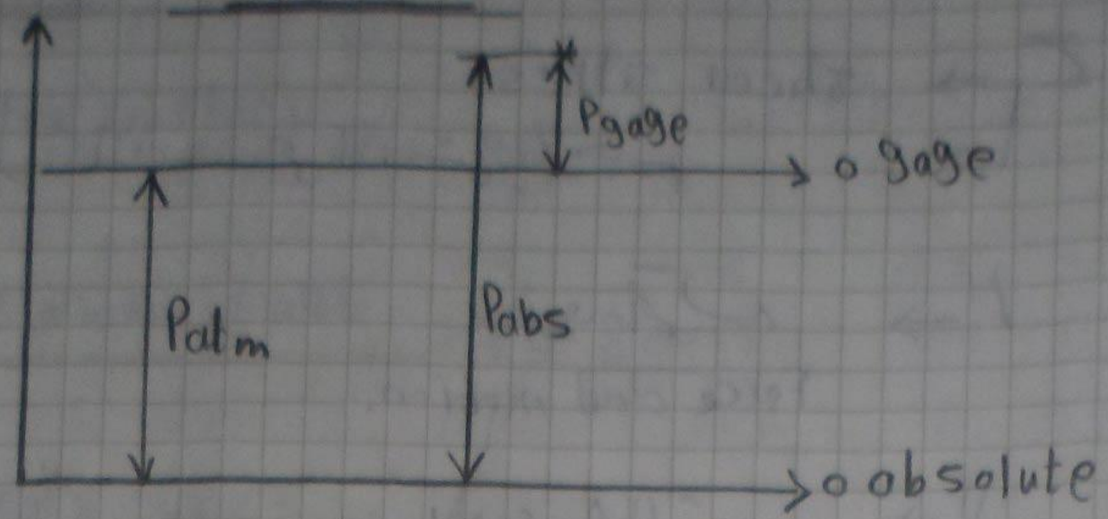
Sheet No. 2

1

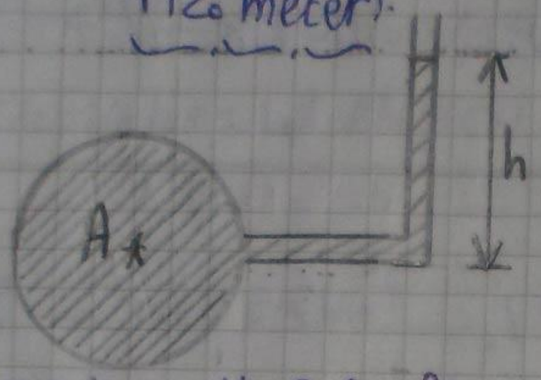
2

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



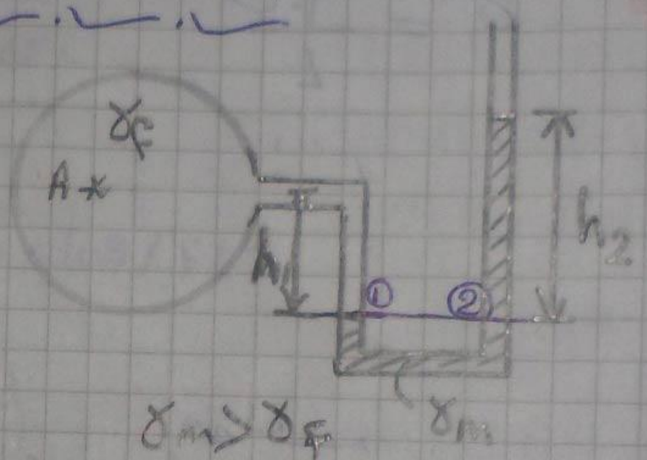
b

Piezometer:



measures +Ve gage Pressures of low magnitudes

Manometer:



