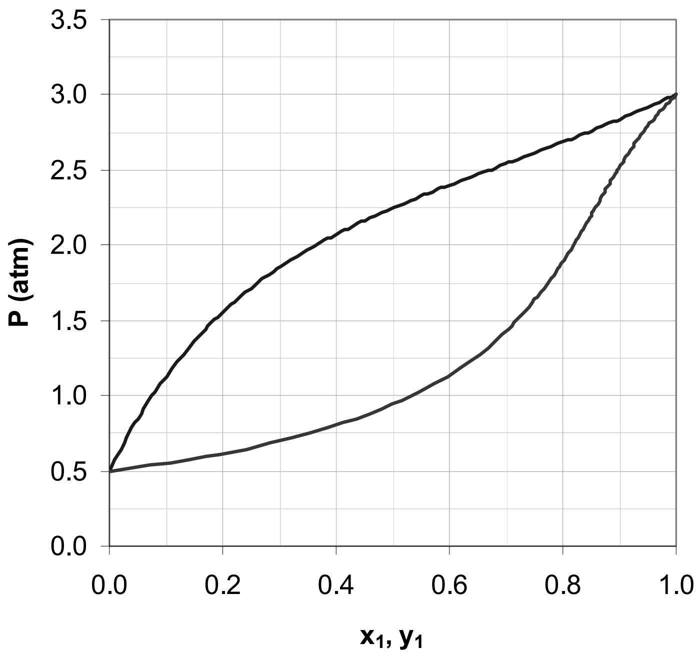
1) Pxy diagram for a binary mixture (1) and (2) at T = 300 K is given below.



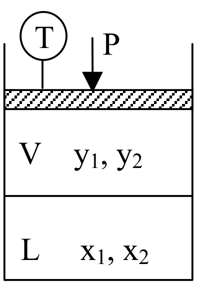
a) Identify the three regions.

b) Which component has a higher P^{sat}? Determine P_1^{sat} and P_2^{sat}.

c) We put a 50-50 mixture of components 1 and 2 in a vessel. We seal the vessel and bring it to 300 K and 1 atm. Describe the content of the vessel.

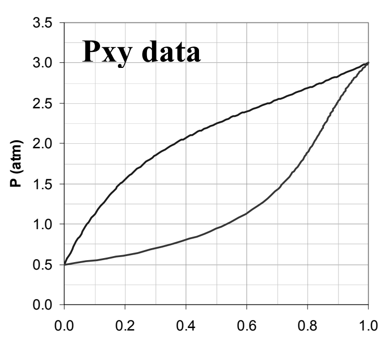
d) What are γ_1 and γ_2 at $x_1 = 0.5$? The vapor phase can be assumed to be ideal.

e) Calculate G^E/RT at $x_1 = 0.5$.



experiment

→



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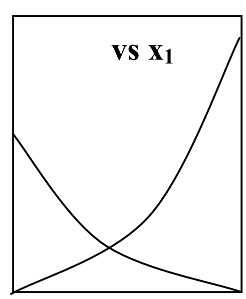

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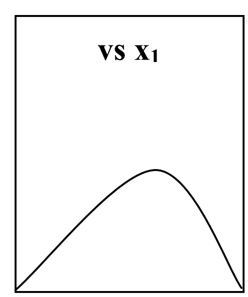

→ fit with model eqns

$G^E/RT = f(x_1, x_2, T)$

→

1) predict

2) predict

Accuracy of prediction depends on

2) A liquid mixture of toluene and polystyrene (PS) is placed in a vessel. At 300°C and 25 bar, the liquid solution is in equilibrium with toluene vapor. PS is very involatile, allowing us to assume that there is no polystyrene in the vapor phase. The following information is known about toluene(1)-PS(2) system:

$\ln \gamma_1 = 0.5\, x_2^2$; $\ln \gamma_2 = 0.5\, x_1^2$; $\ln P_1^{sat}/\text{kPa} = 14 - 3100/[T/°\text{C} + 220]$; $V_1^L \approx 10^{-4}\ \text{m}^3/\text{mol}$

What is the composition of the liquid phase?

a) Assuming both vapor and liquid phases are ideal.

b) Assuming modified Raoult's law applies.

c) Assuming both vapor and liquid phases are non-ideal.

3)

In vapor-liquid equilibrium where the vapor is assumed to be ideal, what is the relationship between Henry's law constant, P_i^{sat}, and other parameters we have worked so far .Note that H's law const. is independent of x_i.

Henry's law: $x_i \rightarrow 0$,	$y_iP = x_i\, \mathcal{H}_i$	(applies for very dilute species *i*)
Modified Raoult's law:	$y_iP = \gamma_i x_i P_i^{sat}$	(applies for all cases where the gas is ideal, e.g. low P)

Comparing the two, we see that $\mathcal{H}_i = \gamma_i P_i^{sat}$. But this only applies when $x_i \rightarrow 0$, or $\mathcal{H}_i = \gamma_i^{\infty} P_i^{sat}$.

The point here is *not* that we want to calculate $\mathcal{H}_i$ from γ_i^{∞} and P_i^{sat}. Rather, sometimes people represent VLE using Henry's law but it's still the same thing that we're talking about. It's just that at infinite dilution, we can approximate $\gamma_i P_i^{sat}$ as a constant.