Problem 1 :-

(1) Formulate the Least Square Problem.

$$\min_{A_{12}, A_{21}} \sum_{i=1}^{11} \left(P_i \left(A_{12}, A_{21} \right) - P_i \right)^2$$

(2) Given :-

	a_1	a_2	a_3
water :-	8.07131	1730.63	233.426
1,4 dioxane :	7.43155	1554.679	240.337

using the formula:-

$$\log_{10} \left(P^{sat} \right) = a_1 - \frac{a_2}{T + a_3}$$

Raising to the power of 10 either side :-

$$\left(P^{sat} \right)^{\log_{10} 10} = 10^{a_1 - \frac{a_2}{T + a_3}}$$

∴ for water :-

$$p^{sat} = 10^{\left(8.07131 - \frac{1730.63}{20 + 233.426}\right)} = 17.469999$$

for dioxane :-

$$p^{sat} = 10^{\left(7.43155 - \frac{1554.679}{20 + 240.377}\right)} = 28.824099$$

$$P = x_1 \exp\left(A_{12} \frac{A_{21} x_2}{A_{12} x_1 + A_{21} x_2}\right)^2 \cdot \left(17.469999\right) +$$

$$x_2 \exp\left(A_{21} \frac{A_{12} x_1}{A_{12} x_1 + A_{21} x_2}\right)^2 \cdot \left(28.824099\right)$$

Yes, the model does fit the data.

We have close optimized and measured values. the differences are shown using the code.

③