Correction of the Exam

Exersise 1((8 points)

1/ A: Homogeneous liquid phase (1) (1 phase) (0.5)

B : Liquid + vapor (2 Phases) (0.5)

C : vapor phase (1 phase) (0.5)

D: boiling curve (give the composition of the methanol in the liquid phase) (0.5)

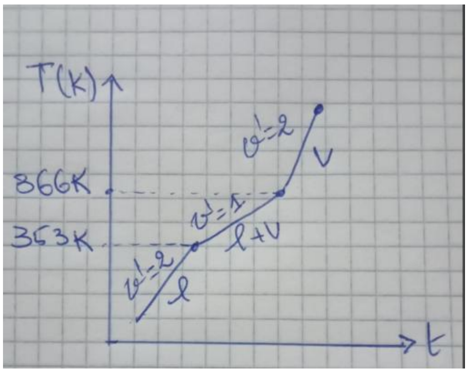
E: dew curve (give the composition of the methanol in vapor phase) (0.5)

2/Yes: methanol and water are miscible in the liquid state (we have a single liquid phase) (0.25)

3/1:the molar fraction of methanol in mixture M: $x_{meth} = \frac{2}{2+6} = 0{,}25$ (0.5)

3/2: the shape of the Analysis curve when the mixture M is heated from 335 K TO 375 K:(1.25)

$the\ reduced\ variance : v' = 1 + c - \varphi$ (0.25)



4/for the previous mixtre M:

1)composition of the liquid and vapor in equilibrium at 360 K:

A liquid with a composition read horizontally on the boiling curve : $x_{meth}^{l} \sim 0.15$(0.25), and a vapor with a composition read horizontally on the dew curve: $x_{meth}^{l} = 0.45$ (0.25).

2/the quantities of matter of the constituents in each phase (n^{l}_{meth} ,n^{v}_{meth} ,n^{l}_{wat} ,n^{v}_{wat})

We know that : $n_T = n_{meth} + n_{wat} = 8$mole (0.25)

According to the chemical moment theorem: $\frac{n^l}{n^v} = \frac{n_{meth} - n^{v}_{meth}}{n^{l}_{meth} - n_{meth}}$ (0.5) $= \frac{0.45-0.25}{0.25-0.15} \sim 2$ (0.25)

Furthermore, $n^l + n^v = 8$mole (0.25). Combining these two equations, we find: $n^l \sim 2.66$ mole (0.25) and $n^v \sim 5.34$ mole (0.25)

Using the molar fractions in the two phases, we deduce: (1)

$n^{l}_{meth} = x^{l}_{meth} n^{l} = 2.66\, X 0.15 = 0.399 mole, n^{v}_{meth} = x^{v}_{meth} n^{v} = 5.34 X 0.45 = 2.403\ mole$ (0.5)

$n^{l}_{wat} = (1 - x^{l}_{meth}) n^{l} = 2.66\, X 0.85 = 2.261 mole, n^{v}_{wate} = (1 - x^{v}_{meth}) n^{v} = 5.34 X 0.55 = 2.937\ mole$ (0.5)

***Exercise 2:**(10 points)*

1/ A: Homogeneous liquid phase (1) (1 phase) (0.5)

B and C: Liquid + Solid (2 Phases) (1)

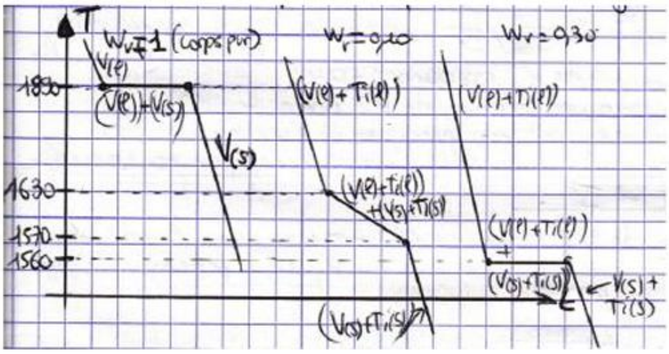
2/ This mixture is called **"indifferent point**".(0.25)

The physical properties of the mixture at this point

-It melts at a constant temperature (0.25)

- has equal solid and liquid phase compositions **($w_I^{l} = w_I^{s}$).** (0.25)

3/Thermal analysis cooling curve at: w_V=0.1 w_v=0,3, and w_v=1: (2.25)



4/ The temperature at which the first crystal appears is read on the liquidus: approximately 1620°C. (0.5)

Horizontally on the solidus, we read the composition of the first crystal to appear: w(1620°C) ≈ 0.05.(0.5)

5/ The mixture studied has a mass fraction of vanadium:

$w_V = \frac{100}{100+900} = 0{,}100.$(0.5)

-At 1600°C and w_v=0.1 the mixture is in the solid+liquid phase (0.25)

A solid with a composition read horizontally on the solidus: w_v^{l}(1600°C) ~ 0.06 (0.25), and a liquid with a composition read horizontally on the liquidus: w_v^{l} (1600°C) = 0.16 (0.25).

According to the chemical moment theorem: $\frac{ml}{m^{s}} = \frac{w_v - w_v^{S}}{w_v^{l} - w_v} = \frac{0.1-0.06}{0.16-0.1} \sim 0.67.$ (0.5)

Furthermore, $m^{l} + m^{s}$ = 1000 kg so $0.67m^{s} + m^{s}$= 1000 kg (0.25) , Combining these equations, we find: m^{l} ~ 400 kg (0.25) and m^{s} ~ 600 kg (0.25)

Using the mass fractions in the two phases, we deduce: (2) (0.5 for each one)

$m_V^l = w_V^l \times m^l \approx 64$ kg $\quad m_{Ti}^l = m^l - m_V^l \approx 3{,}4\times10^2$ kg $\quad m_V^s = w_V^s \times m^s \approx 36$ kg $\quad m_{Ti}^s = m^s - m_V^s \approx 5{,}6\times10^2$ kg

Course questions: (2 points)

A: false **(0.25)**

We have liquid and vapor phases **(0.25)**

B: false **(0.25)**

The vapor pressure of B is lower than that of A**(0.25)**

C: false **(0.25)**

Called the liquidus **(0.25)**

D: True **(0.5)**