RETURN TO DR. THOMAS

HOMEWORK #1

~~1.8, 1.29, 1.36, 1.37, 1.40, 1.80, 1.82~~

1.8, 1.31, 1.65, 1.66-E, 1.69, 1.142, 1.144

PROB. ~~1.8~~

$V = (6m)(6m)(8m) = 288\ m^3$

$m = \rho V = (1.16\ \frac{kg}{m^3})(288\ m^3) = \boxed{334\ kg}$

$F = ma = (334\ kg)(9.8\ \frac{m}{s^2}) = \boxed{3274\ N}$

PROB. 1.~~29~~ 31

$P = 1000 \times 10^6\ W$

$\epsilon = 0.30 = \frac{\text{POWER PRODUCED}}{\text{~~ENERGY~~ POWER CONSUMED}}$

~~ENERGY~~ POWER CONSUMED $= P/0.3 = (1000 \times 10^6\ W)/0.3$

$P.C. = 3.33 \times 10^9\ W = 3.33 \times 10^9\ \frac{J}{s}$

~~ENERGY~~ ~~POWER~~ ENERGY CONSUMED OVER 1 YEAR $= (3.33 \times 10^9\ \frac{J}{s})$

$\times (\frac{60\ s}{1\ min})(\frac{60\ min}{HR})(\frac{24\ HR}{DAY})(\frac{365\ DAY}{YR}) = 1.05 \times 10^{17}\ \frac{J}{YR}$

MASS OF FUEL CONSUMED IN 1 YR $= \frac{\text{ENERGY/YEAR}}{\text{HEATING VALUE}} = \frac{1.05 \times 10^{17}\ \frac{J}{YR}}{28{,}000\ \frac{KJ}{kg}} \cdot (\frac{KJ}{1000\ J})$

$\boxed{= 3.75 \times 10^9\ \frac{kg}{YR}}$

PROB. 1.~~80~~ 65

$P_{vac} = 30$ KPa

$P_{atm} = 755$ mm Hg

$\rho_{Hg} = 13{,}590 \frac{Kg}{m^3}$

FIND $P_{abs} = P_{atm} - P_{VAC}$

$$P_{atm} = \rho g h = \left(13590 \frac{Kg}{m^3}\right)\left(9.81 \frac{m}{s^2}\right)\left(0.755 \text{ m}\right)\left(\frac{1N}{Kg - \frac{m}{s^2}}\right)\left(\frac{KPa}{1000 \text{ Pa}}\right)$$

$P_{atm} = 1.01 \times 10^2$ KPa

70.7

$P_{abs} = P_{atm} - P_{vac} = 101 - 30 \text{ KPa} = \boxed{71 \text{ KPa}}$

PROB. 1.~~80~~ 66-E

$P_{gage} = 50$ PSI, $P_{atm} = 29.1$ INHg, $\rho_{Hg} = 848.4 \frac{LBM}{FT^3}$

FIND P_{abs}

$$P_{atm} = \rho g h = \left(848.4 \frac{LBM}{FT^3}\right)\left(32.2 \frac{Ft}{s^2}\right)\left(29.1 \text{ IN}\right)\left(\frac{Ft}{12 \text{ IN}}\right)\left(\frac{LBF}{32.2 \text{ LBM} \frac{Ft}{s^2}}\right)$$

$$\times \left(\frac{Ft^2}{144 \text{ IN}^2}\right) = 14.3 \frac{LBF}{IN^2}$$

$P_{abs} = P_{gage} + P_{atm} = 50 + 14.3 = \boxed{64.3 \frac{LBF}{IN^2}}$

PROB 1.69

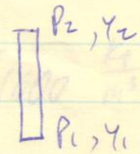
$H_{TOP} = 730\ mm\ Hg$, $H_{BOT} = 755\ mm\ Hg$, $\rho_{AIR} = 1.18\ \frac{kg}{m^3}$

