.

32. The **solids bounded** by the **plane surfaces** directed at **definite angles** and having **definite geometrical shapes** are called **crystals**.

33. The **solids** which are **not** essentially **homogeneous** and are **not** bounded by the **plane surfaces** at definite angles to one another and do **not** have definite **geometrical shapes** are called **amorphous solids**.

34. The **process** of **separating out** the **crystals** from the **hot saturated solution** on **cooling** it slowly is called **crystallisation**.

35. For the **formation** of **crystals**, the **hot saturated solution** must be **cooled slowly**. If **rapid cooling** is done then the **amorphous solid settles** at the base **instead** of **crystals**.

36. **Water** plays a **vital role** in different animals and plant processes.

IMPORTANT QUESTIONS

Q1. Give reasons why

(*i*) Common salt becomes wet during rainy season.

(*ii*) The level of conc. H_2SO_4 in the jar increases when exposed to atmosphere.

(*iii*) Washing soda loses its weight when exposed to atmosphere.

(*iv*) Copper does not react with water even when strongly heated.

(*v*) Ferric chloride is stored in airtight bottles.

Ans. (*i*) Common salt which is chemically sodium chloride contains the impurities of magnesium chloride which is deliquescent (when exposed to atmosphere, absorbs moisture and gets converted to saturated solution). Therefore common salt becomes wet during rainy season. Sodium chloride is neither hygroscopic nor deliquescent.

(*ii*) Conc. sulphuric acid is highly hygroscopic in nature, therefore, when exposed to atmosphere it absorbs moisture thus the level of sulphuric acid in the jar increases.

(*iii*) Washing soda is an efflorescent salt (when exposed to atmosphere loses water of crystallisation and crumbles down to form powder) thus, it loses weight when exposed to atmosphere.

(*iv*) Copper is lying below hydrogen in the metal activity series therefore it does not displace hydrogen from water.

(*v*) Ferric chloride is highly deliquescent in nature, *i.e.*, when exposed to atmosphere absorbs moisture and gets converted into its saturated solution therefore it should be stored in airtight bottles.

Q2. State which salts increase in weight, decrease in weight or remain same when exposed to atmosphere.

(*i*) Washing soda

(*ii*) Glauber's salt

(*iii*) Soda ash

(*iv*) Sodium chloride

(*v*) Magnesium chloride

(*vi*) Sodium hydroxide

(*vii*) Ferric chloride

(*viii*) Green vitriol

(*ix*) Conc. sulphuric acid

(*x*) Common salt

Ans. (*i*) Decreases (*ii*) Decreases

(*iii*) Remains same (*iv*) Remains same

(*v*) Increases (*vi*) Increases

(*vii*) Increases (*viii*) Decreases

(*ix*) Increases (*x*) Increases.

Q3. Name the following :

(*i*) Two metals which react vigorously with cold water.

(*ii*) A metal that reacts reversibly with steam.

(*iii*) A metal that does not react with water under any condition.

(*iv*) A compound made by the chemical combination of highly combustible gas and a gas which is supporter of combustion.

(*v*) The gas used during the process of photosynthesis.

(*vi*) The gas liberated during the process of photosynthesis.

(*vii*) Anhydride of sulphuric acid.

(*viii*) Two metals which react with water to form alkalies.

(*ix*) A metal which burns with golden yellow flame.

(*x*) A metal which burns with violet flame.

(*xi*) A metallic oxide which exists in liquid state at room temperature.

Ans. (*i*) Sodium and potassium

(*ii*) Iron

(*iii*) Copper or silver or gold

(*iv*) Water

(*v*) Carbon dioxide

(*vi*) Oxygen

(*vii*) Sulphur trioxide

(*viii*) Sodium and potassium

(*ix*) Sodium

(*x*) Potassium

(*xi*) Water.

Q4. Name the class of compounds formed when the following react with water.

(*i*) Non-metallic oxides

(*ii*) Metallic oxides.

Ans. (*i*) Acids

(*ii*) Bases or alkalies.

Q5. Gas 'A' is a colourless gas which is produced by the reaction of active metals with dilute HCl. Gas 'B' is produced by the action of heat on potassium chlorate. Gas 'A' undergoes reaction with 'B' and forms colourless liquid 'C'.

(*i*) Identify A, B and C.

(*ii*) Give balanced chemical equation for the formation of liquid 'C' from 'A' and 'B'.

(*iii*) Give two tests to identify liquid 'C'.

