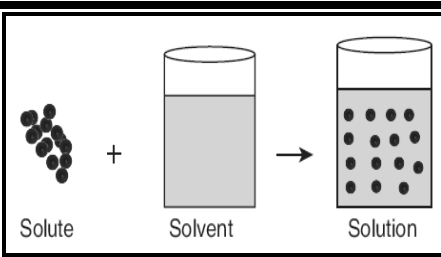# UNIT – 9
SOLUTIONS

Solute + Solvent → Solution

I. Choose the correct answer

1. A solution is a _____ mixture.
   a) homogeneous   b) heterogeneous   c)homogeneous&heterogeneous d)nonhomogeneous
2. The number of components in a binary solution is _____.   **[MAY - 2022]**
   a) 2   b) 3   c) 4   d) 5
3. Which of the following is the universal solvent?
   a) Acetone   b) Benzene   **c) Water**   d) Alcohol
4. A solution in which no more solute can be dissolved in a definite amount of solvent at a given temperature is called _____.
   a) Saturated solution   b) Unsaturated solution
   c) Super saturated solution   d) Dilute solution
5. Identify the non aqueous solution.   **[SEP – 2020]**
   a) sodium chloride in water   b) glucose in water
   c) copper sulphate in water   **d) sulphur in carbon-di-sulphide**
6. When pressure is increased at constant temperature, the solubility of gases in liquid _____.
   a) No change   **b) increases**   c) decreases   d) no reaction
7. Solubility of *NaCl* in 100 ml water is 36 g. If 25 g of salt is dissolved in 100 ml of water how much more salt is required for saturation _____.
   a) 12 g   **b) 11 g**   c) 16 g   d) 20 g
8. A 25% alcohol solution means   **[PTA – 4]**
   a) 25 ml alcohol in 100 ml of water   b) 25 ml alcohol in 25 ml of water
   c) 25 ml alcohol in 75 ml of water   d) 75 ml alcohol in 25 ml of water
9. Deliquescence is due to _____.   **[PTA – 5]**
   a) Strong affinity to water   b) Less affinity to water
   c) Strong hatred to water   d) Inertness to water
10. Which of the following is hygroscopic in nature?
    a) ferric chloride   b) copper sulphate penta hydrate
    c) silica gel   d) none of the above

II. Fill in the blanks

1. The component present in lesser amount, in a solution is called **solute.**   **[MDL – 19]**
2. Example for liquid in solid type solution is **mercury with sodium (amalgam).**
3. Solubility is the amount of solute dissolved in **100 g** of solvent.
4. Polar compounds are soluble in **polar** solvents.
5. Volume percentage decreases with increase in temperature because of **thermal expansion of liquid.**

⟨ **III. Match the following** ⟩

Column I	Column II	Answer
1. Blue vitriol	$CaSO_4.2H_2O$	**1) $CuSO_4.5H_2O$**
2. Gypsum	CaO	**2) $CaSO_4.2H_2O$**
3. Deliquescence	$CuSO_4.5H_2O$	**3) NaOH**
4. Hygroscopic	NaOH	**4) CaO**

⟨ **IV. True or False: (if false give the correct statement)** ⟩

1. Solutions which contain three components are called binary solution. **[False]**

   > *Solutions which contain **two** components are called binary solution.

2. In a solution, the component which is present in lesser amount is called solvent. **[False]**

   > *In a solution, the component which is present in lesser amount is called **solute**. **[PTA-4]**

3. Sodium chloride dissolved in water forms a non - aqueous solution. **[PTA – 4]** **[False]**

   > *Sodium chloride dissolved in water forms an **aqueous solution**.

4. The molecular formula of green vitriol is $MgSO_4.7H_2O$ **[False]**

   > *The molecular formula of green vitriol is **$FeSO_4.7H_2O$** (or) The molecular formula of **epsom salt** is $MgSO_4.7H_2O$.

