Part A: *(3 points)*

The mixture did not obey ideal solution behavior.

For an ideal solution, there should be a linear relation between P and x. $y_i P = x_i P_i^{sat}$ (Raoult's Law) From the graph, P-x curve is not linear.

Part B: *(3 points)*

The behavior represents a positive deviation from the Raoult's Law. For all x_a values, the pressure is greater or equal to the pressure exerted by an ideal solution.

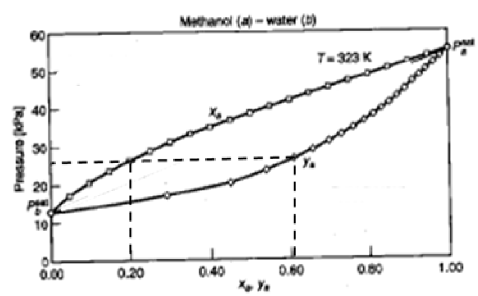
Part C: *(3 points)*

The like interactions are stronger than the unlike interactions. The pressure exerted by the mixture is greater than the ideal solution. This meant that there are greater repulsion forces between the unlike molecules thus increasing the pressure of the mixture.

Alternatively, you can consider the activity coefficient of the solution, $\gamma_i > 1$. This showed that there is a higher tendency for the species to escape from the liquid phase to the vapor phase. Thus the interactions between the unlike species are not favorable.

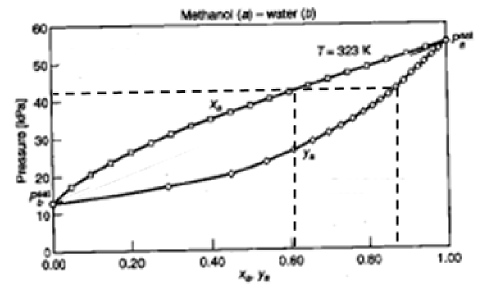
Part D: *(3 points)*

We are looking for the dew point. P_{dew} = 26 kPa. x_a = 0.2 and x_b = 0.8.

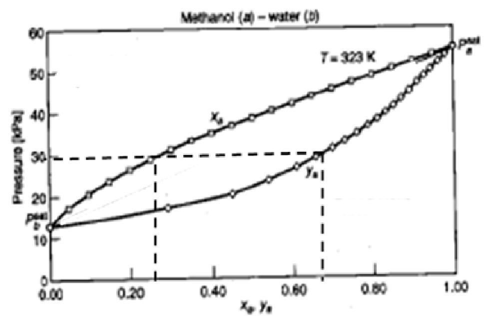


Part E: *(3 points)*

We are looking for the bubble point. P_{bubble} = 42 kPa. y_a = 0.87, y_b = 0.13.



Part F: *(5 points)*



From the graph, at P = 30kPa,

$$x_a = 0.27,\ x_b = 0.73$$

$$y_a = 0.68,\ y_b = 0.32$$

(2 points)

Method 1: Lever Rule

$$\frac{V}{L} = \frac{x_a - z_a}{z_a - y_a}$$

(2 points)

$$\frac{3}{1} = \frac{0.27 - z_a}{z_a - 0.68}$$

Solving for z_a,

$$\boxed{z_a = 0.578}$$ *(1 point)*

$$\boxed{z_b = 0.422}$$

Method 2: Mass Balances

Total Mass Balance: $F = L + V$ (1)

Species Balance: $z_a F = x_a L + y_a V$ (2)

Given vapor to liquid ratio: $V = 3L$ (3)

(1 ½ points)

Substitute Equations (1) and (3) into (2)

$$4z_a = x_a + 3y_a$$

(1/2 point)

Substitute x_a and y_a values

$$4z_a = 0.27 + 3(0.68)$$

Solve for z_a,

$$\boxed{z_a = 0.578}$$ *(1 point)*

$$\boxed{z_b = 0.422}$$