SOLUTIONS

6

MULTIPLE CHOICE QUESTIONS

SOLUTE, SOLVENT

1. In solution the substance that is present in lesser amount is called
   (a) Solute (b) Solvent
   (c) Solution (d) Both "a" & "b"
2. The substance that is present in large amount is called
   (a) Solvent (b) Solute
   (c) Solution (d) Both "a" & "b"

AQUEOUS SOLUTION

3. A solution in which water is solvent is called an
   (a) Aqueous solution (b) Unsaturated solution
   (c) Saturated solution (d) None of these
4. Solution of substance in water is called _____ solution
   (a) Aqueous (b) Dilute
   (c) Infinite (d) All a, b, c

CONCENTRATION UNIT

5. The quantity of a solute present in a given amount of solvent or solution is called.
   (a) Concentration of solution (b) Solution
   (c) Solution (d) Solvent
6. Molarity is defined as the number of moles of solute dissolved per dm^3 of solution is known as
   (a) Molarity (b) Solution
   (c) Solvent (d) Solute
7. A solution containing relatively higher concentration of solute is called
   (a) Dilute solution (b) Saturated solution
   (c) Conc. Solution (d) Suspicious

MOLARITY

8. Number of moles of solute per dm^3 of the solution is called
   (a) Molarity (b) Molality
   (c) Normality (d) Density
9. Solubility of sodium chloride in 100g of water into room temperature is
   (a) 27g (b) 22g
   (c) 40g (d) 35.7g
10. Water molecule is Polar
    (a) Polar (b) Non - polar
    (c) Both "a" & "b" (d) None of these

SOLUBILITY

11. Change of temperature can change the _____ of a solute in a solvent.
    (a) dilution (b) solubility
    (c) molarity (d) dipole moment

12. The amount of solute that dissolves in 100g of a solvent at a particular temperature is called its solubility
(a) dilution
(b) solubility
(c) solute
(d) Molarity

SOLUTION, SUSPENSION AND COLLOIDS

13. Partial size of solution are
(a) 0.1 to 1 nm
(b) 0.1 to 2 nm
(c) 0.1 to 3 nm
(d) 0.1 to 4 nm

14. Suspension are
(a) Homogenous
(b) Heterogeneous
(c) Both A and B
(d) None of these

15. Butter is an example of
(a) Solution
(b) Suspension
(c) Colloids
(d) None of these

16. Which one produce colloidal solution
(a) Blood
(b) Cooper sulphate solution
(c) Silver nitrate solution
(d) None of these

17. In sodium amalgam while two metals as present
(a) Na and Mg
(b) Na and Mu
(c) Na and Hg
(d) Zn and CO

18. Number of moles of solute per dm^3 of the solution is called:
(a) molarity (b) molality (c) normality (d) density

19. In sodium amalgam which two metals as present:
(a) Na and Mg (b) Na and Mμ (c) Na and Hg (d) Zn and Co

20. The concentrated solution of NaCl is called:
(a) fluid (b) brass (c) brine (d) plasma

21. Brass is a familiar alloy, made of:
(a) zinc + carbon (b) Zinc + copper (c) copper + iron (d) zinc + lead

22. The homogeneous mixture of two or more compounds is called:
(a) solute (b) solvent (c) solution (d) fluid

ANSWER KEY

Q.	Ans	Q.	Ans	Q.	Ans
1	a	11	b	21	b
2	a	12	b	22	c
3	a	13	a		
4	a	14	b		
5	a	15	c		
6	a	16	d		
7	c	17	c		
8	a	18	a		
9	d	19	c		
10	a	20	c		

SHORT QUESTIONS

TYPES OF SOLUTION

Q.1 Define unsaturated solution?

Ans: A solution which can dissolve muse of the solute at a given temperature is called an unsaturated solution.

Q.2 Define supersaturated solution?

Ans: A solution that contains muse of the solute than is contained in the saturated solution is called supersaturated solution.

Q.3 Major difference between a solution and a mixture

Ans:

Solution	Mixture
Hormogenous mixture of two or more substances	Combination of two or more things without any ration
The quantity if solute and solvent is fixed is solution	The quantity of compounds is not fixed

CONCENTRATION UNIT

Q.4 What are the types of Percentage solution?

Ans:

TYPES

- m/m Percentage solution.
- m/v Percentage solution.
- v/m Percentage solution.
- v/v Percentage solution.

Q.5 Define concentration of solution?

Ans: The quantity of a solute present in a given amount of solvent or solution is called concentration of solution.

Q.6 Calculate the concentration % (w/w) of a solution, which contains 2.5 g of salt dissolved in 50 g of water.

Ans.

$$\% \text{ w/w} = \frac{\text{Mass of solute (g)}}{\text{Mass of solute + Mass of solvent}} \times 100$$

$$\% \text{ w/w} = \frac{2.5 \text{ gm}}{2.5\text{gm} + 50 \text{ gm}} \times 100$$

$$\% \text{ w/w} = \frac{25 \text{ gm}}{525\text{gm}} \times 100 = \frac{100}{21} = 4.76\ \%$$

$$\% \text{ w/w} = 4.76\ \%$$

MOLARITY

Q.7 Define Molarity.

Ans: **Molarity:-**

Molarity is defined as the number of moles of solute dissolved per dm^3 of solution.

Mathematically:-

$$M = \frac{\text{moles of solute}}{\text{dm}^3 \text{ of solution}}$$

Q.8 Why is the formula of solute necessary for calculation of the molarity of the solution?

Ans. As the formula of molarity shows:

$$\text{Molarity} = \frac{\text{Mass of solute}}{\text{Molar mass of solute}} \times \frac{1000}{\text{Volume of solution in cm}^3}$$

Q.9 Why is the formula of solute necessary for calculation of molarity of the solution?

