HOMEWORK 9 SOLUTIONS

Note Title 1/4/2006

(C3.) $P = \frac{F}{A}$. EVEN A LIGHT WOMAN (OR MAN) WEARING STILETTO HEEL WILL GENERATE LARGE AMOUNTS OF PRESSURE!

$A = 1\,cm \cdot 1\,cm = 1\,cm^2$

$= .0001\,m^2$!

(C6.) NO, EVEN A VERY LONG SNORKEL WOULD NOT WORK WELL. IF THE OUTSIDE PRESSURE IS TOO HIGH, IT WOULD NOT BE POSSIBLE TO FORCE AIR INTO YOUR LUNGS. THAT IS WHY THEY USED TO USE METAL "IRON DIVE SUITS"

(C10.) THE DENSITY OF ALCOHOL IS LOWER THEN THAT OF WATER, AND THAT OF ICE.
IN PURE ALCOHOL, ICE CUBES SHOULD SINK.

P.3) REMEMBER THAT HEELS ARE HIGH STRESS.

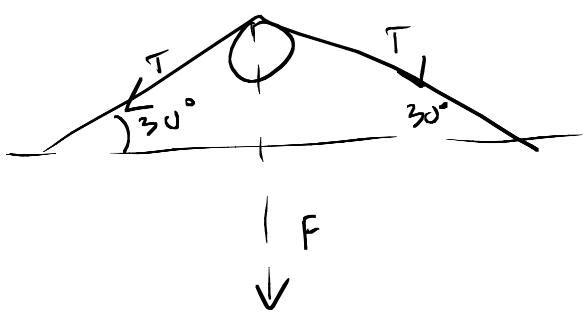
$$\text{STRESS} = \frac{F}{A} \qquad F = 30\% \text{ OF } 480$$

$$= .3 \cdot 480\,N$$

$$A = \pi r^2 = \pi(.005\,m)^2$$

$$\text{STRESS} = \frac{.3 \cdot 480\,N}{\pi(.005)^2} = 1.8 \times 10^6 \, N/m^2 \; !$$

P6.)



$$L_0 = 3.1\,cm = .031\,m \qquad r = .11\,mm = .11 \times 10^{-3}\,m = 1.1 \times 10^{-4}\,m$$

$$\Delta L = 5 \times 10^{-4}\,m$$

$$T = AY \frac{\Delta L}{L_0}$$

$$= \frac{\pi(1.1 \times 10^{-4}\,m)^2 (5 \times 10^{-4}\,m)}{.031\,M} \cdot 18 \times 10^{10}\,Pa$$

$$T = 55N$$

$$= 110N \text{ TOTAL}$$

$$F = 2 \cdot 55 \cdot \sin 30$$

$$= 55N \downarrow .$$

P7.) $Y = 18 \times 10^9\,Pa \qquad L_0 = .50\,m$

IF A FEMUR IS .50 M, AND CAN BE STRESSED BY $1.6 \times 10^8\,Pa$, WE CAN SOLVE EQ 9.3 FOR OUR ANSWER.

$$\frac{1.6 \times 10^8\,Pa \cdot L_0}{Y} = \Delta L = .0044\,M = 4.4\,mm.$$

P12)

$A = 2.4\,cm^2 = 2.4\times10^{-4}\,m^2$

$$a = \frac{\Delta V}{\Delta t} = \frac{80000\,m/s}{5\times10^{-3}\,s} = 16\times10^{6}\,m/s^2$$

$F = ma = 4.8\times10^{7}\,m/s^2$

$$F/A = \frac{4.8\times10^{7}\,m/s^2 \cdot N}{2.4\times10^{-4}\,m^2} = 2\times10^{11}\,Pa.$$

No. THE ARM IS NOT LIKELY TO REMAIN UNSHATTERED.

P17)

$P_{MAX} = 1.7\times10^{7}\,Pa$ $\qquad$ $3.4\times10^{2}\,m$

$P = \frac{F}{A}$ $\qquad$ $F = mg$ $\qquad$ ASSUME $A = 1\,m^2$

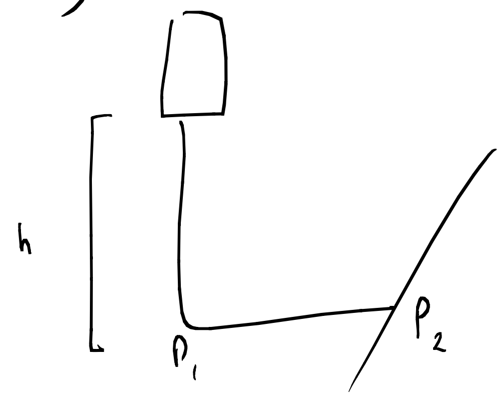
$1.7\times10^{7}\,Pa = mg$

IF $A = 1\,m^2$, THEN EACH METER OF HEIGHT ADDS 5×10^{4} N. THEREFORE,

$1.7\times10^{7}\,Pa = 5\times10^{4}\,N \cdot h$

$$h = \frac{1.7\times10^{7}\,Pa}{5\times10^{4}\,N} = 3.4\times10^{2}\text{ METERS.}$$

P19.)



SPECIFIC GRAVITY IS A COMPARISON OF THE DENSITY OF A LIQUID TO THAT OF WATER. THEREFORE, THE DENSITY OF THE LIQUID IS $1.02 \cdot \rho_{H_2O} = 1.02 \times 10^3\ kg/m^3$

GAUGE PRESSURE IS THE PRESSURE OVER ATMOSPHERIC.

