Tutorial -2-

Exercise 1

At 60°C the vapor pressure of ethanol is 352.7 mmHg and that of methanol is 625 mmHg. Ethanol and methanol form an ideal solution. For a liquid solution that contains 60% mole ethanol calculate:

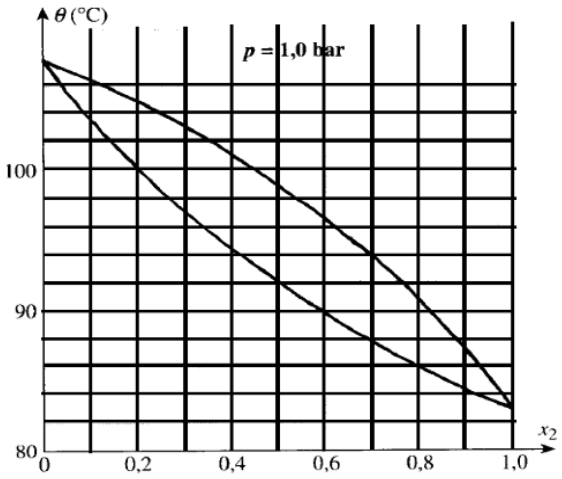
1. Vapor pressure of the mixture ($Psol$)
2. Composition of vaper in equilibrium with mixture
3. Composition of the last drop of liquid before vaporization becomes complete
4. Pressure at which the mixture will completely vaporize at 60° C

Exercise 2

The binary isobaric diagram of the binary mixture formed by propan-2-ol (denoted 2) and 2-methylpropan-2ol (denoted 1) is given below. The composition is given in mole fraction.

The molar masses of (1) and (2) are given: M1 = 74 g.mol-1 and M2 = 60 g.mol^{-1}.

1. Determine the boiling points of these two alcohols. Identify the boiling curve and the dew curve.



2. A mixture A containing 1.5 mol of (2) and 3.5 mol of (1) is heated to 1.0 bar. Determine:

a. The temperature at which boiling begins, and the composition of the first bubble of vapor that forms.

b. The temperature at which boiling ends, and the composition of the last drop of liquid that disappears.

c. The composition of the vapor and liquid phases in equilibrium at 100 °C (in mol of each constituent).

3. Determine the temperature at which boiling begins and the composition of the first vapor bubble that forms when a liquid mixture of composition, in mass fraction, $w_2 = 0.40$, is heated.

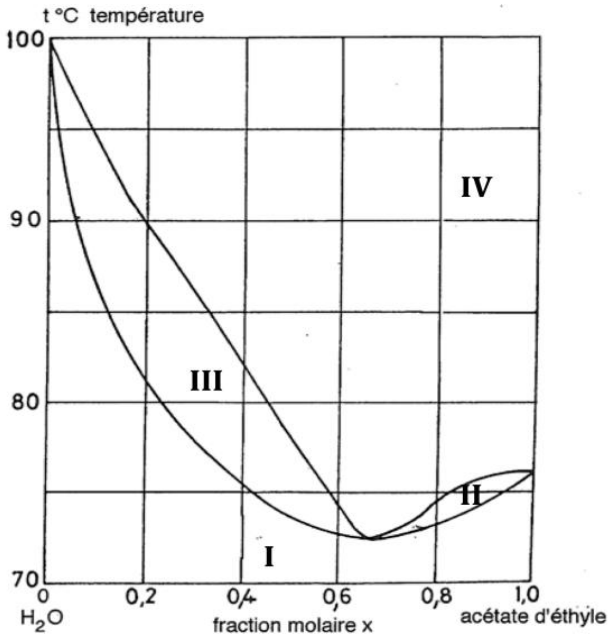
Exercise 3

Opposite, we have reproduced the binary liquid/vapor diagram of the water-ethyl ethanoate mixture at 1.013 bar.

1/ Are the two compounds miscible in the liquid state? Is the mixture ideal? Was it predictable?

2/ Specify the nature of the different domains of the diagram, as well as the name and meaning of the curves appearing there.

3/ Characterize the mixture with molar fraction x = 66%. What will be the shape of its isobaric cooling curve from 95 °C. Justify with a well-chosen reduced variance calculation.

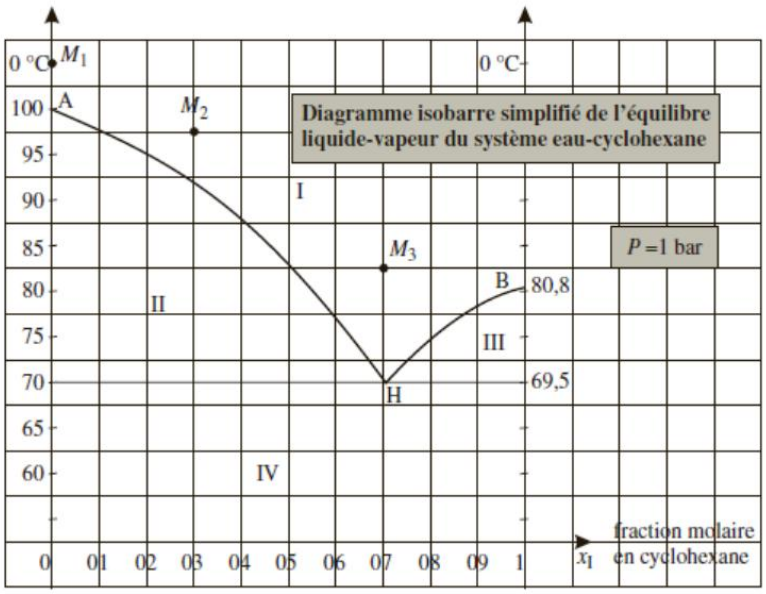


4/ Consider 10 mol of a mixture with a molar fraction of 40% ethyl ethanoate. It is brought to 95 °C under atmospheric pressure. What will be the shape of its isobaric cooling curve? Specify the value of the reduced variance on each portion of the curve.

5/ When this mixture reaches a temperature of 80°C, give the quantities of materials of the different species in the phases present.

Exercise 4:

The simplified isobaric binary phase diagram for the liquid-vapor equilibrium of the water-cyclohexane system is provided below. Water is denoted as *B*1, and cyclohexane as B2.



1/ Indicate the nature of the phases present in each of the areas of the diagram. What type of mixture are we dealing with here?

2/ What is the name of the curve made up of branches AH and HB? What does it represent?

3/ What is point H called on the diagram? How many degrees of freedom does the binary system represented by this point,which we will describe, have? Interpret the value found.

4/ Sketch the shape of the thermal analysis curves by cooling, up to 60°C, of the physicochemical systems represented by points M2 and M3. Indicate the phases present.

5/ In what physical state(s) are 11 mol of a mixture with a total molar fraction of cyclohexane $x_2 = 0.30$ at 80 °C? What are the quantities of matter of the different constituents present?