Homework Assignments for Test 1

HW 1.1
HW 1.2
HW 1.3
HW 1.4

Spencer Reed
HW 1.1
Ch. 1 - 48, 58, 63, 76, 92, 107
Ch. 2 - 17, 18, 27, 35, 61

Ch. 1

48) Given: F = 18,000 lb   d = 2.5"

Oil Pressure: $\frac{18,000}{\frac{\pi}{4}(2.5)^2} \Rightarrow \frac{18,000}{4.909^2}$

$= 3666.73 \text{ lb/in}^2$

58) Given: $\Delta V = 1\%$

$K = -V \frac{\Delta P}{\Delta V} \Rightarrow \Delta P = -K \frac{\Delta V}{V} \Rightarrow \Delta P = -28,000 \times 0.01$
$= 280 \text{ MPa}$

1 MPa = 145.038 Psi
x 280

= 40,610.64 Psi
= 280 MPa

63) Given: $d_i = 0.5''$ $L = 42''$

$E_m = 189{,}000$ Psi

$K = \frac{F}{\Delta\delta}$ $\sigma = \frac{F}{A}$ $F = \sigma \times A$

$K = \frac{E \times (\pi/4\, d^2)}{L} \Rightarrow \frac{189{,}000 \times (\pi/4 \times 0.5^2)}{42} \Rightarrow \frac{189{,}000 \times 0.19634}{42}$

$\Rightarrow \frac{37{,}110.66}{42} = \boxed{883.57 \text{ lb/in}}$

76) Given: 1lb

Slugs - $1\text{lb} \times \frac{1\text{ slug}}{32.174\text{ lb}} = 0.031$ slugs

Mass - $1\text{lb} \times \frac{1\text{ kg}}{2.2046\text{ lb}} = 0.453$ kg

N - $1\text{lb} \times \frac{4.45\text{ N}}{1\text{ lb}} = 4.45$ N

92) Given: $d = 150$ mm $m_1 = 2.25$ N $m_2 = 35.4$ N

$W_{oil} = 35.4 - 2.25 = 33.15$ N

$W_{oil} = \rho_{oil} V g$

$33.15 \text{ N} = \rho_{oil} \times \pi/4 \times 0.15^2 \times 0.2 \times 9.81$

$\rho_{oil} = 956.12$ kg/m³

$\boxed{\gamma_{oil} = \frac{\rho_{oil}}{\rho_{water}} = \frac{956.12 \text{ kg/m}^3}{1000 \text{ kg/m}^3} = 0.95612}$

107) Given: $SG_{alcohol} = 0.79$

Density of water @ 4°C = 1000 $\frac{kg}{m^3}$ or 62.42 $\frac{lb}{ft^3}$

$SG = \frac{\rho_a}{\rho_w} \Rightarrow 0.79 = \frac{\rho_a}{62.42\ lb/ft^3}$

$\rho_a = 49.296 \frac{lb}{ft^3} \times \frac{1\ slug/ft^3}{32.17\ \frac{lb}{ft^3}}$
$= 1.53 \frac{slugs}{ft^3}$

$\rho_a = 790 \frac{kg}{m^3} \times \frac{1\ g/cm^3}{1,000\ \frac{kg}{m^3}}$
$= 0.79\ g/cm^3$

A = 1.53 slugs/ft³
B = 0.79 g/cm³

Ch. 2

17) Pseudoplastic - Blood plasma, syrups, and inks
Dilatant Fluids - titanium dioxide and starch in water
Thixotropic Fluids - time-dependant fluid
Rheopectic Fluids - time-dependant fluid that is rare

