RAOULT'S LAW AND IDEAL MIXTURES OF LIQUIDS

1. a) State Raoult's Law for an ideal mixture of liquids.

   b) An ideal mixture of two liquids A and B contained 1 mole of A and 4 moles of B. The vapour pressure of pure A at the temperature of the mixture was 10 kPa, and that of pure B was 12.5 kPa.

   (i) Calculate the partial vapour pressure of A in the mixture.

   (ii) Calculate the partial vapour pressure of B in the mixture.

   (iii) Calculate the total vapour pressure of the liquid.

   c) Suppose you had two liquid mixtures:

   C: butan-1-ol and butan-2-ol
   D: ethanol and pentane

   (i) One of these is likely to be almost ideal, and the other is very unlikely to be ideal. Which is which?

   (ii) Explain your answer to part (i) with reference to the intermolecular forces in the two mixtures, and the way these affect ideality.

2. At a particular temperature, the pure vapour pressures of liquids E and F were:

   E: 20 kPa
   F: 15 kPa

   a) Draw a graph to show how the partial vapour pressure of E in a mixture of E and F varies with its mole fraction.

   b) On the same axes, draw the graph to show how the partial vapour pressure of F varies with its mole fraction.

   c) Add a third line to show how the total vapour pressure of the mixture varies with its composition.

   d) Which of E and F has the higher boiling point? Explain your reasoning.

3. a) Draw a graph to show how the boiling point of a mixture of E and F (the same as in Q2) varies with the composition. Mark on your graph the boiling points of pure E and pure F.

   b) Draw on the same graph a curve which would enable you to work out the composition of the vapour over the top of a boiling mixture. Label your two curves carefully to show which is which.

   c) Explain how you would use your diagram to work out the composition of the vapour over the top of a boiling mixture in which the mole fraction of both E and F in the liquid was 0.5.