Tehkals.com
Learn & Teach

CHEMISTRY

Class 9th (KPK)

NAME: ______________________________

F.NAME: ______________________________

CLASS:_____________ SECTION: _________

ROLL #: ______ SUBJECT: ______________

ADDRESS: ____

____

SCHOOL: ____

SOLUTIONS
(Topic Wise Questions)

Q1. Write note on:

(a) Solution **(b) Solute** **(c) Solvent**

Ans: **Solution:**

A solution is a homogenous mixture of two or more than two substances the composition of which may be varies within definite limits. In solution the composition and appearance of all parts are uniform and there are no visible boundaries between the components of solution particles. The components of the solution are atoms, ions and molecules. Solution are existing in three physical states in solid, liquid and in gaseous form.

Example:

i. Gas solution: Air ii. Liquid Solution: Sea water iii. Solid Solution: Brass

Solute:

The component present in smaller proportion in a solution and dissolved in a solution is called solute. It may exist in three physical states solid, liquid and gaseous form.

Examples:

Solid solute = in steel carbon is a solute
Liquid solute = in sea water salt is solute
Gas solute = in air O_2 and CO_2 are solute

Solvent:

The component present in the larger proportion in a solution and dissolved the solute is called solvent. It may also exist in three physical state solid, liquid and gas.
Solid solvent = in steel iron is a solvent
Liquid solvent = in sea water, water is a solvent
Gas solvent = in air N_2 are solvent.

Q2. Define the following:

i. Aqueous Solution **ii. Binary Solution**
iii. Dilute Solution **iv. Concentrated Solution**

Ans: **Aqueous Solution:**

The word aqueous is taken from "aqua" aqua means water. A solution in which water is used as a solvent is called aqueous solution. In short cut way it is represented by (aq)

Examples:

Aqueous solution of Nacl is represented as NaCl (aq) similarly H_2SO_4 (aq), HCl (aq), NaOH (aq) etc.

Binary Solution:

Binary means two a solution which has two components one is solute and the other is solvent.

Examples:

i. NaCl + Water ii. Sugar + Water

Dilute Solution:

A solution in which less amount of solute is dissolved in a definite amount of solvent is called dilute solution. In a short cut way, it is represented by "dil"

Examples:

Dilute solution of NaCl is represented as "NaCl (dil)"
Similarly, H_2SO_4 (dil) etc.

Concentrated Solution:

A solution in which more amount of solute is dissolved in a definite amount of solvent is called concentrated solution.
Hence in a short cut way it is represented by "conc"

Examples:

Concentrated solution of NaCl is represented as NaCl (Conc)
H_2SO_4 (conc), HCl (conc) etc.

Q3. What is a solute-solvent interaction? Explain these interactions on the basis of solute and solvents.

Ans: **Solute-solvent interaction:**

There are forces of interaction between the molecules or ions of solute and also between the solute and solvent molecules. These types of interactions are called solute-solvent interaction.

Lithium chloride is highly soluble in water but gasoline is not. On other hand, gasoline mixes readily with benzene, but lithium chloride does not. Why are these such differences in solubility? Like dissolve like is a rough but useful for predicting whether one substance will dissolve in another or not.

Types on the basis of solute and solvent

i. Dissolving ionic compounds in polar solution:

The polarity of water molecules plays an important role in the formation of ionic compounds in water. The charged ends of water molecules attract the ions in the ionic compounds and surround them to keep them separated from other ions in the solution.

For, example we add a few crystals of sodium chloride (NaCl) into a beaker of water. The water molecules come into contact with Na and Cl ions. The positive ends of the water molecules are attracted to Cl ions, while the negative ends area attracted to Na ions. The attraction between water molecules and ions is so strong enough to draw the ions away from the crystal and form solution. This solution formation process with water as the solvent is referred to as hydration. These ions are said to be hydrated.

As hydrated ions diffuse into solution, other ions are exposed and drawn away from the crystal surface by the solvent. The entire crystal gradually dissolves and hydrated ions.

ii. Dissolving ionic compounds in non-polar solvents:

Ionic compounds are generally not soluble in non-polar solvents such as carbon tetrachloride (CCl_4) and benzene (C_6H_6). The non-polar solvent molecules do not attract the ions of the crystal strongly enough to overcome the forces holding the crystal together.

Lithium chloride (LiCl) is not soluble in benzene. Lithium chloride (LiCl) and benzene (C_6H_6) differ widely in bonding, polarity and intermolecular forces.

iii. Liquid solute and solvents:

a. Liquid solute and solvents that are not soluble in each other are immiscible.