18) 6.25×10^{-4} $N \cdot s/m^2$ or $Pa \cdot s$

27) 0.25×10^{-5} $N \cdot s/m^2$ or $Pa \cdot s$

35) 2.5×10^{-4} $lb\text{-}s/ft^2$

61) Given:

steel ball (d) = 1.6mm or 0.0016 m sg_{oil} = 0.94

Steal (w) = 77 kN/m³   s = 250mm or 0.250 m

t = 10.4s

density of steel ball = $\frac{77 \times 100}{9.81}$ = 7,849.13 kg/m³

density of oil = 0.94 × 100 = 940 kg/m³

Viscosity = $\frac{gd^2}{18(V)}$ (density of ball − density of oil) $\frac{N-s}{m^2}$

↑ find velocity

$V = s/t = \frac{0.250}{10.4} = 0.024038$ m/sec

Viscosity = $\frac{9.81(0.0016)^2}{18 \times 0.024038} \times (7,849.18 - 940)$

=> 0.000058 × 6909.18 = 0.401019

Ans = 0.401019

Spencer Reed
HW #2
Ch. 3
6-11 + 13

6) True. - At 0 kPa gauge pressure absolute pressure is 101 kPa

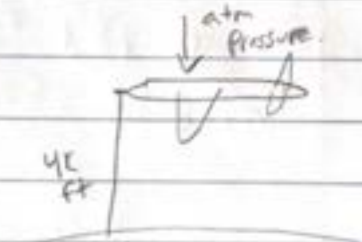
7) True. - Change is minimal in the air

8) False - abs pressure cannot be below zero

9) True - $-4.65 - 14.7 = 10.05$ psi

10) False - abs pressure can not be below zero

11)



Δp = change in pressure
γ = specific weight of liquid
h = change in elevation

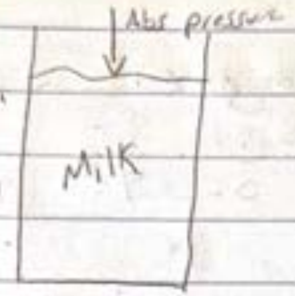
$\gamma = 0.0764$ lb/ft^3 $h = 4000$ ft

$\Delta P = 0.0764\ lb/ft^3 \times 4{,}000\ ft$
$= 305.6\ lb/ft^2$

$= 305.6\ lb/ft^2 \left(\frac{1 ft^2}{(12 in)^2}\right)$
$\Delta P = 2.12$ psia

$P = p_{atm} - \Delta P \Rightarrow 14.7\ psia - 2.12\ psia$
$P = 12.58$ psia

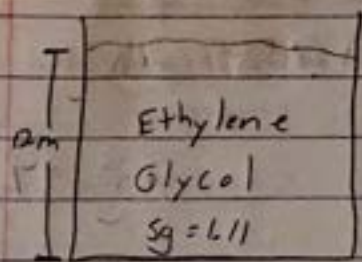
13) Abs pressure on the surface of milk



0 kPa gauge pressure: The pressure is on the surface of the milk which means the only pressure acting on it is atm pressure which equals 101 kPa abs or 0 kPa gauge.

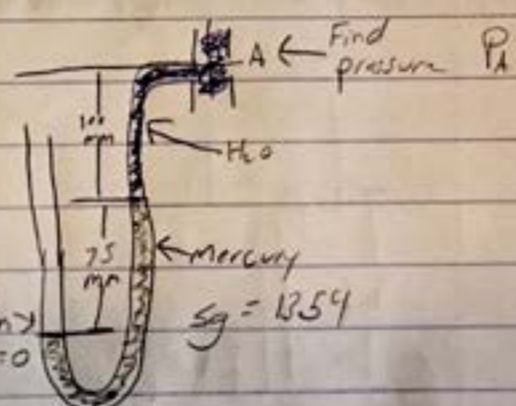
Spencer Reed
MET 330

3.41) Ethylene Glycol $\rho_{@25°C}$ = 1100 kg/m³ HW 1.3
h = 12m
Table B.1 Ch. 3 41, 62, 83, 70, 94
Ch. 4 2, 10, 17, 28, 42, 54



