

Problem 1

What is the required air pressure in the tank on the right in order to deliver 250 gpm of ethyl alcohol. What is the manometer reading?

Using Bernoulli's Equation:

$$\frac{V_1^2}{2g} + \frac{P_1}{\gamma} + z_1 - h_L = \frac{V_2^2}{2g} + \frac{P_2}{\gamma} + z_2$$

Name	Symbol	Value	Unit
Elevation 1	z1	18	ft
Elevation 2	z2	38	ft
Velocity 1	v1	0	ft/sec
Velocity 2	v2	25.54	ft/sec
Pressure 1	P1	?	
Pressure 2	P2	40	lb/sq.in
Head loss	hL	2.11E+00	
Friction factor	f	2.26E-04	
Reynold's number	Re	2.83E+05	
Kinematic viscosity	u	1.50E-05	ft^2/sec

Name	Symbol	Value	Unit
Flow rate	Q	250	gpm
Area	A	0.021814	ft^2
Diameter	D	0.16667	ft
Total Length	L	154	ft
Gravity	g	32.2	ft/sec^2
Gamma	γ	49.01	lbf/ft^3
Density	ρ	49.01	lbm/ft^3

Pressure at Tank 1, P1

7340.068

50.973 psig

Manometer reading, h

1.863244 ft

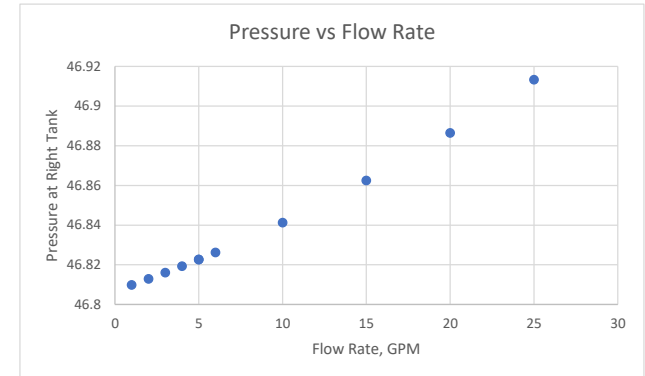
Problem 2

What will be the new manometer reading at that moment there is no flow?

f	Reynolds #	hf	v2	Flowrates	Pressure 1 (psig)	Pressure 1 (psfg)
0.056451	1133.717549	0.00845145	0.10	1	6740.622147	46.80987602
0.028226	2267.435099	0.0169029	0.20	2	6741.060175	46.81291788
0.018817	3401.152648	0.02535434	0.31	3	6741.514086	46.81607004
0.014113	4534.870197	0.03380579	0.41	4	6741.983879	46.81933249
0.011290	5668.587747	0.04225724	0.51	5	6742.469553	46.82270523
0.009409	6802.305296	0.05070869	0.61	6	6742.97111	46.82618827
0.011290	5668.587747	0.04225724	0.51	5	6742.469553	46.82270523
0.005645	11337.17549	0.08451448	1.02	10	6745.136159	46.84122332
0.003763	17005.76324	0.12677172	1.53	15	6748.199816	46.86249872
0.002823	22674.35099	0.16902896	2.04	20	6751.660526	46.88653143
0.002258	28342.93873	0.2112862	2.55	25	6755.518287	46.91332144

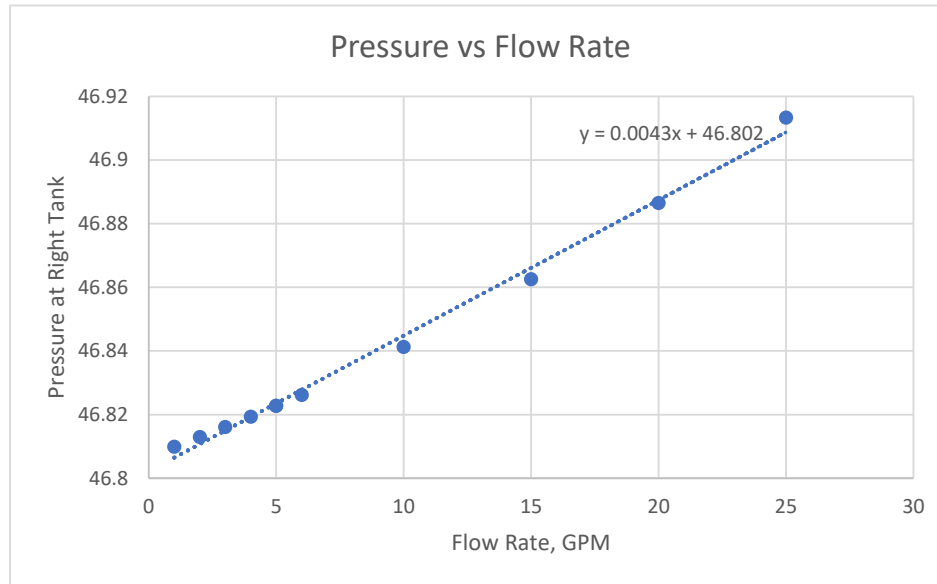
New manometer reading, h

P1	46.81	psi
P2	40	psi
h	1.156387821	ft



Problem 3

Make a plot of pressure versus flow rate. Using the plot, determine the rate when the air pressure is 75 psi



Using the equation from the Chart

$$P = 6 \times 10^{-5}Q^2 + 0.0004Q + 46.80$$

Given that P is 75 psig

$$Q = 682.24 \text{ gpm}$$