(*iv*) Give balanced chemical equations for the reaction of 'C' with

(*a*) Sulphur dioxide

(*b*) Sodium oxide

(*c*) Ammonia

(*d*) Carbon dioxide

(*e*) Potassium oxide.

Ans. (*i*) A — Hydrogen

B — Oxygen

C — Water

(*ii*) $2H_2 + O_2 \longrightarrow 2H_2O$

(*iii*) Liquid 'C' can be tested by the following two ways :

(*a*) It turns anhydrous copper sulphate from white to blue.

(*b*) It turns anhydrous cobalt chloride from blue to pink.

(*iv*) (*a*) $SO_2 + H_2O \longrightarrow H_2SO_3$ (Sulphurous acid)

(*b*) $Na_2O + H_2O \longrightarrow 2NaOH$ (Sodium hydroxide)

(*c*) $NH_3 + H_2O \longrightarrow NH_4OH$ (Ammonium hydroxide)

(*d*) $CO_2 + H_2O \longrightarrow H_2CO_3$ (Carbonic acid)

(*e*) $K_2O + H_2O \longrightarrow 2KOH$ (Potassium hydroxide)

Q6. How will you prepare the following from water ?

(*i*) Water gas (*ii*) Hydrogen

(*iii*) Acid (*iv*) Alkali.

Ans. (*i*) $\underset{\text{White hot coke}}{C} + \underset{\text{Superheated steam}}{H_2O} \longrightarrow \underbrace{CO + H_2}_{\text{Water gas}}$

(*ii*) $Mg + \underset{\text{steam}}{H_2O} \longrightarrow MgO + H_2$

$Zn + \underset{\text{steam}}{H_2O} \longrightarrow ZnO + H_2$

$3Fe + \underset{\text{heated steam}}{4H_2O} \rightleftharpoons Fe_3O_4 + 4H_2$

(*iii*) Non-metallic oxide + Water $\longrightarrow$ Acid

$CO_2 + H_2O \longrightarrow H_2CO_3$

$SO_2 + H_2O \longrightarrow H_2SO_3$

$SO_3 + H_2O \longrightarrow H_2SO_4$

$P_2O_5 + 3H_2O \longrightarrow 2H_3PO_4$

(*iv*) Metallic oxide + Water $\longrightarrow$ Alkali

$Na_2O + H_2O \longrightarrow 2NaOH$

$K_2O + H_2O \longrightarrow 2KOH$

$CaO + H_2O \longrightarrow Ca(OH)_2$

Q7. What are drying agents ? Name the drying agents for the following gases.

(*i*) Chlorine

(*ii*) Hydrogen chloride

(*iii*) Ammonia

(*iv*) Sulphur dioxide

Ans. The substances which easily absorb moisture from the other substances are called drying agents.

Name of the gas	*Drying agent*
(*i*) Chlorine	Conc. H_2SO_4
(*ii*) Hydrogen chloride	Conc. H_2SO_4
(*iii*) Ammonia	CaO
(*iv*) Sulphur dioxide	Conc. H_2SO_4

Q8. Give two differences between deliquescent substances and hygroscopic substances.

Ans. Differences :

Deliquescent substances	*Hygroscopic substances*
(*i*) These are solids, crystalline in nature.	(*i*) They may be crystalline solids or liquids.
(*ii*) They absorb moisture from the atmosphere and dissolve in it to form saturated solution.	(*ii*) They absorb moisture from the atmosphere and become wet (in case of solids) but do not form saturated solution.

Q9. Name the following salts.

(*i*) A decahydrated crystalline salt.

(*ii*) Anhydrous crystalline salt of potassium which is purple in colour.

(*iii*) A hydrated crystalline salt which is green in colour.

(*iv*) A pentahydrated crystalline salt which is blue in colour.

(*v*) Salt which is commonly called sal ammoniac.

(*vi*) Salt commonly called soda ash.

Ans. (*i*) Washing soda $Na_2CO_3 . 10H_2O$

(*ii*) Potassium permanganate $KMnO_4$

(*iii*) Hydrated ferrous sulphate or green vitriol $FeSO_4 . 7H_2O$

(*iv*) Hydrated copper sulphate or blue vitriol $CuSO_4 . 5H_2O$

(*v*) Ammonium chloride NH_4Cl

(*vi*) Sodium carbonate Na_2CO_3

Q10. How can a saturated solution be converted into unsaturated solution ?

Ans. A saturated solution is converted to unsaturated solution by the following two ways:

(*i*) By adding solvent.

(*ii*) By heating the solution or by increasing temperature.

Q11. What is the effect of increasing and decreasing temperature on the solubility of the gas in a liquid ?

