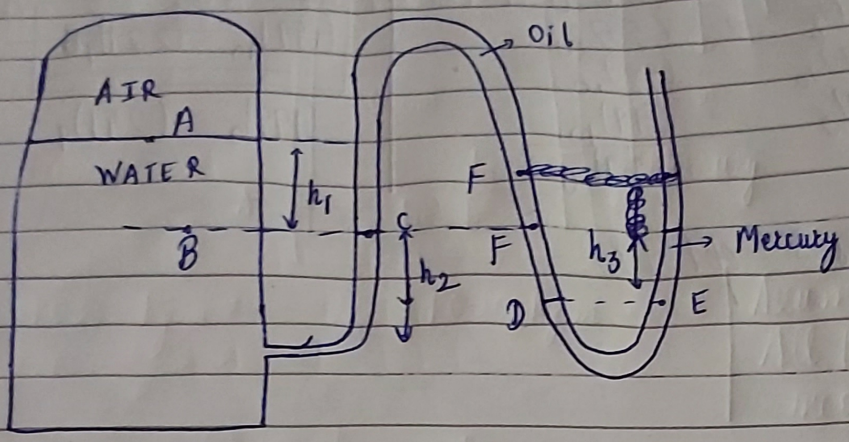
Jitesh Jain [1911 4039] MIN-106 Tutorial 1

O-2

Ans. 1



$\rho_w = 1000\ kg\ m^{-3}$ $\rho_{oil} = 850\ kg\ m^{-3}$ $\rho_{Hg} = 13600\ kg\ m^{-3}$

$h_1 = 0.2m$ $h_2 = 0.3m$ $h_3 = 0.46\ m$

① $\Rightarrow P_D = P_E$

$\Rightarrow P_D = P_{atm} + \rho_{Hg} h_3 g$

② $P_F = P_D - \rho_{oil} g h_2$

$= P_{atm} + \rho_{Hg} h_3 g - \rho_{oil} h_2 g$

③ $P_F = P_C = P_B$

④ $P_A = P_B - \rho_{water} g h_1$

$P_A = P_{atm} + \rho_{Hg} g h_3 - \rho_{oil} h_2 g - \rho_{water} g h_1$

$= 1\ kPa + [(13600)(9.8)(0.46) - (850)(0.2)(9.8) - (1000)(0.3)(9.8)] \times 10^{-3}$

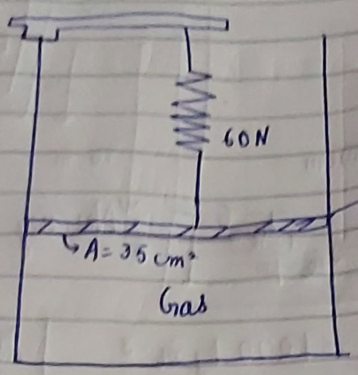
$P_{gauge} = P_A - P_{atm} \approx \boxed{56.9\ kPa}$

Assumptions

① Pressure of Air is uniform (as its density is ~~much~~ ~~small~~ too less as comp. to those of the liquid)

② Liquids are incompressible

Ans 2



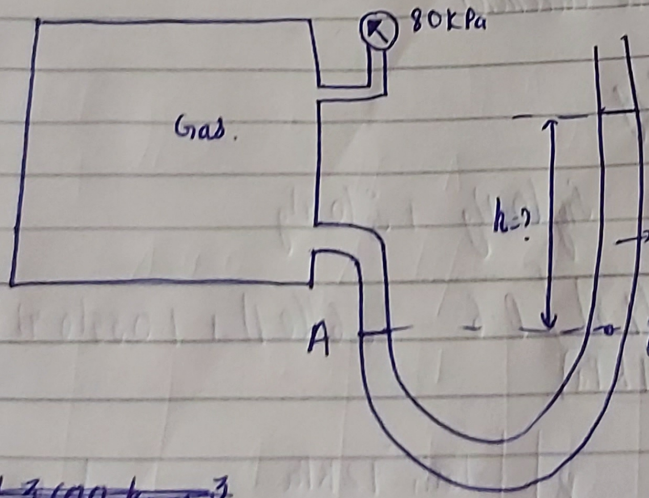
$$P_{gas} = P_{atm} + P_{piston} + P_{spring}$$

$$\Rightarrow P_{gas} = 95\,kPa + \left(\frac{4\times(9.81)}{35\times10^{-4}}\right)10^{-3} + \left(\frac{60}{35\times10^{-4}}\right)10^{-3}$$

$$\approx 123.84\,kPa$$

Assumptions
① Piston is in eqm
② Gas is not compressed into a liquid.

