Answer Sheet for CHE494 Homework Set #4
(100 points)

Note: **For all problems, submit a copy of your process flow diagram and a copy of your input summary of the process.**

15. (30 points) *Quick Property Analysis, I*

Answer the following questions:

(a) The values of the retrieved binary parameters in °C for the 3 binary systems are

Binary System	Interaction Parameters	Range of Temperature (°C)
Acetonitrile-Water		
Ethanol-Butylamine		
Acid-Pyridine		

If a pair has no interaction parameters, why?

_____

_____

(b) Description of a minimum-boiling azeotrope:

_____

_____

Description of a maximum-boiling azeotrope:

_____

_____

Classification:

Acetonitrile-Water   :   ☐ Minimum   ☐ Maximum boiling-point azeotrope

Ethanol-Butyl-amine   :   ☐ Minimum   ☐ Maximum boiling-point azeotrope Acetic

acid-Pyridine   :   ☐ Minimum   ☐ Maximum boiling-point azeotrope

(c) UNIQ-RK property method is not appropriate for the Acetic acid-Pyridine system

because _____

_____

Two alternate property methods better suited to predict the azeotrope for the acetic acid-

pyridine system are: _____

(d) Don't forget to submit the *T-xy* plots of each system!

Summary Table:

Binary System	Azeo. Temp.	% Err.	Azeo. X	% Err.
Acetonitrile-Water				
Ethanol-Butylamine				
Acetic acid-Pyridine				

(e) Don't forget to submit the vapor pressure profile (in psia) of all components as a function

of T from 0 to 100 °C.

Rearrange the relative volatility in increasing order:

_____

16. (40 points) *Choosing Appropriate Property Methods, I*

(a) Activity coefficient γ of ethanol in an equimolar liquid solution of ethanol and cyclohexane at 60 °F and 20 psia.

Property Method: _____   O With   O Without   Henry's Law

Activity coefficient of ethanol = _____

(b) Critical temperature of a mixture with a composition of 30 mol% benzene, 30 mol% cyclohexane, 30 mol% *n*-hexane, and 10 mol% N_2.

Property Method: _____   O With   O Without   Henry's Law

Critical temperature of the mixture = _____ °C

(c) Vapor fugacity coefficient φ^V of formic-acid in an equimolar mixture of formic-acid and water at 20 psia in which 50 mol% of the mixture is vapor.

Property Method: _____   O With   O Without   Henry's Law

Vapor fugacity coefficient of formic-acid = _____

(d) Which gas has higher solubility in the liquid solution and by how much: 1 lbmol of helium or 1 lbmol of argon in a liquid solution of 10 lbmol of ethanol at 70 °F and 14.7 psia? (Special note: you are not allowed to pick an equation of state for this problem).

Property Method: _____   O With   O Without   Henry's Law

Gas with higher solubility is _____ and by more than _____ ppm (mole)

(e) Energy required to vaporize 1 gmol (i.e. heat of vaporization) of a saturated liquid containing 40 mol% aniline, 40 mol% acetol, and 20 mol% cyclohexene at 1 bar.

Property Method: _____   O With   O Without   Henry's Law

Energy required = _____ cal

(f) Vapor compressibility factor Z of a mixture containing 40 mol% formaldehyde, 40 mol% chloroform, and 20 mol% acetylene at 150 °C and 20 bar.

Property Method: _____   O With   O Without   Henry's Law

Vapor compressibility factor = _____

(g) Solubility of water in the organic phase in a mixture containing 45 mol% water, 45 mol% 1-methylcyclohexanol, and10 mol% O_2 at 20 °C and 1 bar.

Property Method: _____   O With   O Without   Henry's Law

Solubility of water = _____ mol%

(h) What temperature increase is required to produce a vapor stream containing 30 mol% acetone from a one-lbmole saturated liquid mixture with an overall composition of 40 mol% water, 40 mol% benzene, and 20 mol% acetone at 14.7 psia, assuming there is no pressure change in the vaporization? (You must save this problem and email the file to me at the end of the exam.)

Property Method: _____   O With   O Without   Henry's Law

Temperature increase = _____ °F

18. (30 points) *Waste Stream Purification Using Multiple Property Methods*

(a) SR-POLAR property method is appropriate for the high pressure section of the process because

_____

Suitable method for the LP section: _____

(b) Don't forget to submit input summary!

Molar vapor fraction in the LP-partial condenser: _____

Operating parameters of the 2 columns:

	Reflux ratio	Actual # of stages
LP-Column	_____	_____
HP-Column	_____	_____

Mole fractions of acetone, water, and acetic acid in their respective purified streams:

Acetone from LP-column: _____

Water from HP-column: _____

Acetic acid from HP-column: _____