Molarity Chemistry Questions with Solutions

Q1: Differentiate between Solute and Solvent.

Answer:

A solute is a component that dissolves in a solvent to generate a solution. Solutes can exist in three states: liquid, gaseous, and solid. Solutes usually make up a smaller proportion of a solution than the solvents.

A solvent is a material that has the ability to dissolve other substances. Solvents can exist in three states: liquid, gaseous, and solid. Solvents are most typically employed as liquids.

Q2: Define Mole fraction.

Answer:

Mole fraction is defined as the number of moles of one component of a solution divided by the total number of moles of all of the components in the solution.

The sum of all the mole fractions of a solution's components is always 1.

Q3: Define Mass Percentage.

Answer:

The mass percentage of an element of a solution is defined as the mass of the solute in grammes present in 100 g of the solution. It's written like this:

Mass % of a component = $\frac{Mass\ of\ component\ in\ solution}{Total\ mass\ of\ solution} x\ 100$

Q4: Two solutions of a substance (non electrolyte) are mixed in the following manner. 480 mL of 1.5 M first solution + 520 mL of 1.2 M second solution. What is the molarity of the final mixture?

a) 1.20 M

b) 1.50 M

c) 1.344 M

d) 2.70 M

Answer:

The correct option is 'c'.
Explanation: The molarity of a mixture, M_{mix}, can be calculated using the following formula:

$M_{mix} = (M_1V_1 + M_2V_2) / (V_1 + V_2) = (1.5 \times 480) + (1.2 \times 520)/(480 + 520) = (720 + 624)/1000 =$ **1.344 M**

Q5: With increase in temperature, which of these changes?
a) molality

b) fraction of solute present in water

c) mole fraction

d) weight fraction of solute

Answer:

d) The weight fraction of solute present in water will vary with temperature.
Explanation: The volume of a solution is affected by temperature. Thus, the formula for concentration that includes volume will change as temperature changes.

Q6: The density of a solution prepared by dissolving 120 g of urea (mol.mass = 60 u) in 1000 g of water is 1.15 g/mL. The molarity of this solution is:
a) 2.05 M

b) 1.02 M

c) 0.50 M

d) 1.78 M

Answer:

The correct option is 'a'.
Explanation: Molarity of a solution (M) = n/V

Where:

n = number of moles of urea = 120/60 = 2 mol

V = volume of the solution = mass of solution / density of solution = (120 + 1000) g / 1.15 g mL^{-1} = 974 mL = 0.974 L

Therefore:

M = 2 mol / 0.974 L = **2.05 mol.L^{-1}**

Note: Volume of solution should be expressed in litres.

Q7: The density (in $g.mL^{-1}$) of a 3.60 M sulphuric acid solution that is 29% H_2SO_4 (Molar mass = 98 $g.mol^{-1}$) by mass will be:

a) 1.45

b) 1.64

c) 1.88

d) 1.22

Answer:

The correct option is 'd'.

Explanation: The relation between Molarity, M and mass percent (%) is given by:

M = (% x 10 x d) / MW

Where:

MW = molecular weight of solute

d = density of solution

Therefore:

d = M x MW / (% x 10) = 3.60 x 98 / 29 x 10 = **1.216 $g.mL^{-1}$**

Q8: What is the difference between Molarity and Molality?

Answer:

The difference between a solution and a solvent is a fundamental distinction between molality and molarity.

The ratio of the moles of a solute to the total litres of a solution is known as molarity. Both the solute and the solvent are present in the solution.

Molality, on the contrary, is the ratio of a solute's moles to a solvent's kilograms.

	Molarity (M)	**Molality (m)**
Measure of	Concentration	Concentration

Definition	The moles of a solute per litre of a solution.	The moles of a solute per kilogram of a solvent.
Units	*M*	*m*
Equation	*M = moles solute / litres solution*	*m = moles solute / kg solvent*
Ratio of moles to:	Volume (in litres)	Mass (in kilograms)

Q9: What is the number of moles of solute in 250 mL of a 0.4 M solution?

Answer:

There are 0.1 moles of solute present in a 250 mL of 0.4 M solution.