5. When Silica gel is kept open, it absorbs moisture from the air, because it is hygroscopic in nature. **[PTA – 4]** **[True]**

⟨ **V. Short answer questions** ⟩

1. Define the term - Solution.

   ❖ It is a homogeneous mixture of two or more substances. ***Ex :*** Sea water
   ❖ Components: Solute (lesser amount) and Solvent (larger amount)

2. What is mean by binary solution?

   Binary solution consists of two components one solute and one solvent. ***Ex:*** NaCl in water

3. Give an example each i) gas in liquid ii) solid in liquid iii) solid in solid iv) gas in gas

   i) Gas in liquid   - Soda water   ii) Solid in liquid - NaCl in water   **[PTA – 1]**
   iii) Solid in solid - Copper in gold   iv) Gas in gas   - Mixture of Helium and oxygen

4. What is aqueous and non-aqueous solution? Give an example.

   Aqueous solution : It is the solution in which water acts as a solvent. ***Ex: Sugar in water.***

   Non - Aqueous solution : It is the solution in which any liquid other than water acts as solvent.
   Ex: Sulphur dissolved in carbon - disulphide.

5. Define Volume percentage.

   It is the percentage by volume of solute (in ml) present in the given volume of the solution.

   $$\text{Volume percentage} = \frac{\text{Volume of the solute}}{\text{Volume of the solute + Volume of the solvent}} \times 100$$

6. The aquatic animals live more in cold region. Why? **[PTA – 5]**

   ❖ In cold regions, solubility of gas in liquid is more at lower temperature.
   ❖ Thus, more oxygen is dissolved in water. Hence, aquatic animals live more in cold regions.

7. Define Hydrated salt.

It is the ionic substances, which contain water of crystallization. *Ex :* Blue vitriol ($CuSO_4 . 5H_2O$)

8. A hot saturated solution of copper sulphate forms crystals as it cools. Why?

❖ When hot saturated solution of copper sulphate is cooled, excess copper sulphate in the solution will be crystallized.

❖ This is because solubility decreases with decrease in temperature.

9. Classify the following substances into deliquescent, hygroscopic. **[AUG - 2022]**

(Conc. Sulphuric acid, Copper sulphate penta hydrate, Silica gel, Calcium chloride, and Gypsum salt)

❖ *Deliquescent substances :* Calcium chloride

❖ *Hygroscopic substances :* Conc. Sulphuric acid, Silica gel, Gypsum salt, Copper sulphate penta hydrate

VI. Long answer questions

1. Write notes on   i) saturated solution   ii) unsaturated solution

i) Saturated solution :   It is the solution in which no more solute can be dissolved in a definite amount of solvent at a given temperature.

Ex : 36 g of sodium chloride in 100g of water at 25^0C

ii) Unsaturated solution : It is the solution that contains less solute than that of saturated solution at a given temperature. *Ex : 10 g of sodium chloride in 100g of water at 25°C*

2. Write notes on various factors affecting solubility. **[MDL – 19]**

i) Nature of the solute and solvent:

❖ "Like dissolves Like".

❖ Polar compounds are soluble in polar solvents only. *Ex: Common salt dissolves in water.*

❖ Non-polar compounds are soluble in non-polar solvents only. *Ex: Fat dissolved in ether.*

ii) Temperature:

a) Solubility of solid in liquid:

❖ It increases with increase in temperature.

Ex: More *sugar will dissolve in warm water than in cold water.*

❖ In endothermic process, solubility increases with increase in temperature.

❖ In exothermic process, solubility decreases with increase in temperature.

b) Solubility of gases in liquid:

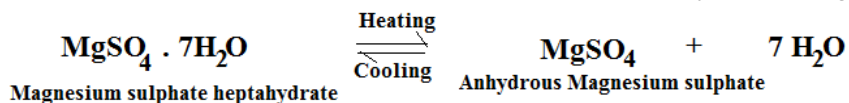It decreases with increase in temperature. *Ex: Aquatic animal live more in cold regions.*

iii) Pressure:

When pressure is increased, solubility is also increased. *Ex: soft drinks*

3. a) What happens when $MgSO_4.7H_2O$ is heated? Write the appropriate equation.

