Pressure and Depth Problems

1. Blood is poured into the left side of a U-shaped tube until the water height on the left side is 0.8 m. What is the height of water on the right side?

a. find the total pressure at the top and bottom of the tube.

b. now gasoline is poured into the left side. It does not mix with the blood, so a layer of 0.70 m of oil sits atop the blood in the left side.

Find the pressures at the top and bottom of the tube and the total height of fluid on each side.

Prob11. A 35 cm tall, 5.0 cm diameter cylindrical beaker is filled its brim with water. What is the downward force of the water on the bottom of the beaker?

prob 10. A 1.0 m diameter open vat of liquid is 2.0 m deep. The pressure at the bottom of the vat is 1.3 atm. Find the density and mass of liquid in the vat.

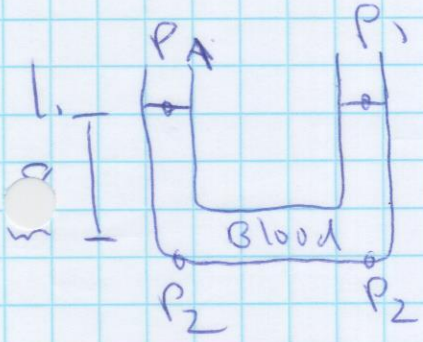
4. An open cylinder contains a depth of 8 cm of mercury. Floating on top of the mercury is a layer of 110 cm of ethyl alcohol. Find the pressures at the top, the ethyl/mercury interface, and the bottom of the cylinder.

Prob.18 Glycerin is poured into an open U-shaped tube until the height in both sides is 20 cm. Ethyl alcohol is then poured into the left arm until the height of the alcohol is 20 cm. The two liquids do not mix.

a. do you expect the left side to contain only ethyl, or ethyl on top of glycerin?

b. do you expect the right side to contain only glycerin, or glycerin on top of ethyl? Explain your reasoning for these.

c. find the height difference between the top surface of the glycerin and the top surface of the ethyl.



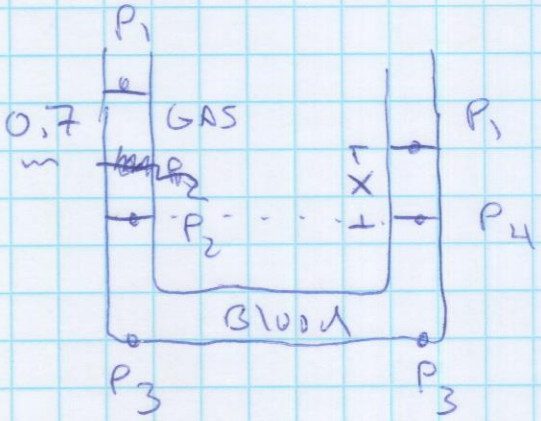
$P_1 = P_{Atm}$

$P_2 = P_1 + \rho g d$

$P_2 = 1.013 \times 10^5 + (1060)(9.8)(0.8)$

$= 1.013 \times 10^5 + 8.31 \times 10^3$

$= 1.096 \times 10^5$



What is P_4? Discuss.

$P_2 = P_{Atm} + (\rho g d)_{GAS}$

$P_4 = P_{Atm} + (\rho g x)_{BLOOD}$

$P_2 = P_4$

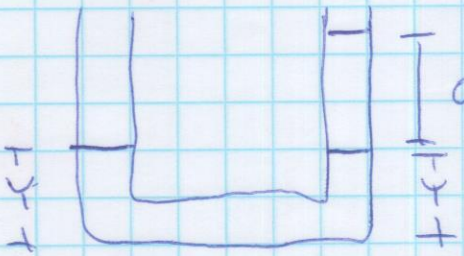
$P_{Atm} + (\rho g d)_{GAS} = P_{Atm} + (\rho g x)_{BLOOD}$

$(680)(9.8)(0.7) = (1060)(9.8)\, x$

$x = 0.45$ m

Has total mass of blood changed?

