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ChE 3853
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HW 6

1) a) $P_1^{Sat} = {}_{10}A - \frac{B}{T+C}$

Toluene
A = 6.95087
B = 1343.31
C = 219.187

$P_1^{Sat} = 244.4\ mmHg \cdot \frac{0.133\ KPa}{1\ mmHg} = 32.6\ KPa$

$y_1 = \frac{P_1^{Sat} x_1}{P} = \frac{32.6 \cdot 0.7}{30} = 0.76 \rightarrow$ **76.0% = y_1**

$y_2 = 1 - y_1$ **= 24.0%**

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b) $P_r = 10^{\wedge}\left(\frac{7}{3}(1+\omega)\cdot\left(\frac{1}{1-T_r}\right)\right)$

$P = P_r * P_c$

$\omega = 0.264$

$T_r = \frac{75+273}{591.8}$

$P_c = 4.109\ MPa$

$P_r = 0.0086 \rightarrow P = 0.0086 \cdot 4.109 = 0.0354\ MPa$

$P = 35.4\ KPa$

$y_1 = \frac{P_1^{Sat} x_1}{P} = \frac{35.4 \cdot 0.7}{30} = 0.827$

y_1 = 82.7%

$y_2 = 1 - y_1$ **= 17.3%**

HW 6

2) ethyl Bromide : 1 $P_1^{Sat} = 0.7569$ Bar $x_1 = 0.4723$
n-heptane : 2 $P_2^{Sat} = 0.0773$ bar $x_2 = 0.5277$

$BP = P_1 x_1 + P_2 x_2 = 0.7569 \cdot 0.4723 + 0.0773 \cdot 0.5277$
$= 0.398$ Bar

$y_1 = \frac{x_1 \cdot P_1^{Sat}}{P} = \frac{0.4723 \cdot 0.7569}{0.398} = 0.8976 \simeq 89.8\%$

$y_2 = 1 - y_1 = 0.1024 \simeq 10.2\%$

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3) $z_1 = 0.07$ $P = 4$ bar
$z_2 = 0.12$
$z_3 = 0.41$ $P_r = 10^{\left(\frac{7}{3}(1+\omega)\cdot\left(\frac{1}{1-T_r}\right)\right)}$
$z_4 = 0.40$

a) T_{BP}: $P = \sum x_i P_i^{Sat}(T) \rightarrow$ excel $\rightarrow T_{BP} = 279$ K

b) T_{DP}: ~~$P = \sum \frac{y_i}{P_i^{Sat}(T)}$~~ $\rightarrow$ excel $\rightarrow T_{DP} = 304$ K

$P_i = \frac{1}{\sum \frac{y_i}{P_i^{Sat}}}$

c) $K_i = \frac{P^{Sat}}{P} \rightarrow 0 = \sum \frac{z_i(1-K_i)}{K_i + \frac{L}{F}(1-K_i)} \rightarrow$ Excel

$\frac{L}{F} = 0.0688$
$\simeq 6.88\%$

$\therefore 93.1\%$ vap $\therefore$ 93.12%

A7

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	eth	p1sat	w1	tr1	pc		x		x*psat		sum(x*psat)						
2		28.15923	0.099	0.91481	4.88		0.07		1.971146								
3	prop	p2sat									3.999996305						
4		5.732791	0.152	0.755497	4.249		0.12		0.687935								
5	n	p3sat															
6		1.338365	0.193	0.657062	3.797		0.41		0.54873								
7		p4sat															
8		1.980464	0.177	0.684594	3.648		0.4		0.792185								
9																	
10																	
11																	
12																	
13																	
14		T	P														
15		279.383	4														
16																	
17																	
18																	
19																	
20																	
21																	
22																	
23																	
24																	
25																	

F16

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	eth	p1sat	w1	tr1	pc		y		y/psat		sum(x*psat)						
2		47.08798	0.099	0.993988	4.88		0.07		0.001487								
3	prop	p2sat									3.999998603						
4		11.0098	0.152	0.820887	4.249		0.12		0.010899								
5	n	p3sat															
6		2.911013	0.193	0.713932	3.797		0.41		0.140844								
7	iso	p4sat															
8		4.133526	0.177	0.743847	3.648		0.4		0.09677								
9																	
10																	
11																	
12																	
13																	
14		T	P														
15		303.564	4														
16																	
17																	
18																	
19																	
20																	
21																	
22																	
23																	
24																	
25																	

O2 =SUM(M2:M8)

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	eth	p1sat	w1	tr1	pc		z		k		L/F		Flash		sum flash		
2		46.70756	0.099	0.992633	4.88		0.07		11.67689		0.068810563		-0.0683027		3.92E-11		
3	prop	p2sat															
4		10.89703	0.152	0.819767	4.249		0.12		2.724257				-0.07940975				
5	n	p3sat															
6		2.875542	0.193	0.712959	3.797		0.41		0.718886				0.156126169				
7	iso	p4sat															
8		4.085818	0.177	0.742833	3.648		0.4		1.021455				-0.00841372				
9																	
10																	
11																	
12																	
13																	
14		T	P														
15		303.15	4														
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Hw 6

