



MEGA LECTURE

Chapter

9

SOLUTIONS

MATHEMATICAL EQUATIONS

(i) Concentration units of solutions

$$(1) \text{ Molarity (M)} = \frac{\text{mass of solute}}{\text{molar mass of solute}} \times \frac{1}{\text{vol. of solution dm}^3}$$

$$\text{Molarity (M)} = \frac{\text{number of moles of solute}}{\text{vol. of solution in dm}^3}$$

$$(2) \text{ Molality (m)} = \frac{\text{mass of solute}}{\text{molar mass of solute}} \times \frac{1}{\text{mass of solvent in kg}}$$

$$= \frac{\text{number of moles of solute}}{\text{mass of solvent in kg}}$$

$$(3) \text{ Mole fraction (X)} =$$

(4) Sum of the mole fractions of all the components is unity.

$$(5) \text{ Parts per million (p.p.m)} = \frac{\text{mass of solute}}{\text{mass of solution}} \times 10^6$$

(ii) Raoult's Law

(6) Raoult's law is defined in three ways

$$(a) p = p^\circ x_1$$

$$(b) \Delta p = p^\circ x_2$$

$$(c) \frac{\Delta p}{p^\circ} = x_2$$

where:

p = vapour pressure of solution

p° = vapour pressure of pure solvent

Δp = lowering of vapour pressure

x_1 = mole fraction of solvent

x_2 = mole fraction of solute

(7) The equation for Raoult's law, when both components A and B are volatile

$$P_t = (p^\circ_A - p^\circ_B) X_A + p^\circ_B$$

(iii) Molar mass by the lowering of vapour pressure

$$\frac{\Delta p}{p^\circ} = \frac{W_2}{M_2} \times \frac{M_1}{W_1}$$

$$\text{or } M_2 = \frac{W_2}{\Delta p} \times \frac{M_1 \times p^0}{W_1}$$

where:

- W_2 = mass of solute
- W_1 = mass of solvent
- M_2 = molar mass of solute
- M_1 = molar mass of solvent
- Δp = lowering of vapour pressure
- p_0 = vapour pressure of pure solvent

(iv) Molar mass by the elevation of boiling point and depression of freezing point

Equation for the determination of molar mass by the elevation of boiling point and depression of freezing point:

$$\Delta T_b = K_b \cdot \frac{1000 W_2}{M_2 W_1}$$

$$\text{or } M_2 = \frac{K_b \cdot 1000 W_2}{\Delta T_b \cdot W_1}$$

$$\Delta T_f = K_f \cdot \frac{1000 \cdot W_2}{M_2 \cdot W_1}$$

$$M_2 = \frac{K_f \cdot 1000 W_2}{\Delta T_f W_1}$$

where:

- W_2 = mass of solute
- W_1 = mass of solvent
- M_2 = molar mass of solute
- M_1 = molar mass of solvent
- ΔT_b = elevation of boiling point
- K_b = molal boiling point constant of solvent
- ΔT_f = depression of freezing point
- K_f = molal freezing point constant of solvent

METHOD TO SOLVE THE NUMERICALS

- (1) In order to calculate the percentage composition of solutions, we should know the mass or volume of the solute and the mass or volume of the solution. The ratio of these two masses is multiplied with 100.
- (2) To calculate the molarity, we should know the mass of solute, molar mass of solute and the volume of solution in dm^3 .
- (3) To calculate the molality, we should know the mass of the solute, molar mass of the solute and mass of solvent in kg.
- (4) In order to calculate the mole fractions of the components, we should know the number of moles of the component and total number of moles of the solution.
- (5) In order to get the parts per million of a solute, we should know the mass of solute and the mass of solution. The ratio of these two masses is multiplied with one million.

- (6) **Conversions of weight/weight % to molality:**
From the weight/weight %, we calculate the number of moles of solute. For this purpose, the mass of solute is divided by its molar mass. The mass of solvent is converted into kg. The number of moles of solute divided by the mass of solvent in kg gives the molality of the solution.
- (7) **Conversion of weight/weight % to molarity: (when density is given):**
With the help of density of the solution, we convert the volume of 100 cm³ of solution into mass of solution. With the help of percentage, we can calculate the mass of solute. From the mass of solute we get the number of moles, the number of moles is the molarity.
- (8) To get the vapour pressure of solutions, first of all get the number of moles of solute and solvent. In this way, get the mole fraction of solvent. This mole fraction is multiplied by vapour pressure of pure solvent to get the vapour pressure of solution.
- (9) To calculate the molar masses of non-volatile, non-electrolyte solutes, we use the following equations of lowering of vapour pressure, elevation of boiling point and depression of freezing point

$$M_2 = \frac{p^\circ}{\Delta p} \frac{W_2 \times M_1}{W_1}$$

$$M_2 = \frac{K_b}{\Delta T_b} \frac{1000 W_2}{W_1}$$

$$M_2 = \frac{K_f}{\Delta T_f} \frac{1000 W_2}{W_1}$$

DEFINITIONS

(May be used in short questions with examples)

- (1) **Azeotropic mixture:** (Gujranwala-2006, B. Pure 2012, D.G. Khan 2014, Sarg. 2014)
That mixture of the two components which boils at constant temperature and distills over without change in composition at any pressure is called azeotropic mixture. This is also called azeotropic solution. H₂O and C₂H₅OH give an azeotropic mixture which boils at 78.15°C. This is lower than 100°C and 78.5°C both.
- (2) **Colligative properties:** (B. Pur 2014)
Those properties of dilute solutions, which depend upon the number of solute particles. These properties are defined when solutes are non-volatile, non-electrolyte, and the solutions are dilute. Lowering of vapour pressure, elevation of B.P., depression of F.P. and osmotic pressure are its examples.
- (3) **Completely miscible liquids:**
Those pairs of liquids, which mix with each other in all proportions are called completely miscible liquids. H₂O and ethyl alcohol is the pair which is completely miscible.
- (4) **Concentration units:**
Those units of solution which tell us the relative amounts of solute and the solvent in a solution. These are % composition, molarity, molality, mole fraction, normality and ppm.
- (5) **Conjugate solutions:** (Guj. 2014)
Two solutions of same two components which are not miscible with each other, and they have different compositions under the given conditions of temperature. Water and

phenol make two solutions. One is solution of water in phenol and other phenol in water. They form separate layers. The layer of lower density is upper one.

(6) **Consolute temperature:** (Multan 2005, Guj. 2014)

That temperature at which two conjugate solutions merge into one another. It is also called upper consolute temperature or critical solution temperature. Water and phenol make conjugate solution but they merge into a single phase at 65.9°C.