" " volume?



Originally had

$0.8 + 0.8 = 1.6$

Now

$y + y + 0.45 = 1.6$

still

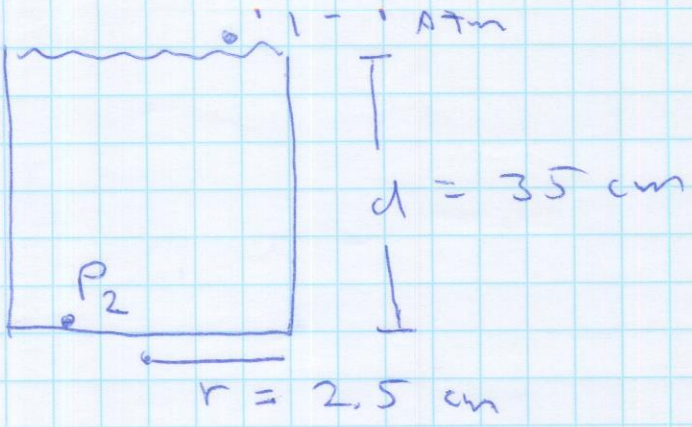
$2y + 0.45 = 1.6$

$y = 0.575$ m

Left: 0.575 m blood + 0.7 m Gas.

Right: $0.575 + 0.45 = 1.025$ m Blood

13 - 11



$$P_2 = P_1 + \rho g d$$

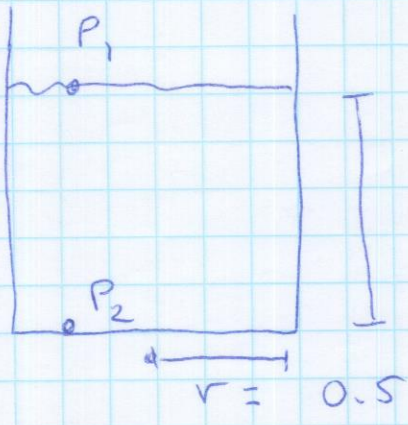
$$P_2 = 1.013 \times 10^5 \ N/m^2 + (1000)(9.8)(0.35)$$
$$\qquad\qquad\qquad\qquad\quad kg/m^3 \quad m/s^2 \quad m$$

$$P_2 = 104730 \ N/m^2$$

and $P = F/A$

$$F = PA$$
$$= (104730 \ N/m^2)\,\pi(0.025 \ m)^2$$
$$= 205 \ N$$

13 - 10



Assume container is open to atmosphere at top.

$P_1 = 1\ Atm = 1.013 \times 10^5\ N/m^2$

$P_2 = 1.3\ Atm = 1.317 \times 10^5\ N/m^2$

$$P_2 = P_1 + \rho g d$$

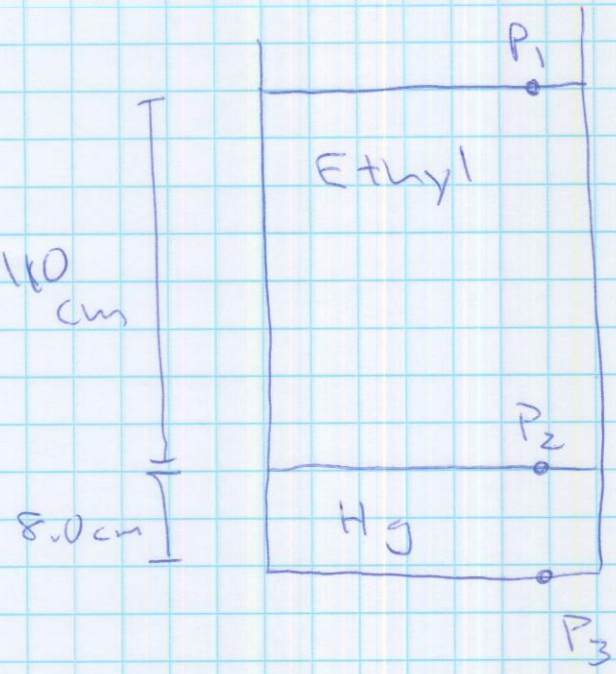
$$1.317 \times 10^5\ N/m^2 = 1.013 \times 10^5\ N/m^2 + \rho\,(9.8\ m/s^2)(2.0\ m)$$