Ans. On increasing the temperature the solubility of gas in a liquid decreases whereas on decreasing temperature the solubility of a gas in liquid increases. This shows that the solubility of a gas in a liquid is inversely proportional to temperature.

Q12. What is the effect of increasing and decreasing pressure on the solubility of the gas in a liquid ?

Ans. On increasing pressure the solubility of a gas in a liquid increases whereas on decreasing pressure the solubility of a gas in a liquid decreases. This shows the mass of a given volume of gas which dissolves in liquid at constant temperature is directly proportional to the pressure on the surface of the liquid and thus in accordance with Henry's law.

Q13. Name the solvents for the following solutes :

(*i*) Potassium nitrate (*ii*) Rust

(*iii*) Iodine (*iv*) Phosphorus

(*v*) Sulphur (*vi*) Grease

(*vii*) Nail polish (*viii*) Alcohol

(*ix*) Paint (*x*) Chlorophyll.

Ans. (*i*) Water

(*ii*) Oxalic acid

(*iii*) Ethyl alcohol

(*iv*) Carbon disulphide

(*v*) Carbon disulphide

(*vi*) Petrol

(*vii*) Acetone

(*viii*) Water

(*ix*) Turpentine oil

(*x*) Methylated spirit.

Q14. Define the following :

(*i*) Solution

(*ii*) Melting point

(*iii*) Boiling point.

Ans. (*i*) Solution :

The homogeneous liquid mixture of solute and solvent is called solution.

(*ii*) Melting point :

The constant temperature at which solid gets converted into its liquid.

(*iii*) Boiling point :

The constant temperature at which liquid gets converted into its vapour state.

Q15. Name the products formed when hydrocarbons are burnt in sufficient quantity of oxygen.

Ans. Carbon dioxide and water vapour.

Q16. Why the salt content in the cooked vegetable remains the same, whether the cooked food is hot or cold ?

Ans. The salt mainly used for cooking purpose is common salt (NaCl) and its solubility does not change with temperature.

LET'S RECALL

Fill Your Answer in the Space Given for Each Question.

Q1. Match the following :

Column I (Acid)	Column II (Acid anhydride)
(*i*) Sulphuric acid	(*a*) Phosphorus pentaoxide
(*ii*) Phosphoric acid	(*b*) Carbon monoxide
(*iii*) Carbonic acid	(*c*) Sulphur dioxide
(*iv*) Sulphurous acid	(*d*) Sulphur trioxide
(*v*) Formic acid	(*e*) Carbon dioxide

Ans. (*i*) ☐ (*ii*) ☐ (*iii*) ☐ (*iv*) ☐ (*v*) ☐

Q2. Fill in the blanks.

(*i*) At 0°C water has _____ volume but _____ density.

(*ii*) At 4°C pure water has _____ volume and _____ density.

(*iii*) If electric current is passed through acidified water _____ is obtained at cathode and _____ is obtained at anode in the ratio of _____ by volume.

(*iv*) Water turns _____ from white to _____.

(*v*) Water turns _____ from _____ to pink.

(*vi*) Pure water boils at _____ and freezes at _____.

(*vii*) Water gas is equivolume mixture of _____ and _____.

(*viii*) _____ solids lack definite geometrical shape.

(*ix*) On increasing temperature the solubility of a gas in a liquid _____.

(*x*) Acid anhydrides are also called _____.

Q3. State whether the following statements are True or False.

(*i*) The formation of solution is a physical change. ☐

(*ii*) Sodium reacts moderately with cold water. ☐

(*iii*) Copper displaces hydrogen from dilute acids. ☐

(*iv*) Sodium chloride is a deliquescent salt. ☐

(*v*) Sodium oxide dissolves in water. ☐

Q4. Each question has four options out of which only one option is correct. Dark the bubble for correct answer.

(*i*) Chlorine reacts with water in the presence of sunlight to liberate

(*a*) hydrogen (*b*) hydrogen chloride gas

(*c*) ammonia (*d*) oxygen

Ans. (*a*) (*b*) (*c*) (*d*)

(*ii*) The homogeneous mixture of solute and solvent is called

(*a*) solution (*b*) salt

(*c*) mixture (*d*) compound

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

(*iii*) The effect of temperature on the solubility of a gas in a liquid is governed by

(*a*) Boyle's law (*b*) Charles' law

(*c*) Henry's law (*d*) Avogadro's law

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

(*iv*) The burning of hydrocarbon in air produces

(*a*) CO_2 and H_2 (*b*) CO_2 and H_2O

(*c*) CO only (*d*) CO_2 only

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

(*v*) Ferric chloride is a

(*a*) deliquescent salt (*b*) efflorescent salt

(*c*) hygroscopic in nature (*d*) None of these

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

Q5. Complete and balance the following equations.