(7) **Continuous solubility curve:**

That graph between temperature and solubility of a substance, which shows regular change of solubility with temperature is called continuous solubility curve. The solubility of KNO_3 in water goes on increasing continuously and a continuous curve is obtained.

(8) **Cryoscopy:**

The depression of freezing point of a solvent when a non-volatile solute is added into that. When 1 mole urea is dissolved in 1000 g of H_2O , the F.P of water becomes -1.86°C .

(9) **Depression of freezing point:**

It is the decrease of freezing point of a solvent by the addition of non-volatile solute into the solvent. It is also called cryoscopy. The F.P of water is depressed when glucose is dissolved in it.

(10) **Discontinuous solubility curve:**

That graph between temperature and solubility of a substance which shows sudden changes of solubilities with temperature. $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$ shows discontinuous solubility curve.

(11) **Elevation of boiling point:**

It is the rise of the boiling point of the solvent by the addition of a non-volatile solute in a volatile solvent. It is also called ebullioscopy. H_2O boils at 100.52°C when 180 g glucose is dissolved in 1000 g of H_2O .

(12) **Formality:**

It is the number of the formula weights in grams dissolved dm^{-3} of a solution. 58.5 g of NaCl dissolved in 1000 g of H_2O gives one formal solution.

(13) **Fraction distillation:**

It is the separation of the components of a liquid mixture on the basis of difference of boiling points by repeated distillation. Benzene and toluene can be separated by this method.

(14) **Heat of solution:**

It is the amount of heat which is absorbed or evolved when one mole of solute is dissolved in large excess of solvent at a given temperature. The heat of solution of AgNO_3 is $+22.77 \text{ kJ mol}^{-1}$.

(15) **Hydrate:**

It is a crystalline substance which contains chemically combined water in definite proportions. $\text{AlCl}_3 \cdot 6\text{H}_2\text{O}$ is a hydrate.

(16) **Hydration:** (Sarg. 2010, Multan 2012)

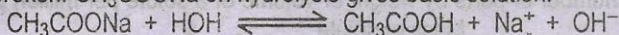
It is the process in which H_2O molecules surround and interact with the particles of the solute. CuSO_4 is hydrated with $5\text{H}_2\text{O}$ to give $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$.

(17) **Hydration energy:** (Federal 2013, B. Pur 2014)

It is the amount of energy liberated during the process of hydration. Na^+ is hydrated and evolves 390 kJ of energy. But the hydration energy of Li^+ is much greater due to small size and greater charge density.

(18) **Hydrolysis:** (Sargodha 2010, Multan 2012)

It is a reaction of salts or other compounds with water in which the bonds of H_2O molecule are broken. CH_3COONa on hydrolysis gives basic solution.



(19) **Ideal solution:**

Those solutions which obey the Raoult's law are called ideal solutions. Benzene and toluene give ideal solution.

(20) **Lowering of vapour pressure:**

It is the decrease of the vapour pressure of a solvent by the addition of a non-volatile solute into that. When sugar is dissolved in water, then vapour pressure of water falls.

(21) **Molal boiling point constant, or ebullioscopic constant (K_b):** (Lahore 2014)

It is the elevation of boiling point of the solvent, when one mole of the non-volatile non-electrolyte solute is dissolved in one kg of the solvent. The K_b value of H_2O is $0.52^\circ C$.

(22) **Molal freezing point constant: or cryoscopic constant (K_f):**

It is the depression of freezing point, when one mole of non-volatile and non-electrolyte solute is added in one kg of solvent. The K_f value of H_2O is $1.86^\circ C$.

(23) **Molality (m):**

(Multan 2009, Guj. 2010, D.G. Khan 2012, Faisalabad 2013, Federal Board 2013, D.G. Khan 2013, Lahore 2014, D.G. Khan 2014)

It is the number of moles of solute in 1000 gms of the solvent. 6g of urea in 1000 g of H_2O is 0.1 molal solution of urea.

(24) **Molarity (M):** (Multan 2009, Guj. 2010, D.G. Khan 2012, D.G. Khan 2013, Lahore 2014, Sarg. 2014)

It is the number of moles of solute dissolved dm^{-3} of solution. 18 g of glucose in 1000 mL of solution is 0.1 molar.

(25) **Mole fraction:** (Sargodha 2010, Rwp. 2014, Sarg. 2014)

It is the ratio of number of moles of the component of a solution to the total number of moles of all the components present in the solution.

$$X_1 = \frac{n_2}{n_t}$$

Here n_2 is number of moles of component 2 and n_t is total number of moles of solution.

(26) **Negative deviation from Raoult's law:**

When a graph is plotted between composition and the vapour pressures of solution and graph show the minimum point for the vapour pressure value, then such a solution shows negative deviation from Raoult's law. Solution of HNO_3 in water shows negative deviation from Raoult's law.

(27) **Non-ideal solutions:**

Those solutions which do not obey the Raoult's law are non-ideal solutions. H_2O in ethanol is a non-ideal solution.

(28) **Normality (N):**

It is the number of gram equivalents of the solute dissolved dm^{-3} of solution. 49 g of H_2SO_4 in 1000 mL of solution is 1N solution. 49 is equivalent weight of H_2SO_4 .

(29) **Partially miscible liquids:**

Those liquids which are dissolved into one another to a limited extent are called partially miscible liquids. Water and phenol are partially miscible liquids.

(30) Parts per million (ppm):

(Lahore 2009, Sargodha 2010, Sarg. 2011, D.G. Khan 2013, Rwp. 2014, Sahiwal 2014)

It is the number of parts by weight or volume of a solute per million parts by weight or volume of a solution.
$$\text{ppm} = \frac{\text{Mass of solute}}{\text{Mass of solution}} \times 10^6$$

(31) Phase:

A sample of matter with uniform properties, fixed composition and uniform throughout is called a phase. NaCl dissolved in water gives us a single phase solution.

(32) Positive deviation from Raoult's law:

When a graph is plotted between composition and vapour pressure of solution and the a solution shows the maximum point for their vapour pressure value, then such solutions are said to show positive deviation from the Raoult's law. H₂O and ethanol show positive deviation from Raoult's law.

(33) Raoult's law:

Raoult's law is defined in three ways:

(a) The vapour pressure of the solution is directly proportional to the mole fraction of the solvent.
$$p = p^{\circ} X_1$$

(b) The lowering of the vapour pressure is directly proportional to the mole fraction of the solute.
$$\Delta p = p^{\circ} X_2$$

(c) The relative lowering of vapour pressure is equal to the mole fraction of the solute.
$$\frac{\Delta p}{p^{\circ}} = X_2$$

(34) Saturated solution:

It is that solution which contains maximum amount of the solute in a solution at a given temperature. The solution cannot accommodate the amount of solute more than that under the given conditions.