Ans: As the formula of molarity shows

$$\text{molarity} = \frac{\text{mass of solute}}{\text{molar man of solute}} \times \frac{1000}{\text{volume of solution in cm}^3}$$

SOLUBILITY

Q.10 Define solubility?

Ans: The amount of solute that dissolves in 100g of an solvent at a particular temperature is called solubility.

Example:

Solubility of sodium chloride in 100g of water at room temperature is 35.7g

Q.11 How does nature of attractive forces of solute-solute and solvent-solvent affect the solubility?

Ans: Solution formation depends upon the relative strength of attractive forces between solute, solvent and solute-solvent. Generally, solutes are solids. Ionic solids are arranged in such a regular pattern that the inter-ionic forces are the solute-solute attractive, the solute dissolves and makes a solution. if forces between solute particles are strong enough than solute-solvent forces, solute remains insoluble and solution is not formed.

Q.12 How you can explain the solute-solvent interaction to prepare a NaCI solution?

Ans: When NaCl is added in water it dissolves readily because the attractive interaction between the ions of NaCl and polar molecules of water are strong enough to overcome the attractive forces between Na^+ Cl^- ions in solid NaCl crystal. In this process, positive end of the water dipole is oriented towards the Cl^- ions and the negative end of water dipole is oriented towards the Na+ ins. These ion-dipole attractions between Na^+ ions and water molecules, Cl^- ions and water molecules are so strong that they pull these ions from their positions in the crystal and thus NaCl dissolves.

Q.13 Justify with an example that solubility of a salt increases with the increase in temperature

Ans: Solubility of some salts which are usually ionic in nature increases with the increase in temperature for such solutes. It means that heat is required to break the attractive forces between the ions solute. This requirement falls down and test tube becomes cold.

Q.14 What will happen if the solute-solute forces are stronger than those of solute-solvent forces?

Ans. If solute-solute forces are stronger than those of solute-solvent forces, solute remains insoluble and solution is not formed.

SOLUTION, SUSPENSION AND COLLOIDS

Q.15 Differentiate between solution and suspension

Ans:

Solution	Suspension
(1) Homogenous	Heterogeneous
(2) Particles size very from 0.10 to 1nm	Pride size is greater then 10^3nm
(3) Particles are invisible by naked eye, ordinary microscope as well as electron microscope	Particles are visible by naked eye
(4) Particles can pass through ordinary as well as utter filter paper.	Particles can not pass through ordinary as well as utter filter paper.
(5) Cannot scatter light	Scatter light
(6) Salt solution in water is examples of solution	Sand in water is a example of suspensions.

Q.16 What is tyndall effect and on what factors it depends?

Ans: Scattering of light in colloids is called tyndall effect. Tyndall effect is because of the particle size of colloids which is not very big nor very small particles scatter the path of light rays thus emitting the beam of light i.e. exhibit the tyndall effect.

Q.17 Can colloids be separated by filtration, if not why?

Ans: Colloids can not be separated by filtration because the particles in colloids are big but not big enough so that they can pass through a filter paper. Hence, colloids can not be separated by filtration process.

Q.18 Why are the alloys considered solutions?

Ans. The solution of solids in solid is called alloy.

Example: Brass, Bronze etc.

Q.19 Why is iodine soluble in CCl_4 and not in water?

Ans. Iodine soluble in CCl_4 because it is the general rule/principle of solubility that "like dissolves like", which means that polar-substances dissolve in polar-solvents while non-polar substances dissolve in non-polar solvents. Iodine and CCl_4 are both covalent in nature so iodine dissolve in CCl_4 but not in water because water is ionic in nature.

Q.20 Can colloids be separated by filtration, if not why?

Ans. Colloids can not be separated by filtration because the particles in colloids are big but not big enough so that they can pass through a filter paper. Hence, colloids can not be separated by filtration process.

Q.21 Why does the colloid show tyndall effect?

Ans. The particles in colloids are smaller than suspension but larger than solution. So, they show tyndall effect in which particles of colloids scatter the path of light rays thus emitting the beam of light i.e., exhibit the tyndall effect.

[redacted]ESTIONS

Q 1: Why solutions are important for us? Justify.

Ans: Importance:

- Brass, steel, gemstone silver, air, soft drinks, juices, shampoo, crude oil, cough syrup and many others are all solutions. These solutions are widely used for making cooking utensils, surgical tools, cutlery, musical instruments, health tonics, motor fuel and many other objects.
- Gases when dissolved in liquid also produce some important solutions.

  For example,

  1. Water dissolves small amount of air giving a solution whose oxygen content (Solute) is important for the survival of fish and other aquatic animals.
  2. Carbon dioxide gas dissolves readily in water, for this reason, it is used in making carbonated drinks.

  Thus we conclude that solutions are important for us.

Q 2: Define the following with example

(i) Solution (ii) Binary solution (iii) Aqueous Solution (iv) Solute (v) Solvent

Ans: i) Solution

A homogenous mixture of two or more different chemical substances with uniform chemical and physical properties is called solution.

For example,

Sugar solution, salt solution

ii) Binary Solution

A solution which consist of only two substances is called BINARY SOLUTION.

For example

Sugar solution (sugar + water)

Salt solution (salt + water)

iii) Aqueous Solution

The word aqueous is derived from the Latin word Aqua which means water. A solution in which water is used as a solvent is called AQUEOUS SOLUTION.

For example

Sugar solution and salt solution. In both solutions, water is used as a solvent

iv) Solute

The substance or component present in lesser amount in solution is called SOLUTE.

For example

In salt and sugar solutions, salt and sugar act as a solute.

v) Solvent

The substance or component of solution present in relatively large amount in solution is called SOLVENT.

For example

In salt and sugar solutions, water is a solvent.