(*i*) $Cl_2 + H_2O \xrightarrow[\text{sunlight}]{\text{diffused}}$ _____ + _____,

$HOCl \longrightarrow$ _____ + _____,

$2[O] \longrightarrow$ _____

(*ii*) $Cl_2 + H_2O \xrightarrow[\text{sunlight}]{\text{direct}}$ _____ + _____

(*iii*) $Fe + H_2O \longrightarrow$ _____ + _____

(*iv*) $K_2O + H_2O \longrightarrow$ _____

(*v*) $Zn + H_2O \longrightarrow$ _____ + _____

(*vi*) $Na + H_2O \longrightarrow$ _____ + _____

(*vii*) $P + O_2 \longrightarrow$ _____

(*viii*) $CH_4 + O_2 \longrightarrow$ _____ + _____

(*ix*) $C_2H_6 + O_2 \longrightarrow$ _____ + _____

(*x*) $C_2H_2 + O_2 \longrightarrow$ _____ + _____

Answers

1. (*i*) *d* (*ii*) *a* (*iii*) *e* (*iv*) *c* (*v*) *b*

2. (*i*) maximum, minimum (*ii*) minimum, maximum

(*iii*) hydrogen, oxygen, 2 : 1 (*iv*) anhydrous copper sulphate, blue

(*v*) anhydrous cobalt chloride, blue (*vi*) 100°C, 0°C

(*vii*) CO, H_2 (*viii*) amorphous (*ix*) decreases (*x*) acidic oxides

3. (*i*) True (*ii*) False (*iii*) False (*iv*) False (*v*) True

4. (*i*) *d* (*ii*) *a* (*iii*) *c* (*iv*) *b* (*v*) *a*

5. (*i*) $Cl_2 + H_2O \xrightarrow[\text{sunlight}]{\text{diffused}} HCl + HOCl$,

$HOCl \longrightarrow HCl + [O]$,

$2[O] \longrightarrow O_2$

(*ii*) $2Cl_2 + 2H_2O \xrightarrow[\text{sunlight}]{\text{direct}} 4HCl + O_2$

(*iii*) $3Fe + 4H_2O \longrightarrow Fe_3O_4 + 4H_2$

(*iv*) $K_2O + H_2O \longrightarrow 2KOH$

(*v*) $Zn + H_2O \longrightarrow ZnO + H_2$

(*vi*) $2Na + 2H_2O \longrightarrow 2NaOH + H_2$

(*vii*) $4P + 5O_2 \longrightarrow 2P_2O_5$

(*viii*) $CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$

(*ix*) $2C_2H_6 + 7O_2 \longrightarrow 4CO_2 + 6H_2O$

(*x*) $2C_2H_2 + 5O_2 \longrightarrow 4CO_2 + 2H_2O$

SELF EVALUATION TEST

Time : *30 minutes* ***Marks*** *: 30*

Q1. State Henry's law. **1**

Q2. Define solubility. **1**

Q3. Give equations for the reactions taking place at cathode and at anode during the electrolysis of acidulated water. **2**

Q4. How boiling point and freezing point of pure water are affected on addition of impurity ? **2**

Q5. Name the products formed when the following are dissolved in water. **2**

(*a*) Metallic oxide

(*b*) Non-metallic oxide

Q6. Give two equations for the formation of water from hydrogen other than by burning. **2**

Q7. Define the following . **5**

(*i*) Efflorescence

(*ii*) Deliquescence

(*iii*) Hygroscopy

(*iv*) Water of crystallization

(*v*) Anhydrous

Q8. What do you observe when **5**

(*i*) neutral litmus solution is added to pure water ?

(*ii*) crystals of copper sulphate are heated ?

(*iii*) chlorine water is exposed to sunlight ?

(*iv*) water droplets are added to anhydrous cobalt chloride ?

(*v*) sodium piece is added to cold water ?

Q9. Name the following. **5**

(*i*) A mixed anhydride.

(*ii*) A fuel having very high calorific value and is a mixture.

(*iii*) A greenish yellow coloured gas.

(*iv*) A blue crystalline salt which on heating changes to white.

(*v*) The process of separating crystals from its hot saturated solution.

Q10. Define with examples. **5**

(*a*) Saturated solution.

(*b*) Unsaturated solution.

(*c*) Supersaturated solution.