For example, benzene and water are immiscible and the components of this system exists in two distinct phases.

b. Non-polar substances, such as fats, oils and greases are generally quite soluble in non-polar liquids, such as carbon tetrachloride and gasoline.

Liquids that dissolve freely in on another in any proportion are said to be completely miscible.

Benzene and carbon tetrachloride are completely miscible. The non-polar molecules of these substances expert no strong forces of attraction or repulsion and the molecules mix freely with one another.

c. Ethanol and water also mix freely. The – OH group on an ethanol molecule is somewhat polar. This group can form hydrogen bonds with water as well as with other ethanol molecules. The intermolecular forces in the mixture are so similar in the pure liquids are mutually soluble in all proportion. The components of this system exist in a single phase with a uniform arrangement. Hydrogen between the solute and solvent enhances the solubility of ethanol in water

Q4. Define and explain with example.
i. Suspension ii. Colloidal Solution

Ans: **Suspension (Turbidity):**

It is heterogeneous mixture of two or more than two different substance.

Explanation:

In suspension the solute particles do not dissolved in a solvent and remain suspended into the liquid (solvent) and can be seen with naked eye without the help of an instrument.

Its composition is not uniform throughout the solution.

The particles (solute) present in a solvent cannot pass through the filter paper and stay behind on the filter paper during filtration. They settle down at the bottom of the container it allowed to stand for some time. Suspension are the result of solute which do not dissolve in true sense and remain suspended or settle down at bottom and the solute is not uniform.

Examples:

A mixture of chalk in water, mud in water etc.

Suspension among the medicine like antibiotic, disiprin and paracetamol are the examples of suspension.

Colloids or colloidal solutions:

A solution in which solute particles are bigger in size than the solute particles of a solution but smaller than the solute particles of suspension is called colloid or colloidal solution. In colloids, solute particles are not homogenized with the solvent.

Explanation:

These are a little but bigger than the solute particles of a solution but not so bigger that can be seen by naked eye. Particles between 1nm-1000nm in diameter may form colloids. These can pass through the filter paper during filtration. They do not settle down at the bottom of the container of allowed to stand for some time.

A mixture of starch in water, milk, fog, smoke, blood and water-soluble paints.

CLASS OF COLLOID	PHASES	EXAMPLE
Sol	Solid dispersed in liquid	Paints, mud
Gel	Solid network extending throughout liquid	Gelatin
Liquid Emulsion	Liquid dispersed in liquid	Milk, Mayonnaise
Foam	Gas dispersed in gas	Smoke, airborne particles, matter, exhaust
Liquid aerosol	Liquid dispersed in gas	Fog, mist, clouds, aerosol, spray
Solid emulsion	Liquid dispersed in solid	Cheese, butter

Q5. Write the properties of solution, colloids and suspensions.

Ans: **Properties of solution, colloids and suspension:**

S.No	Solution	Colloids	Suspension
1	Homogenous	Heterogeneous	Heterogeneous
2	Their particle size is in between 0.01 – 1 nm. It can be atoms, ions or molecules.	Their particle size in between 1 – 1000 nm and are dispersed. It can be aggregates, or large molecules.	Their particles size is over 1000 nm and are suspended. It can be large particles or aggregates.

3	They cannot be separated on standing for long time	They cannot be separated on standing for ling timing.	Their particles are settling down on standing.
4	They cannot be separated by filtration.	They cannot be separated by filtration	They can be separated by filtration
5	They do not scatter light	They scatter light showing the Tyndall effect	They may scatter light, but are not transparent
6	Their particles are so small that they can't be seen with naked eye	Their particles are big but can't be seen with naked eye.	Their particles are big enough to be seen with naked eye.
7	e.g. table salt in water	e.g. milk in water	e.g. flour in water

SOLUTIONS

(Long Questions Answers)

Q1. Define solution? Explain types of solution on the basis of states of matter.

Ans: **Solution:**

A solution is a homogenous mixture of two or more than two substances the composition of which may be varies within definite limits. In solution the composition and appearance of all parts are uniform and there are no visible boundaries between the components of solution particles. The components of the solution are atoms, ions and molecules. Solution are existing in three physical states in solid, liquid and in gaseous form.

Example:

i. Gas solution: Air
ii. Liquid solution: sea water
iii. Solid solution: Steel, Brass

Types of solution on the basis of states of matter:

Solution exists in gas, liquid and solid states. On this basis there are nine classes of solutions.