Q 3: Define the following solutions with example.
i) Unsaturated **ii) Saturated** **iii) Supersaturated**

Ans: i) Saturated Solution
A solution which contains the maximum amount of a solute at a particular temperature and which is unable to dissolve further amount of solute in it is saturated solution.
Example: A saturated solution of sodium thiosulphate $(Na_2S_2O_3)$ in water at 20^oC has 20.9 g of salt per 100 cm^3 of water.

ii) Unsaturated Solution
A solution which can dissolve further amount of solute at a particular temperature is called an unsaturated solution.
For example
Take a beaker half filled with water. Add a spoon of sugar in it. It will dissolve. Such a solution is unsaturated because it can still dissolve more amount of solute in it.

iii) Supersaturated Solution
A solution which contains more amount of a solute in a particular amount of solvent then the saturated solution is called supersaturated solution.
For example
Add more sugar in the above solution, stir it, it will dissolve. Go on a adding more sugar and stirit. A stage will come when no more sugar will dissolve and will start settling down at the bottom of the beaker.

Q 4: How to know whether a solution is unsaturated, saturated or supersaturated? Demonstrate it with experiment.

Ans: A supersaturated solution is not stable in the presence of crystals of solute. If we add a crystal of sodium thiosulphate to its saturate solution, it will simply drop to the bottom, without dissolving but if we add a crystal of sodium thiosulphate to a supersaturated solution of sodium thiosulphate, crystallization will starts while in unsaturated solution the crystal will be dissolved as shown in the fig. (a).
When crystallization has finished, we will have a saturated solution in presence of sodium Thiosulphate Fig (b) shows the crystallization from a supersaturated solution of sodium thiosulphate.

Experiment:
Based on differentiating saturated, unsaturated and super saturated solution.

You will need:
- Three test tubes.
- Sodium thiosulphate, $Na_2S_2O_3$
- Water

Carry out the following:
1) Take 20 cm^3 water in each test tube and label them as A, B, C.
2) Add 4g $Na_2S_2O_3$ in A, 12g in B and 16g in C and shake. In test tube A, $Na_2S_2O_3$ is dissolved.
3) Heat test tubes B and C till $Na_2S_2O_3$ in dissolved completely.
4) Cool test tube C at room temperature without disturbing, ppt formed.
5) Write down what happens in test tube C before heating and after heating.
6) What do you observe in test tube C after cooling? ppt formed
7) Compare test tubes B and C and notice difference.
8) Identify test tubes containing unsaturated, saturated and supersaturated solutions.

Conclusion

1) Test tube A containing unsaturated solution.
2) Test tube B containing saturated solution.
3) In test tube C, before heating it is saturated and after heating settle amount will dissolve and become a supersaturated solution.

Q 5: Describe various types of solutions.

Ans: Types of Solutions

Solution exists in any one of the three states of matter I,e. solid, liquid or gas. Physical state of solution is same as the for solvent.

In fact, nine different types of solutions can be prepared by mixing together substances. These substances, in any physical state can serve as a solute or solvent. The following table indicates nine types of solutions.

Table: Common types of solutions

Sr. No.	Solute	Solvent	State of resulting solution	Examples
1	Gas	Gas	Gas	Air (a mixture of O_2, N_2, CO_2, etc.), water gas ($CO + H_2$)
2	Gas	Liquid	Liquid	Soda water (carbonated drink) Hydrochloric Acid.
3	Gas	Solid	Solid	H_2 absorbed on Ni, Pt, Pd
4	Liquid	Gas	Gas	Mist, fog, clouds
5	Liquid	Liquid	Liquid	Alcohol in water
6	Liquid	Solid	Solid	Amalgams Hg in Ag, wet NaCl in rainy season
7	Solid	Gas	Gas	Carbon particles in air (smoke)
8	Solid	Liquid	Liquid	Sugar in water, salt in water
9	Solid	Solid	Solid	Allys such as Solder (Pb + zn), Bronze (Cu + zn)

Q 6: Writes notes on the following.

i) Solutions of Gases **ii) Solutions of Liquids** **iii) Solutions of Solids**

Ans: i) Solutions of Gases

Gaseous solutions are commonly used by chemical industries to prepare chemical substances.

For example

1) Ammonia synthesis: A gaseous mixture of nitrogen and Hydrogen is used with ratio of $N_2 : H_2$ is 1:3 which is strictly maintained under varying reaction conditions.
2) Urea Fertilizer: A gaseous mixture of Ammonia and CO_2 is used for synthesis of urea.
3) Nitric Acid: A gaseous mixture of NH_3 and oxygen is used for the preparation of nitric acid.

In all these cases, gaseous mixture of solution of gases is used. In these solutions, solute and solvent both are gases.

ii) Solutions of Liquids

Solution of liquid in gas, liquid or solid solvents are also very common.

For Example

1) **Fog, clouds or mist:** In this liquid in gas mixture, water vapours are dissolved in air (solvent).

2) **Fermentation of cane sugar:**
95% v/v o ethyl alcohol called rectified spirit contains 5 cm^3 water (solute) 95cm^3 ethyl alcohol to make 100 cm^3 of liquid solution. Similarly 5% v/v vinegar solution contains 5cm^3 Acetic Acid (Solute) dissolved in 95cm^3 water (solvent) to make 100 cm^3 of liquid in liquid solution.

3) **Amalgam:**
It is a mixture/solution of Mercury liquid as solute in solids (Ag, Tin) as solvent.
It is widely used to make dental filling a cavity. On standing in cavities, it forms a hard solid and expands slightly.

iii) Solution of Solids

Some common solution of solid in gas, liquid or solids solvent are given below:

1) Smoke: It contains solid carbon particles (solute) spread in air (solvent and make a solution of solid in gas.
2) Saline Solution: It is a solution of 0.85g of NaCl (solid solute) in water (solvent) to make 0.85% m/m NaCl solution which is used in intravenous solution for caring persons suffering from dehydration.
3) Alloys: It is a solution/mixture of solids in solids.