4) a) P = 15 $z_1 = 0.45$ $z_2 = 0.55$

$$P_{DP} = \frac{1}{\sum \frac{y_i}{P_i^{Sat}[T]}}$$

Set $P_{DP} = 15 \rightarrow$ excel $\rightarrow$ **T = 405 K**

$$x_i = \frac{y_i * P_{DP}}{P_i^{Sat}} \rightarrow x_1 = 0.264 \quad x_2 = 0.735$$

first drop': 26.4% but 73.6% pent

b) $P_{BP} = 15 = \sum x_i \cdot P_i^{Sat} \rightarrow$ excel $\rightarrow$ **T = 395 K**

last drop': 65.7% but 34.3% pent

Given yi, P, calculate dew point temperature

	A	B	C	Pi_sat (bar)	yi	yi/Pi_sat	xi
nbutane	6.80897	935.86	238.73	25.54516734	0.45	0.017615856	0.2642
npentane	6.85221	1064.63	232	11.21286906	0.55	0.049050782	0.7358

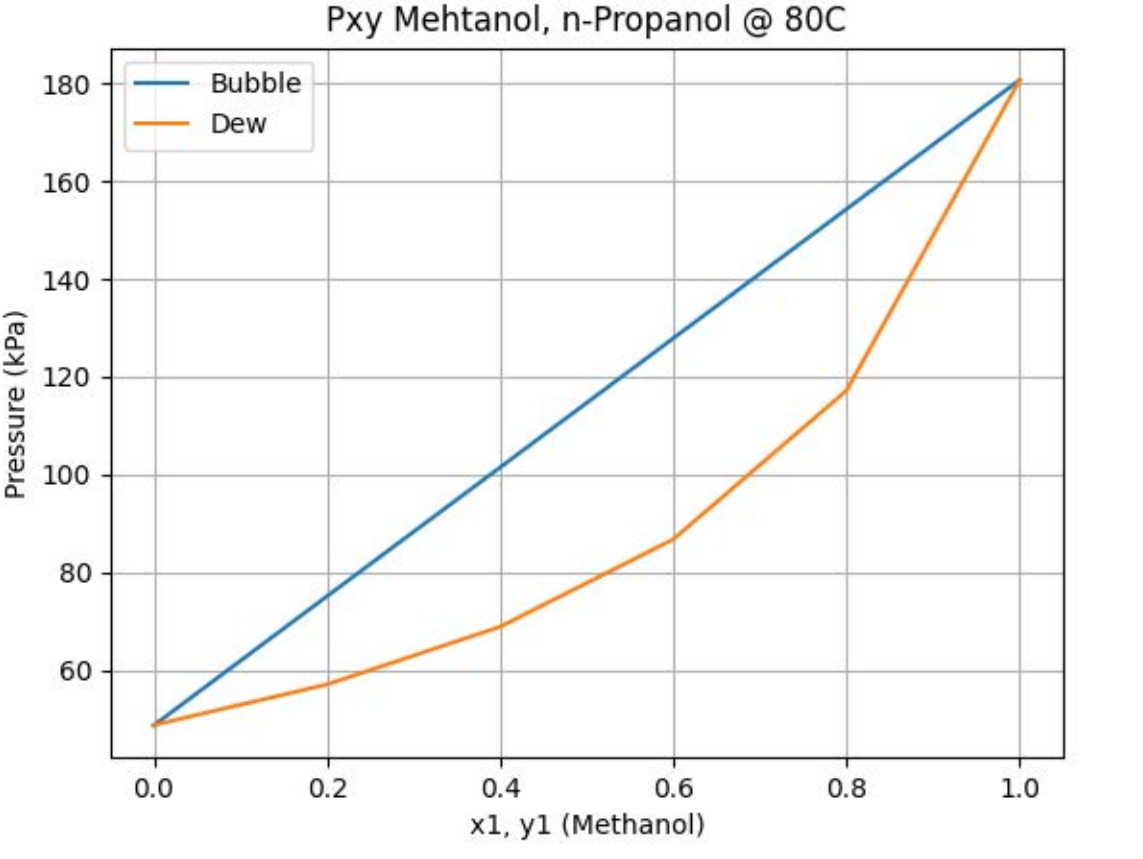
DP pressure	15.00000627	bar
T	131.6780086	c
	404.8280086	K

Given xi, P, calculate bubble point temperature

	A	B	C	Pi_sat (bar)	xi	Pi_sat*xi (bar)	yi
nbutane	6.80897	935.86	238.73	21.9040854	0.45	9.856838432	0.6571
npentane	6.85221	1064.63	232	9.351205698	0.55	5.143163134	0.3429
		BP pressure	15.00000157	bar			
		T	122.1393033	c			
			395.2893033				

$P_1^{sat}(T)$

Iterate T until
P=$\sum x_i P_i^{sat}(T)$


Pxy Mehtanol, n-Propanol @ 80C
Bubble
Dew
Pressure (kPa)
180
160
140
120
100
80
60
0.0
0.2
0.4
0.6
0.8
1.0
x1, y1 (Methanol)