FIND HEIGHT OF BUILDING

~~$\Delta P = -\rho g \Delta h$~~

$P_1 - P_2 = \rho g (y_2 - y_1)$

$P_{BOT} - P_{TOP} = \rho g h$



~~$P_{TOP} - P_{BOT} = -\rho_{AIR}\, g\, (h_{TOP} - h_{BOT})$~~ COLUMN OF AIR

~~IF $h_{BOT} = 0$,~~

~~$h = \frac{(P_{BOT} - P_{TOP})}{\rho_{AIR}\, g}$~~

$$h = \frac{(P_{BOT} - P_{TOP})}{\rho_{AIR}\, g}$$

$P_{TOP} = \rho_{Hg}\, g\, H_{TOP}$, $P_{BOT} = \rho_{Hg}\, g\, H_{BOT}$] MERCURY MANOMETER

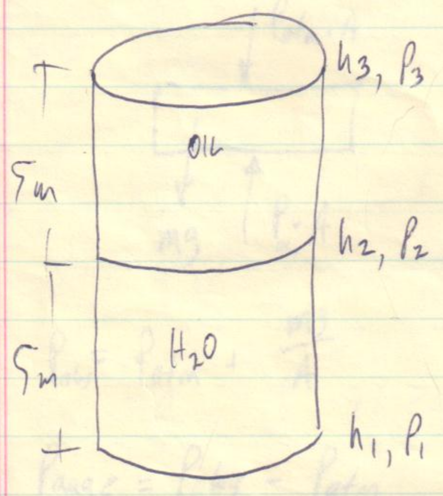
$$h = -\frac{\rho_{Hg}\, g\, (H_{TOP} - H_{BOT})}{\rho_{AIR}\, g}$$

$$h = -\left(\frac{\rho_{Hg}}{\rho_{AIR}}\right)(H_{TOP} - H_{BOT})$$

$$h = -\left(\frac{13590\ \frac{kg}{m^3}}{1.18\ \frac{kg}{m^3}}\right)(0.730 - 0.755\ m)$$

$$\boxed{h = 288\ m}$$

PROB. 1.142



$$\rho_{H_2O} = 1000 \ \frac{kg}{m^3}$$

$$\rho_{OIL} = 0.85\left(1000 \ \frac{kg}{m^3}\right) = 850 \ \frac{kg}{m^3}$$

FIND PRESSURE DIFFERENCE.

$P_1 - P_3$

$$P_1 = P_2 + \rho_{H_2O}\, g\,(h_2 - h_1)$$

$$P_2 = P_3 + \rho_{OIL}\, g\,(h_3 - h_2)$$

$$P_3 = P_2 - \rho_{OIL}\, g\,(h_3 - h_2)$$

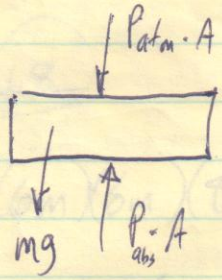
$$P_1 - P_3 = \left[P_2 + \rho_{H_2O}\, g\,(h_2 - h_1)\right] - \left[P_2 - \rho_{OIL}\, g\,(h_3 - h_2)\right]$$

$$P_1 - P_3 = g\left[\rho_{H_2O}\,(h_2 - h_1) + \rho_{OIL}\,(h_3 - h_2)\right]$$

$$P_1 - P_3 = \left(9.81 \ \frac{m}{s^2}\right)\left[\left(1000 \ \frac{kg}{m^3}\right)(5m) + \left(850 \ \frac{kg}{m^3}\right)(5m)\right]\left(\frac{1 \ N}{1 \ \frac{kg \cdot m}{s^2}}\right)$$

$$P_1 - P_3 = 90{,}742 \ \frac{N}{m^2} = \boxed{90.7 \ KPa}$$

PROB. 1.~~80~~ 144



$$P_{abs} = P_{atm} + \frac{mg}{A}$$

$$P_{gage} = P_{abs} - P_{atm}$$

$$P_{gage} = \frac{mg}{A}$$

~~Pgage = W~~ $m = \frac{P_{gage} A}{g}$

$$m = \frac{(100\ KPa)(4\ mm^2)}{(9.8\ \frac{m}{s^2})} \cdot \left(\frac{1000\ \frac{N}{m^2}}{KPa}\right)\left(\frac{m}{1000\ mm}\right)^2\left(\frac{Kg\ \frac{m}{s^2}}{N}\right)$$

$$\boxed{m = 0.0408\ Kg = 40.8\ g}$$