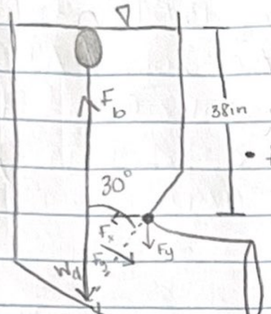
Test 1 - Fluids

a1)



$F_b = \rho_w V_d g$

$F_b \geq F_g$

$\cdot\ F_b = (62.42 \frac{lb}{ft^3})(0.303\ ft^3)(32.2 \frac{ft}{s^2})$

$F_b = 599.348 \frac{lb\,ft}{s^2}$

Table A.1

water @60°F $= \gamma = 62.4 \frac{lb}{ft^3}$

$\rho = 1.94 \frac{slugs}{ft^3}$

googled conversion: $\rho = 62.42 \frac{lb}{ft^3}$

$g = 32.2 \frac{ft}{s^2}$

$h = 38in \approx 3.167\ ft$

$F_g = P \cdot A = \rho_w h g \cdot A$

$F_g = (62.42 \frac{lb}{ft^3})(3.167 ft)(32.2 \frac{ft}{s^2}) \cdot (0.545 ft^2)$

$F_g = 3,414.137 \frac{lb\,ft}{s^2}$

assuming buoy is d=10in

sphere

$\hookrightarrow V_d = \frac{4}{3}\pi r^3 \Rightarrow \frac{4}{3}\pi(5in)^3$

$V_d = 523.6\ in^3 \approx 0.303\ ft^3$

$A_g = \pi r^2 \Rightarrow \pi(5in)^2 = 78.54 in^2 \approx 0.545 ft^2$

★ we don't know r for bouy

$V_d = \frac{4}{3}\pi r^3$

$F_b = F_g$

$\cdot\ (62.42 \cancel{\frac{lb}{ft^3}}) \frac{4}{3}\pi r^3 (\cancel{32.2 \frac{ft}{s^2}}) = (\cancel{62.42} \frac{lb}{ft^3})(3.167 ft)(\cancel{32.2 \frac{ft}{s^2}}) \cdot (0.545 ft^2)$

$\frac{4}{3}\pi r^3 = 1.726015\ ft^3$

$\boxed{r_b = 0.744 ft \approx 8.93 in}$

a2) Yes, as long as the center of buoyancy remains below center of gravity when submerged.

a4) $30° \frac{\pi}{180} = 0.5236$ rads (1)

$A_g = \frac{(5)^2}{2}(\theta - \cos\theta)$ (2)

$A_g = \pi r^2$

$\sqrt{\frac{A_g}{\pi}} = \sqrt{r^2}$

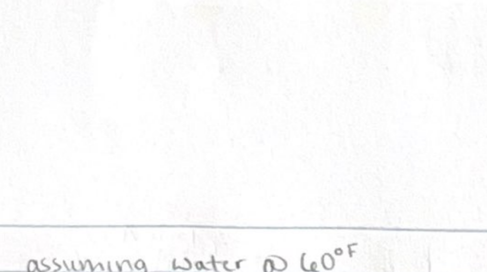
$r = \sqrt{\frac{A_g}{\pi}}$

The smallest buoy would be at 40° with a diameter of 1.04 in

With a larger buoy, the system would be more stable bc it has a greater F_b to resist other forces.

With a smaller buoy, the system would be less stable bc it's F_b is smaller and more susceptible to other forces.

