Ref. No: EX/CHE/T/415A/2017

B. CHEM. 4TH YEAR 1St SEM. EXAMINATION 2017

Separation of Multicomponent Systems Time: 3 hrs Full Marks : 100

1. (a) Define (a) Raouit's Law (b) Henry's Law (c) Equilibrium Vaporization Ratio (d) Relative Volatility of Multicomponent Mixture **2+2+3+3=10**

   (b)Calculate the bubble point temperatures of an ideal solution containing 20 mole% n Pentane (1) and 40 mole % each of n-hexane (2), and n-heptane (3) at 1.5 atm total pressure. **20**

   Given (M_1=86 , M_2= 100, M_3 = 114)

2. Calculate the dew point of a vapour containing 15 mole% n- butane (1), 15 mole% n-Pentane(2), 20 mole% cyclo-hexane(3), 20 mole% n-hexane(4) and 30 mole% n-heptanes(5) at 1.5 bar total pressure. Raoults law may be used. **20**

   Given (M_1=58, M_2= 72, M_3 = 84, M_4= 86, and M_5 = 100)

3. A mixture of 25 mole% n hexane (1), 40 mole% n –heptane (2) and 35 mole% n- octane (3) at 400K and bar total pressure. Will the mixture separate two phases? If so, calculate the amounts and the composition of the liquid and the vapour products. **25**

4. A mixture 0.3 k mole n –Pentane(1), 0.30 kmole n- Hexane (2) and 0.40 k mole of n – Octane (3) is batch distilled at 1 atm pressure to remove 90 % of n –Pentane. Calculate the amount and composition of the distillate. Take K values from De Priester chart. **25**

   (Mol.wt of : n hexane ,=86 , n heptanes = 100, n Octane = 114, n pentane=72)

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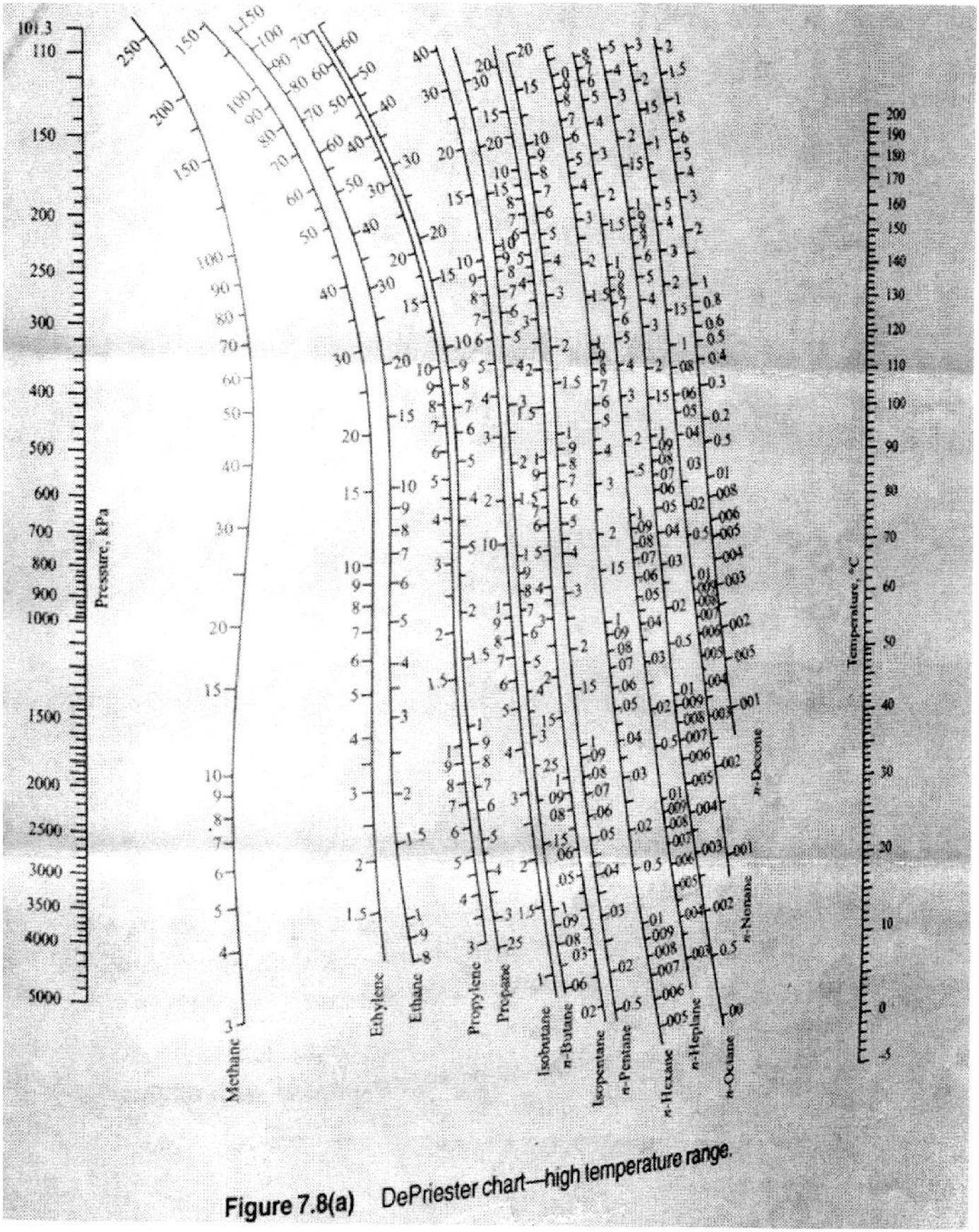