Explanation: To begin, understand that the molar concentration indicates the number of moles of the solute present in one litre of solution. In a 0.4 M solution, each litre of solution contains 0.4 moles of solute. Using dimensional analysis, we can figure out how many moles of solute are in 250 mL of solution.

250mL x (1L/1000mL) x (0.4mol/1L) = 0.1 mol.

Q10: Calculate the molarity of each of the following solutions:

a) 30 g of Co $(NO_3)_2.6H_2O$ in 4.3L of solution
b) 30 mL of 0.5M H_2SO_4 diluted to 500 mL.

Answer:

Molarity = Moles of Solute / Volume of Solution in Litre

a) Molar mass of Co $(NO_3)_2.6H_2O$ (solute) = 59 + 2 (14 + 3 × 16) + 6 × 18 = 291 $g.mol^{-1}$

∴ Moles of $Co(NO_3)_2.6H_2O$ = 30 / 291 mol = 0.103 mol

Therefore, molarity = 0.103 mol / 4.3 L = **0.023 M**

b) Number of moles present in 1000 mL (Solvent) of 0.5 M H_2SO_4 (Solute) = 0.5 mol

∴ Number of moles present in 30 mL of 0.5 M H_2SO_4 = (0.5 x 30) / 1000 mol = 0.015mol

Therefore, molarity = 0.015 mol / 0.5 L = **0.03 M**

Q11: How many moles of Na_2CO_3 are there in 10.0L of 2.0M solution?

Answer:

Molarity is represented by the following equation:

Molarity = Moles of Solute / Volume of Solution in Litre

We already have the molarity and volume of solution, both of which have good units.

Let's rewrite the equation to figure out how many moles there are. We may do this by multiplying both sides of the equation by the L solution. On the right side, the L solution cancels out, leaving the number of moles equal to the molarity times volume:

Moles of solute = Molarity x Volume of Solution in Litre = (10.0 L) (2.0M) = **20 moles**.

Thus, there are 20 moles of Na_2CO_3 in 10.0L of 2.0M solution.

Q12: How many grams of hydrogen chloride (HCl) are required to prepare 4 Litre of 5M HCl in water?

Answer:

Given:

Molarity = 5M

Volume = 4L

$\therefore$ Moles of HCl = Molarity x Volume = 5 x 4 = 20 moles.

1 mole of HCl = 36.5gm

$\therefore$ 20 moles of HCl = 36.5 x 20gm = **730 gm**

Therefore, **730gm** of HCl is required to prepare 4 Litre of 5M HCl in water.

Q13: How many grams of sodium dichromate should be added to a 50ml volumetric flask to prepare 0.025 molar sodium dichromate when the flask is filled to mark with water?

Answer:

50 ml volumetric flask is filled upto the mark so, 50 ml is the final volume.

So, volume required = 50 ml

Concentration = 0.025 M

Molecular weight of sodium dichromate ($Na_2Cr_2O_7$) = 261.97 g

So, for 1 M solution ≡ 261.97 g of $Na_2Cr_2O_7$ in 1000 ml

∴ 0.025 M solution ≡'X' of $Na_2Cr_2O_7$ in 1000 ml

∴ 'X' = (0.025 x 261.97)/1000 = **6.54 g**

∴ 0.025 M solution ≡ 6.54 g of $Na_2Cr_2O_7$ in 1000 ml

So, 0.025 M ≡ 'X' g of $Na_2Cr_2O_7$ in 50 ml

= (50 x 6.54)/1000 = **0.3274 g** of $Na_2Cr_2O_7$

Thus, **0.3274 g of $Na_2Cr_2O_7$** is required to prepare 0.025 M 50 ml sodium dichromate solution.

Q14: A solution is prepared by bubbling 1.56 grams of hydrochloric acid in water. Here, the volume of the solution is 26.8 mL. Calculate the molarity of the solution.