Types	Examples	Solute	Solvent
Gas solutions	Air	O_2	N_2
Gas in gas	Fog	Water vapour	Air
Solid in gas	Smoke	Carbon particle	Air
Liquid solutions	Vinegar	Acetic acid	Water
Liquid in liquid	HCl Solution	HCl Gas	Water
Gas in liquid	Sea water	NaCl	Water
Solid in liquid			
Solid Solutions	Brass	Zinc	Copper
Solid in Solid	Hydrogen absorbed	H_2 Gas	Palladium
Gas in Solid	Palladium palate	Mercury (Hg)	Silver (Ag)
Liquid in Solid	Dental amalgam		

Q2. a. Discuss the solubility of a substance?

Ans: **a. Solubility:**

The amount of solute in grams required to saturate 100 gm of the solvent at a particular temperature is called solubility.

(OR) The maximum amount of solute in gram required to saturate 100gm of the solvent at a particular temperature is called solubility.

Different substances have different solubilities in the same amount of solvent at a specific temperature. For example, sodium nitrate ($NaNO_3$) is more soluble than silver chloride (AgCl) in water. Generally, the solubility of a solute is taken to be the quantity required to make a saturated solution in a given quantity of the solvent.

$$\text{Solubility} = \frac{wt\ of\ solute}{wt\ of\ solvent} \times 100$$

Q2. b. Explain the factors that are responsible for the solubility of a substance?

Ans: **b. Factors affecting solubility:**

i. Temperature
ii. Pressure
iii. Nature of the solute
iv. Nature of the solvent

Temperature:

The solubility of many substances is affected with temperature. Increasing the temperature, usually decrease gases solubility. As the temperature increases, the average kinetic energy of the molecules in

the solution increase. A greater number of solute molecules escape from the attraction of solvents molecules and return to gas phase. At higher temperature, gases are generally less soluble.
The effect of temperature on the solubility of solids and liquids is more difficult to predict. It is often observed that solubility of many solutes in solution generally increases with the increase in temperature, but this not always happens. When a solute is added into solvent, there are different possibilities with respect to temperature.

These possibilities are given below:

i. The solubility of some solutes in solution generally increases with the increase in temperature. For example, the solubility of potassium nitrate (KNO_3), $CaCl_2$ and Pb $(NO_3)_2$.
ii. The solubility of some solutes decreases also with the increase in temperature. For example, $Ce_2(SO_4)_3$, Li_2CO_3 and CaO.
iii. The solubility of the NaCl and KBr is not affected by increase or decrease in temperature and remains constant.
iv. The solubility of some solids increases up to a certain temperature and then decrease (Na_2SO_4. $10H_2O$) at 32.4^0C. Above this temperature, it forms anhydrous Na_2SO_4. The maximum solubility of Sodium Sulphate is 32.4^0C.

Pressure:

Since solids and liquids are incompressible therefore the solubilities of solids and liquids are not affected by changing the pressure. Solubility of gases increases with the increase in pressure.

Example:

CO_2 is filled in soda water bottles under 4 atmospheric pressure. When a bottle of soda water is opened, CO_2, comes out with effervescence (bubbles) because pressure in the bottle is released and reduced to 1 atm resulting in decrease in the solubility of the gas.

Nature of solvent:

When the molecules of solute are similar in structure and properties to the molecules of the solvent, the solubility is greater because “like dissolve like”.

For example:

Sodium chloride is an ionic compound. It has greater solubility in a polar solvent like water but low solubility in a non-polar solvent like benzene.

Nature of Solute:

It also affects the solubility, if a solute is changed in the same solvent, the solubility changes. If a solute is changed and solvent remain the same, the solubility also changes.
For example, sodium chloride has high solubility in water and sugar has comparatively low solubility.
“Like dissolve like” is the general principle of solubility. It means that:
i. The ionic and polar substances are soluble in polar solvents. Ionic solids and polar covalent compound are soluble in water.
For example, Nacl, Kcl, Na_2CO_3, sugar, glucose and alcohol are soluble in water.
ii. Non-polar substances are not soluble in polar solvents. Non-polar covalent compounds are insoluble in water such as benzene and petrol is insoluble in water.
iii. Non-polar covalent substances are soluble in non-polar solvents. Grease, paints are soluble in petrol, ether or carbon tetrachloride etc.