Q 7: Give short answers of the following questions.

i) Role of zone in atmosphere.

ii) Importance of alloys on commercial levels.

iii) What is Amalgam? Why it is preferred in dental filling?

Ans:

i) Ultraviolet radiations causes changes in the structure of the genetic material like DNA. Long exposure to this radiation can cause cancer. Ozone is found in the upper atmosphere i.e. stratosphere i.e. Stratosphere and filters most of the harmful ultraviolet (uv) rays in the sunlight before they could reach the earth.

ii) Pure gold is very soft therefore cannot be used for making Jewellery. To make it harder, copper is added to the gold. This produces a solid solution of Gold called Alloys that melts at lower temperature than pure Gold. Therefore, it is easier to cast.

iii) A solution of any metal in mercury is called an amalgam e.g. silver and tin amalgams are widely used to make dental filling.
It is preferred in dental filling because when silver or tin is dissolved in mercury, it forms a semisolid amalgam which tightly fits within the cavity. It forms a hard solid and expands slightly.

Q 8: i) Define concentration of solution with example.

ii) Differentiate between dilute and concentrated solutions.

Ans: i) Concentration of Solution

It is the amount of solute present in a given amount of solvent or solution is called concentration of solution. Since both parts of the ratio (solute and solvent) can be given in terms of mass, volume or moles, therefore chemists use a variety of concentration terms e.g.: 5g of solute required to dissolve in 95g of solute to make 100g of m/m solution.

ii) Dilute Solution and Concentrated Solution

A solution which contains small amount of solute in a solvent is called a dilute solution while a solution which contains large amount of solute in a solvent is called concentrated solution.

For example

5g of NaCl in 95g of solvent in beaker A to make 100g solution of NaCl while in beaker B, 10g of NaCl in 90g of solvent (water) to make 100gm solution of NaCl. The beaker-A solution will be called dilute solution and beaker-B solution will be called concentrated solution.

Q 9: Define concentration units and describe percentage composition units.

Ans: 1. definition:

"The quantity of solute present in a given amount of solvent or solution is called concentration of solution."

2. Percentage Composition

The percentage composition is the unit of concentration that specifies the quantity of solute in 100 parts of solution Quantity of solute and solvent can be expressed by mass in grams or volume in cm^3. therefore, by the percentage of a solution we mean the mass or volume of solute dissolved in 100g or $100cm^3$ of solution.

There are four different ways of expression for percentage composition.

i) Mass by Mass Percentage (m/m)

It is the mass of the solute dissolved per 100 parts by mass of solution.

For Example

10% m/m NaCl solution means that 10 g NaCl in 90g water to make 100g of solution.

$$\therefore \quad \text{\% of solution by m/m} = \frac{\text{mass of solute (g)}}{\text{mass of solutions (g)}} \times 100$$

ii) Mass by Volume percent (m/v)

it is the mass of the solute dissolved per 100 per 100 parts by volume of solution.

For example

10% m/v NaCl solutions means that 10g NaCl in $90cm^3$ water to make $100cm^3$ of solution.

$$\therefore \quad \text{\% of solution by m/v} = \frac{\text{mass of solute (g)}}{\text{volume of solution (cm}^3\text{)}} \times 100$$

iii) Volume by mass Percent (v/m)

It is the volume of solute dissolved per 100 parts by mass of solution.

For example

10% v/m Alcohol solution means that $10cm^3$ of Alcohol in 90g of water to make 100g of solution.

$$\therefore \text{\% of solution by v/m} = \frac{\text{volume of solute(cm}^3\text{)}}{\text{mass of solution (g)}} \times 100$$

iv) Volume by volume percent (v/v)

It is the volume of solute dissolved per 100 parts by volume of solution.

For example

10% v/v Alcohol solution means that $10cm^3$ of Alcohol in 90 cm^3 of water to make 100 cm^3 of alcohol solution.

$$\text{\% of solution by v/q} = \frac{\text{volume of solute (cm}^3\text{)}}{\text{volume of solution (cm}^3\text{)}} \times 100$$

Q.No.1

TEXT BOOK EXERCISE
MULTIPLE CHOICE QUESTIONS

1. **The maximum amount of sodium acetate that dissolves in 100g of water at 0°C is 119 g and 170g at 100°C. If you place 170g of sodium acetate in 100g of water at °0, the resulting solution would be**
   A. unsaturated B. saturated C. supersaturated D. IM
2. **How many moles of sodium atoms are present in 2.3g Na?**
   A. 1 B. 1.5 C. 0.1 D. 0.15
3. **What is the mass of 5 moles of hydrogen gas?**
   A. 5g B. 5.04 C. 10.08g D. 1.008gm
4. **How many atoms are there in 28g of nitrogen gas?**
   A. 2 B. 1 C. 6.022×10^{23} D. 12.044×10^{23}
5. **How many atoms are there in 0.1 mole of carbon?**
   A. 6.022×10^{23} B. 6.022×10^{22} C. 6.022×10^{24} D. 6.022×10^{21}
6. **A solution of NaOH has concentration of $4g/dm^3$. what is the mass of NaOH contained in $250cm^3$ of this solution?**
   A. 40g B. 20g C. 1g D. 2g
7. **Which of the following solution is more dilute?**
   A. 1M B. 2M C. 0.1M D. 0.009M
8. **A solution of NaOH contains 20g of this compound in $2dm^3$ of solution. What is the molarity of this solution?**
   A. 2M B. 1M C. 0.25M D. 0.5M
9. **Which quantity is the same for one mole of hydrogen gas and one mole of water?**
   A. mass B. number of atoms
   C. number of molecules D. number of gram atomic mass
10. **If one mole of Na contains x atoms of sodium, what is the number of moles contained in 46g of sodium?**
    A. x B. 2 C. 2x D. 1.5x