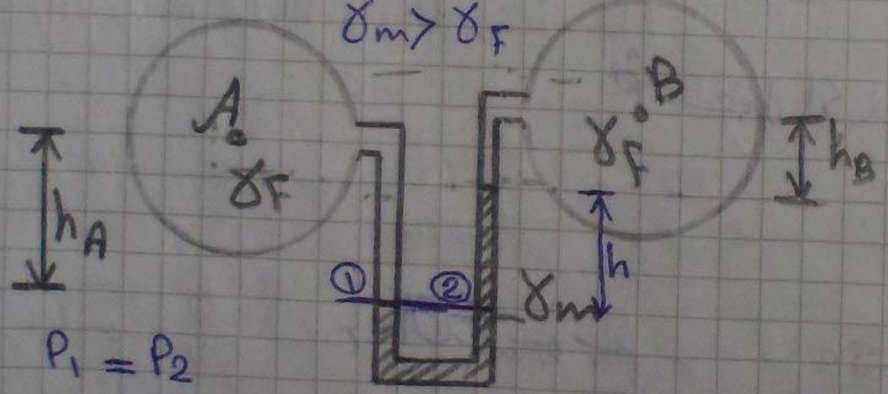
$\gamma_m > \gamma_f$

$P_1 = P_2$

$P_{Agage} = \gamma_m h_2 - \gamma_f h_1$

differential manometer:

$\gamma_m > \gamma_f$



$P_1 = P_2$

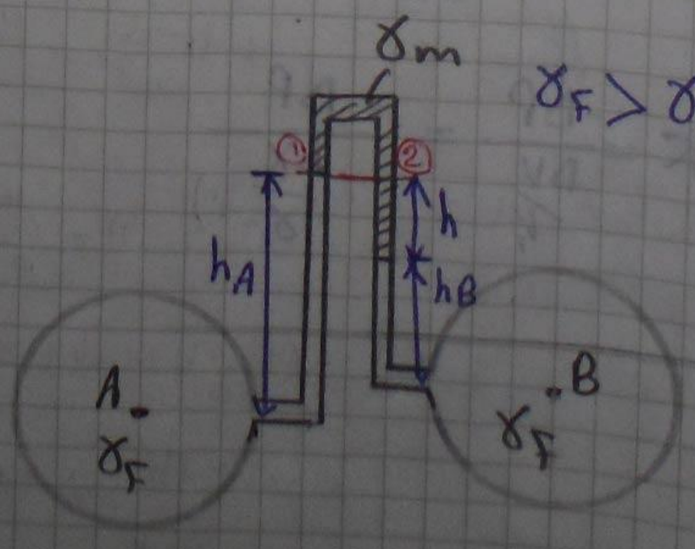
$P_A = -\gamma_f h_A$ & $P_B = -\gamma_f h_B - \gamma_m h$

$P_A - P_B = -\gamma_f h_A + \gamma_f h_B + \gamma_m h$

$P_1 = P_2$

$P_A = \gamma_f \gamma_A$, $P_B = \gamma_f h_B + \gamma_m h$

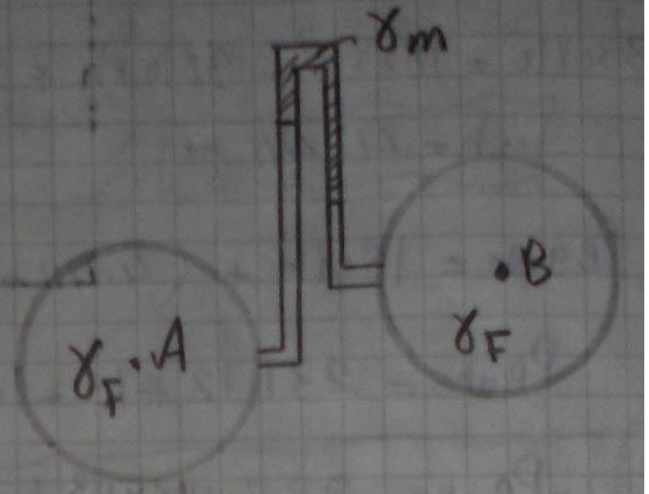
$P_A - P_B = \gamma_f \gamma_A - \gamma_f h_B - \gamma_m h$



(c) ① Can't measure (-Ve) Gage Pressure.
② measure Pressure only of low magnitudes.

