RAOULT'S LAW AND NON-VOLATILE SOLUTES

1. a) The vapour pressure of a solution of a non-volatile solute is equal to the vapour pressure of the pure solvent at that temperature multiplied by its mole fraction.

   b) (i) 1 mole $C_{12}H_{22}O_{11}$ weighs 342 g; 1 mole H_2O weighs 18 g.

   No of moles $C_{12}H_{22}O_{11}$ = 6.84/342 = 0.0200
   No of moles H_2O = 90.0/18 = 5.00

   (ii) Total moles = 5.02, of which 5.00 is water
   mole fraction of water = 5.00/5.02 = 0.996

   (iii) From Raoult's Law:
   vapour pressure of solution = vapour pressure of pure solvent x its mole fraction
   vapour pressure of solution = 101325 x 0.996 = 101000 Pa (No more than 3 sfs.)

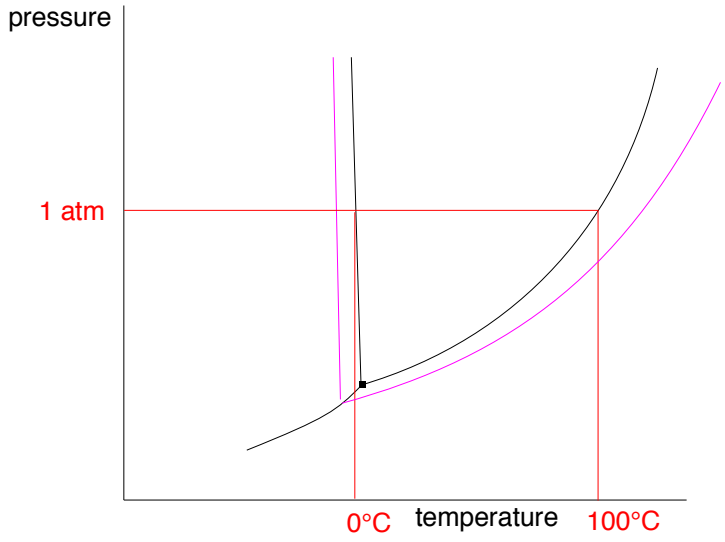
   (iv) No it wouldn't. A liquid boils when its svp becomes equal to the external pressure. If the external pressure is 101325, but the svp of the solution is only 101000, then it won't boil. The boiling temperature will be a little bit higher for the solution.

2. a) The more dilute the solution, the more it approaches ideal behaviour.

   b) The attractions between the solvent particles themselves, and the forces between solvent and solute particles, should be the same.

   c) The solute molecules shouldn't change their nature when they dissolve. For example, they shouldn't ionise or associate. (Or if they do, you have to know exactly to what extent it happens, and allow for it in calculating the number of moles of particles in the solution coming from the solute.)

3. a) The magenta lines represent the changes in the presence of a solution rather than pure water.



b) Freezing will happen at 1 atmosphere when you decrease the temperature of the solution enough to hit the magenta line at F. Because this line is to the left of the line for pure water, the solution will freeze at a lower temperature than pure water.

Boiling happens when the temperature is raised enough to hit the other magenta line at B. Because this line is to the right of the line for pure water, the solution will boil at a higher temperature than pure water.