Multiple Choice Answer with Explanation

S. No.	Answers with Explanation
i.	b = Saturated
ii.	c = 0.1 Moles = mass/Atomic mass = 2.3/23 = 0.1
iii.	c = 10.08g Moles × M × of H_2 = Mass, 5×1.008×2 = 10.08
iv.	c = 6.002×10^{23} No. of atoms = no. of moles × NA (Avogadro's Number) $= \dfrac{\text{Mass of } N_2}{\text{Mr of } N_2} \times 6.022\times10^{23}$ $= 28/28 \times 6.022 \times 10^{23} = 6.022 \times 10^{23}$
v.	b = 6.022×10^{22} No. of atoms = $0.1 \times 6.022 \times 10^{23} = 6.022 \times 10^{22}$
vi.	a = 40g

	Molarity $= \frac{\text{Mass of NaOH}}{\text{Mr of NaOH}} \times \frac{1}{\text{vol. in dm}^3}$ $4g/dm^3 = \frac{\text{Mass}}{40} \times \frac{1}{0.25} = 40g$
vii.	d = 0.009M lesser the molarity, more will be he dilute solution
viii.	c = 0.25M Molarity $= \frac{\text{Mass of NaOH}}{\text{Mr of NaOH}} \times \frac{1}{\text{vol. in dm}^3}$ $\frac{20}{40} \times \frac{1}{2} = 0.25M$
ix.	c = Number of molecules one mole of $H_2O = 2g = 6.022 \times 10^{23}$ molecules one mole of $H_2O = 18g = 6.022 \times 10^{23}$ molecules
x.	c = 2x one mole of Na contains mass = 23 g = x atoms so, x atoms of Na contains mass = 23g 2x atoms of Na contains mass = $\frac{23}{x} \times 2x = 46g$

Q 2: **Give the short answers.**

Q.1 **Differentiate between saturated and unsaturated solution?**

Ans: See Question 3(ii) and 3(iii)

Q.2 **Give example of solid solution containing two solids.**

Ans: Solder (Pb + Zn solids) and Bronze (Cu + Zn)

Q.3 **Can you call collide a solution?**

Ans: No, because collide are solute particles suspended in a solution. See more detail in Q.13 (iii).

Q.4 **Gasoline does not dissolve in water, why?**

Ans: Gasoline is non-polar liquid while water in polar liquid we know that 'like dissolve like. so non-polar liquid (Gasoline) cannot be dissolved in polar liquid (H_2O) because of different Intermolecular forces.

Q.5 **Are gem stones solutions?**

Ans: Yes, because Gemstones (Ruby Quartz, Opal etc.) consist of mixture of solids.

Q.6 **A tiny crystal of a solid substance is added to an aqueous solution of the same substance. What would happen if the original solution was?**

a) supersaturated **b) unsaturated** **c) saturated**

Ans: See Question 4.

Q.7 **Explain why CH_3OH (Methanol) is soluble in water but C_6H_6 is not.**

Ans: CH_3OH (Methanol) is a polar compound and containing Hydrogen bonding with each other and with water also. Water is also a polar compound because of same intermolecular forces and nature of compounds, CH_3OH is soluble in water while Benzene (C_6H_6) is an non polar molecule and not consist of Hydrogen Bonding.

In general, we can stay that "Like dissolve Like".

Q.8 How can you prepare 250 cm^3 of 0.5M $MgSO_4$ from a stock solution of 2.5M $MgSO_4$?

Ans: According to the molarity equation

Required : Given

$$M_1V_1 = M_2V_2$$

$$0.5M \times 250cm^3 = 2.5M \times V_2$$

$$V_2 = 50cm^3$$

Transfer 250cm^3 from a stock solution of 2.5M $MgSO_4$ into a 250cm^3 volumetric flask and up to the mark, water will be added [illegible]t becomes 0.5M $MgSO_4$ solution.

Q.9 Copy and complete the following table for aqueous solution of NaOH.

Ans: As we know that molarity = mass of solute Mr. of NaOH (40) $\times \frac{1}{\text{Vol. in dm}^3}$

S. No.	Mass of solute	Moles of solute	Volume of solution	Molarity	
1	20g		500cm^3		
2		0.25		0.25	
3			200 cm^3	0.1	

Ans: Solution

1) We know that moles of solute = $\frac{\text{Mass of solute (Given)}}{\text{Mr of Solute (NaOH)}}$

$$= \frac{20g}{40} = 0.5\text{moles}$$

So, $$\text{Molarity} = \text{No. of moles} \times \frac{1}{\text{Vol. in dm}^3}$$

Or $$\text{no. of moles} \times \frac{1000}{\text{Vol. in cm}^3}$$

$$\text{Given volume} = 500cm^3$$

$$\frac{500}{1000} = 0.5\ dm^3$$

$$\text{Molarity} = 0.5\ \text{mol} \times \frac{1}{0.5\,dm^3}$$

$$\text{Molarity} = 1.0\ \text{mol/dm}^3$$

2) $$\text{Molarity} = \text{no. of moles} \times \frac{1}{\text{Vol. in dm}^3}$$

Or $$\text{vol. in dm}^3 \times \frac{\text{No. of moles}}{\text{Molarity}}$$

$$= \frac{0.25}{0.25} = 1\,dm^3$$

Volume of solution in cm^3 = 1000 cm^3

Now for mass of solute determination,

$$\text{Molarity} = \frac{\text{Mass of solute}}{\text{Molar mass of NaOH}} \times \frac{1}{\text{Vol. in dm}^3}$$

$$0.25 = \frac{\text{Mass of solute}}{40} \times \frac{1}{1}$$

Moles of solute = 0.25 × 40
Mass of solute = 10 g

3)

$$\text{Molarity} = \frac{\text{Mass of solute}}{\text{Molar mass of NaOH}} \times \frac{1000}{\text{Vol. in cm}^3}$$

$$0.1 = \frac{\text{Mass of solute}}{40} \times \frac{1000}{200}$$

$$\text{Mass of solute} = \frac{0.1 \times 40 \times 200}{1000} = 0.8\text{g}$$

Now for moles of solute

$$\text{Molarity} = \text{No. of moles} \times \frac{1000}{\text{Vol. in cm}^3}$$

$$0.1 = \text{No. of moles} \times \frac{1000}{250}$$

$$\text{No. of moles} = \frac{0.1 \times 250}{1000}$$

No. of moles = 0.025 moles

Q.10 Give examples of the following solutions:
a) a liquid solution of a liquid solvent and gaseous solute
b) a solid solution of two solids.

