as follows:

$$\ln \phi_i = \left(\frac{\partial n \ln \phi}{\partial n_i}\right)_{P,T,n_j}.$$

In other words, the logarithm of the fugacity coefficient—rather than the coefficient itself—is a partial molar property.

b) Based on your previous result, outline the procedure for the calculation of the fugacity coefficient of a component in a mixture using an equation of state such as the SRK.

Problem 10.3: At 50 °C, 1.2 bar, the system n-pentane (1), n-hexane (2), and n-heptane (3) exists ion vapor-liquid equilibrium. The mole fractions in the two phases are: $x_1 = 0.6$, $x_2 = 0.2$, $x_3 = 0.2$ in the liquid; and $y_1 = 0.87$, $y_2 = 0.1$, $y_3 = 0.03$ in the vapor.

a) Calculate the fugacity and the fugacity coefficient of each component in the vapor and in the liquid. ~~Fill out the table below but explain your work.~~

b) Calculate the chemical potential of n-heptane in the liquid. The reference state is the ideal-gas state at 200 K, 35 bar.

Additional information: Ideal-gas heat capacity of n-heptane: $C_P = 200$ J/mole K.

Problem 10.4: Your company faxed you some results, shown below, for the system hydrogen (1) / methane (2). Use these data to answer the following:

a) Because the fax machine malfunctioned, some entries were missing. Supply the missing numbers and explain your calculations.

b) What is the saturation pressure of methane at 250 K?

c) Calculate the fugacity of saturated liquid methane at 250 K.

d) Calculate the fugacity of methane at 250 K, 300 bar.

e) A solution with composition $x_1 = 0.2$ is to be stored at 250 K. It is important to avoid the formation of vapor. What is the minimum pressure required?

f) Calculate the volume of the tank needed to store a saturated liquid mixture of the two components with composition $x_1 = 0.2$ at 250 K. Report the result in cubic meters per million of mol.

1 = hydrogen, 2 = methane

P (bar)	T (K)	x_1	y_1	ϕ_1^L	ϕ_1^V	ϕ_2^L	ϕ_2^V	Z_V	Z_L
0.074	250	0	0.0000	438.1532	1.0018	0.9953	0.9953	0.9953	0.0004
6.148	250	0.2	0.9876		0.9479	0.0126		0.9433	0.0310

Problem 10.5: Calculate the ideal work for the separation of the following mixtures into their pure components. In all cases initial mixture as well as the purified components are at 10 °C, 1 bar. You may take the surroundings to be at 25 °C.

a) Gas mixture containing 25% Ne (1) + 75% H_2 (2).

b) Gas mixture containing 25% methane (1) + 75% ethane (2).