Figure 7.8(a) DePriester chart—high temperature range.

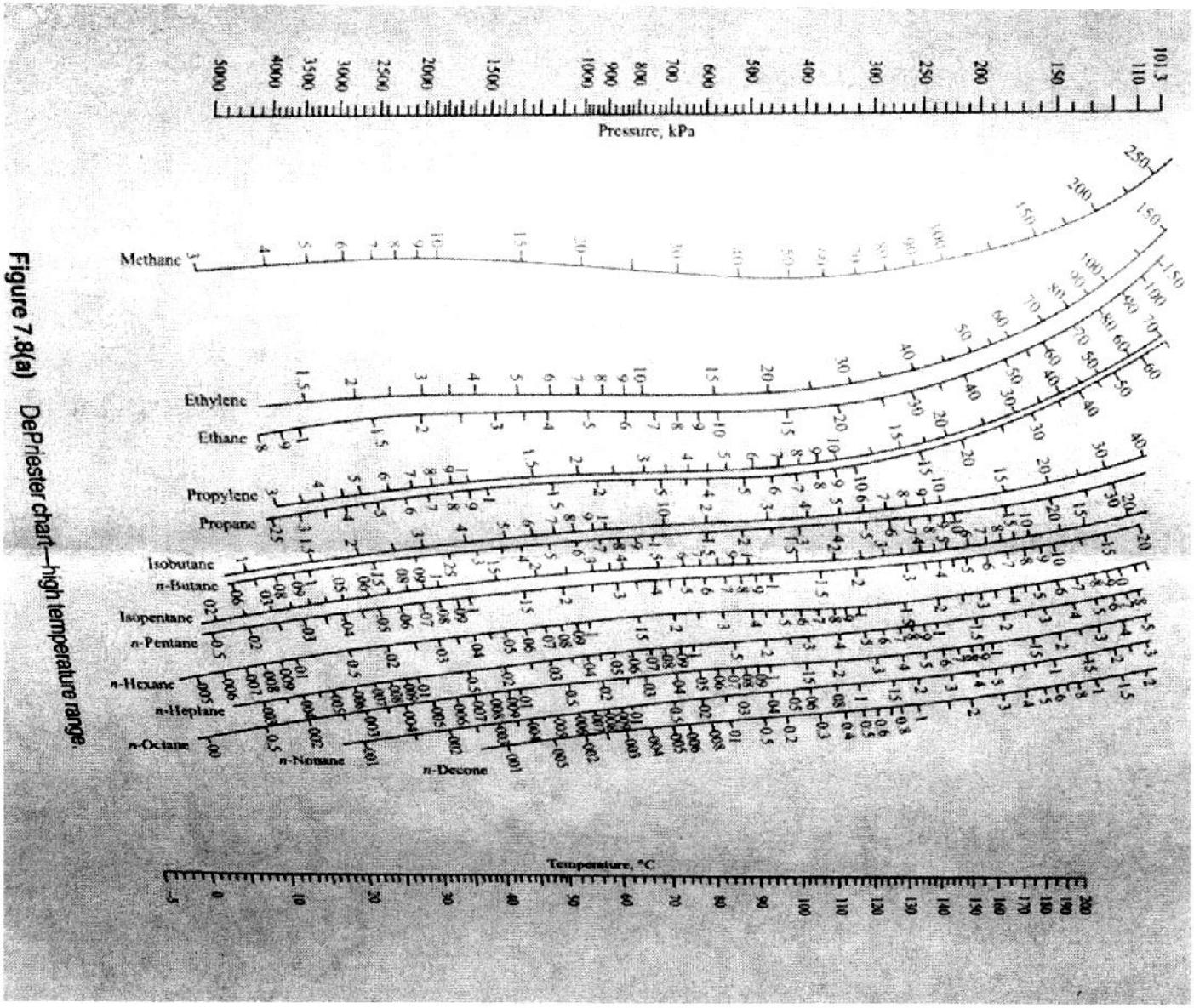

Figure 7.8(a) DePriester chart—high temperature range.

Table 7.2 Constants of the vapour pressure relation (Antoine equation) (Contd)

Compound	BP (°C)	A'	B'	C'
n-Propanol	97.2	17.8349	3310.4	198.5
iso-Propanol	82.2	20.4463	4628.95	252.64
Propane	−42	15.7277	1872.82	250
Pyridine	115	16.1520	3124.45	212.66
Styrene	135	16.11023	3270.26	206
Tetrahydrofuran	66	16.00531	2768.37	226.3
Toluene	110.6	15.01158	3090.78	219.14
Trichloroethylene	87	15.7212	2345.48	192.73
Triethylamine	89	7.00154	2674.7	205
o-Xylene	134.5	6.99052	1476.393	213.672
p-Xylene	129.2	18.5882	1453.430	215.307
	100		3984.92	233.43

Vapour pressure relation (Antoine equation) (Contd.)

Compound	BP (°C)	A'	B'	C'
Acetone	56.2	16.39112	2787.5	229.67
Acetonitrile	81.5	16.90395	3413.1	250.48
Acrylonitrile	77.5	15.92847	2762.21	222
Ammonia	−33.4	17.51202	2363.24	250.54
Aniline	184.5	16.67784	3858.22	200
Benzaldehyde	179	6.73163	1369.460	177.081
Benzene	80	15.9037	2789.01	220.79
n-Butane	−0.5	15.68151	2154.9	238.74
n-Butanol	117.6	17.62995	3367.12	188.7
iso-Butane	−11.7	15.77506	2133.24	245