Ans: a) The example for gas (solute) in liquid (solvent) is Soda water which contains CO_2 gas under pressure in a water.

b) The example for solid (solute) in solid (solvent) is Alloyws such as solder (Pb + Zn) and Bronze (Cu + Zn).

Q.11 What is the molarity of a solution prepared by dissolving 1.25 g of HCl gas into enough water to make 30 cm³ of solution?

Ans: Mass of solute of HCl 1.25 g
Volume of solution = 30 cm^3
Molar mass of HCl gas = 1 + 35.5 = 36.5 g/mol
Molarity of solution = ??
According to the formula

$$\text{Molarity of solution} = \frac{\text{Mass of solute}}{\text{Molar mass of HC}l} \times \frac{1000}{\text{volume of solution in cm}^3}$$

$$= \frac{1.25}{36.5} \times \frac{1000}{30}$$

Molarity = 1.14 g/dm^3 = 1.14 M

Q.12 Formation is an aqueous solution of formaldehyde (HCHO), used as a preservative five biological specimens. A biologist wants to prepare 1dm³ of 11.5 M formalin. What mass of formaldehyde he requires?

Ans: Volume of solution = 1 dm^3
Molarity of solution = 11.5 M
Mass of Formaldehyde (HCHO) = ??
Molar Mass of an organic compound Formaldehyde (HCHO)
= 1 + 12 + 1 + 16 = 30 g/mol

According to the formula

$$\text{Molarity of solution} = \frac{\text{Mass of solute}}{\text{Molar Mass of}} \times \frac{1}{\text{Vol. in dm}^3}$$

Mass of solution (Formaldehyde) = Molarity × Molar Mass × Volume

$= 11.5 \times 30 \times 1$

Mass of Formaldehyde = 345 g

Q.13 A solution of $Ca(OH)_2$ is prepared by dissolving 5.2mg of $Ca(OH)_2$ to a total volume of 1000cm³. Calculate the molarity of this solution.

Ans.

Mass of $Ca(OH)_2$ $= 5.2\text{mg} = \frac{5.2}{1000}$

$= 0.0052\text{g} = 5.2 \times 10^{-3}\text{g}$

Volume of solution in cm³ $= 1000\text{cm}^3$

Molar mass of $Ca(OH)_2$ $= 40 + 2 \times 16 + 2 \times 1 = 74\text{g/mol}$

Molarity of solution = ??

According to the formula

$$\text{Molarity of solution} = \frac{\text{Mass of } Ca(OH)_2}{\text{Molar mass}} \times \frac{1000}{\text{vol.in cm}^3}$$

$$= \frac{5.2\times10^{-3}}{74} \times \frac{1000}{1000}$$

$$= 0.0703 \times 10^{-3}$$

$$= 0.0703 \times 10^{-3}\ \frac{100}{100} \qquad \therefore \frac{1}{100} = \frac{1}{10^2} = 10^{-2}$$

$$= 7.03 \times 10^{-3} \times 10^{-2}$$

$$= 7.03 \times 10^{-5}\text{M}$$

Q.14 Calculate the number of moles of solute present in 1.25cm³ of 0.5 MH_3PO_4 solution.

Ans.

No. of moles = ??

Volume in cm³ = 1.25cm³

Molarity of H_3PO_4 solution = 0.5M

According to the formula

$$\text{Molarity of solution} = \text{no.of moles} \times \frac{1000}{\text{Vol.in cm}^3}$$

$$\text{No. of moles} = \frac{\text{Molarity} \times \text{Volume in cm}^3}{1000}$$

$$= \frac{0.5\times1.25}{1000}$$

No. of moles $= 6.25 \times 10^{-4}$ moles

Q.15 Calculate the new molarity when $100cm^3$ of water is added to $100cm^3$ of 0.5M HCl.

Ans.

According to the molar equation

	Given	=	Required
	M_1V_1	=	M_2V_2
	$M1 \times 200$	=	0.5×100
New	M_1	=	$\frac{0.5\times100}{200}$
	Molarity	=	0.25M

Q.16 How are solution useful for society? Give three examples.

Ans.

See Question 1.

SELF ASSESSMENT

EXERCISE 6.1

The maximum amount of sodium acetate that dissolve in 100g of water at 0°C is 119g and 170g at 100°C.

(a) If you add 170g of sodium acetate in 100g of water at 0°C, how much will dissolve?

(b) Is the solution saturated unsaturated or supersaturated?

(c) If the solution is heated to 100°C, is the solution now saturated, unsaturated or supersaturated?

(d) If the solution is cooled back to 0°C and no crystals appear. Is the solution saturated, unsaturated or supersaturated?

Solution

(a) 119g sodium acetate will dissolve in 100g of water at 0°C

(b) The solution will be saturated.

(c) The solution will be supersaturated

(d) The solution will be unsaturated

EXERCISE 6.2

What are the physical states of solute and solvent in each of the following solutions. Also identify the type of solution.

(a) Deep sea divers use a breathing mixture of helium and oxygen.

(b) Brass contains 80% copper and 20% zinc.

(c) Dental filling.

(d) Brine (salt in water)

(e) Drinking water containing chlorine as disinfectant.

(f) Gemstone, Ruby contains Cr_2O_3 and Al_2O_3.

