**المساق 103 الشعبة 13**

Chapter 13 exercises

**Q1**. Practice exercise page 543

1. calculate the mass percentage of NaCl in solution containing 1.50 g of NaCl in 50.0 g

of water.

b) A commercial bleaching solution containing 3.62 mass % NaOCl. What is the mass of

NaOCl in bottle containing 2.50 Kg of bleaching solution?

Answer:

a) mass 5 = (mass of NaCl ) x (mass of NaCl + mass of water) x 100

= (1.5) / (50.0 + 1.5) x 100 = 29.1% of NaCl

b) 3.62 % = (mass of NaOCl g ) / (2.5 x 103  g) x 100

mass of NaOCl = 90.5g

**Q2**. Practice page 544

What is the molality of solution made by dissolving 36.5 g of naphthalene (C10H8) in

425 g of toluene (C7H8)?

Answer:

mole of naphthalene = mass of naphthalene / molar mass

= (36.5 g) / (128 g/mol) = 0.285 mol

molality = moles / Kg of solvent = (0.285 mol) / (425 /1000 Kg) = 0.671 m

**Q3**. Practice exercise page 545

A commercial bleach solution contains 3.62 mass % NaOCl in water. Calculate

a) the mole fraction and b) the molality of NaOCl in the solution.

Answer:

a) mole of NaOCl = (3,62 g ) / (74.5 g/mol) = 0.049 mol

100 g solution – 3.62 g NaOCl = 96.38 g H2O

mol H2O = (96.38 g) / (18 g/mol) = 5.34 mol

XNaOCl= (0.049 molNaOCl) / (0.049 + 5.340) = 9.00 x 10-3

b) molality of NaOCl = (mol of NaOCl) / (Kg of solvent)

= (0.049 g) / (96.38 /1000) = 0.505 m

**Q4**. Practice exercise page546

A solution containing equal masses of glycerol (C3H8O3) and water has a density 1.10 g/mL

calculate:

a) the molality of glycerol.

b) the mole fraction of glycerol.

c) the molarity of glycerol in solution.

Answer:

a) mass of glycerol = X g = mass of water

mole of glycerol = ( X g) / ( 92 g/mol) = 0.011X mol

molality = (mol of glycerol)/(Kg of water) = (X / 92)/ (X/1000) = 10.87 m

b) mole fraction of glycerol = (X / 92) / (X/92 + X/18) = 0.164

c) mole of glycerol = X / 92 = 0.011 X

mL of water = ( X g ) (1 mL) / (1.19 g) = X / 1.19 = 0.84 mL

molarity = ( mole of glycerol) / (Kg of solution)

X g of glycerol + X g of H2O = 2X g of solution = 2X/1000 Kg of solution

molarity = (0.011X) / (2X / 1000) = 5.5 M

**Q5**. Practice exercise page547

The vapor pressure of pure water at 110˚C is 1070 torr. A solution of ethylene glycol and

water has a vapor of 1.00 atm at 110˚C. Assuming that Raoultʼs law is obeyed, what is the

mole fraction of ethylene glycol in the solution?

Answer:

A atm= 760torr

PH2O  = XH2O x P0 H2o

760 torr= XH2O x 1070 torr

XH2O  = 0.710 Xethylene= 1 – 0.710 = 0.290

**Q6**. Practice exercise page 551

Calculate the freezing point of a solution containing 0.600 Kg of CHCl3 and 42.0 g eucalyptol

C10H18O, a substance found in the leaves of eucalyptus trees.

Answer:

mole of eucalyptol = (42.0 g) / (154 g/mol) = 0.273

molality = (0.273 mol) / (0.600 Kg) = 0.455 m

ΔTf = kf x m = 4.68 ˚C /m x 0.455 m = 2.13 ˚C

Freezing point of pure CHCl3 = - 63.5

Freezing point of solution = - 63.5 – 2.13 = - 65.63 ˚C

**Q6**. Practice exercise page 551

Which of the following solutes will produce the largest increase in boiling point upon

addition to 1 Kg of water?

Answer:

molality of Co(NO3)2  = 1 mol / 1 Kg = 1 m

Co(NO3)2 → Co2+  + 2NO3- ­ this form 3 m

molality of KCl =2 mol / 1 Kg = 2 m

KCl→ K+ + Cl-  this form 4 m

Molarity of C2H6O2 = 3 mol / 1Kg = 3 m this form only 3 m because it is

Non polar

KCl>Co(NO3)2 > C2H6O2

**Q7**. Practice exercise 554

What is the osmotic pressure at 20˚C of 0.0020 M sucrose (C12H12O11) solution?

Answer:

∏ = MRT

= 0.0020 M x (0.0821 L-atm / mol-K ) x 293 k

= 0.002 mol/L x ( 0.0821 L-atm/mol-K) x 293 K 0.048 atm

1 atm = 760 torr

0.048 atm = 36.6 torr = 37 torr

**Q8**. Practice exercise page 555

Comphore (C10H16O) melts at 179.8 ˚C, and it has a particular large freezing – point-

depression constant, Kf= 40.0 ˚ C/m. When 0.186 g of an organic substances of unknown

molar mass is dissolved in 22.01 g of liquid comphore, the freezing point of the mixture

is found to be 176.6˚C. what is molar mass of the solute?

Answer:

179.8 – 176.6 = 3.2 ˚C

molality (m) = ΔTf / Kf = (3.2 ˚C) /( 40.0 ˚C/m) = 0.08 m

mole of substance =( 0.08 mol) ( 0.02201 Kg / 1 Kg) = 1.76 x 10-3 mol

1.76 x 10-3 mole = (0.186 g) / (molar mass)

molar mass = 110 g/mol

**Q9**. Practice exercise page 556

A sample of 2.05 g of polystyrene of uniform polymer chain length was dissolved in

enough toluene to form 0.100 L of solution. The osmotic pressure of the solution was

found to be 1.21 KPa at 25˚C. Calculate the molar mas of polystyrene.