$$\rho = 1550\ kg/m^3$$

$$V = \pi r^2 d$$
$$= \pi (0.5\ m)^2 (2.0\ m)$$
$$= 1.57\ m^3$$

$$m = \rho V$$
$$= (1550\ kg/m^3)(1.57\ m^3)$$
$$= 2430\ kg$$

4. $P_1 = P_{Atm.}$



$$P_2 = P_1 + \rho g d$$

$$P_2 = 1.013 \times 10^5 + (790)(9.8)(1.10)$$

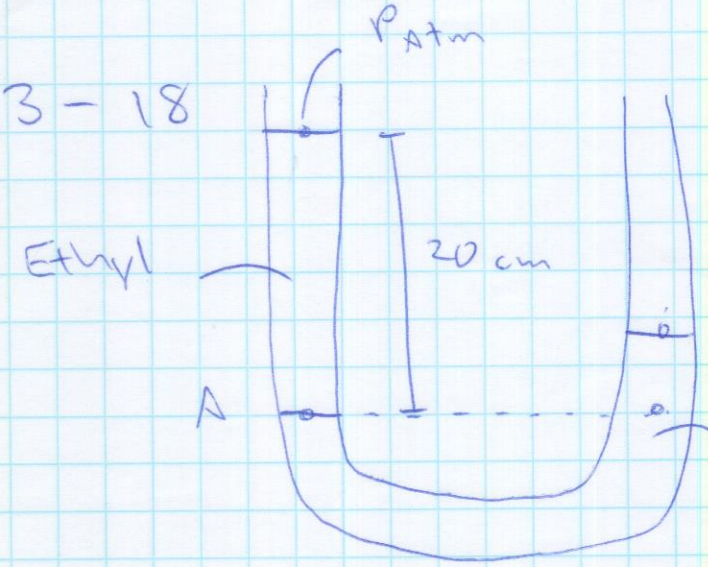
$$P_2 = 1.10 \times 10^5 \ N/m^2$$

$$P_3 = P_2 + \rho g d$$

$$P_3 = 1.1 \times 10^5 + (13,600)(9.8)(0.08)$$

$$P_3 = 1.21 \times 10^5 \ N/m^2$$

13 - 18



Open at both ends.

A and B are at same level.

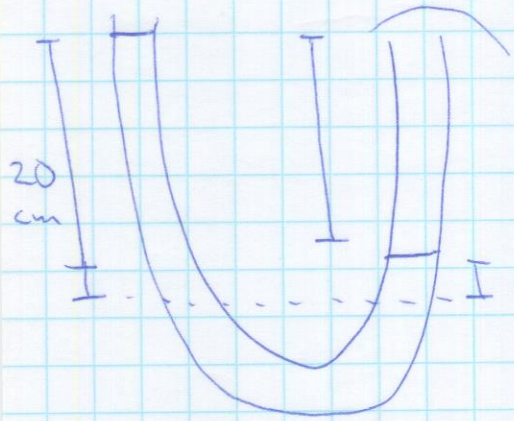
A is bottom of the Ethyl.

$$P_A = P_B$$

$$P_{Atm} + \underbrace{\rho g (0.20\ m)}_{\text{Only Ethyl above pt. A}} = P_{Atm} + \underbrace{\rho g x}_{\text{Only Glycerine above pt B}}$$

$$(790\ kg/m^3)\, g\, (0.20\ m) = (1260\ kg/m^3)\, g\, x$$

$$x = 0.125\ m = 12.5\ cm$$



Difference in heights = Δy

$$\Delta y + x = 20\ cm$$
$$\Delta y = 20 - 12.5$$
$$= 7.5\ cm$$