Flow Measurement – Homework
(Industrial Flow Measurement, Chapter 2)

2.1 (100 ^{o}F -- 32) (5 / 9) = 37.8 ^{o}C

298 ^{o}K - 273 = 25 ^{o}C

[(500 ^{o}R - 460) - 32] (5 / 9) = 4.4 ^{o}C

2.2 14.696 psi + (-3 psi) = 11.696 psia

14.696 psi - (100 mm Hg / 25.4 mm/inch) (0.491154 psi / inch Hg) = 12.762 psia

17 psig + 14.696 psi = 31.696 psia

14.696 psi + (42 ft. WC) (12 in. / ft.) (0.03609 psi/inch WC) = 32.885 psia

14.696 psi + (15 bar) (14.5038 psi / bar) = 232.253 psia

2.3 R_D = (3160) (600 gpm) (1.00) / (1 cP) (7.981 in.) = 237,564

$\Delta P_{6in.}$ = (20 + 15 + 15 + 200 ft.) (1.02 psi / 100 ft.) (2.309 ft. / psi) = 5.89 ft. WC

$\Delta P_{8in.}$ = (10 + 10 + 15 + 150 ft.) (0.258 psi / 100 ft.) (2.309 ft.) / psi) = 1.10 ft. WC

+15 ft. WC Static Pressure at Pump Inlet
+115 ft. WC Gain Through Pump
- 60 ft. WC Loss Due to Elevation
-5.89 ft. WC Pipe Loss (6 in.)
-1.10 ft. WC Pipe Loss (8 in.)
(63.01 ft. WC) (12 in. / ft.) (0.03609 psi / in. WC) = 27.29 psi

2.4 (1.5 ft.) (1.09) (12 in. / ft.) (0.03609 psi / in. WC) = 0.708 psi
No flow unless siphoning.

2.5 Specific Gravity = (76.75 lb/ft^3 / 62.33630 lb/ft^3) = 1.231

+1 ft. WC	Static Pressure at Pump Inlet
+85 ft. WC	Gain Through Pump
-90 ft. WC	Loss Due to Elevation
-4 ft. WC	(No Flow)

2.6 $Q_{gpm} = (R_D D / 3160) (\mu cP / SG) = (4000) (2.067 \text{ in.}) / 3160) (5 cSt) = 13.08 \text{ gpm}$

2.7 7.65 fts/sec. (From Table 2.3)

2.8 $Q_{acfm} = 0.3272 D^2 v = (0.3272) (4.026 \text{ in.})^2 (50 \text{ ft./sec.}) = 265.2 \text{ acfm}$ (Calculated)

$Q_{acfm} = (50 \text{ ft./sec.})(60 \text{sec./min.})(1.003 \text{ft}^3/\text{sec.}) / (11.34 \text{ft./sec.}) = 265.3 \text{acfm}$ (From Table)

$V = (ZTP_0 / Z_0T_0P) V_0$

$= [(0.987) (460 + 59 \,^oF) (14.696 + 28 \text{ psi}) / (0.955) (460 + 90 \,^oF) (14.696 \text{ psia})] V_0$

$= 2.833 V_0$

$Q_{scfm} = (2.833) (265.2 \text{ acfm}) = 751.3 \text{ scfm}$

$\rho = (0.1869 \text{ lb/ft}^3) (2.833) = 0.5295 \text{ lb/ft}^3$

$R_D = 379 Q_{acfm} \rho_{lb/ft^3} / \mu_{cp} D_{in.} = 379(265.2 \text{ acfm})(0.5295 \text{ lb/ft}^3)/[(0.017 \text{ cP})(4.026 \text{in})]$

$R_D = 777{,}600$

2.9 $Q_{acfm} = 0.3272 D^2 v = (0.3272) (3.826 \text{ in})^2 (60 \text{ ft/sec}) = 287.4 \text{ acfm}$

$Q_{acfm} = (14.696 + 50 \text{ psi}) (273 + 15 \,^oC) / [(14.696 \text{ psi}) (273 + 30 \,^oC)] (287.4 \text{ acfm})$

$Q_{acfm} = 1202.6 \text{ scfm}$