Ans 3



~~(a) $\rho = 13600\,kg\,m^{-3}$~~

① $P_A = P_B \Rightarrow P_{gas} = P_B$ ~~$\rho_g h$~~

$\Rightarrow P_c = P_B - \rho_g h = P_{gas} - \rho_g h = 0$ [As gauge is there]

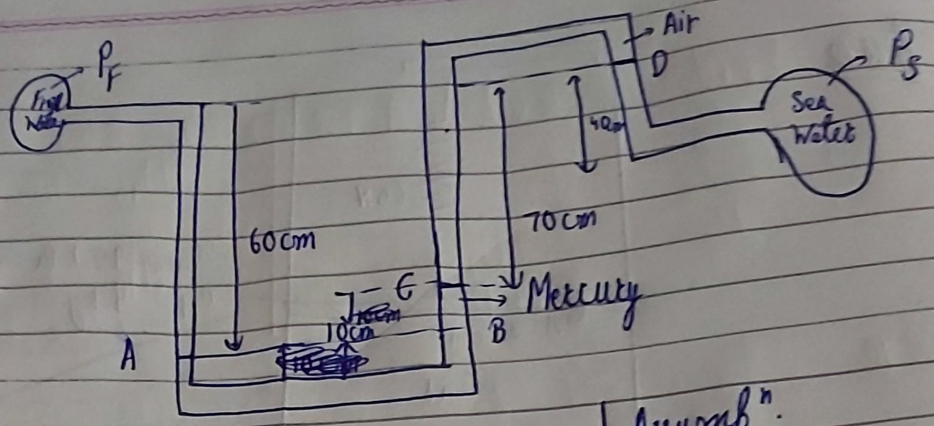
$\therefore h = \frac{P_{gas}}{\rho_g}$

Assumptions:
liquid is incompressible

ⓐ $\rho = 13600\,kg\,m^{-3} \Rightarrow h = 0.6\,m$

ⓑ $\rho = 1000\,kg\,m^{-3} \Rightarrow h = 8.16\,m$

Ans. 4



$\rho_{sea} = 1035\ kg\,m^{-3}$ $\quad \rho_W = 1000\ kg\,m^{-3}$

$\rho_{Hg} = 13600\ kg\,m^{-3}$

Assumpⁿ:
All fluids are incompressible

① $P_A = P_F + \rho_W (60)(10^{-2}) g = P_B$

② $P_C = P_B - \rho_{Hg}(0.1)g = P_F + \rho_W(0.6)g - \rho_{Hg}(0.1)g$

③ $P_C = P_B$ (as air column)

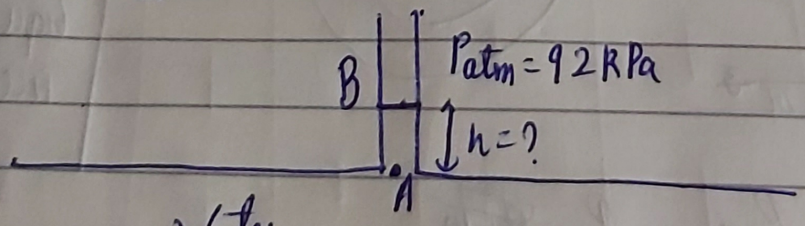
④ $P_S = P_D + \rho_S(0.4)g$

$\Rightarrow P_S = P_F + (\rho_W)(0.6)g - \rho_{Hg}(0.1)g + \rho_S(0.4)g$

$\Rightarrow P_S - P_F = (10^3)(9.8)\left[0.6 - (13.6)(0.1) + 1.035(0.4)\right]$

$= \boxed{3.39\ kPa}$

Ans. 5



$P_A = 115\ kPa$

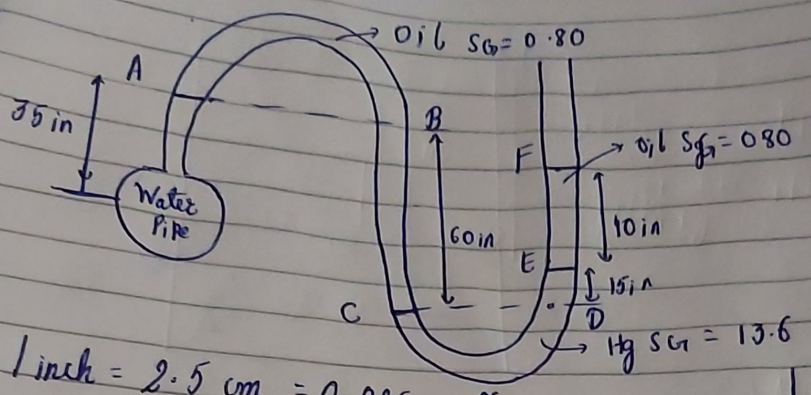
$P_{atm} + \rho_W g h = P_A$

$\Rightarrow \boxed{h = \frac{23}{9.8} = 2.346\ m}$

Assumption:

① A is a still point in the water column

Ans.6



All fluids are incompressible.

let 1 inch = 2.5 cm = 0.025 m = x

① $P_A = P_w - \rho_w (35x) g = P_B$

② $P_C = P_B + \rho_{oil} (60x) g$

$= P_w - \rho_w (35x) g + \rho_{oil} (60x) g = P_D$

③ $P_E = P_D - \rho_{Hg} (15x) g$

④ $P_F = P_{atm} = P_E - \rho_{oil} (40x) g$

Putting all together:

$$92\ kPa = P_w - \rho_w (35x) g + \rho_{oil} (60x) g - \rho_{Hg} (15x) g - \rho_{oil} (40x) g$$

$$\Rightarrow P_w = 92\ kPa + [35 - (0.8)(20) + (15)(13.6)] (0.025)(9.8)$$

$$\approx \boxed{146.635\ kPa}$$