Q3. a. What is the difference between a concentrated and dilute solutions? Give example of each.

Ans: **a. Difference between a concentrated and dilute solutions:**

Dilute Solution:

A solution in which less amount of solute is dissolved in a definite amount of solvent is called dilute solution. In a short cut way it is represented by “dil”.

Example:

Dilute solution of NaCl is represented as “NaCl (dil)”.

Similarly, H_2SO_4 (dil) etc.

Concentrated Solution:

A solution in which more amount of solute is dissolved in a definite amount of solvent is called concentrated solution.

Hence in a short cut way it is represented by "conc".

Example:

Concentrated solution of NaCl is represented as "NaCl (conc)"

H_2SO_4, (Conc), HCl (Conc) etc.

Q.3.b Differentiate between unsaturated, saturated and supersaturated solutions.

Ans: **b. Saturated Solution:**

A solution which contain maximum amount of solute and cannot dissolve any more solute at a particular temperature is called saturated solution.

Explanation:

If more of the solute is added in it, it remains un-dissolved and will be settle down at the bottom of the container at a room temperature.

Example:

Take some water in a beaker and add NaCl in small amount at interval with constant stirring. If more quantity is added it remain insoluble. The insoluble salt will be settle at the bottom of the beaker at room temperature and water is incapable to dissolve more salt, such a solution is known as saturated solution.

Unsaturated Solution:

A solution which can dissolve further amount of a solute and have the capacity to dissolve more solute at a particular temperature is called as unsaturated solution.

Example:

Take a glass half filled with water. Add a spoon of table salt (NaCl) in it. It will dissolve. Add another spoon of salt in it. It will also dissolve in it. Such a solution is unsaturated because it can still dissolve more amount of solute in it at a particular temperature.

Super Saturated Solution:

A solution which contain more amount of solute than a saturated solution at a given temperature is called super saturated solution. (OR)

A solution which is more concentrated than a saturated solution is known as a super saturated solution. Such a solution is unable to dissolve more solute and the excess solute is separated out in the form of solid particles or crystals.

Example:

Fill half a test tube water and add sufficient crystals of $Na_2S_2O_3$ (Sodium thio sulphates) in it. Cool the test tube water under a tap water without shaking. A super saturated solution is formed having no crystals. Another example are custard, curd and kheer.

Q4. Describe one way to prove that a mixture of sugar and water is solution and that a mixture of sand and water is not a solution.

Ans: Mixing a little amount of sand in the glass of water, while the sand will get mixed in the Water it will not dissolve and will form a heterogeneous mixture. Now according to definition, solution is a homogeneous mixture which has uniform composition in which solute particles cannot be seen by naked eyes. Hence mixture of sand in water is not a solution because:

i. It forms heterogeneous mixture in which components are not in uniform composition in which sand is present in the bottom of glass.

ii. Sand particles can be seen in glass of water by naked eyes.

iii. Sand can be easily filtered by simple filtration while the solute particles in solution cannot be filtered by simple filtration.

Now mixing of a little amount of sugar in glass of water, When the sugar is mixed into the glass, it dissolved completely, which means that the individual particles of sugar cannot be seen in water. Hence the mixture of sugar in water is a solution because:
i. It forms a homogenous mixture which has uniform composition.
ii. The sugar cannot be seen in glass of water by naked eyes.
iii. Sugar cannot be separated from water easily by means of simple mechanical methods. The only separation method is mostly used is distillation.

Q5. Explain the following concentration units.
a. Percentage composition **b. Molarity**

Ans: **a. Percentage composition:**
The percentage composition of a solution can be expressed as:

i. Percentage Mass by Mass (Mass-Mass Relationship m/m):
It is the number of grams by mass of solute present in 100 grams by mass of a solution.
For example, 10% solution by mass means, 10 gram of sugar inn 90 grams of solvent, so that solution weight 100 grams.

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

$$\%mass / mass = \frac{mass\ of\ solute\ (g)}{Mass\ of\ solution\ (g)} \times 100$$

ii. Percentage mass by volume (Mass-volume relationship m/v):
It is the number of grams by mass of solute present in 100 cm^3 of solution.
For example, 10% solution of Nacl in solvent to make 100 cm^3 of the solution. In this case, the total mass of the solution is not considered.

$$\%\ volume / mss = \frac{mass\ of\ solute\ (g)}{volume\ of\ solution\ (cm)^3} \times 100$$

iii. Percentage volume by mass (volume – mass relationship v/m):
It is the volume in cm^3 of a solute dissolved in 100 grams of the solution.
For example, 10% solution of Alcohol by volume means, 10 cm^3 of Alcohol in (unknown) volume of water so that the total mass of the solution in 100 grams of solvent. In this case the total volume of the solution is not considered.