(d) using lighter fluid

$\gamma_F > \gamma_m$



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(2) @ $P = 1.75\ kgw/cm^2 = \frac{1.75 * 9.81}{10^{-4}} = 171675\ N/m^2$ (P = γh)

① $171675 = 9810 * h_w$ ∴ $h_w = 17.5\ m$

② $\gamma = 0.85 \times 9810 = 8338.5\ N/m^3$

$\therefore h_{oil} = \frac{171675}{8338.5}$ ∴ $h_{oil} = 20.59\ m$

③ $\gamma = 13.6 \times 9810 = 133416\ N/m^3$

$h_{Hg} = \frac{171675}{133416}$ ∴ $h_{Hg} = 1.28\ m = 128\ cm$

(b) $h_w = 12\ m$

① $P = 12 \times 9810$ ∴ $P = 117720\ N/m^2$

$1\ lb = 4.44\ N$ $inch = 0.0254\ m$

$\therefore P = \frac{(117720)(0.0254)^2}{(4.44)}$ ∴ $P = $ ~~17.105~~ lb/in^2

② $h_{Hg} = \frac{117720}{13.6(9810)}$ ∴ $h_{Hg} = 0.88\ m$ ∴ $h_{Hg} = 88\ cm$

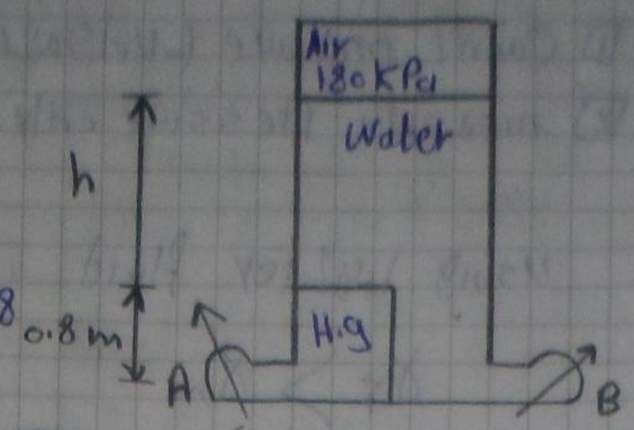
③ h = ? P_{Babs} = ?

$P_{Agage} = 330 \times 10^3 \ N/m^2$

$P_{Agage} = P_{air} + \gamma_w h_1 + \gamma_{H.g} * 0.8$

$330 \times 10^3 = 180 \times 10^3 + 9810 * h + 13600 \times 9.81 * 0.8$

$\therefore h = 4.411 \ m$



$P_{Bgage} = 180 \times 10^3 + (4.411 + 0.8) 9810$

$\therefore P_{Bgage} = 231.12 \ kPa$

$P_{Babs} = 231.12 * 10^3 + 101.3 \times 10^3$

$\therefore P_{Babs} = 332.42 \ kPa$

---

④ $h_{H.g} = -0.229 \ m$ $\gamma_{H.g} = 13600 \times 9.81$

$P_{H.g} = -30552.264 \ Pa$

$P_A = P_1 \ \gamma(h + 1.9)$

$P_A = \gamma_w (h + 1.9) + 0.197 \times 10^5$

$P_1 = \gamma_{1.6} h + \gamma_{oil} (36.1 - 32.2) - 30552.264$

$\therefore 9810(h + 1.9) + 0.197 \times 10^5 = 1.6 \times 9810 \times h + 0.9 \times 9810 * 3.9 - 30552.264$

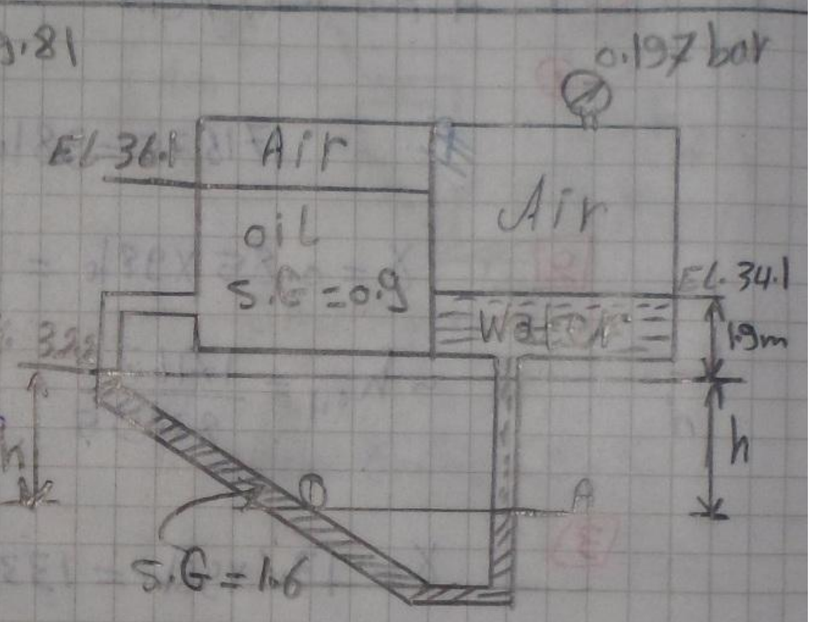
$\therefore 9810h - 1.6 \times 9810 h = 9810 * 1.9 - 15819.104$