$P = \rho g h$ 1100 kg/m³ x 9.81 m/s² x 12 m
= 129,492 Pa
= 129.492 KPa

3.62) Water = sg = 1.01
Mercury = sg = 13.54



P_{atm} = -13.54 x g x 0.075
+ 1.01 x g x 0.01 + P_A
=> -13.54 x 9.81 x 0
+ 1.01 x 9.81 x 0.1 + P_A
P_{atm} = -10.95 kN/m²
$-P_a$ $-P_a$
$P_{atm} - P_a$ = -10.95 kN/m² => -10.95 kPa
$P_{atm} - P_a$ = -10.95 kPa
0 - P_a = -10.95 kPa
$-P_a$ = -10.95 kPa
P_a = 10.95 kPa

3.83) Given: $P_{atm} = 14.2$ psia

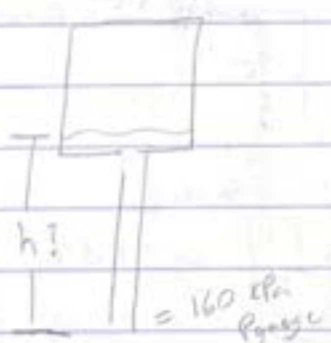
$1 \text{ psia} = 2.036 \text{ inHg}$

$14.2 \text{ psia} \times \frac{2.036 \text{ inHg}}{1 \text{ psia}} = 28.91 \text{ in Hg}$

3.90) Given: $P = -12.6$ psig

$-12.6 \text{ psig} \times \frac{2.036 \text{ inHg}}{1 \text{ psig}} = -25.654 \text{ inHg}$

3.94) Given: Min $P_{gauge} = 160$ kPa   Need elevation of tank: h



density of water: 1000 Kg/m³
Table A.1

$P = hdg \Rightarrow h = \frac{P}{dg}$

$h = \frac{160 \times 10^3 \text{ Pa}}{9.8 \times 1000}$

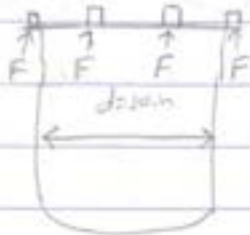
$h = \frac{160,000 \text{ Pa}}{9,800}$

$h = 16.33 \text{ m}$

(10)

4.2) Given: $d = 30\text{in}$ $\Delta P = 23.6\text{psig}$ or $23.6 \frac{\text{Pounds}}{(\text{inch})^2}$

Find: Total force on bolts



$F = PA$ (pressure, area)

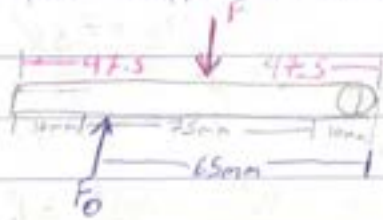
$A = \frac{\pi}{4} \times 30^2$ $A = 706.86\,\text{in}^2$

$F = 23.6\,\text{lb/in}^2 \times 706.86\,\text{in}^2$

$F = 16,680.48\,\text{lbs}$

4.10) Given: $d_1 = 500\text{mm}$ $h = 1.8\text{m}$ $d_2 = 75\text{mm}$

Find: Force to open Flapper Valve.



Area of Flapper $= \frac{\pi}{4} \times (0.075)^2$

$A_F = 0.0044\,\text{m}^2$

Specific weight of H_2O

$P = \gamma_w \times h$ $\gamma = 9.81\,\text{kN/m}^3$ - Table A.1

$9.81\,\text{kN/m}^3 \times 1.8\,\text{m}$

$P = 17.66\,\text{kN/m}^2$

$F = PA$

$= 17.66\,\text{kN/m}^2 \times 0.0044\,\text{m}^2$

$= 0.0778\,\text{kN}$

$\Sigma M_0 = 0 \quad F \times \frac{75mm}{2} - F_0 \times 65mm = 0$

$0.0778 kN \times 37.5mm - F_0 \times 65mm = 0$

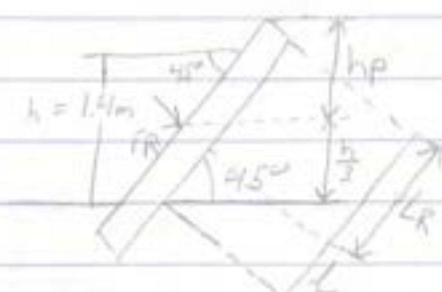
$+F_0 \times 65mm \quad +F_0 \times 65mm$