(35) Solubility:

(D.G. Khan 2013, Guj. 2014)

It is the amount of solute dissolved in 100 gm of the solvent to form a saturated solution at a given temperature. The solubility of NaCl in water at 25°C is 35.9 g/100 mL.

(36) Solubility curve:

(Guj. 2014)

It is a graphical representation between temperature and solubility of a substance. It may be rising or falling, continuous or discontinuous.

(37) Solute:

The substance in a solution which is to be dissolved in the solution is called solute. It is present in smaller amount as compared to the solvent. When NaCl is dissolved in water than NaCl is a solute.

(38) Solution:

A homogeneous mixture of two or more than two substances, whose composition can be varied with in certain limits. Glucose forms a homogeneous mixture with H₂O and composition can be changed.

(39) Solvated ion:

An ion which is surrounded by the solvent molecules in the solution is called a solvated ion. Na⁺ and Cl⁻ are surrounded by H₂O molecules when dissolved in water.

(40) Salvation:

The process in which the solvent molecules surround and interact with the solute ions or molecules is called solvation. H⁺ undergoes solvation to give H₃O₄⁺.

(41) Solvent:

It is dispersion medium in which the solute is dispersed to get homogeneous mixture. It is present in greater quantity as compared to solute. Sugar dissolved in water, where water acts as solvent.

(42) True solution:

That solution which is homogeneous throughout and the particles of solute are uniformly distributed in the whole solution. NaCl gives true solution in water.

**MULTIPLE CHOICE QUESTIONS
(EXERCISE OF THE TEXTBOOK)**

MULTIPLE CHOICE QUESTIONS	ANSWER WITH REASONS
<p>(1) Molarity of pure water is: (a) 1 (b) 18 (c) 55.5 (d) 6</p>	<p>1. (c) (B.Pur 2005, Multan 2009, Rwp. 2010, Sarg. 2011, Lahore 2012, Lahore 2014, E. Pur 2014, Guj. 2014, F. Abad 2014) In order to calculate the molarity of pure water, we take 1000 cm³ of water which is very close to 1000 g of water. So the number of moles of water in 1000 g of water is $\frac{1000}{18} = 55.5.$</p>
<p>(2) 18 g of glucose is dissolved in 90 g of water. The relative lowering of vapour pressure is equal to: (a) $\frac{1}{5}$ (b) 5.1 (c) $\frac{1}{51}$ (d) 6</p>	<p>2. (c) (Bahawalpur 2011, Multan 2014) Mass of glucose = 18 g The relative lowering $\frac{\Delta P}{P^0}$ is equal to X_2. The value of $X_2 = \frac{n_2}{n_1 + n_2}$ $n_2 = \frac{18}{180} = 0.1,$ $n_1 = \frac{90}{18} = 5$ So $X_2 = \frac{0.1}{0.1 + 5} = \frac{0.1}{5.1} = \frac{1}{51}$ Hence $\frac{\Delta P}{P^0} = \frac{1}{51}$</p>
<p>(3) A solution of glucose is 10%. The volume in which 1 g mole of it is dissolved will be: (a) 1 dm³ (b) 1.8 dm³ (c) 200 cm³ (d) 900 cm³</p>	<p>3. (b) (Rawalpindi 2007, F. Abad 2012, D.G. Khan 2014) First learn that how % is converted to molarity. The 10 % solution of glucose means that 10 g is dissolved in 100 g of solution. So, 100 g of glucose is dissolved in 1000 g of solution. 1000 g of water or solution is approximately equal to 1000 cm³ of water or solution. So 100 g of glucose dissolves in water = 1000 cm³ 1 g of glucose dissolves in water = $\frac{1000}{100}$ dm³ 180 g of glucose dissolves in water = $\frac{1000}{100} \times 180 = 1800$ cm³ = 1.8 dm³</p>
<p>(4) An aqueous solution of ethanol in water has vapour pressure: (a) equal to that of water</p>	<p>4. (c) (Rawalpindi 2007) Solution of water and ethanol shows positive deviation from Raoult's law. The vapour pressures of solutions are greater</p>

ANSWERS TO THE SHORT QUESTIONS

Concentration Units of Solutions

Q.1 How will you prepare 5% w/v urea solution in water?

(Rwp. 2009, Faisalabad 2011)

-1 آپ پانی میں 5% w/v سولیوشن کیسے تیار کریں گے۔

Ans. We will dissolve 5 grams of urea and make the total volume of solution as 100 cm³ (5 grams urea or 100 cm³ solution). In this solution, we know the mass of solute and not the mass or volume of solution.

Q.2 In weight/weight %, we know the masses of solute and solvent but in weight/volume % age, we don't know the mass of solvent and that of the solution. Give comments. (Multan 2008)

-2 % $\frac{W}{W}$ میں ہمیں سالونٹ اور سولیوشن دونوں کی کیت کا پتہ ہوتا ہے۔ لیکن % $\frac{W}{V}$ میں ہمیں سالونٹ کے وزن اور سولیوشن

کے وزن کا پتہ نہیں ہوتا۔ کیوں؟

Ans: w/w % is weight of the solute dissolved per 100 parts by weight of solution. In 5 % w/w glucose solution, we know the weight of the solute, wt. of the solvent and wt. of the solution.

In w/v % glucose solution, we dissolve 5 g of glucose in 100 cm³ of solution. So, we do not know the final mass of solvent and the weight of solution.

Q.3 The concentration in terms of molality is independent of temperature but molarity depends upon temperature. How?

(Lahore-2006, Rawalpindi 2007, Faisalabad 2007, Guj. 2009, Faisalabad 2011, Multan 2011, Lahore 2013, Rwp. 2013)

-3 سولیوشن کے ارتکاز کو جب molality میں ظاہر جائے تو یہ درجہ حرارت سے آزاد دلیو ہوتی ہے۔ لیکن مولیرٹی درجہ

حرارت پر انحصار کرتی ہے۔ کیسے؟

Ans: In molal solutions the mass of the solvent and that of the solute are also fixed. The masses of the substances are not temperature dependent (درجہ حرارت پر منحصر).

In molar solutions we have the volumes of solutions. Volume of a liquid is a temperature dependent. So the molality is not influenced (متاثر ہوتا) by temperature but molarity does change.

Q.4 The sum of mole fractions of all the components is always equal to unity for any solution. Justify it.