$-5886 h = -34458.104$

$\therefore h = 5.85 \ m$

$\therefore EL \ A = 34 + 1.9 - 5.85$

$\therefore E.L. \ A. = 26.35$



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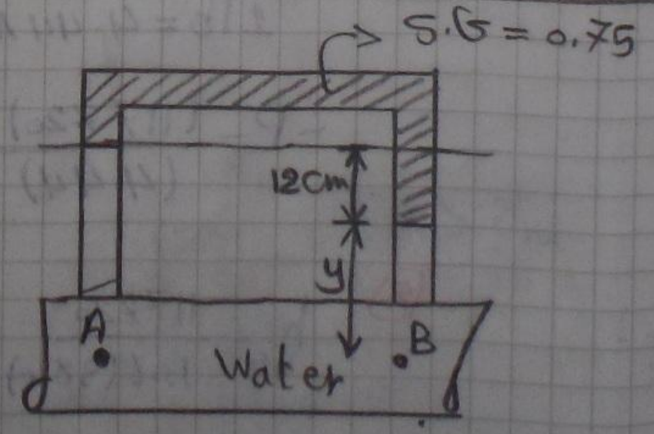
⑤ $P_A = \gamma_w (y + 0.12) = \gamma_w y + 12 \gamma_w$

$P_B = \gamma_w y + 0.12 (0.75 \times 9810)$

$P_A - P_B = .12(9810) - .12 * 0.75 * 9810$

$\therefore P_A - P_B = 294.30 \ Pascal$

$\therefore P_A - P_B = 2.943 \times 10^{-3} \ bar$



1 bar ⟶ 10^5 Pascal

? bar ⟶ 294.30

(6)(a) $P_A - P_B = ?$ oil

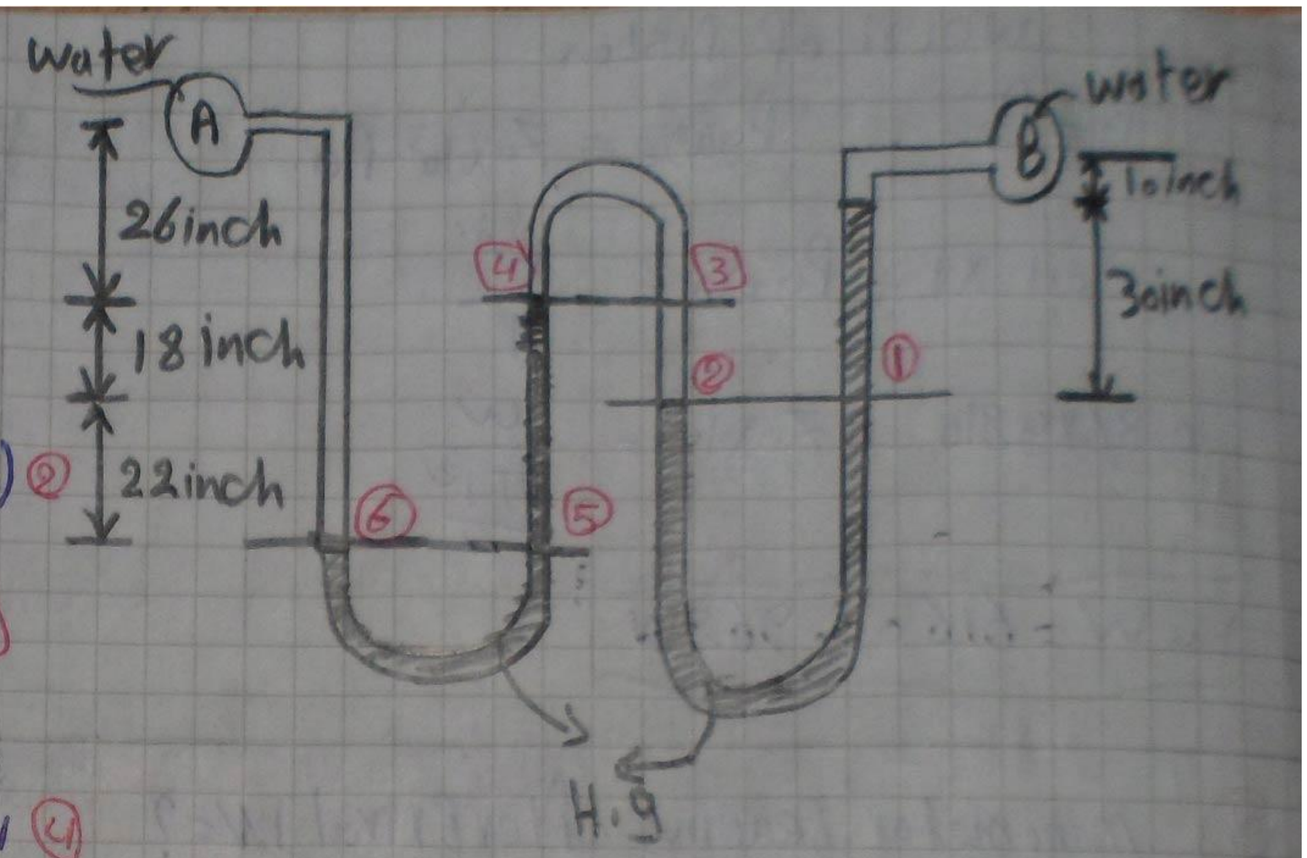
$P_1 = P_2$ & $P_3 = P_4$ & $P_5 = P_6$

$P_1 = (13600 \times 9.81)(30 \times 0.025u)$ (1)

$+ (9810)(10 \times 0.025u) + P_B$

$P_2 = P_3 + (0.8 \times 9810)(18 \times 0.025u)$ (2)

$P_6 = (9810)(66 * 0.025u) + P_A$ (3)



$P_5 = (13600 \times 9.81)(40 \times 0.25u) + P_4$ (4)

~~(1), (3)~~

~~$P_1 + 10662.552 + 2491.74 + P_B = 16445.48u + P_A - P_6$~~

~~$P_A = P_B$~~ $P_1 = P_2$