$\frac{0.0778 kN \times 37.5mm}{65mm} = \frac{F_0 \times 65mm}{65mm}$

$\boxed{F_0 = 0.449 kN}$

4.17) Given: $w = 4m$ $\quad a = 45°$ $\quad$ oil $sg = 0.86$ $\quad h = 1.4m$

$860 kg/m^3$



$\sin 45 = \frac{1.4m}{l}$

$l = \frac{1.4m}{\sin 45} = 1.98m$

$A = Ll = 4m \times 1.98m = 7.92m^2$

$F_R = \gamma\left(\frac{h}{2}\right)A \rightarrow (860 \times 9.81)\left(\frac{h}{2}\right)A \rightarrow (860 \times 9.81)\left(\frac{1.4}{2}\right)7.92$

$8436.6\left(\frac{1.4}{2}\right)7.92 \Rightarrow 46,772.51N$

$46.77 kN$

$h/3 = 1.4/3 = 0.467m$

$l/3 = \frac{1.98}{3} = 0.66m$

$L_p = l + \frac{l}{3} = \frac{2l}{3} = \frac{2(1.98)}{3} = \frac{1.96}{3} = 1.32m$

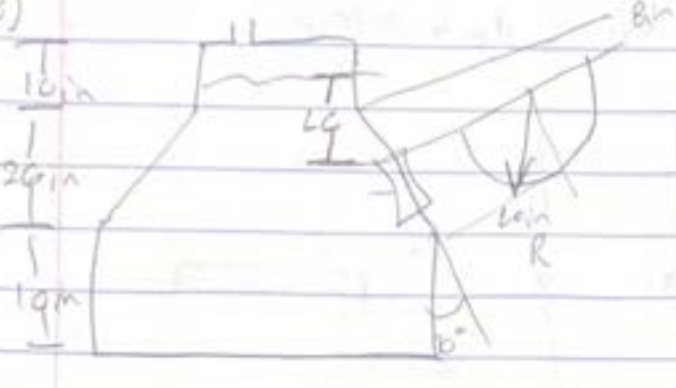
$h_p = h + h/3 = \frac{2h}{3} = \frac{2(1.4)}{3} = \frac{2.8}{3} = 0.933m$

Force on wall = 46.77 kN

$L_p = 1.32m$

$h_p = 0.933m$

4.28)



Given: sg = 1.10

$\bar{y} = \frac{4r}{3\pi} \Rightarrow \frac{4(20)}{3\pi} = \frac{80}{9.42}$

$= 8.49_{in}$

$L_c = 8 + 8.49 + \frac{10}{\cos 30}$

$16.49 + 11.55$

$= 28.04_{in}$

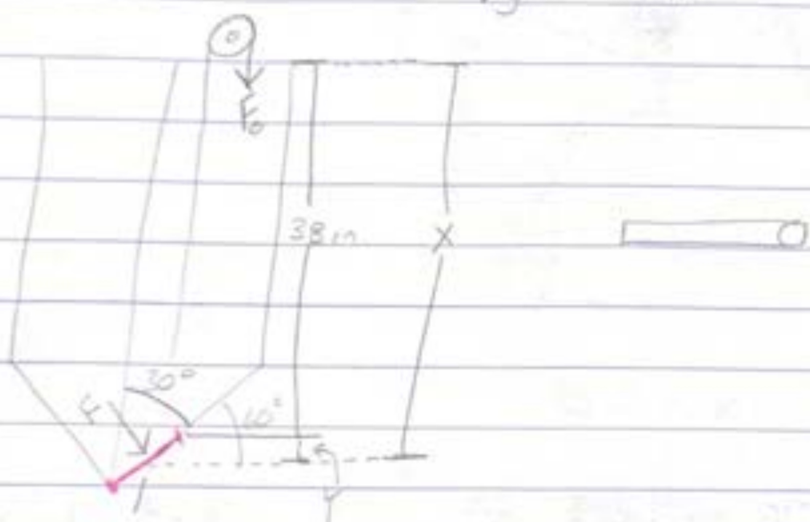
$h_c = L_c \cos 30 \Rightarrow 28.04 \cos 30$

