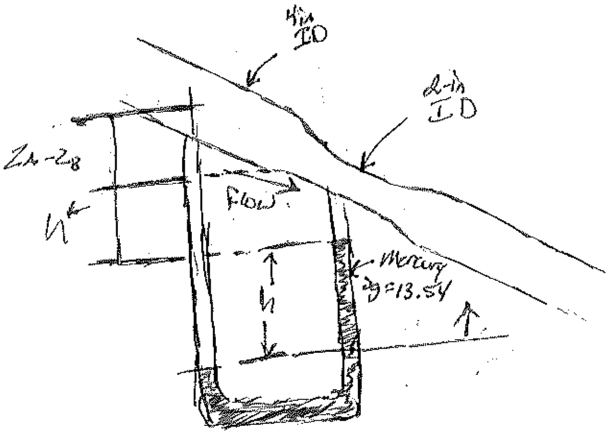
6.79)

Dane Baxter

532699BAXTER
669108BAxter

Oil $\gamma_{water} =$
$Sg = 0.90$
$h = 28in$

Calculate volume flow rate



$4in = \frac{4}{12} = \frac{1}{3} ft$
$2in = \frac{2}{12} = \frac{1}{6} ft$
$28in = \frac{28}{12} = \frac{7}{3} ft$

$$\frac{P_1}{\gamma} + \frac{V_1^2}{2g} + Z_1 = \frac{P_2}{\gamma} + \frac{V_2^2}{2g} + Z_2$$

$$Q = V \times A$$

$$\frac{Q^2}{2g}\left(\frac{1}{A_A^2} - \frac{1}{A_B^2}\right) = \frac{P_B - P_A}{\gamma} + (Z_A - Z_B)$$

$$Q = \sqrt{\frac{2g\left(\frac{P_B - P_A}{\gamma} + (Z_A - Z_B)\right)}{\frac{1}{A_A^2} - \frac{1}{A_B^2}}}$$

$$\frac{P_B - P_A}{\gamma_{Hg}} = (Z_A - Z_B) + \left(1 - \frac{Sg_H}{Sg_{oil}}\right)h$$

$A_A = \frac{\pi}{4} D_A^2$
$= \frac{\pi}{4}\left(\frac{1}{3}\right)^2$
$= 0.0873 ft$

$A_B = \frac{\pi}{4}\left(\frac{1}{6}\right)^2$
$= 0.0218 ft$

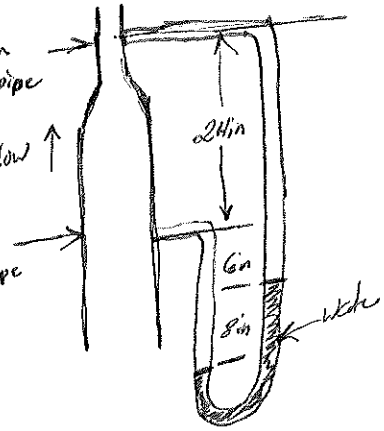
$$Q = \sqrt{\frac{2g\left(1 - \frac{Sg_{Hg}}{Sg_{oil}}\right)h}{\frac{1}{A_A^2} - \frac{1}{A_B^2}}}$$

$$= \sqrt{\frac{2\left(32.2 \frac{ft}{s^2}\right)\left(1 - \frac{13.54}{0.90}\right)\left(\frac{7}{3} ft\right)}{\frac{1}{(0.0873)^2} - \frac{1}{(0.0218)^2}}}$$

$$= 1.034 \frac{ft^3}{s}$$

6.82)

Oil
Specific weight = 55.0 lb/ft³
Water
Specific weight = 62.4 lb/ft³



Sg water = 62.4 lb/ft³
Gravity = 32.2 ft/s²

Calculate Volume flow rate

$6in = \frac{1}{2}ft$

$8in = \frac{2}{3}ft$

$24in = 2ft$

$2in = \frac{1}{6}ft$

$4in = \frac{1}{3}ft$

$A_A = \frac{\pi}{4}\left(\frac{1}{6}\right)^2$

$= 0.0218\,ft^2$

$A_B = \frac{\pi}{4}\left(\frac{1}{3}\right)^2$

$= 0.0873\,ft^3$

$$\frac{P_1}{\gamma} + \frac{V_1^2}{2g} + Z_1 = \frac{P_2}{\gamma} + \frac{V_2^2}{2g} + Z_2$$

$$Q = V \times A$$

$$\frac{Q^2}{2g}\left(\frac{1}{A_A^2} - \frac{1}{A_B^2}\right) = \frac{P_B - P_A}{\gamma} + (Z_A - Z_B)$$

$$Q = \sqrt{\frac{2g\left(\frac{P_A - P_B}{\gamma} + (Z_A - Z_B)\right)}{\frac{1}{A_A^2} - \frac{1}{A_B^2}}}$$

$$\frac{P_B - P_A}{\gamma} = \left(Z_A - Z_B + \left(1 - \frac{Sg_{H_2O}}{Sg_{oil}}\right)h\right.$$

$$Q = \sqrt{\frac{2g\left(1 - \frac{Sg_{H_2O}}{Sg_{oil}}\right)h}{\frac{1}{A_A^2} - \frac{1}{A_B^2}}}$$

$$= \sqrt{\frac{2(32.2)\left(1 - \frac{62.4}{55.0}\right)\left(\frac{2}{3}\right)}{\frac{1}{(0.0873)^2} - \frac{1}{(0.0218)^2}}}$$

$$= 0.0514\,\frac{ft^3}{s}$$

7.11)