(F. Abad 2008, Rwp. 2008, B.P. 2008, Lahore 2010, Multan 2012, D.G. Khan 2012, Faisalabad 2013)

-4 سولیوشن بنانے میں حصہ لینے والی تمام چیزوں کے مول فریکشنز کا مجموعہ ایک کے برابر ہوتا ہے۔ صحیح ثابت کریں۔

Ans: Mole fraction is the ratio of number of moles of one component to total number of moles. Hence mole fraction of any substance is always less than unity. The mole fractions of three components A, B and C, in a solutions are

$$X_A = \frac{n_A}{n_A + n_B + n_C}, X_B = \frac{n_B}{n_A + n_B + n_C}, X_C = \frac{n_C}{n_A + n_B + n_C}$$

Adding these mole fractions ;

$$X_A + X_B + X_C = \frac{n_A}{n_A + n_B + n_C} + \frac{n_B}{n_A + n_B + n_C} + \frac{n_C}{n_A + n_B + n_C} = 1$$

Q.5 Write a short note on molarity of a solution?

(Gujranwala 2005, Lahore 2008, Fd. Abad 2009, Multan 2009, Lahore 2014)

-5 کسی سولوشن کی مولیرٹی پر مختصر نوٹ لکھیں۔

Ans: Molarity is the number of moles of the solute per dm^3 of the solution. It has the following formula:

$$\text{Molarity (M)} = \frac{\text{Mass of solute}}{\text{Molar mass of solute}} \times \frac{1}{\text{Volume of solute in dm}^3}$$

$$\text{Molarity (M)} = \frac{\text{Number of moles of solute}}{\text{Volume of solution in dm}^3}$$

Q.6 100 g of 98% H_2SO_4 has a volume of 54.34 cm^3 of H_2SO_4 because its density is 1.84 g cm^{-3} . Justify it.

-6 98% سلفیورک ایسڈ کے 100 گرام کی کل جسامت 54.34 cm^3 سی ہے کیونکہ اس کی کثافت اضافی 1.84 g cm^{-3} سی ہے۔ اس کو درست ثابت کریں۔

Ans: 98% H_2SO_4 means that 100 g of H_2SO_4 solution has 98 g of H_2SO_4 and only 2 g of water.

$$\text{Density} = \frac{\text{mass}}{\text{volume}}$$

$$\text{Since, Volume} = \frac{\text{mass}}{\text{density}}$$

Putting the values

$$\text{Volume} = \frac{100 \text{ g}}{1.84 \text{ g cm}^{-3}} = 54.34 \text{ cm}^3$$

It means that the 98% H_2SO_4 having total mass of 100 g has a volume of 54.34 cm^3 .

Q.7 The total volume of the solution by mixing 100 cm^3 of water with 100 cm^3 of alcohol may not be equal to 200 cm^3 . Is it true?

(Mirpur-2006, Sargodha 2008, D.G. Khan 2014)

-7 100 سی سی پانی اور 100 سی سی الکل ملنے سے 200 سی سی سولوشن نہیں بنتا کیا یہ درست ہے؟

Ans: Molecules of water and alcohol have bent (تیز صی) structures (ساخت). The forces of attractions among water and alcohol in pure states are greater than after mixing. So the total volume of the mixture of the two components (جزو) is greater than the sum of individual volumes.

Q.8 One molal solution of urea in water is dilute as compared to one molar solution of urea but the number of particles of the solute is same. Justify it.

(Model Paper-2006-07, Fd. Abad 2007, Mtn 2008, B. Pur 2009, Fd. Abad 2009, Faisalabad 2010, Guj. 2011, Rwp. 2011, M. Pure 2012, Guj. 2013, Sarg. 2014, Multan 2014, D.G. Khan 2014)

-8 آپ کس طرح ثابت کریں گے کہ پانی میں تیار شدہ یوریا کا ایک مولل سولوشن ایک مولریویریا سولوشن اور نکاز کے لحاظ سے ہلکا ہوگا۔

Ans: In one molal solution of urea, 60 g of urea is dissolved in 1000 g of water, which is approximately (اندازاً) 1000 cm^3 of water. In one molar solution of urea, 60 g of urea is added in water to make total volume of solution as 1000 cm^3 . So the volume of water in molar solution is less than 1000 cm^3 . Hence molar solution is concentrated (ار نکاز زیادہ ہے) and molal solution is dilute (ار نکاز کم ہے).

Solubility and solubility curves

- Q.9** Why glucose is not soluble in CCl_4 , but dissolves in water?
(B. Pure 2012, F. Abad 2014, Guj. 2014)
-9 گلوکوزہ CCl_4 میں حل پذیر نہیں ہوتا۔ لیکن پانی میں حل کیوں ہو جاتا ہے؟
- Ans.** The molecule of glucose has strong hydrogen bonding due to the presence of five – OH groups. CCl_4 being non-polar molecule cannot break the hydrogen bonding among the glucose molecules. Water is a polar solvent, so it breaks the hydrogen bonding of glucose and dissolves it. Similarly can sugar is not soluble in benzene.
- Q.10** $\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$ shows discontinuous solubility curve, when plotted against temperature. Why? (Lahore 2004, Rwp. 2008, F. Abad 2012, F. Abad 2014)
-10 $\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$ کو جب پانی میں حل کی جائے تو اس کی حل پذیری کا گراف تسلسل والا نہیں ہے۔ کیوں؟
- Ans:** The changes of temperature changes the extent of hydration (پانی کا ساتھ لگنا). The solubility change with temperature depends upon the number of water molecules in the substance.
- Q.11** What do you mean by discontinuous solubility curves?
(Model Paper, Lahore 2011, F. Abad 2012, F. Abad 2014)
-11 حل پذیری کا گراف بغیر تسلسل کے ٹوٹا پھوٹا ہو تو اس کا معنی کیا ہے؟
- Ans.** The graph between solubilities (حل پذیریاں) and temperatures may show a sudden change in the direction. Such a graph is called discontinuous solubility curve (تواتر کو برقرار نہ رکھنے والا). Such curves are the combinations of two or more than two curves due to the changing behaviour (طور طریقہ میں بدلاؤ) of that compound.
- Q.12** How does fractional crystallization help in removing the impurities from a solid substance? (Rwp. 2010, Rwp 2010, D.G. Khan 2011)
-12 جزوی قلم کاری کا عمل کثافتوں کو الگ کرنے میں ہماری کیسے مدد کرتی ہے؟
- Ans.** The impure substance (ناخالص چیزیں) is dissolved in hot solvent. The solute to be purified should be less soluble than impurities. When cooling is done, this solute settles down in the form of crystals and impurities are left behind in the solution. Filtration is done to get the crystals of the required substance.
- Q.13** What is conjugate solution? (Bahawalpur-2006, Lahore 2008, Guj. 2014)
-13 کانجوگیٹ سولیوشن کیا ہوتا ہے؟
- Ans.** When two partially miscible liquids (جزوی طور پر حل ہونے والے) are mixed, two layers are produced. They are the solutions of one component into the other. These two solutions have distinct line of demarcation (حدود کی لائن) and are called conjugate solutions.
- Q.14** What is effect of temperature on the conjugate solution of water and phenol?
-14 پانی اور فینول کے کانجوگیٹ سولیوشن پر درجہ حرارت کا کیا اثر ہے؟
- Ans.** Water and phenol are partially miscible. They make two distinct (مٹھدہ علیحدہ نمایاں) solutions and two separate layers (دو الگ تہیں) at room temperature. By increasing the temperature, the composition of the two conjugate solution change and at 65.9°C a homogeneous mixture (ایک جیسی کچھڑ) of two components is formed.
- Q.15** What is consolute temperature or critical solution temperature?
(D.G. Khan 2012)
-15 کانسولیوٹ درجہ حرارت کیا ہوتا ہے؟

