**Colligative properties test 1 answers**

Name:

**State** what happens to the **vapour pressure** of a solution if we make it more concentrated (by adding more solute).

Vapour pressure decreases.

At 25oC, pure water has a vapour pressure of 3.2 kPa. **Calculate** the **vapour pressure** of a solution 10 moles benzoic acid in 60 moles water at 25oC?

Vp solution = Vp pure solvent x molar fraction of solvent

(60/70) x 3.2 = 2.74 kPa

**Calculate** the **boiling point elevation** when 8.5 g of borane (BH3) is dissolved in 500 g of water? *(Data: Atomic masses 🡪 B=10.8, H=1.0 , Kb for water is 0.512 °C/m)*

Increase in BP = Kb x m

8.5 g /13.8 = 0.62 moles

0.62 moles BH3 / 0.5 kg H20 = 1.24 molal solution

0.512 oC/m x 1.24 m = 0.63 degree increase in BP

(Question only asks for the increase)

**Calculate** the **new freezing point** if a solution of water is made with 1.2 moles of sugar in 200 g water? *(Data: The freezing point of pure water is 0oC and the cryscopic constant is 1.86 oC/m)*

Decrease in FP = Kc x m

1.2 moles / 0.2 kg = 6 molal solution

1.86 oC/m x 6 m = 11.16 degree drop in FP

Normal FP of water = 0 oC

New FP = 0 – 11.16 = -11.16 oC

An aqueous solution of concentration 9.2 g/L of a certain substance exerts an osmotic pressure of 0.474 atm at 0°C. **Calculate** the **molecular mass of the solute**. *(Data: This question requires temperature in Kelvin)*

π = MRT 🡪 M = π / RT

M = 0.474 / (0.082 x 273) = 0.021 moles/L

We are told the solution has 9.2 g/L of the substance so in 1 litre we have 0.021 moles of it and 9.2 grams of it:

Molecular mass = mass (g) / moles = 9.2 / 0.021 = 438 g/mol

When dissolving 5 g of a certain solute in 100 g of water, the resulting solution boils at 100.5°C. What is the corresponding **molecular mass of the solute**?

Pure water boils at 100oC so there has been an increase of 0.5 oC

Increase in temperature = Kb x m

m = 0.5 / 0.512 = 0.98 molal solution = 0.98 moles per kg of water

If we have 0.98 moles in 1 kg water then in 100 g water we will have 0.098 moles.

So in 100 g of water we have 5 g of solute and 0.098 moles of the solute.

mm = mass (g) / moles = 5 / 0.098 = 51.0 g/mol