$\therefore 10445u.732 + P_B = P_3 + 3588.1056$ (5)

$P_5 = P_6$

$1355501.656 + Pu = 16445.48u + P_A$ (6)

$\therefore P_3 = Pu$ and soln (5,6)

$\therefore$ ~~P_3~~ $- P_B - 100566.6264 = -P_A$ ~~$+ Pu$~~ $+ 119105.172$

$P_A - P_B = 21967l.7984 \, N/m^2$

(6)(B)

Air

(6) (8)

Air

$P_1 = P_2$, ~~P_3~~ $P_3 = P_4$, $P_5 = P_6$

$P_1 = 13600 \times 9.81 \times 30 \times 0.025 u + 9810 \times 10 \times 0.025 u + P_B$

$\therefore P_1 = 10115u.732 + P_B \rightarrow (1)$

~~$P_2 = P_2$~~ $P_2 = P_3 \rightarrow (2)$

$P_6 = 9810 \times 66 \times 0.025 u + P_A$ $\therefore P_6 = 16115.48u + P_A \rightarrow (3)$

$P_5 = 13600 \times 9.81 \times 40 \times 0.025 u + P_4$ $\therefore P_5 = 135550.656 + P_4 \rightarrow (4)$

$\therefore P_1 = P_2 = P_3 = P_4$

$10115u.732 + P_B = P_3 \rightarrow (5)$

$16115.48u + P_A = 135550.656 + P_4 \rightarrow (6)$

$\therefore P_3 = P_4$

$\therefore$ ~~P_3~~ $- 10115u.732 - P_B = 135550.656$ ~~$+ P_4$~~ $- 16115.48u - P_A$

