Appendix A
Answers to Unsolved Problems

Chapter 2

2.1 (a) 26.82 m/s; (b) 0.626 lb_f/ft^2, (c) 1.548×10^{-2} Btu, (d) 4.21×10^3 J/s

2.2 (a) 0.518 lb, (b) 21.5 ft^3, (c) 1.87 lb/ft^3, (d) 1.034 kg/cm^2

2.3 2.40×10^5 (ft) (lb_f)

2.4 1.4×10^3 (ft) (lb_f)

2.5 Btu/(hr) (ft^2) (°F)

2.6 cm/s or cm^2/(s) (cm of height)

2.7 (a) A is g/cm^3, B is g (cm^3)(°C), C is atm^{-1}; (b) A is 68.4 lb_m/ft^3, B is 0.055 $lb_m/(ft^3)$(°R), C is 0.0000648/(lb_f/in^2)

2.8 (a) 2.27 g mol, (b) 0.22 lb N_2

2.9 (a) 3.18×10^6g, (b) 15.4 lb, (c) 932 g mol, (d) 4.54×10^{-3} lb mol

2.10 (a) 0.0311 lb mol/gal, (b) 22.9 lb/ft^3, (c) 366 g/L, (d) 0.428 lb H_2SO_4/lb H_2O, (e) 0.927 lb mol H_2O/lb mol total solution

2.11 (a) 0.659, (b) 15 gal

2.12 18.2 ppm

2.13 (a) 17.5° API, (b) 7.94 lb/gal, (c) 59.3 lb/ft^3

2.14 72.2 lb

2.15 21.8 lb/ lb mol

2.16 CO_2:21.7, CO:10.9, CH_4:49.5, H_2:17.9

2.17 (a) –30°C, (b) 243.2K

2.18 (a) 356.8°C, (b) 675°F, (c) 1135°R

2.19 $1.07\ 10^4$ lbf/in^2

2.20 2.06 psia

2.21 4.49 psia

2.22 (a) $h_3 = 7.15$ in., (b) $h_2 = 20.65$ in.

Chapter 3

3.1 (a) closed, (b) open, (c) open, (d) open if it leaks, closed otherwise

There is no 3.2

3.3 rank = 3

3.4 No; you have 3 unknown variables and two independent equations

3.5 At 100 C (because phenol freezes at 42.5 C!)

3.6 Pick up the second beaker from the left, pour all the ethanol into the fifth beaker from the left, and replace the second beaker in its original location.

3.7 No.

Chapter 4

4.1 $51.90/ton

4.2 (a) Na_2SO_4 28%, H_2O 72%, (b) 33.3 g crystals/100 g solution

4.3 Overhead: C_2H_4 (7.8%), C_2H_6 (11.7%), C_3H_6 (19.4%), C_3H_8 (56.0%), iC_4H_{10} (5.1%).
Bottoms: C_3H_8 (0.8%), iC_4H_6 (31.9%), nC_4H_{10} (47.1%), nC_5H_{12} (20.2%)

Chapter 5

5.1 0.945 g Cr_2S3

5.2 (a) $BaSO_4$ is limiting reactant, C is excess reactant, (b) % xs = 50.6%, (c) degree of completion = 0.901

There is no 5.3

5.4 686%

5.5 8.98%

Chapter 6

6.1 (a) 87.6%, (b) 25.0%

6.2 (a) 17,650 bbl, (b) 1:52.45%, 2:40.20%, 3:6.67%, 4:0.68%; (c) 1:49.90%, 2:44.05%, 3:6.05%; (d) 22.14 bbl

6.3 (a) 1 mol NO/1 mol NH_3 in, (b) R = 42.9 mol NH_3/mol NH_3 fed

6.4 (a) R = 111 lb Ca $(Ac)_2$/hr, (b) 760 lb HAc/hr

6.5 (a) 75.1 kg C_2H_2, (b) 250 kg, (c) 454 kg (d) 2.00

Chapter 7

7.1 248 gal/hr

7.2 A leak occurred. The CO_2 balance indicates the analysis is correct.

7.3 (a) C_6H_6:1.13 mol/min, C_6H_{12}:11.5 mol/min, H_2:11.5 mol/min; (b) C_6H_6:44.5 L/min, C_6H_{12}:452.5L/min, H_2:452L/min; (c) C_6H_6:6.4 mol/min (200L/min), H_2:25.8 mol/min (799L/min)

7.4 (a) all kN/m^2:CH_4 (80), C_2H_4 (10), N_2 (10); (b) No.

7.5 (a) RK:1193.1 cm^3/g mol, (b) PR:1168.9 cm^3/g mol

7.6 (a) van der Waals: 18.3lb, (b) 23.4 lb

7.7 (a) Eq. of State: 0.862 ft^3, (b) compressibility factor: 0.877 ft^3

Chapter 8

8.1 (a) 20 atm

8.2 50 psia (340 kPa)

8.3 140.9

8.4 O_2:296 ft^3 at 745 mm Hg and 25°C; C_2H_2: 54 ft^3 at 745 mm Hg and 25° C

8.6 7.2L at SC

8.7 L/V = 1.59

8.8 Hexane 0.545, heptane 0.280, octane 0.180

8.9 (a) 75.2 lb H_2O/100 lb feed, (b) 48.4 wt% nonvolatile

8.10 Yes

8.11 775 kPa

8.12 684 kPa

8.13 C_2H_6: 14.4 mol%; C_3H_8: 78.6; C_4H_{10}: 6.6; C_5H_{12}: 0.4

8.14 1.18lb

8.15 (a) Boiling point: 129° F; (b) the vapor composition (in mole %): C_4: 0.247, C_5: 0.299, C_6: 0.428, C_7: 0.024, C_8: 0.002.

Chapter 11

11.1 (a) 43.6%, (b) 0.0136 mol Tol/mol H_2, (c) 0.043, (d) 42.9%, (e) 1.34%

11.2 (a) 219 psia, (b) 0.00435 lb mol H_2O/lb mol N_2, (c) 0.999

11.3 (a) 20.5°C, (b) 0.024, (c) 0.805

11.4 The solution is wrong. The problem is underspecified. No unique solution is possible.

11.5 (a) 50.5%, (b) 200 kPa, (c) 11° C, (d) 7%, (e) No

11.6 (a) 103.6° F, (b) 80.3 in. Hg, (c) 84%

11.7 (a) 89 ft^3/min, (b) 1180 mm Hg

11.8 (a) 0.078, (b) 0.871 atm, (c) 99°F, (d) 100°F

11.9 (a) T_B = 166°F, T_c = 85.2 °F; (b) ΔH_I = 3080 Btu, ΔH_{II} = 860 Btu

11.10 Refrigeration = 4830 Btu/min; Reheating = 124.5 Btu/min