(g) Conc. H_2SO_4, we use in the laboratory is 98% H_2SO_4 and contains only 2%H_2O.

Solution

Sr. No	Solution	State of solute	State of solvent	Type of Solution
(a)	Mixture of helium and oxygen	Helium (g)	Oxygen(g)	Gas in Gas
(b)	Brass	20% Zinc (s)	80% Copper(s)	Solid in Solid
(c)	Dental filling	Mercury (L)	Silver (s)	Liquid in Solid
(e)	Drinking water contains chlorine	Chlorine (g)	Water(L)	Gas in Liquid
(f)	Gem stones Ruby	Cr_2O_3(g)	Al_2O_3(s)	Solid in Solid
(g)	98% H_2SO_4 (Conc.)	2% H_2O(L)	98% H_2SO_4 (L)	Liquid in Liquid

EXERCISE 6.3

(1) Write four ways to express percentage of solutions

(2) A saline solution is administered intravenously to a person suffering from severe dehydration. This is labeled as 0.85% m/v of NaCl. What does it mean?

Solution

(1) Percentage of solution can be expressed in four ways i.e,

(a) Mass by mass percent (m/m)

(b) Mass by volume percent (m/v)

(c) Volume by mass percent (v/m)

(d) Volume by volume percent(v/v)

(2) 0.85% m/v solution of NaCl means that 0.85g of NaCl in 99.15cm^3 of water to make 100cm^3 of solution.

EXERCISE 6.4

Potassium chlorate ($KClO_3$) is a white solid. It is used in making matches and dyes. Calculate the molarity of solution that contains

(a) 1.5 moles of this compound dissolved in 250cm^3 of solution.

(b) 75g of this compound dissolved to produce 1.25dm^3 of solution.

(c) What is the molarity of a 50cm^3 sample of potassium chlorate solution that yields 0.25g residue after evaporation of the water.

Solution

(a) Number of moles of $KClO_3$ = 1.5 moles

Volume of solution = 250cm^3

$$= \frac{250}{1000}$$

Molarity of KClO3 = ??

Now according to molarity formula

$$\text{Molarity} = \frac{\text{Moles of solute}}{\text{Volume of solution in dm}^3}$$

$$= \frac{1.5\text{mol}}{0.25\text{dm}^3}$$

$$\text{Molarity} = 6.0 \text{ mol/dm}^3$$

(b)

Mass of $KClO_3$ = 75g

Molar mass of $KClO_3$ = $39 + 35.5 + 3 \times 16$

= 122.5 g

Volume of solution = $1.25dm^3$

Molarity $KClO_3$ = ??

$$\text{Molarity} = \frac{\text{Mass of } KClO_3}{\text{Molar mass of } KClO_3} \times \frac{1}{\text{volume in } dm^3}$$

$$= \frac{75}{122.5} \times \frac{1}{1.25}$$

$= 0.49 \ mol/dm^3$

Molarity = 0.49M

(c)

Mass of $KClO_3$ (residue) = 0.25g

Molar mass of $KClO_3$ = $39 + 35.5 + 3 \times 16$

= 122.5g

Volume of solution $50cm^3$

$$= \frac{50}{1000} = 0.05dm^3$$

Molarity solution = ??

Now

$$\text{Molarity of solution} = \frac{\text{Mass of } KClO_3}{\text{Mopar mass of } KClO_3} \times \frac{1}{\text{Vol. in } dm^3}$$

$$\frac{0.25}{122.5} \times \frac{1}{0.05}$$

$= 0.041 \ mol/dm^3$

Molarity = 0.041M

EXERCISE 6.5

(1) Sodium hydroxide solutions are used to neutralize acids and in the preparation of soaps and rayon. If you dissolve 25g of NaOH to make 1 dm^3 of solution, what is the molarity of this solution?

(2) A solution of NaOH has concentration 1.2M. Calculate the mass of NaOH in g/dm^3 in this solution.

(3) A solution is prepared by dissolving 10g of hemoglobin in enough water to make up $1dm^3$ in volume. Calculate molarity of this solution. Molar mass of haemoglobin is 6.51×10^4 g/mole.

Answer.

(1)

Mass of NaOH = 25g

Molar mass of NaOH = 23 + 16 + 1g/mol

Volume of solution = $1dm^3$

Molarity of solution = ??

We know that Molarity of solution = $\frac{\text{Mass of NaOH}}{\text{Molar mass of NaOH}} \times \frac{1}{\text{Volume in } dm^3}$

$$= \frac{25}{40} \times \frac{1}{1}$$

Molarity $= 0.625\ mol/dm^3$

$= 0.625\ M$

(2) Molarity (concentration) of NaOH solution = 1.2M

Mass of NaOH = ??

Molar mass of NaOH = 23 + 16 + 1 = 40g/mol

Volume of solution = $1dm^3$

We know that molarity (Concentration)

$$= \frac{mass\ of\ NaOH}{Molar\ mass\ of\ NaOH} \times \frac{1}{Volume\ in\ dm^3}$$

$$1.2M = \frac{Mass\ of\ NaOH}{40} \times \frac{1}{1}$$

Mass of NaOH = 48g

3)

Mass of Haeomoglobin = 10g

Moalr mass of Haeomoglobin = $6.51+10^4$ g/mol

=65100 g/mol

Volume of solution = $1dm^3$

Molarity of solution = ??

We know that

$$\text{Molarity of solution} = \frac{\text{mass of Haeomoglobin}}{\text{Molar mass}} \times \frac{1}{\text{Volume in } dm^3}$$

$$= \frac{10}{65100} \times \frac{1}{1}$$

$= 1.536 \times 10^{-4}\ g/dm^3$

Molarity $= 1.536 \times 10^{-4}$ M

EXERCISE 6.6

1) How can you prepare 500 cm^3 of 0.2m $KMnO_4$ solution.
2) How can you prepare $25cm^3$ of 0.25 M solution of $CuSO_4\ 5H_2$ (blue vitriol)

Solution:

(i) To prepare 0.2M $KMnO_4$ solution in $500cm^3$ volumetric flask, follow the following steps.