$\therefore P_A - P_B = 223259.90u \ N/m^2$

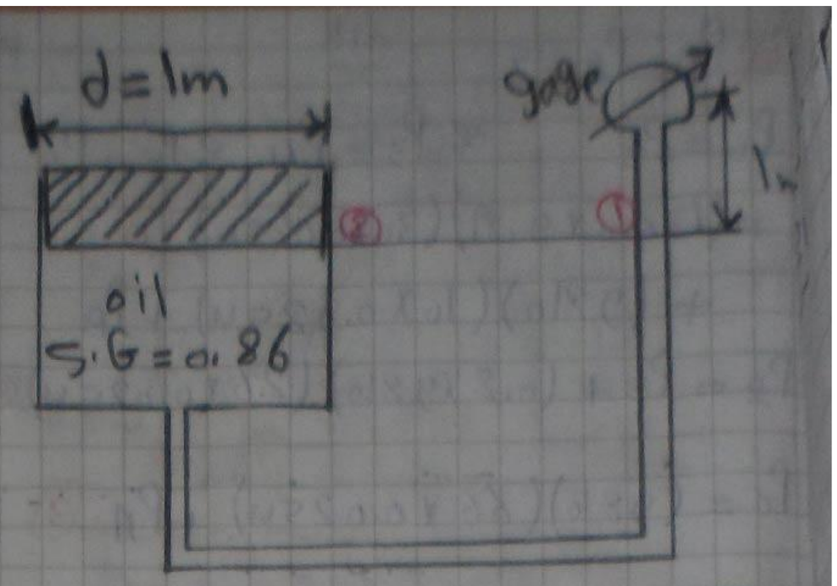
(7) Weigh of Piston

$P_1 = P_2$ $\quad P_{gage} = 70\times10^3$ Pa

$\gamma_{oil} \times 1 + P_{gage} = \frac{W}{A}$

$0.86\times9810 + 70\times10^3 = \frac{W}{\frac{\pi 1^2}{4}}$

$\therefore W = 61603.962$ N



(8) manometer reading after Extral 1N = ?

$P_1 = P_2$

$\gamma_{H.g}(0.075) = \gamma_{oil}(0.6) + P_{Pan}$ (W/A)

$13600\times9.81\times0.075 = 0.92(9810)(0.6) + \frac{W}{\frac{\pi 50^2}{4}}$

$\therefore W = 9.01$ N

after loading

$W = 10.01$ N

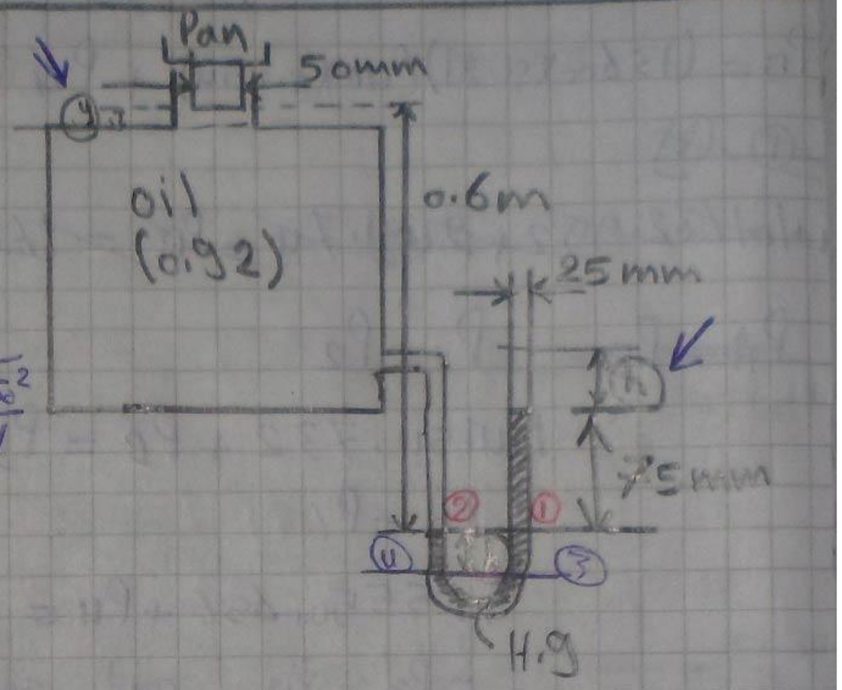
$P_3 = P_4$

$\gamma_{H.g}(0.075 + 2h) = \gamma_{oil}(0.6 + h - y) + \frac{W}{A}$

$\therefore 25^2 = 625 \quad \therefore 50^2 = 2500$

$\therefore \frac{2500}{625} = 4$

$\therefore y = 4h$



$\therefore 13600\times9.81(0.075 + 2h) = 0.92(9810)(0.6 + h - 4h) + \frac{10.01}{1.9\times10^{-4}}$