Answer:

The chemical formula of hydrochloric acid = HCl

The chemical formula for Water = H_2O

The molecular weight of HCl = 35.5 ×1 + 1×1 = 36.5 moles/gram

The molecular weight of H_2O = 1 ×2 + 16 ×1 = 18 moles/gram

Given, mass of hydrochloric acid in the solution = 1.56 g

The number of moles of hydrochloric acid =

$$n_T = \frac{mass\ in\ grams}{molecular\ weight}$$

$n_T = \frac{1.56}{36.5}$ = **4.27 x 10^{-2} mole**

Now, given volume of the solution = 26.8 mL

Expressing the volume in terms of litres,

∴ Volume = $\frac{26.8}{1000}$ = **2.68 x 10^{-2} Litres**

Now, calculating the molarity of the solution using the formula given above.

Molarity = $\frac{No.\ of\ moles\ of\ element}{Volume\ of\ solution\ in\ litres}$

∴ *Molarity* = $\frac{4.27\ x\ 10-2}{2.68\ x\ 10-2}$ = **1.59 M**

Thus, the molarity of the solution is **1.59 M**.

Q15: Find the molarity of a solution with 0.2074g of $CA(OH)_2$ in 40ml of solution.

Answer:

Given, Mass of $Ca(OH)_2$ (solute) = 0.2074g
Volume of solution = 40mL

Molar mass of Calcium (Ca) = 40g

Molar mass of Oxygen (O) = 16g

Molar mass of Hydrogen (H) = 1g

∴ Molar mass of $Ca(OH)_2$ = 40 + 16×2 + 1×2 = 40+32+2 = **74g**

Now, number of moles in 0.2074g of $Ca(OH)_2$:

= *Given Mass/Molar mass*

= $\frac{0.2074}{74}$ = **2074/740000 moles**

Converting the volume of the solution from mL to L, we get,

=> 1L = 1000mL

=> 40mL = 40/1000

=> **4/100 L**

Therefore,
Molarity of a solution = Moles of solute/Litres of solution

= $[\frac{2074}{740000}]$ / $[\frac{4}{100}]$

= $\frac{2074}{740000}$ × $\frac{100}{4}$

= $\frac{518.5}{7400}$

= **0.07 M** [approximately]

Thus, the molarity of the solution is **0.07 M**.

Practise Questions on Molarity

Q1: What is the molarity of a solution with a mass of solute 10 kg mass and 100 litre volume?
a) 0.1 molar

b) 1 molar

c) 10 molar

d) 100 molar

Answer:

The correct answer is ‘a’.

Q2: Which one is more concentrated? 1M or 1*m* of solution? Give a reason.

Answer:

The number of moles of solute dissolved in one litre of solution is known as molarity (M).
The amount of moles of the solute per kilogram (kg) of the solvent is known as molality (m).
In 1 molar solution, 1 mole of solute is in 1 litre of solution This equates to 1 litre of solute and solvent.
While in 1 molal solution 1 mole of solute is dissolved in 1 litre of solvent.
As a result, a molar solution has a higher concentration than a molal solution.

Q3: The molarity of an aqueous solution of CaCl is defined as the
a) moles of CaCl per millilitre of solution

b) grams of CaCl per litre of water

c) grams of CaCl per millilitre of solution

d) moles of CaCl per litre of solution

Answer:

The correct answer is ‘d’.

Q4: If 2 moles of salt is dissolved to form 1 litre of solution, calculate the molarity of the solution.
a) 1 M solution

b) 1.5 M solution

c) 2 M solution

d) 2.5 M solution

Answer:

The correct answer is ‘c’.

When given the moles of the solute and the litres of the solution, the formula for calculating molarity is = moles of solute/ litres of solution.

Moles of Solute = 2 moles of sugar
Solution litres = 1 litres

∴ The molarity of the solution = 2 moles of solvent/1 litres of solution = 2 M solution.

Q5: To calculate the Molarity of a solution when the solute is given in grams and the volume of the solution is given in millilitres, you must first:
a) Convert grams to moles, but leave the volume of solution in millilitres

b) Convert volume of solution in millilitres to litres, but leave grams to moles

c) Convert grams to moles, and convert volume of solution in millilitres to litres

d) None of the above

Answer:

The correct answer is ‘c’.