$= 24.28_{in}$

$h_p = h_c + \frac{I_c \sin^2\theta}{h_c A} = 24.283_{in}$

$h_p = 24.283 + \frac{\pi/64\,(40)^4 \sin^2(60)}{\pi/4\,(40)^2 (24.283)} = 27.37_{in}$

4.42) Given: 30° $h = 38_{in}$ $d_{gate} = 10_{in}$



$x = 38 + \frac{d}{2}\sin 30 \rightarrow 38 + \frac{10}{2}\sin 30$
$= 40.5_{in}$

$I = \frac{\pi}{64} D^4 \rightarrow \frac{\pi}{64} 10^4$
$= 490.87_{in^4}$

$A = \frac{\pi}{4} D^2 \rightarrow \frac{\pi}{4} 10^2$
$= 78.54_{in^2}$

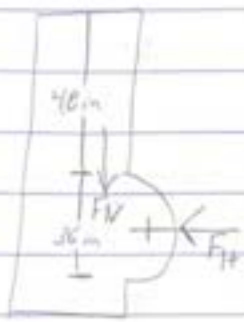
$F = PA$ $P = \rho g$ $P = 1.94 \times 9.81$
$= 19.034 \times 78.54$ $= 19.03 lb/in^2$
$= 1{,}494.73 lb$

$H = x + \frac{I \sin^2 \theta}{Ax} \rightarrow 40.5 + \frac{490.87 \sin^2 60}{78.54 \times 40.5}$
$= 42.3 in$

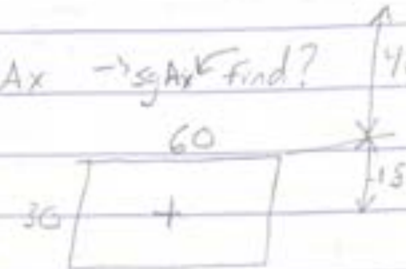
$Y = 42.3 - 38 = 4.3_{in}$
$\Sigma F_0 = 0$
$-F \times OA + P \times OB \sin 30 = 0 \rightarrow -1{,}494.73 \times \left(\frac{4.3}{\cos 30}\right) + P \times 10 \sin 30 = 0$
$P = 37{,}108.26$

4.54) Given = 60 in long $sg = 0.79\ kg/m^3$

in = 0.0254m



$F_H = PA_x \rightarrow sgA\bar{x}$ find?



$\bar{x} = 48 + 15 = 63in$

$F_H = 0.79 \times 9.81 \times (30 \times 60) \times 63 \times 0.0254^3$

1800

$F_H = 14.40\ N$

$F_V = sg \times \left(\frac{\pi r^2}{2}\right) \times L \times (0.0254)^3$

$0.79 \times 9.81 \left(\frac{\pi 15^2}{2}\right) \times 60 \times 0.0254^3$

$F_V = 2.693\ N$

$F_R = \sqrt{F_H^2 + F_V^2} \rightarrow \sqrt{14.4^2 + 2.693^2}$

$F_R = 14.65\ N$

$\tan^{-1}\left(\frac{FV}{FH}\right) \rightarrow \tan^{-1}\left(\frac{2.693}{14.4}\right)$

$\theta = 10.59°$