

Pledge and signature:

- I. (35) Elective Experiments. Do only ONE of the following two problems; pick one that correspond to your lab work. (Other choices will not be counted.)**

A. Thermal Expansivity. [Hint: Precision is *very* important in all these calculations.]

1. The data given here concern a dilatometer like that you used in the lab. It has a capillary extension of diameter 0.900 mm. Neglect buoyancy corrections and the thermal expansivity of Pyrex glass in your calculations.

The empty, dry dilatometer weighs 108.663 g. Filled with water at 20.0°C ($\rho = 0.998207$ g/mL) to the low mark on the capillary extension, it weighs 134.334 g. Later, containing a sample of an alcohol, the capillary reading is $h = 3.3$ mm at 22.3°C and rises to $h = 107.2$ mm at 25.6°C. Calculate V_b for the dilatometer and estimate the thermal expansivity β for the alcohol over this T range.

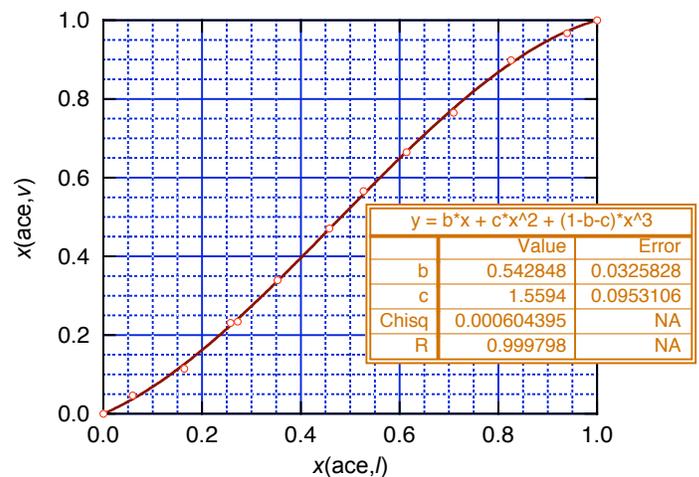
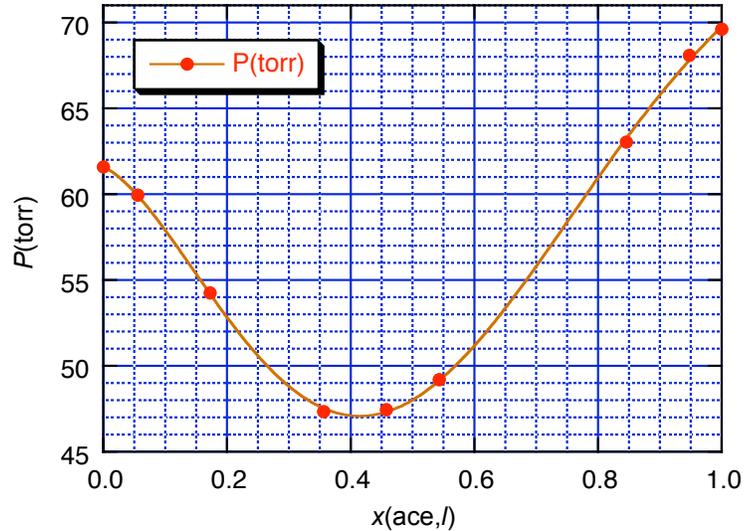
2. Assuming that the h measurements just given are uncertain by 0.2 mm, and the T measurements by 0.1°C, calculate the uncertainties in β , βT , and β . Then use the 10% rule to properly state β and its uncertainty.

B. Liquid-Vapor Equilibrium. I. M. Al-Knowing collects equilibrium data for the chloroform/acetone system at 0.0°C and processes them according to our specified procedures, obtaining the illustrated plots and fitted curves.

1. Use the fitted curves in these figures to answer the following questions, reading P s to the nearest 0.1 torr and x s to 0.01:

(a) What are the vapor pressures of pure acetone and pure chloroform at 0.0°C ?

(b) Letting A = acetone, calculate P_A , P_B , $P_{A,\text{id}}$, $P_{B,\text{id}}$, \bar{V}_A , and \bar{V}_B for a liquid acetone mole fraction of 0.70 (where "id" stands for ideal).