Ans. Partially miscible liquids (جزوی طور پر حل ہونے والے مادعات) make two distinct layers of conjugate solutions. By changing the temperature, the two layers become completely miscible (مکمل طور پر حل پذیر) and homogeneous solution is produced. This temperature is called consolute temperature.

Q.16 How does an increase in temperature may increase or decrease the solubility of a substance? (Lahore 2010, Sargodha 2010, D.G. Khan 2013, D.G. Khan 2014)

-16 درجہ حرارت کے بڑھانے سے ایک چیز کی حل پذیری کیسے کم دیش ہوتی ہے؟

Ans: When the heat of solution ΔH_v is positive and such solutions are heated, they dissolve more solutes and the solubility increases. When the heat of solution is negative, then the heat is being evolved during the formation of solution. When such solutions are heated, their solubilities decrease.

Raoult's Law

Q.17 Give two statements of Raoult's law?

(Faisalabad 2004, F. Abad 2008, Guj. 2008, F. Abad 2012, F. Abad 2014)

-17 راولٹس کے قانون کو مختلف طریقوں سے بیان کریں۔

Ans. (i) The vapour pressure of solvent in the solution state is directly proportional the mole fraction of solvent $p = p^\circ x_1$. (ii) Lowering of V.P. is directly portional to the mole fraction of solute $\Delta P = P^\circ x_2$.

Q.18 The boiling point of one molal urea solution is 100.52°C , but the boiling point of two molal urea solution is less than 101.04°C . Why?

-18 پانی کے اندر ایک مولل یوریا سولوشن کا B.P. 100.52°C ہے۔ جبکہ 2 مولل سولوشن کا B.P. 101.04°C سے کم ہوتا ہے۔ کیوں؟

Ans: Two molal urea solution is a concentrated solution (گاڑھا سولوشن) as compared to one molal urea solution. The number of molecules of urea in two molal solution are twice the Avogadro's number but the number of particles which are free to move in the solution are less than twice (فزی ماکیو لڑکی تعداد دگنی سے کم ہے) the Avogadro's number. Because one dm^3 volume is less to accommodate $2N_A$ molecules of solute and behave as non-ideal solution to show colligative property. So the elevation of B.P. is not doubled.

Q.19 Why the relative lowering of vapour pressure is independent of temperature.

(Faisalabad 2008, Sarg. 2009, Guj. 2009, Rwp. 2009, Lahore 2012, Guj. 2012)

-19 بخارات کے اضافی دباؤ میں کمی درجہ حرارت پر منحصر کیوں نہیں ہے؟

Ans: The relative lowering of vapour pressure (بخارات میں اضافی کمی) and mole fraction of solute are related as:

$$\frac{\Delta p}{p^\circ} = x_2$$

Vapour pressure and lowering of vapour pressure depend upon temperature. So, when the temperature of a solution is increased both the factors ΔP and P° increase in such a way that the ratio remains the same.

Q.20 When we plot a graph between temperature and compositions of binary liquid mixture, straight line is not obtained. We get two curves even for ideal solutions. Justify it. (Model Paper-2006-07)

20- دوامعات کے بہت سے سویوشنز کے درجہ حرارت اور ترکیب کے گراف پلاٹ کریں تو سیدھی لائن نہیں ملتی۔ بلکہ ہمیں دو منحنی لائنز ملتی ہیں خواہ سویوشنز آئیڈیل ہی کیوں نہ ہوں۔ اس کی کیا وجہ ہے؟

Ans: Different solutions of two components have their own percentage in the liquid state and the vapour state (مالع حالت اور بخاراتی حالت میں A اور B کی ترکیب مختلف ہوگی). So, if the graph is plotted between compositions on x-axis and temperature on y-axis, then we will get two curves (دو منحنی لائنز ملیں گی). The lower curve is for the % of liquid mixtures at various temperatures and the upper curve is for % of vapours of various mixtures (مختلف کمپوزیشن کی بخاراتی حالت میں).

Q.21 Non-ideal solutions do not obey the Raoult's law. Why?

(Sarg. 2009, B.Pur 2009, Rwp.2010, Rwp. 2011, B. Pure 2013, Guj. 2013, Rwp. 2014, Guj. 2014, Sahiwal 2014)

21- نان آئیڈیل سویوشنز راؤلٹس کے لاء کے پابند نہیں ہوتے۔ کیوں؟

Ans: The molecules of components in non-ideal (غیر مثالی) solutions have forces of attractions (کشش کی قوتیں رکھتے ہیں) for each other. The values of vapour pressures of individual components are not proportional (متناسب نہیں ہیں) to their mole fractions as in Raoult's law.

Q.22 What is negative deviation from Raoult's law?

22- راؤلٹ کے لاء سے منفی انحراف کا کیا مطلب لیا جاتا ہے؟

Ans: The pairs of liquids which have lesser values of the vapour pressures for some of their composition than those of pure components show negative deviation (منفی انحراف) from Raoult's law. They show a minimum point (بہت ہی نیچے والا نقطہ) in the vapour pressure composition curve.

Q.23 What is positive deviation from Raoult's law? (Model Paper, Lhr-2007)

23- راؤلٹ کے لاء سے مثبت انحراف کا کیا مطلب لیا جاتا ہے؟

Ans: The pairs of liquids which have greater value of vapour pressure for some of their compositions than those of pure components show positive deviation (مثبت انحراف) from Raoult's law. They show a maximum point (گراف میں اونچی جگہ پر نقطہ) in the vapour pressure composition curve.

Q.24 What do you mean by minimum boiling point mixture?