[AUG-22, SEP-21, PTA-4]

When $MgSO_4.7H_2O$ is heated, it loses its water and become anhydrous magnesium sulphate.

$$MgSO_4 . 7H_2O \underset{\text{Cooling}}{\overset{\text{Heating}}{\rightleftharpoons}} MgSO_4 + 7 H_2O$$

Magnesium sulphate heptahydrate   Anhydrous Magnesium sulphate

b) Define Solubility.
- ❖ It is the number of grams of solute that can be dissolved in 100 g of solvent to form its saturated solution at a given temperature and pressure.
- ❖ *Ex:* *36 g of sodium chloride has to be dissolve in 100g of water to form its saturated solution.*

4. **In what way hygroscopic substances differ from deliquescent substances.[SEP-2021, PTA-2]**

Hygroscopic substances	Deliquescence substances
1. When exposed to atmosphere, they absorb moisture and *do not dissolve*.	1. When exposed to atmosphere, they absorb moisture and *dissolve*.
2. *Do not change its physical state*.	2. *Change its physical state* on exposure to air.
3. *Amorphous* solids or liquids.	3. *Crystalline* solids.
4. *Do not form saturated solutions*.	4. *Form saturated solutions*.
5. *Ex:* Quick lime, Silica gel.	5. *Ex:* Caustic soda, Caustic potash.

5. **A solution is prepared by dissolving 45 g of sugar in 180 g of water. Calculate the mass percentage of solute.**
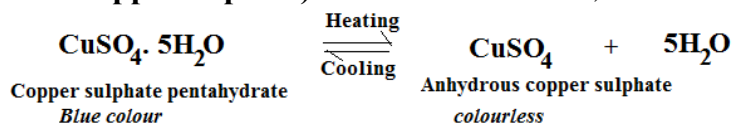
Mass percentage of solute $= \dfrac{\text{Mass of solute}}{\text{Mass of solvent+ mass of solute}} \times 100 \ = \dfrac{45}{180+45} \times 100 \ = \dfrac{4500}{225} = \mathbf{20\%}$

6. **3.5 litres of ethanol is present in 15 litres of aqueous solution of ethanol. Calculate volume percent of ethanol solution.** **[PTA – 2]**

Volume percentage $= \dfrac{\text{Volume of solute}}{\text{volume of solution}} \times 100 \ = \dfrac{3.5}{15} \times 100 \ = \mathbf{23.33\%}$

VII. HOT Questions

1. **Vinu dissolves 50 g of sugar in 250 ml of hot water, Sarath dissolves 50 g of same sugar in 250 ml of cold water. Who will get faster dissolution of sugar? and Why?** **[PTA – 6]**
   Vinu readily dissolves sugar than Sarath because solubility increases with increase in temperature.

2. **'A' is a blue coloured crystalline salt. On heating it loses blue colour and to give 'B'. When water is added, 'B' gives back to 'A'. Identify A and B, write the equation.** **[MAY - 2022]**
   - ❖ When **blue vitriol (A)** is heated, it loses its five water molecules and becomes colourless **$CuSO_4$ (Anhydrous copper sulphate) 'B'**. If water is added, it returns back to blue vitriol (A).

$$CuSO_4 \cdot 5H_2O \underset{\text{Cooling}}{\overset{\text{Heating}}{\rightleftharpoons}} CuSO_4 + 5H_2O$$

Copper sulphate pentahydrate   Anhydrous copper sulphate
Blue colour   *colourless*

A →	blue vitriol, Copper sulphate pentahydrate ($CuSO_4 \cdot 5H_2O$)
B →	Anhydrous copper sulphate ($CuSO_4$)

3. **Will the cool drinks give more fizz at top of the hills or at the foot? Explain.**
   - ❖ Pressure is reduced when we move from foot to top of the hill.
   - ❖ When pressure is decreased, solubility is decreased.
   - ❖ Thus, cool drinks fizzes lesser at top than at the foot of hills.