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

iv. Percentage volume by volume (volume – volume Relationship v / v):
It is the volume in cm^3 of solute dissolved per 100 cm^3 of the solution.
For example, 10% solution of alcohol by volume means, 10 cm^3 of alcohol in sufficient volume of solvent, so that volume of solution is 100 cm^3.

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

b. Molarity:
Molarity is the number of moles of solute present in one dm^3 of the solution. It is defined as the number of moles of solutes dissolved per dm^3 of solution. Molarity is represented by M.

$$M = \frac{Number\ of\ moles\ of\ solute}{volume\ of\ solution\ in\ dm^3 or\ litre}$$

By definition

$$Mole = \frac{Amount\ of\ solute\ in\ gram}{Molecular\ weight\ of\ solute}$$

So molarity can also be given as:

$$M = \frac{Amount\ of\ solute\ in\ gram}{Molecular\ weight\ of\ solute\ x\ volume\ of\ solution\ in\ dm^3\ or\ litre}$$

SOLUTIONS
(Short Questions Answers)

Q1. Is sea water a solution? How would you prove with a simple experiment whether it is pure water or solution?

Ans: Yes, sea water is a solution of salts in water. We can differentiate between pure water and solution by doing two simple experiments.

Experiment 1:

As we know that pure water is tasteless. Now simply taste a little water from sea. If it is tasteless it is pure and if it has a taste then it is a solution.

Experiment 2:

Pure water is bad conductor of electricity. Now take a sample of water from the sea, allow the current through the water. The current will passed "it means that the sea water is solution".

Q2. A bottle in a drug store contains a label "3 percent Hydrogen peroxide". What does it mean?

Ans: It shows the percentage composition of Hydrogen peroxide solution i.e. percentage volume by volume. 3 % Hydrogen peroxide by volume means 3 cm^3 of Hydrogen peroxide in sufficient volume of solvent, so that volume of solution in 100 cm^3 i.e. 3% of hydrogen peroxide dissolve in 97% of water by volume-volume composition.

Q3. Classify the following as a solution, colloids or suspension and explain why:

i. Milk ii. Hot cup of tea iii. Orange juice with pulp iv. Mayonnaise
v. Listerine mouthwash vi. Milk of Magnesia v. Cheese viii. Mist
ix. Bottled water

Ans:

SOLUTIONS	COLLOIDS	SUSPENSION
Listerine mouthwash bottled water	Milk Hot cup of tea Mayonnaise Milk of magnesia Cheese Mist	Orange juice with pulp

Reason:

i. Solution is homogenous mixture of two or more components. Listerine mouthwash and Bottled water are homogenous mixtures so they are solution.

ii. Colloids is solution in which particles are intermediate in size between those in solutions and suspensions. Milk, Hot cup of tea, Mayonnaise, Milk of magnesia, Cheese and Mist have larger solute particles than true solution but not enough than suspension so they are colloids.

iii. Suspension is a heterogeneous mixture of undissolved particles in a given medium. The solute particles of Orange juice with pulp can be seen with naked eyes so it is suspension.

Q4. Why we stir paints thoroughly before using it?

Ans: Paint is a colloid, made of many components like pigments, colour in solvent. The solute particles of paint are not homogenized with the solvent so, it is better to stir paints thoroughly with the stirrer to get a uniform composition. By using it will cover the surface uniformly. So that's why we stir paints before using it.

Q5. Why suspension and solution do not show Tyndall effect, while colloids do?

Ans: When light is scattered by colloidal particles dispersed in a transparent medium is called Tyndall effects.

Reason:

In case of Colloids:

In colloids solute particles are intermediate in size between those in solutions and suspensions. Hence the particles size is large comparable to that of wavelength of light. That's the light rays are scattered and produce Tyndall effect.

In case of Suspension:

In suspension the solute particles are large in size even they can be seen with naked eyes and the wavelength of the visible is smaller than the solute particles. They block the light rays instead of scattering it and hence do not shows the Tyndall effect.

In case of solution:

Solutions are the homogenous mixture of two or more substance in which the solute particles are very small than the wavelength of the visible light. Due to very small solute particles the light rays are passed in straight line without showing the Tyndall effect.