Practicing Molarity and Molality

1) 190 g of $CuSO_4$ are placed in 3500 g of water. Determine the molality.

2) 95.0 mL of a solution of NaOH is diluted to a final volume of 135 mL, and the new molarity is 0.0500 M. Calculate the original molarity of the base.

3) Find the molarity of all ions in a solution containing 0.165 moles of aluminum chloride in 820 mL.

4) What is the concentration of each type of ion and total concentration of ions in a 0.375 M ammonium phosphate solution?

5) A commonly purchased disinfectant is a 3.0% (by mass) hydrogen peroxide (H_2O_2) solution in water. Assuming the density of the solution is 1.0 g/cm^3, calculate the molarity and molality of H_2O_2.

6) A solution is made by dissolving 25 g of NaCl in enough water to make 1.0 L of solution. Assume the density of the solution is 1.0 g/cm^3. Calculate the molarity and molality of the solution.

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Answers

1) 190 g of $CuSO_4$ are placed in 3500 g of water. Determine the molality.

Molality = (190 g x 1 mol $CuSO_4$/159.9 g)/3.5 kg = 0.3 m

2) 95.0 mL of a solution of NaOH is diluted to a final volume of 135 mL, and the new molarity is 0.0500 M. Calculate the original molarity of the base.

$M_1V_1 = M_2V_2$

=> M_1(95.0 mL) = (0.0500)(135) => M_1 = 0.0711 M

3) Find the molarity of all ions in a solution containing 0.165 moles of aluminum chloride in 820 mL.

1 mole of $AlCl_3$ contains 1 mole of Al^{3+} and 3 moles of Cl^-

$[Al^{3+}]$ = 1 x 0.165 mol = 0.165 mol

Molarity of Al^{3+} = 0.165 mol/0.820 L = 0.201 M

$[Cl^-]$ = 3 x 0.165 mol = 0.495 mol

Molarity of Cl^- = 0.495 mol/0.820 L = 0.603 M

4) What is the concentration of each type of ion and total concentration of ions in a 0.375 M ammonium phosphate solution?

1 mol of $(NH_4)_3PO_4$ contains 2 moles of NH_4^+ and 1 mole of PO_4^{3-}

$[NH_4^+]$ = 3 x 0.375 M = 1.13 M

$[PO_4^{3-}]$ = 1 x 0.375 M = 0.375 M

5) A commonly purchased disinfectant is a 3.0% (by mass) hydrogen peroxide (H_2O_2) solution in water. Assuming the density of the solution is 1.0 g/cm^3, calculate the molarity and molality of H_2O_2.

Volume = 0.350 moles/0.300 M = 1.17 L

Moles of H_2O_2 = 3 g x 1 mol/34.02 g = 0.088 mol

Volume = (100 g solution x 1 mL/1 g) x (1 L/1000 mL) = 0.10 L solution

Molarity = 0.088 mol/0.10 L = 0.88 M

Mass of solvent = 100 g solution – 3 g solute = 97 g solvent = 0.097 kg

Molality = 0.088 mol/0.097 kg = 0.91 m

6) A solution is made by dissolving 25 g of NaCl in enough water to make 1.0 L of solution. Assume the density of the solution is 1.0 g/cm^3. Calculate the molarity and molality of the solution.

Moles of NaCl = 25 g x 1 mol/58.5 g = 0.43 mol NaCl

Molarity = 0.43 mol/1 L = 0.43 M

Mass of solution = (1.0 L solution x 1000 mL/1.0 L) x 1 g/(1 cm^3 or 1 mL) = 1000 g

Mass of solvent = 1000 g solution – 25 g solute = 975 g solvent or 0.975 kg

Molality = 0.43 mol/0.975 kg = 0.44 m