You are studying the thermodynamics of a binary liquid mixture (components 1 and 2) at 100°C. The Antoine Equation constants for the pure components are given:

$$\ln P_i \,/\, \text{kPa} = A_1 - \frac{B_1}{T/°\text{C} + C}$$

$(A_1, B_1, C_1) = (16, 3800, 220)$

$(A_2, B_2, C_2) = (15, 3200, 210)$

With VLE data in hand, you are debating on describing the excess Gibbs energy using one of the following two models:

Model 1: $\frac{G_m^E}{RT} = Ax_1 - Ax_1^2$ Model 2: $\frac{G_m^E}{RT} = Bx_1 - Ax_1^2$

a) (10 pts) Develop expressions for the activity coefficients, γ_1 and γ_2, for both models.

b) (5 pts) Your VLE experiments suggest that when you add small amounts of one component 1 to a pure solution of the other, there is a huge positive deviation from ideal solution behavior. Moreover, that deviation is much larger when you add small amounts of component 1 to pure 2 versus adding small amounts of component 2 to pure 1. Based on these results, you decide that Model 2 is more appropriate for your system. Explain why.

c) (15 pts) You obtain a good fit of your VLE data to Model 2, with A = 3.0 and B = 3.65. Assuming that the vapor phase can be treated as ideal, does an azeotrope form at any composition, at T = 100°C? If so, find that composition and the azeotropic pressure. Comment on the validity of your assumption of ideal vapor