iso-Butanol	108	18.02933	3413.34	199.97
Butyl acetate	126	16.4145	3293.66	210.75
Carbon disulphide	46	15.77889	2585.12	236.46
Carbon tetrachloride	76.5	15.8434	2790.78	226.46
Chlorobenzene	131.5	16.4	3485.35	224.87
Chloroform	61.2	16.017	2696.25	226.24
Cyclohexane	80.5	15.7794	2778	223.14
Cyclohexanol	161	19.23534	5200.53	251.7
Cyclohexanone	155.5	16.40517	3677.63	212.7
Cyclopentane	49.2	15.8602	2589.2	231.36
1-4-Dioxane	101.5	17.1151	3579.78	240.35
Dichloromethane	40	17.0635	3053.08	252.6
Diethyl ether	34.5	16.5414	2847.72	253
Diethylamine	55.5	15.73382	2434.73	212
Ethanol	78.3	18.68233	3667.70	226.1
Ethyl acetate	77	16.35578	2866.6	217.9
Ethyl benzene	136	16.04305	3291.66	213.8
Ethylamine	16.5	7.3862	1137.300	235.85
Formic acid	100.5	15.9938	2982.45	218
Furfural	162	15.14517	2760.09	162.8
n-Hexane	69	15.9155	2738.42	226.2
n-Heptane	98.5	15.877	2911.32	226.65
Methanol	64.5	18.61042	3392.57	230
Methyl acetate	57	16.58646	2839.21	228
Nitrobenzene	131.5	16.42172	3485.35	224.84
Nitrogen	−195.8	15.3673	648.59	270.02
n-Octane	126	15.9635	3128.75	209.85
Oxygen	−183	15.06244	674.59	263.07
1-Octanol	195	7.18653	1515.427	158.787
n-Pentane	36	15.8365	2477.07	233.21
	180	15.9614	3183.67	159.5