$10006.2 + 266832h = 5415.12 - 2707.5h + 5268.021$

$293907h = 677.341$

$h = 2.305\times10^{-3}$ m

$\therefore h = 2.305$ mm

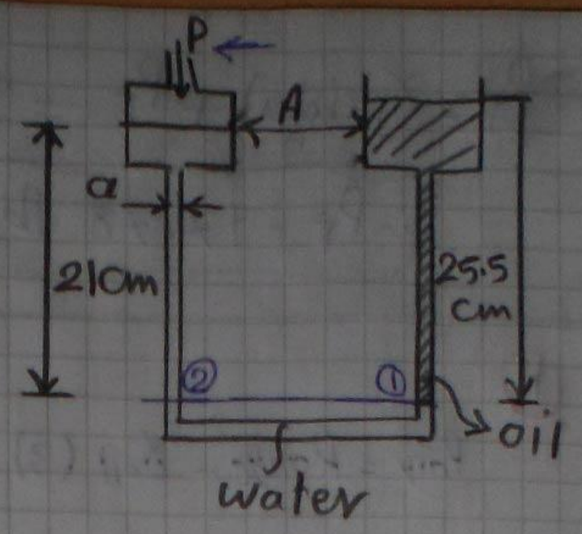
h + 75 mm

$\therefore$ Manometer reading after Extra 1N = 77.3mm

(9)

$S.G_{oil} = ?$ $\quad P = ?$ $\quad D = 3\,cm$

$A/a = 50 \leftarrow$



$P_1 = P_2$

$\gamma_{oil}(0.255) = \gamma_w(0.21)$

$\gamma_{oil}(0.255) = 9810(0.21)$

$\therefore \gamma_{oil} = 8078.82\mu\ N/m^3$

$S.G_{oil} = \dfrac{\gamma_{oil}}{\gamma_w} = \dfrac{8078.82\mu}{9810}$

$\therefore S.G_{oil} = 0.82\mu$

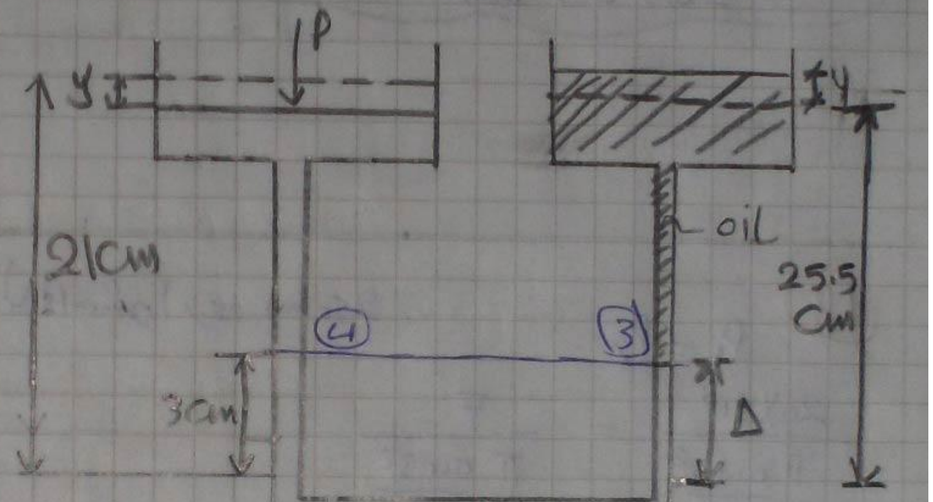
after loading :-

$\Delta Volume = Constant$

$Ay = a\Delta$

$(50a)\,y = a(0.03)$

$\therefore y = 6\times10^{-4}\,m$



$P_3 = P_4$

$\therefore \gamma_{oil}(0.255 - 0.03 + 6\times10^{-4}) = \gamma_w(0.21 - 0.03 - 6\times10^{-4}) + P$