(Multan 2009, Lahore 2010, Multan 2011)

24- کم سے کم درجہ حرارت پر اُبلنے والی کمپوزیشن کا کیا معنی ہے؟

Ans: This is an azeotropic mixture which shows positive deviation from Raoult's law. It boils at low temperature than either of pure components.

ترکیب اور بخاراتی دباؤ کے گراف میں نقطہ بلند ترین جگہ پر ہو گا لیکن ترکیب اور B.P کے لحاظ سے ایسا سویوشن کم ترین درجہ حرارت پر اُبلے گا۔

Q.25 What do you mean by maximum boiling point mixture?

(Multan 2009, Lahore 2010, Multan 2011)

25- زیادہ سے زیادہ درجہ حرارت پر اُبلنے والی کمپوزیشن کا کیا معنی ہے؟

Ans: This is an azeotropic mixture which shows negative deviations from Raoult's law. It boils at higher temperature than either of the pure components.

Colligative properties

Q.26 Define colligative properties? Name some important colligative properties. (Lahore Board 2005, Rawalpindi 2005, Multan-2006, Sargodha 2010, Lahore 2011, D.G. Khan 2011, R. Pindi 2012, B. Pure 2012, D. G. Khan 2013, Faisalabad 2013, Sarg. 2014, Rwp. 2014, Lahore 2014, Sarg. 2014)

26- کالی گیٹیو صفات کی تعریف کریں ایسی چند اہم صفات کا نام لیں۔

Ans: Those properties of solutions which depend upon the number of the particles of the solute and not upon their nature are called colligative properties. There properties are

وہ صفات جو سولیوشن کے ذرات کی تعداد پر انحصار کریں لیکن ان کی فطرت پر نہ ہوں کالی گیٹیو صفات کہلاتی ہیں۔

- (i) Lowering of vapour pressure (V.P. کا کم ہونا)
- (ii) Elevation of boiling point (B.P. کا بڑھنا)
- (iii) Depression of freezing point (F.P. کا کم ہونا)
- (iv) Osmotic pressure (نفوذی دباؤ)

Q.27 Colligative properties are obeyed when the solute is non-electrolyte and also when the solutions are dilute. (Guj. 2009, Sarg. 2011)

27- کالی گیٹیو صفت اس وقت کام کرتی ہے جب سولیوشن سے برقی رو نہ گزر سکے اور سولیوشن ہلکا بھی ہو۔ ایسے کیوں ہے؟

Ans: In the case of electrolytes, ions are produced, number of particles of the solutes increase and the amounts of colligative properties also increase. Colligative properties are obeyed (لاگو ہوتا) when the solutions are dilute, so that the solute particles are behaving independently. (تاکہ سولیوشن کے مالیکیولز آزاد سے کام لیں)

اگر آئنز بن جائیں گے تو متافو قتا ان کے جگھٹنے بن جائیں گے اور کالی گیٹیو صفت امید سے کم ہو جائے گی۔

Q.28 Boiling points of solvents increase due to the presence of solutes. Why? (Federal-2006, Faisalabad 2007, Guj. 2008, Guj. 2010, Lahore 2012, Multan 2013, Lahore 2014, D.G. Khan 2014)

28- سولیوشن کی موجودگی میں سولیوشن کے B.P. بڑھ جاتے ہیں۔ کیوں؟

Ans: The surface of the solution has molecules of solute as well. They do not allow the solvent to leave the surface as rapidly as (تاتی جلدی) in pure solvent. To boil the solutions, we have to increase the temperature of solutions in comparison (مقابلہ) to pure solvents. So, the B.P. of solutions are higher than pure solvents.

Q.29 Why the freezing points are depressed due to presence of solutes? (Lahore 2007, Faisalabad 2010, Rwp. 2011, Guj. 2012, Sarg. 2014)

29- سولیوشن کی موجودگی میں سولیوشن کے F.P. کیوں کم ہو جاتے ہیں؟

Ans: The lowering of vapour pressure compels the solutions (سولیوشن کو مجبور کرتا ہے) to freeze at those temperatures, which are below the freezing point of pure solvent. The reason is that the vapour pressure temperature curve (بخاراتی دباؤ اور درجہ حرارت کا گراف) meets the solid phase of pure solvent at lower temperature than the pure solvent.

Q.30 What is ebullioscopic constant? (Multan 2011, Lahore 2012, Guj. 2013)

30- اٹیپوسکوپک کانسٹنٹ کیا ہوتا ہے؟

Ans. It is elevation (زیادہ ہونا) of the boiling point of the solvent when one mole of the non-volatile, non-electrolyte solute is dissolved in 1 kg of the solvent. It is the property of solvent and not of the solute. It is denoted by K_b . Its value is 0.52°C for water.

Q.31 What is cryoscopic constant? (B.P. 2008, Multan 2011)

31- کریسکوپک کانسٹنٹ کیا ہوتا ہے؟

Ans. It is the depression (دب جانا) of freezing point of the solvent, when one mole of non-volatile, non-electrolyte solute is dissolved in 1 kg of the solvent. It is the property of the solvent (سالونٹ کی صفت ہے) not of the solute. It is denoted by K_f . Its value is 1.86°C for water.

Q.32 Why Beckmann thermometer is used to note the depression of freezing point? (Rawalpindi 2007, Multan 2009, Bahawalpur 2011, Guj. 2013, Multan 2014)

F.P کی کو نوٹ کرنے کے لئے ہم بیک مین کا تھرمامیٹر کیوں استعمال کرتے ہیں؟ -32

Ans: Beckmann thermometer can measure up to $1/20^{\text{th}}$ of the degree (ایک ڈگری کا بیسواں حصہ پڑھ سکتا ہے). The elevation of boiling points and the depressions of freezing points for dilute solutions are very small quantities. Hence, one can measure these very small changes of temperatures.

Q.33 The lowering of vapour pressure, elevation of boiling point and the depression of freezing points are called colligative properties. Comment upon it. (B.P. 2008, Lahore 2013, Guj. 2014)

-33 بخاراتی دباؤ کا کم ہونا، B.P کا بڑھنا اور F.P کا کم ہونا کالیگٹیو صفات ہیں۔ اس پر بحث کریں۔

Ans: Colligative properties are those properties which depend upon the number of particles of the solute in the solution. If we dissolve equal number of moles (مولز کی برابر مقدار) of non-volatile and non-electrolyte solutes in the same quantity of the solvent, then the lowering of vapour pressure, elevation of boiling point and the depression of freezing point will be the same because the number of particles (ذرات کی تعداد) are same.

Q.34 Why a non-volatile solute in a volatile solvent lowers the vapour pressure of solution?

