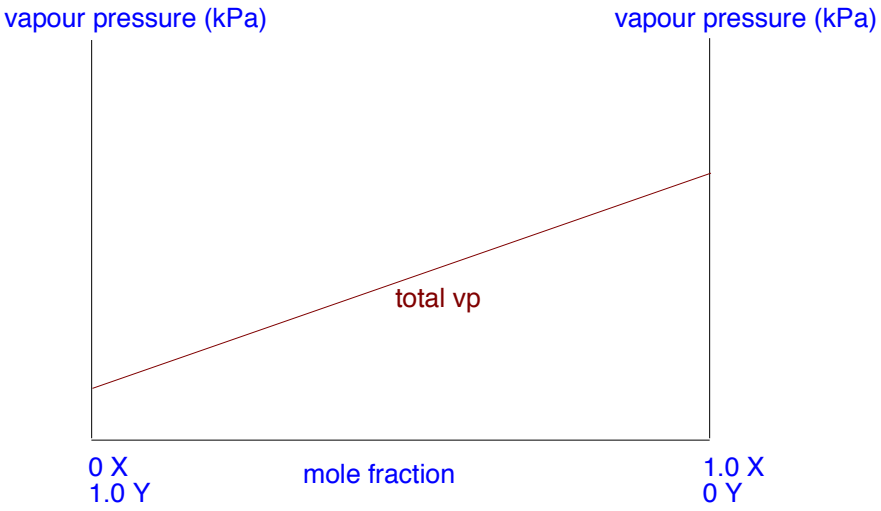
NON-IDEAL MIXTURES OF LIQUIDS

1. For an ideal mixture of liquids X and Y obeying Raoult's Law, the total vapour pressure varies with the composition as follows:



a) Draw the graph you would expect for total vapour pressure if a mixture of X and Y showed a large positive deviation from Raoult's Law.

b) Explain why a liquid mixture might show a large positive deviation from Raoult's Law.

c) What simple piece of evidence would show that what you suggest in (b) is right?

d) Draw the graph you would expect for total vapour pressure if a mixture of X and Y showed a large negative deviation from Raoult's Law.

e) Explain why a liquid mixture might show a large negative deviation from Raoult's Law.

f) What simple piece of evidence would show that what you suggest in (e) is right?

2. Pure water boils at 100°C.
Pure ethanol boils at 78.5°C.
An azeotropic mixture of ethanol and water contains 95.6% by mass of ethanol, and boils at 78.2°C.

a) Draw the phase diagram for mixtures of ethanol and water, including both liquid composition and vapour composition curves. (Feel free to distort your diagram if it makes it clearer.)

b) What is an *azeotropic mixture*? What would happen if you boiled a mixture of this composition?

c) Use your diagram to help to explain what would happen if you fractionally distilled a mixture of ethanol and water containing about 15% ethanol by mass.

3. A mixture of nitric acid and water shows a large negative deviation from Raoult's Law.

   Pure water boils at 100°C.
   Pure nitric acid boils at 86°C.
   An azeotropic mixture of nitric acid and water contains 68% by mass of nitric acid, and boils at 120.5°C.

   a) Draw the phase diagram for mixtures of nitric acid and water, including both liquid composition and vapour composition curves.

   b) Use your diagram to help to explain what would happen if you fractionally distilled dilute nitric acid containing about 15% nitric acid by mass. Be clear about what you would collect from the top of the fractionating column, and what would be left in the flask.

   c) If you fractionally distilled some nitric acid which contained 75% nitric acid by mass, what would you collect from the top of the fractionating column, and what would be left in the flask? Explain your reasoning.