$1822.583 = 1759.914 + P$

$\therefore P = 62.669\ Pascal$

(10) $P_A = 1.2\,bar = 1.2\times10^5\ Pascal$

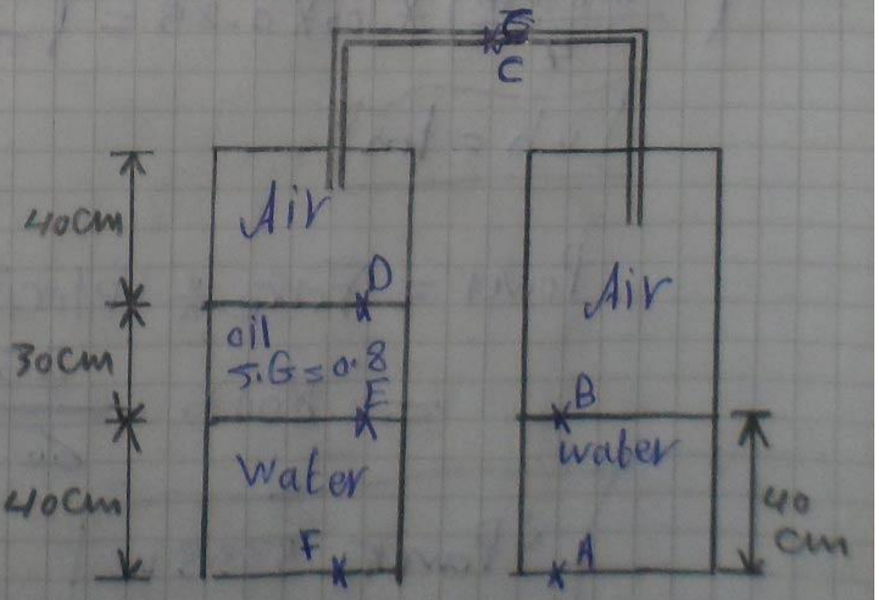
$P_B = P_A - \gamma_w(h) = 1.2\times10^5 - 9810(0.4)$

$\therefore P_B = 116076\ Pascal = 1.16076\,bar$

$P_B = \dfrac{116076(0.0254)^2}{4.44}$

$\therefore P_B = 16.871\,lb/inch^2$

$P = \gamma h$ $\quad \therefore h = 38.81\,ft$



$P_B = P_C = P_D = 1.16076\,bar = 16.871\,lb/inch^2$

$P_E = \gamma_{oil}(0.3) + P_D = 0.8\times9810\times0.3 + 116076 = 118430\ Pascal$

$\therefore P_E = 1.18\,bar$
$= 17.21\,lb/inch^2$

$P_T = \gamma_w(out) + P_E = 9810(out) + 11830 = 122350$ Pascal

$\therefore P_T = 17.78$ lb/inch^2 $= 1.22$ bar

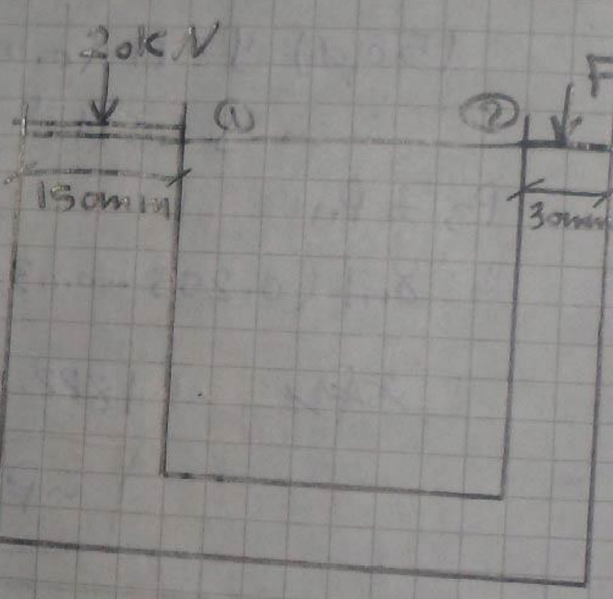
(11)

$P_{air} = P_{gage} - \gamma_{oil}(3) - \gamma_{H.g}(0.65) - \gamma_w(1.5)$

$P_{air} = 2\times10^5 - 0.75\times9810\times3 - 13600\times9.81\times0.65 - 9810\times1.5$

$\therefore P_{air} = 76492.1$ Pascal

$= 0.765$ bar



(12)

$P_1 = P_2$

$\frac{20\times10^3}{\pi\frac{0.15^2}{4}} = \frac{F}{\pi\frac{0.03^2}{4}}$

$\therefore F = 800N$

250mm = ربع متر

$V_d = V_u$ الحجم اللي هتنزله = الحجم اللي هتطلعه

$(\frac{0.03^2\times\pi}{4}) * 100 * 0.25 = (\frac{0.15^2\times\pi}{4})\, h$

$\therefore h = 1m$

Power = Force * Velocity

$= 800 * \frac{25}{60}$

$\therefore$ Power = 333.3 W