-34 بخارات میں جلدی سے نہ تبدیل ہونے والا سولیوٹ جب دو لائٹل سالونٹ میں حل کیا جائے تو بخارات کے دباؤ میں کمی کیوں رونما ہوتی ہے؟

Ans: The particles of the solute are distributed (تقسیم شدہ ہیں) throughout the bulk (سارے سولیوشن کے اندر) of the solution and some of the particles of the solute are also present on the surface (سطح پر) of the solution. The number of molecules of the solvent per unit area on the surface of the solution become less. Hence the evaporating tendency (بخارات بننے کا رجحان) of the solvent decreases and vapour pressure of solution becomes less.

Q.35 How the relative lowering of vapour pressure can help us to calculate the molar mass of a non-volatile, non-electrolyte solute?

-35 بخاراتی دباؤ کی اضافی کمی ایک نان ولٹائل اور نان الیکٹرولائٹ سولیوٹ کا مولر ماس حاصل کرنے میں کیسے مدد کر سکتی ہے؟

Ans: According to the third definition of the Raoult's law, the relative lowering of vapour pressure (بخاراتی دباؤ میں اضافی کمی) is equal to the mole fraction of the solute

$$\frac{\Delta p}{p^\circ} = X_2$$

$$\text{Since } X_2 = \frac{n_2}{n_1 + n_2} = \frac{n_2}{n_1} \quad (n_1 \gg n_2)$$

$$\text{So, } \frac{\Delta p}{p^\circ} = \frac{W_2}{M_2} \times \frac{M_1}{W_1}$$

$$\text{or } M_2 = \frac{W_2}{W_1} \cdot M_1 \cdot \frac{p^\circ}{\Delta p}$$

From this equation molar mass can be calculated.

Q.36 Why the boiling point of a solution of a non-volatile solute in a volatile solvent is always greater than the boiling point of a pure solvent?

(Model Paper-2006-07, Guj. 2008)

-36 ایک نان وولائلٹ اور نان الیکٹرولائٹ سولیوٹ کو جب دو لائٹل سالونٹ میں حل کیا جائے تو سولیوشن کا B.P کیوں بڑھ
کیوں جاتا ہے؟

Ans: The elevation of the boiling point of the solution is due to the lowering of vapour pressure of the solution as compared to the pure solvent. In the case of solution the vapour pressure becomes less. In order to equalize (برابر کرنا) the vapour pressure of the solution to the external pressure (باہر کا دباؤ), more temperature (زیادہ درجہ حرارت) is required than that in the pure state of the solvent, which causes (سبب بنتا ہے) elevation of boiling point.

Q.37 Why the freezing point of the solution is always less than the freezing point of the pure solvent?

(Mirpure Board 2004, Lahore 2009, Fd. Abad 2009, Faisalabad 2011)

-37 ایک سولیوشن کا F.P. سے ہمیشہ کم کیوں ہوتا ہے؟

Ans: The depression of freezing point of the solution is again due to lowering of vapour pressure (V.P. میں کمی کی وجہ سے) of the solution as compared to the pure solvent. A graph between temperature and vapour pressure shows that the curve for the solution lies below the curve for the pure solvent. The curve for the solution touches (چھوٹا) the curve for the solid phase of the pure solvent at a lower temperature, than the freezing point of the pure solvent.

Q.38 Prove that the colligative properties like ΔT_b and ΔT_f are inversely proportional to the molar masses of the solute.

-38 ثابت کریں کہ کالی گیٹیو صفات جیسا کہ ΔT_b , ΔT_f وغیرہ سولیوٹ کے مولر ماس کے الٹ متناسب ہوتی ہیں۔

Ans: When we look at the mathematical relation between ΔT_b and ΔT_f with M_2 of the solute, then they are as follows

$$\Delta T_b = K_b \frac{1000 W_2}{W_1 \times M_2}$$

$$\text{So, } \Delta T_b \propto \frac{1}{M_2}$$

$$\Delta T_f = K_f \frac{1000 W_2}{W_1 \times M_2}$$

$$\text{So, } \Delta T_f \propto \frac{1}{M_2}$$

Q.39 Colligative properties are obeyed when solutions are dilute. Why?

(Multan Board 2004)

-39 کالی گیٹیو صفات اس وقت کام کرتی ہیں جب سولیوشنز ہلکے ہوں۔ کیوں؟

Ans: Colligative properties depend upon the number of particles of the solute. In dilute solutions the particles of the solute are far away and independent (آزاد ہیں) from each other and their number is according to the concept of molarity. When the solutions are concentrated, the two or more than two particles of the solute may

remain together and may not behave independently (دو یا دو سے زیادہ ذرات کا گروپ بن جاتے) (کی وجہ سے آزاد ذرات کی تعداد کم ہو جاتی ہے) colligative properties.

Q.40 If an electrolyte is dissolved in a solvent, the abnormal colligative properties are observed. Why?

-40 جب ایک الیکٹرولائٹ کو کسی سالونٹ میں حل کیا جائے تو مولیوشن کالی گٹیو صفات سے منحرف ہو جاتا ہے۔ کیوں؟

Ans: Electrolytes are those substances which dissociates into positive and negative ions. In this way the number of particles dissociated in a solution increase. The increased number of particles increase the colligative properties, called abnormal (عام عادات سے پرے) colligative property.

Q.41 In summer the antifreeze solutions protect the radiator from boiling over. Why? (Model Paper, Rawalpindi 2007, Multan 2008, D.G. Khan 2012, Guj. 2013, Multan 2014)

-41 گرمیوں کے موسم میں نہ جھننے والا سولوشن گاڑی کے ریڈی ایٹر کو ابلنے سے بچا لیتا ہے۔ کیوں؟

Ans: Water boils at 100°C. It is used in the radiators (گاڑی کو ٹھنڈا کرنے والے) to decrease the temperature of the working engine. If we add some suitable solutes which increase the boiling point of water, above 100°C, then easy boiling over of water is avoided (روکا جاسکتا). Actually such solutes also decrease the F.P. of solutions as well.

Q.42 Why the NaCl and KNO₃ are used to lower the melting point of ice? (Multan Board 2005, Guj. 2011, Lahore 2013, Multan 2013)

-42 NaCl اور KNO₃ برف کے نقطہ پگھلاؤ کو نیچے کیسے کرتے ہیں؟

Ans: NaCl and KNO₃ are electrolytes and are sufficiently (کافی حد تک) soluble in water. They double the number of particles after dissociation in water. In this way they, can manage to decrease the freezing point of water to a greater extent as compared to a non-electrolyte.

