**Unit 4a questions**

**Equations**

1. Which equation is used to calculate molarity, molality and molar fraction?
2. Which equation is used to work out the vapour pressure of a solution that is made from a non-volatile solute (Raoult´s Law)?
3. Which equation is used to work out the “boiling point elevation” (increase in boiling point ∆BP) of a solution?
4. Which equation is used to work out the “freezing point depression” (decrease in freezing point ∆FP) of a solution?
5. Which equation describes “osmotic pressure (π)”?

**Easy problems**

At 25 ºC, pure water has a vapour pressure of 3.2 kPa. What is the vapour pressure of these 3 sugar solutions at 25 ºC (*First work out the molar fraction of the solvent*):

5 moles sugar in 55 moles water.

15 moles sugar in 40 moles water.

A 2 molal solution. (*Hint: how many moles of sugar in would be in 1 kg water? How many moles of water in 1 kg water*)

What is the boiling point elevation when 11.4 g of ammonia (NH3) is dissolved in 200 g of water? Kb for water is 0.512 °C/m. (*Hint: First work out the molality of the solution)*

What is the new freezing point if a solution of water is made with 2 moles of sugar in 500 g water? The freezing point of pure water is 0oC and the cryscopic constant is 1.86 oC/m. (*Hint: first work out the molality of the solution*)

**Difficult problems**

Calculate how much ethanol would be needed per litre of water in order to give a freezing point of -4.8 °C.

20.7 g of ethanol are dissolved in 100 g of water, resulting in a volume of 112 mL. Calculate the freezing and boiling points of the solution prepared. What will the osmotic pressure be at 25 °C?

An aqueous solution of 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.

How many grams of acetic acid (mm=60 g/mol) should we dissolve in 250 mL of water in order to change its boiling point up to 101.3 °C? What would the corresponding freezing point be?

When dissolving 5 g of a certain solute in 50 g of water, the resulting solution boils at 100.5°C. What is the corresponding molecular mass of the solute?

What is the vapour pressure of problem 5 at 20 °C? And what should it be at 100 °C? At what temperature will this solution boil?

Explain with your own words how antifreezes work.

Calculate the freezing point of a solution of 5.00 g of diphenyl (C12H10) and 7.50 g of naphthalene (C10H8)dissolved in 200.0 g of benzene (FP = 5.5 °C)

**Data section**

**Molar masses (g/mol):** C-12, N-14, H-1, Sugar (sucrose)-342, Acetic acid-60

Kb H2O = 0.512 Kc H2O = 1.86

R = 0.082