b1) assuming water @ 60°F



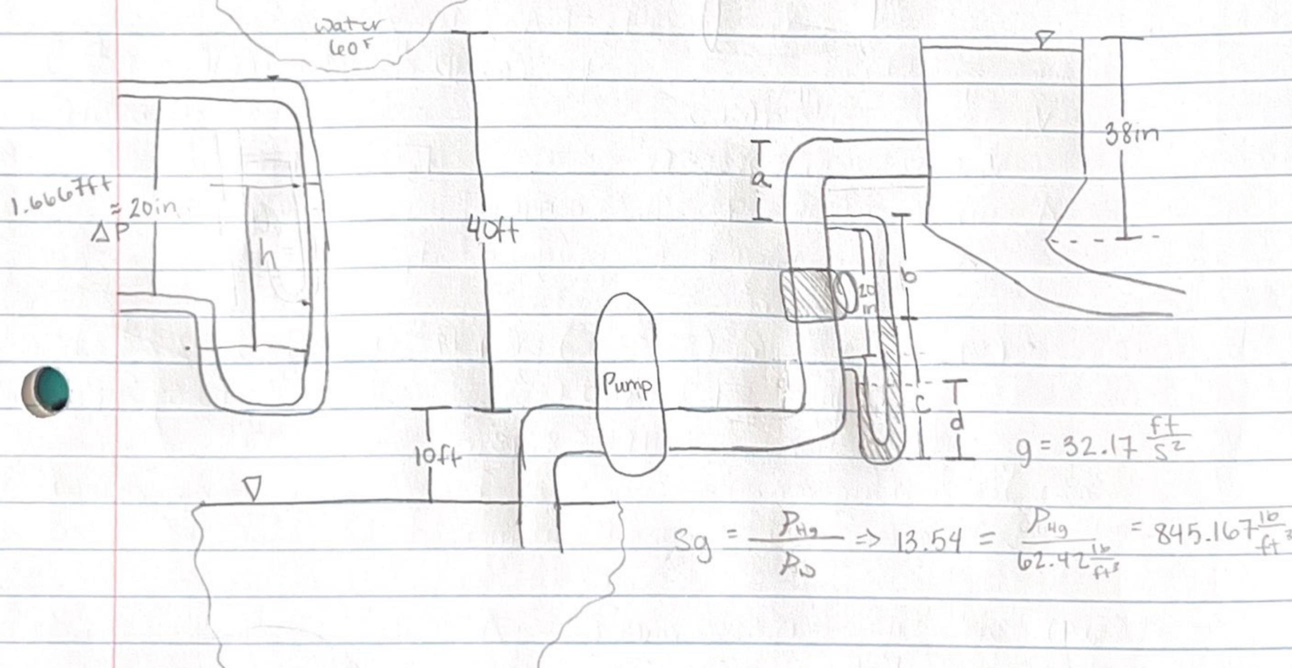
$Sg_{hg} = 13.54$ flowrate $= 3.387 \frac{ft^3}{s}$

$\Delta d = 20in$ $\Delta P = 3.393$ psi

water @ 60°F table A

$\gamma = 62.4 \frac{lb}{ft^3}$ $\rho = 1.94 \frac{slugs}{ft^3} = 62.42 \frac{lb}{ft^3}$

$\Delta P \approx 489.552 \frac{lb}{ft^2}$ $Q = 3.387 \frac{ft^3}{s}$



$g = 32.17 \frac{ft}{s^2}$

$$Sg = \frac{\rho_{Hg}}{\rho_w} \Rightarrow 13.54 = \frac{\rho_{Hg}}{62.42 \frac{lb}{ft^3}} = 845.167 \frac{lb}{ft^3}$$

$$\Delta P = \rho g h \Rightarrow 489.552 \frac{lb}{ft^2} = \left(845.167 \frac{lb}{ft^3}\right)\left(32.17 \frac{ft}{s^2}\right) h$$

$$h = \frac{\Delta P}{\rho g} \Rightarrow \frac{489.552 \frac{lb}{ft^2}}{\left(845.167 \frac{lb}{ft^3}\right)\left(32.2 \frac{ft}{s^2}\right)} = 0.01799\,ft \times 12 = h = 0.2159\,in$$

b2) no flow = no ΔP

$$h = \frac{0}{'' \quad ''} = 0$$

b4) 1 psi $\frac{1 \frac{lb}{ft^2}}{0.006944}$

Yes, my results make sense. As the valve pressure difference increases, so does the manometer reading. They both increase in a linear relationship.