Heat of solution

Q.43 When the heat of solution is negative, then increase in temperature decreases the solubility and vice versa. Why? (Sargodha 2008)

-43 جب ΔH_s منفی ہو تو درجہ حرارت بڑھانے سے حل پذیری کم ہوتی ہے۔ کیوں؟

Ans: When the heat of solution is negative, it means that the vessel is heated up during the solution formation. So, when heat is supplied from outside, then the system will go to that side where greater amount of heat can be stored and that is the side of low solubility (کم حل پذیری کی طرف).

Q.44 Heat of solution of a substance is measured at infinite dilution. Why? (Model Paper-2006-07, Sargodha 2008, Guj. 2008)

-44 ΔH_s اس وقت پیمائش کرتے ہیں جب سولوشن انتہا کا ہلکا ہو۔ کیوں؟

Ans: Actually the maximum amount of heat is evolved or absorbed, when each particle of one mole of solute is completely solvated by the solvent molecules (جب سولیوٹ کا ہر مالیکیول مکمل طور پر سالونٹ کے مالیکیولز سے گھر جائے تو زیادہ سے زیادہ حرارت خارج ہوتی ہے جس کو heat of solution کہتے ہیں). These solvated particles of the solute should be far away from each other in the solution. This is only possible when this solution is very dilute.

Q.45 How the ions are stabilized when a strong electrolyte like NaCl and KCl are dissolved in H₂O?

-45 جب NaCl اور KCl کو پانی میں حل کیا جاتا ہے تو آنز کیسے استحکام پذیر ہوتے ہیں۔

Ans: Strong electrolyte are dissociated to the maximum extent (زیادہ سے زیادہ حد تک) and positive and negative ions are produced. These ions are surrounded by the water molecules as follows. Their charges are satisfied by the solvent molecules. In this way, they get the stabilities.

Q.46 How the forces of attractions between the ions and the solvent molecules depend upon the charge densities of the ions?

(Model Paper, B.P. 2008, B. Pure 2013)

-46 کس طرح سے آنز اور سالونٹ کے مائیکرو لوز کے درمیان کشش کی قوتیں آنز کے چارج کے گاڑھے پن پر انحصار کرتی ہیں؟

Ans: Smaller the size of the ion or greater the amount of the positive charge on the ion, greater the charge density (چارج کا گاڑھا پن). Such ions have greater forces of attractions for the molecules of the solvent. They are solvated (سالونٹ سے گھیرے جاتا) more effectively (با اثر طریقے سے). Negatively charged ions are bigger in sizes, so they are not solvated in a better way.

Hydration and Hydrolysis

Q.47 What are hydrates? How they are formed? Give some examples.

(Azad Jammu & Kashmir Board 2005, B.P. 2008, Faisalabad 2010, Lahore 2010, D.G. Khan 2012, D.G. Khan 2013, B. Pure 2013, Faisalabad 2013, Lahore 2014, Lahore 2014)

-47 ہائیڈرٹس کیا ہوتے ہیں؟ وہ کیسے بنتے ہیں؟ چند مثالیں دیں۔

Ans: The crystalline substances (تقریبی شکل کے مرکبات) which contain chemically combined water in definite proportion (خاص نسبت سے) is called a hydrate. They are produced when aqueous solution of soluble salt is evaporated. Examples are: MgCl₂ · 6H₂O, AlCl₃ · 6H₂O, Na₂CO₃ · 10H₂O, CuSO₄ · 5H₂O.

Q.48 Why a salt produced from a strong acid and a strong base is not hydrolysed in water?

(Lahore 2011, Federal Board 2013)

-48 ایک طاقت ور اینڈ اور طاقت میں سے تیار کردہ سالٹ پانی سے ری ایکشن کیوں نہیں کرتا؟

Ans: The positively charged ions like Na⁺, K⁺, etc. are derived from strong bases. These bases are dissociated (ٹوٹ جاتے ہیں) almost 100 % in water. These positive ions have least tendencies (کم سے کم رجحان) to react with H₂O molecules. The negatively charged ions like Cl⁻, Br⁻, I⁻, SO₄²⁻ etc. are derived from strong acids. These acids are dissociated almost 100 % in water. The negative ions have little tendencies to react with H₂O. In other words, they are not hydrolysed (پانی سے تعامل کرنا) by H₂O.

Q.49 Why a salt produced from a weak acid and a strong base gives a basic aqueous solution like CH₃COONa?

(Sargodha 2008, B.Pur 2009, Guj. 2010, D.G. Khan 2012, B. Pure 2013, Guj. 2013)

-49 CH₃COONa ایک کمزور اینڈ اور طاقت ور میں کا سالٹ ہے۔ یہ پانی میں بیسیک سولوشن کیوں دیتا ہے؟

Ans: The salt like CH₃COONa is formed from a strong base and a weak acid. It dissociates in water to give CH₃COO⁻ and Na⁺. Na⁺ does not react with water. CH₃COO⁻ reacts with water to give CH₃COOH and OH⁻. Due to free OH⁻ ion, the solution is basic.

Q.50 Explain why CuSO_4 and NH_4Cl give acidic solution when put separately in water?

(Rwp. 2005, Lahore 2005, Multan 2007, B.Pur 2007, B.Pur 2009, Sarg. 2009, Guj. 2010, M. Pure 2012, Lahore 2012, Sahiwal 2014)

-50 CuSO_4 اور NH_4Cl کو جب پانی میں الگ الگ حل کیا جائے تو تیزابی سولوشنز کیوں بنتے ہیں؟

Ans: CuSO_4 is a salt made up of a weak base, $\text{Cu}(\text{OH})_2$ and strong acid H_2SO_4 . CuSO_4 ionizes in water to give Cu^{2+} and SO_4^{2-} ions. Copper ions are hydrolysed (پانی سے عمل کرنا) and H^+ ions are set free in the solution. So solution is acidic. Similarly NH_4Cl is made up of NH_4Cl a weak base, and HCl a strong acid. Hence its aqueous solution is acidic.

Q.51 Aqueous solution of salt derived from a weak acid and a weak base may not be neutral. Why?

-51 یہ کیوں ضروری نہیں ہے کہ کمزور ایسڈ اور کمزور بیس سے بنا ہوا اسالٹ نیوٹرل ہی ہو؟

Ans: If the pK_a and pK_b value of positive and negative are equal, then the solution will be neutral (تعدیل شدہ). If the individual ions have unequal pK_a and pK_b values, then such solutions are not neutral. In case of NH_4CN the solution is basic. The reason is that NH_4^+ is a stronger acid and CN^- is a weaker base. In case of NH_4F the solution is acidic, because HF is stronger acid while NH_4OH is a weaker base.