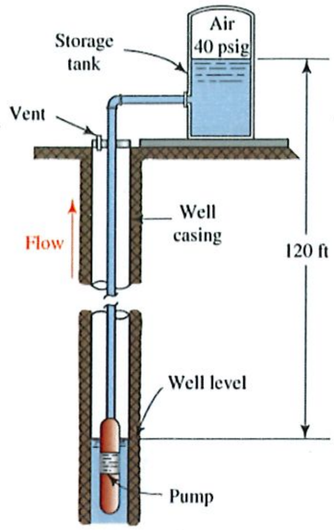
Rate of flow = 745 gal/h = 0.0276644 = Q

Dia = 1in

energy loss = 10.5 lb-ft/lb

a) Calculate the power delivered by the pump to the water

b) if the pump draws 1hp, calculate its efficiency



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

$$h_A = \frac{P_2 - \cancel{P_1}^{0}}{\gamma} + \frac{\cancel{V_2^2}^{0} - \cancel{V_1^2}^{0}}{2g} + z_2 - \cancel{z_1}^{0} + h_L$$

$$h_A = \frac{P_2}{\gamma} + z_2 + h_L$$

$$= \frac{40 \frac{lb}{in^2}\left(\frac{144 in^2}{1 ft^2}\right)}{62.4 \frac{lb}{ft^3}} + 120 + 10.5 ft$$

$$= 222.81 ft$$

$$P_A = \gamma Q h_L$$

$$= 62.4 \frac{lb}{ft^3}(0.0276644)(222.81 ft)$$

$$= \frac{384.63 \frac{lb \times ft}{s}}{550 \frac{lb \times ft}{s}}$$

* $1 Hp = 550 \frac{lb \times ft}{s}$

a) $= 0.70 Hp$

$$n_A = \frac{P_A}{P_M}$$

$$= \frac{0.70 Hp}{1.00 Hp}$$

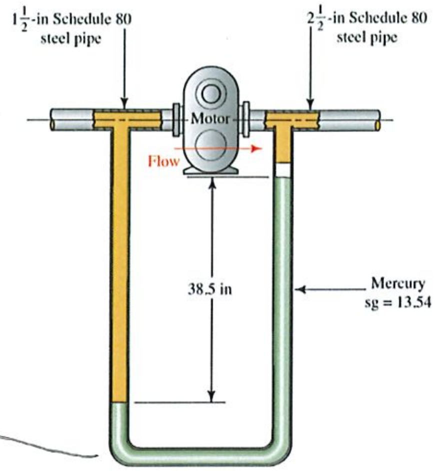
$$= 0.70 \times 100$$

b) $= 70\%$

7.48)

Flow rate of hydrolic = 135 gal/min

$= 0.30067 \ \frac{ft^3}{s}$



Compute power removed from fluid by the motor?

Efficincey = 72 %

$= 0.72$

Hg

$Sg = 13.54$

Specific weight $= 13.54(62.4)$

$= 844.9 \ lb/ft^3$

Oil

$Sg = 0.90$

Specific weight $= 0.90(62.4)$

$= 56.16 \ lb/ft^3$

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

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

$$P_1 + \gamma_o y + \gamma_M (38.5 in) - \gamma_o (38.5 in) - \gamma_o y = P_2$$

$$P_2 = P_1 + \gamma_M (38.5 in) - \gamma_o (38.5 in)$$

$$\frac{P_2 - P_1}{\gamma_o} = \frac{\gamma (38.5 in)}{\gamma_o} - 38.5 in$$

$$= \left(\frac{\gamma_m}{\gamma_o} - 1\right) 38.5 in$$

$$= \left(\frac{844.9 \ lb/ft^3}{56.16 \ lb/ft^3} - 1\right)\left(\frac{38.5}{12}\right)$$

$$= 45.06 ft$$

$A_1 = \frac{\pi}{4}\left(\frac{1.5}{12}\right)^2$

$= 0.0123 \ ft$

$A_2 = \frac{\pi}{4}\left(\frac{2.5}{12}\right)^2$

$= 0.0341 \ ft$

$V_1 = \frac{Q}{A_1}$

$= \frac{0.30067 \ ft^3/s}{0.0123 \ ft^2}$

$= 24.44 \ ft/s$

$V_2 = \frac{Q}{A_2}$

$= \frac{0.30067 \ ft^3/s}{0.0341 \ ft^2}$

$= 8.82 \ ft/s$

$$\frac{V_2^2 - V_1^2}{2g} = \frac{(8.82^2) - (24.44^2)}{2(32.2)}$$

$$= -8.06 ft$$

$h_A = 38.5 + 0 - 8.06$

$= 30.44 ft$

$$P_A = h_A \gamma Q$$

$$= (30.44)(56.16)(0.30067)$$

$$= 514.16 \ \frac{lb\text{-}ft}{s}\left(\frac{1 hp}{550 \ lb\text{-}ft/s}\right)$$

$$= 0.93 \ Hp$$

$$e_M = \frac{P_A}{P_M}$$

$$0.70 = \frac{0.93}{P_M}$$

$$P_M = \frac{0.93}{0.70}$$

$\underline{P_M = 1.33 \ Hp}$