Required volume of solution $= 500cm^3 = \frac{500}{1000}$

$= 0.5dm^3$

0.2 M $KMnO_4$ solution means that

$1dm^3$ solution containing moles of $KMnO_4$ = 0.2

$$= \frac{0.2}{1} \times 0.5$$

= 0.1 moles of $KMnO_4$

Molar mass of $KMnO_4$ $= 39 + 55 + 16 \times 4$

$$= 158/mol$$

$$\text{Moles of } KMnO_4 = \frac{\text{mass of } KMnO_4}{\text{Molar mass}}$$

$$0.1 = \frac{mass}{158}$$

$$\text{Mass of KMnO4} = 0.1 \times 158 = 15.8\ g$$

(ii) Weigh out 15.8g of KMnO4 (0.1 mole)

(iii)Add this solid into a beaker and add some water to dissolve it.

(iv)Transfer this solution to the 500cm^3 volumetric flask and add more water.

(v) Keep adding water until the volume of solution rises to the etched line and mix the solution.

This is desired 0.2M $KMnO_4$ solution.

(3) Required volume of solution = $25cm^3 = \frac{25}{1000} = 0.025dm^3$

0.25M solution of $CuSO_4.\ 5H_2O$ means that

1 dm^3 solution of $CuSO_4.\ 5H_2O$ contains moles = 0.25

0.025 solution of $CuSO_4.\ H_2O$ $\frac{0.25}{1} \times 0.025$

$$= 0.00625 \text{ moles}$$

$$\text{Molar mass of } CuSO_4.5H_2O = 63.5 + 32 + 16 \times 4 + 18 \times 5$$

$$= 249.5g/mol$$

$$\text{Moles of CuSO4} = \frac{\text{Mass of } CuSO_4.5H_2O}{\text{Molar Mass}}$$

$$0.00625 = \frac{Mass}{249.5}$$

$$\text{Mass of } CuSO_4.5H_2O = 1.56g$$

To prepare 0.25m $CuSO_4.\ 5H_2O$ in 25cm^3. Add 1.56 of this solid with water up to the mark of 25cm^3 volumetric flask. This will be desired solution.

EXERCISE6.7

(1) A stock solution of hydrochloric acid is 12.1m. How many cm^3 of this solution should we use to prepare 500cm^3 of 0.1M HCl.

(2) Potassium dichromate ($K_2Cr_2O_7$) is a red-orange compound. It is a strong oxidizing agent and is used in the estimation of iron content in ores. A stock solution is 2.5M $K_2Cr_2O_7$. How many cm^3 of this solution we need to dilute to make 50 cm^3 of 0.05M $K_2Cr_2O_7$.

(3) Commercial acetic acid is 17.8 molar. How can we convert this into 0.1 M acetic acid.

Solution:

(1) Molarity of HCl given (m1) = 12.1M

Volume of HCl needed to dilute (vi) = ?

Molarity of HCl required (desired) = M_2 = 0.1M

Volume of desired HCl = V_2 = 500cm^3

So according to molarity equation

Given HCl = Desired HCl

$$M_1V_1 = M_2V_2$$

$$V1=\frac{M_2V_2}{M_1}=\frac{0.1\times500}{12.1}=4.13cm^3$$

Transfer $4.13cm^3$ of 12.1m HCl to a $500cm^3$ volumetric flask and dilute it by adding water up to the mark and mix. Resulting solution will be 0.1 M HCl.

Molar mass of K2Cr2O7 = 2 × 39 + 2 × 52 + 7 × 16 = 294= 1M

(2) Molarity of given $K_2Cr_2O_7(M_1) = 2.5M(735g/dm^3)$

Volume of $K_2Cr_2O_7$ solution needed = V_1 = ??

Molarity of desired $K_2Cr_2O_7 = M_2 = 0.05M\ (14.7g/dm^3)$

Volume of deseeded $K_2Cr_2O_7 + V_2 = 50cm^3$

Now according to molarity equation

Given $K_2Cr_2O_7$ = Desired $K_2Cr_2O_7$ solution

$$M_1V_1 = M_2V_2$$

$$V_1=\frac{M_2V_2}{M_1}=\frac{0.05\times50}{2.5}$$

$$V_1 = 1cm^3$$

Transfer $1cm^3$ of 2.5 $K_2Cr_2O_7$ solution $(735g/dm^3)$ to a $50cm^3$ volumetric flask and dilute it by adding water up to the mark and mix. Resulting solution will be 0.05M $K_2Cr_2O_7(14.7g/dm^3)$.

(3) **Molarity of given Acetic Acid = M_1 = 17.8M**

Volume of Acetic acid needed = V_1 = ??

Molarity of Acetic acid required = M_2 = 0.1M

Volume of Acetic Acid required = $V_2 = 1000\ cm^3$

Now according to molarity Equation

$$M_1V_1 = M_2V_2$$

$$V_1=\frac{M_2V_2}{M_1}$$

$$V_1=\frac{0.1\times1000}{17.8}$$

$$V_1 = 5.62cm^3$$

Transfer of $5.62cm^3$ of commercial 17.8 molar solution to a $1000cm^3$ volumetric flask and dilute it by adding water up to the mark and mix. Resulting solution will be 0.1M Acetic acid.

EXERCISE 6.8

(1) Sodium Chloride and glucose both are soluble in water. But the solubility of NaCl is greater than glucose. Explain why?

(2) In which liquid of each of the following pairs you would expect KCl, an ionic solid to be more soluble.

(a) H_2O or CCl_4 (b) CH_3OH or Benzene

(3) Which of the following pairs of liquids are miscible?

(a) Water and benzene (b) Benzene and CCl_4

(c) An oil and benzene