(c) If this system behaved ideally, what would be the values of P and $x_{A,v}$ for this $x_{A,l}$?

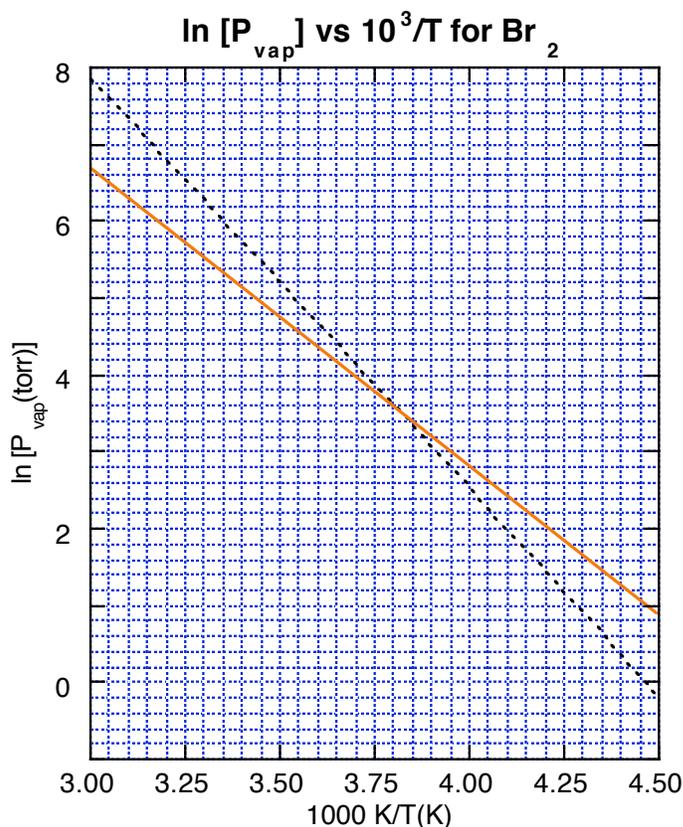
(d) Does this system form an azeotrope? If so, is it maximum- or minimum-boiling? Compare the strengths of A-A, B-B, and A-B interactions. (A = acetone)

- (e) Sketch the approximate vapor-composition curves on the first figure, showing clearly the point you obtain for $x(\text{ace},l) = 0.70$. Also, indicate the liquid, vapor, and two-phase regions of the diagram.
2. Why was the indicated function used in the second plot? How would you modify this function to go to 4th order in x ? (Give its KaleidaGraph form.)
3. The smooth curve in the first figure represents an unweighted fit to a 5th-order polynomial (6 parameters) and gives $\text{Chisq} = 0.21547$. Estimate the standard deviation in P from this fit. Similarly, estimate the standard deviation in $x(\text{ace},v)$ from the 2nd fit.

Before beginning Part II, enter here the names of your lab partners and the number of peer points you wish to award to each. The total must not exceed 24, and the maximum to any one partner is 18. If you leave this space blank, your points will be distributed 12:12. (Members of teams of two receive 24 each.)

II. (15) Review.

- A. (10) Consider the accompanying figure, which shows the natural log of the vapor pressure of Br₂ as a function of 1/T, for both solid and liquid phases. Using this figure, estimate (1) the triple point T and P ; (2) the normal boiling point T ; (3) $\Delta H_{m,vap}$; (4) $\Delta H_{m,sub}$; and (5) $\Delta H_{m,fus}$. [$R = 8.3145 \text{ J mol}^{-1} \text{ K}^{-1}$]



- B. (5) In KG Exercise 3 and again in analyzing your sucrose inversion data, you used the **General** routine to fit the data to an exponential plus a background.
1. Give the mathematical equation you used for the inversion data, in terms of the parameters, β_0 , β , and k_{eff} , and the variables β and t . (Derive if necessary, using definitions of β_0 and β .)
 2. Using **a**, **b**, and **c** for the parameters, and **x** for the independent variable, write exactly what you had to enter in the **Define Fit** box for this fit.