Answer:

∏ = M R T

1 atm = 101.325 KPa

atm of solution = (1.21 KPa) (1 atm) / (101.325 KPa) = 0.012 atm

0.012 atm= M x (0.0821 L-atm/mol-K) x 298 K

M = 4.905 x 10-4 mol/L

mole of polystyrene = (4.905 x 10-4 mole) x (0.1 L/1 L) = 4.905 x 10-5 mole

molar mass = (2.05 g polystyrene) / (4.905 x 10-5 ) = 4.2 x 104  g/mlo

**Exercises page 565**

**13.35**

Calculate the mass percentage of Na2SO4 in solution containing 10.6 g Na2SO4 in 483 g water.

Answer:

% mass of Na2SO4 = (mass of Na2SO4 ) / (mass of Na2SO4 + mass of water) x 100

= 2.15 %

**13.37**

A solution is made containing 14.6 g of CH3OH in 184 g H2O, calculate:

a) the mole fraction of CH3OH.

b) the mass percentage of CH3OH, and C) the molality of CH3OH.

Answer:

a) mole of CH3OH (14.6 g) / (32 g/mol) = 0.456 mole

mole of H2O = (184 g) / (18 g/mol) = 10.222 mol

mole fraction of CH3OH = (0.456 g CH3OH) / (0.456 g CH3OH + 10.222 g H2O)

= 0.043

b) mass percentage of CH3OH = (14.6 g CH3OH) / (14.6 g CH3OH + 184 g H2O) x 100

= 7.35%

c) the molality = (0.456 mol CH3OH) / (0.184 Kg H2O) = 2.48 m

**13.43**

A sulfuric acid solution containing 571.6 g H2SO4 per liter of solution has a density of

1.329 g/cm3 , calculate; a) the mass percentage b) the mole fraction

c) the molality d) the molarity of H2SO4 .

Answer:

1. 1.329 g/cm3  = 1.329 g/L

gram of solution = grams of H2SO4  + grams of water

mass % of H2SO4  = (571.6 g H2SO4 ) / (1329 g of solution) x 100 = 43.01%

b) mole of H2SO4  = (571.6 g) / ( 98 g/mol H2SO4) = 5.83 mol

1329 – 571.6 757.4 g H2O

mole H2O = (757.4 g) / (18 g/mol) = 42.08 mol

XH2SO4 = (5.83 g H2SO4 ) / (5.83 g H2SO4 + 42.08 g of H2O) = 0.122

1. molality = (mole of H2SO4 ) / ( Kg of solvent) = (5.85 g0 / (757.4/1000)

= 7.72 m

d) molarity = (5.85 g / 1 L solution) = 5.85 M

the solution volume is 1 L obtained from the density

**13.45**

The density of acetonitrile (CH3CN) is 0.786 g/mL and density of methanol is 0.791 g/mL.

a solution is made by dissolving 22.5 mL CH3OH in 98.7 mL of CH3CN.

a) What is the mole fraction of methanol in the solution?

b) What is the molality of the solution?

Answer:

a) grams of CH3OH = (0.791 g/mL) x (22.5 mL) = 17.80 g

grams of CH3Cn = (0.789 g/mL) x (98.7 mL) = 77.58 g

mole of CH3OH = (17.80 g) / (32 g/mol) = 0.556 mol

mole of CH3CN = (77.58 g) / 941 g/mol) = 1.892 mol

XCH3OH  = (0.556 g CH3OH) / ( 0.556 g CH3OH + 1.892 g CH3CN) = 0.227

b) molality = mol / Kg solution = (0.556 mol CH3OH) / (77.58 /1000) = 7.17 m

**13.67**

List the following aqueous solutions in order to increasing the boiling point:

0.120 m glucose, 0.05 m LiBr, 0.050 m Zn(NO3)2

Answer:

ΔTb for glucose = kb  x m = 0.51 ˚C/m x 0.120 m = 0.0612

boiling point = 100 + 0.0612 = 100.0612 ˚C

ΔTb for LiBr = kb x m = (0.51 ˚C/m) x ( 0.05 + 0.05) m = 0.05 ˚C

boiling point = 100 + 0.05 = 100.05 ˚C

ΔTb for Zn(NO3)2  = ( 0.51 C/m) x ( 3 x 0.05) = 0.0765 ˚C

boiling point = 100 + 0.0765 = 100.0765˚C

0.05 m Zn(NO3)2 > 0.120 m glucose > 0.05 LiBr

**13.71**

How many grams of ethylene glycol (C2H6O2) must added to 1.00 Kg of water to produce

a solution that freeze at – 5.00˚C ?

Answer:

ΔTf =kf x m

5.0 ˚C = 1.86 ˚C/m x mm = 2.69

grams of C2H6O2 = (2.69 m of C2H6O2) x ( 1Kg water) = 166.67 g

**13.73**

What is the osmotic pressure formed by dissolving 44.2 mg of aspirin (C9H8O4) in

0.358 l water at 25˚C?

Answer:

mole of aspirin = (0.0442 g) / (180 g/mol) = 2.456 x 10-4 mol

molality of aspirin = (2.456 x 10-4 ) / (0.358 L) = 6.86 x10-4

∏= (6.86 x 10-4 M) x ( 0.0821 L-atm/mol-K) x (298 K) = 0.0168 atm

OH O