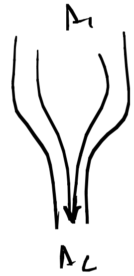
$P_2 = 1.33 \times 10^3$

$\Delta P = P_1 - P_2 > 0$ FOR INFUSION OF THE LIQUID.

$= \rho g h - P_2$

$h_{min} = \dfrac{P_2}{\rho g} = 13\ cm.$

44)



$$A_1 v_1 = A_2 v_2$$

$$A_1 (15\,cm/s) = A_2 (30\,cm/s)$$

$$2A_2 = A_1$$

BECAUSE $P = \frac{F}{A}$, THE PRESSURE DROPS BY A FACTOR OF 2.

54) SURFACE TENSION: $.058\ N/m$

$\rho = 1.05 \times 10^{3}\ Kg/m^3$

$r = 2.0 \times 10^{-6}\ m$

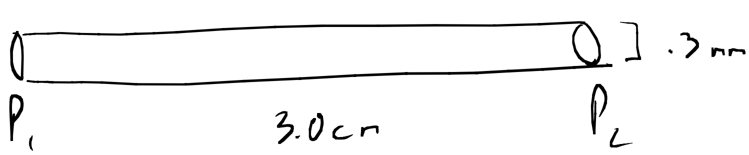
$\theta = 0.$

USE EQUATION 9.22

$$h = \frac{2\gamma \cos\theta}{\rho g r} \Rightarrow h = \frac{2 \cdot .058\,N/m}{1.05 \times 10^3\,Kg/m^3 \cdot 9.8\,m/s^2 \cdot 2.0 \times 10^{-6}\,m}$$

$$= 5.6\ M.$$

62.) $v = 1g/s$, $V_{1s} = 1 \times 10^{-3}\ Pa \cdot s$ $\qquad P_1 = ?$



ASSUME $P_2 = 1atm$.

FROM POISEUILLE'S LAW:

$$\frac{\Delta V}{\Delta t} = \frac{\pi r^4 (P_1 - P_2)}{8 \eta L}$$

85 31 404 Pa?

THEREFORE,

$$\frac{\Delta V}{\Delta t} \cdot \frac{8\eta L}{\pi r^4} = (P_1 - P_2)$$

$$\frac{\Delta V}{\Delta t} \cdot \frac{8\eta L}{\pi r^4} + P_2 = P_1$$

$1\,ATM = 1.01 \times 10^5\ Pa$

$r = 3 \times 10^{-4}\ M \cdot \frac{1}{2}$

$\eta = 1 \times 10^{-3}\ Pa \cdot S$

$L = 3 \times 10^{-2}\ M$

$\frac{\Delta V}{\Delta t} = 1 \times 10^{-3}\ Kg/s$

PLUGGING IN NUMBERS, WE

GET $P_1 = 9.5 \times 10^6\ Pa$

63.)

$V = 500\,cm^3$

$L = 2.5\,cm$

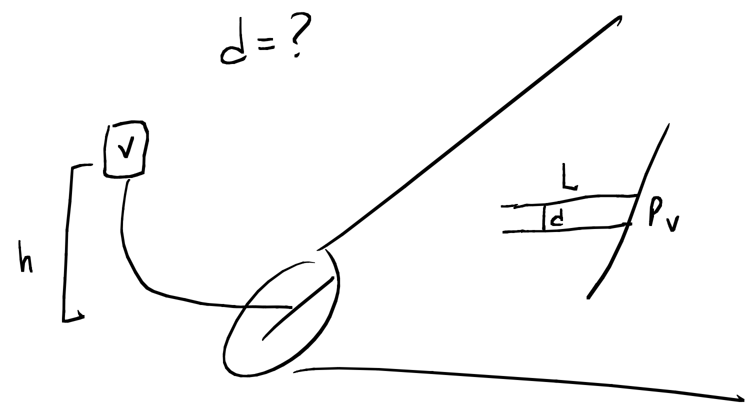
$h = 1.0\,m$

$\eta = 1 \times 10^{-3}\ Pa \cdot S$

$P_v = 1.01 \times 10^5\ Pa$

$t = 30\ min$

$d = ?$



REMEMBER EXAMPLE 9.18.

$$\frac{\Delta V}{\Delta t} = \frac{\pi r^4 (P_1 - P_2)}{8\eta L} \Rightarrow d = 2\left(\frac{\Delta V}{\Delta t} \frac{8\eta L}{\pi (P_1 - P_v)}\right)^{1/4}$$

WE NEED TO KNOW $P_1 - P_v$. WELL, BECAUSE P_v IS 1 ATM,

$P_1 - P_v = \rho g h \qquad \rho = 1 \times 10^3\ kg/m^3 \qquad g = 9.8\ m/s^2$

$$\frac{\Delta V}{\Delta t} = \frac{500\,cm^2}{30\,MIN} = \frac{5 \times 10^{-4}\ m^3}{1800\,s} = 2.7 \cdot 10^{-7}\ M^3/s$$

NOW, WE PLUG IN.

$$d = 2\left(2.7 \times 10^{-7}\ \frac{m^3}{s}\left(\frac{8(1 \cdot 10^{-3}\ Pa \cdot s) \cdot (.025\ M)}{\pi\ (1 \cdot 10^3\ Kg/m^3)(9.8\ m/s^2)}\right)\right)^{1/4} = .4\ mm$$