15-3, 10, 21 ● on Final

3. $T = 1.2s$ $f = 1/T = .83\ Hz$ $\omega = 2\pi f =$
$5.23\ rad/s$

b) $A = ?$ $.2$ to $-.2 = .4$

c) $x = A\cos(\omega t)$ (max at $t=0$)

$x=0$ when $\cos(\omega t) = 0$ $\omega t = \pi/2$

$(5.23\ rad/s)t = \pi/2$ $t = .3\ s$

d $x = .2\cos(\omega t)$

$v = -\omega(.2)\sin(\omega t)$

put $t = .3s$ $\rightarrow v = \left(-5.23\ \frac{rad}{s}\right)(.2)$
$\sin\left(5.23\ \frac{rad}{s}(.3s)\right)$

$= -1.04\ m/s$

10) $\omega = 2\pi f = 2\pi(261.7\ Hz) = 1644\ rad/s$

$T = 1/f = 3.82 \times 10^{-3}\ s$

$V_{max} = A\omega$ $a_{max} = A\omega^2$

21

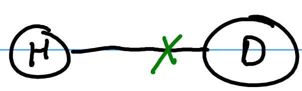
$$\omega = \sqrt{\frac{K}{m}} \quad \text{so} \quad f = \sqrt{\frac{K}{m}} \Big/ (2\pi)$$

$$f_{H_2} = 1.31 \times 10^{14}\ Hz = \frac{\sqrt{\dfrac{K}{(2)(1.7 \times 10^{-27}\ Kg)}}}{2\pi}$$

so

$$K = \left((2\pi)\ 1.31 \times 10^{14}\ Hz\right)^2 (2)\left(1.7 \times 10^{-27}\ kg\right)$$

$$= 2.3 \times 10^{3}\ N/m$$

so for 

$$f = \frac{1}{2\pi}\sqrt{\frac{K}{m}} \qquad m \simeq 3 \times 1.7 \times 10^{-27}\ Kg$$

$$\text{so } f = \frac{1}{2\pi}\sqrt{\frac{2.3 \times 10^{3}\ N/m}{3 \times 1.7 \times 10^{-27}\ Kg}}$$

$$= 1.1 \times 10^{14}\ Hz$$

16) 3, 7, 25, 44, 45, 56, 62

3) $V = f\lambda$ $\qquad f \sim 6\frac{1}{2}$ cycles / 3hrs

$$= \frac{6.5}{(3600s)3} = 6 \times 10^{-4}\ Hz$$

so $\frac{740\ Km}{hr} = (6 \times 10^{-4}\ Hz)\ \lambda$

$$\frac{740\ Km\left(\frac{1000m}{Km}\right)}{hr\left(\frac{3600s}{hr}\right)} = (6 \times 10^{-4}\ Hz)\ \lambda$$

$$\lambda = 3.4 \times 10^{5}\ m = 340\ Km$$

7) $d/v = t = \frac{8000\ Km}{740\ Km/hr} = 10.8\ hrs$

b) $\lambda = 300\ Km$ $\quad f = ?$ $\quad V = f\lambda$

$$\frac{740\ Km}{hr} = (f)(300\ Km)$$

$$f = 2.5\ Hz$$

25) $V = \sqrt{\frac{F}{M/L}} = \sqrt{\frac{250N}{(.012kg)(3m)}} = 83m/s$

44) $\omega_B = \omega_2 - \omega_1 = 7$ rads/s

$f = \frac{\omega}{2\pi} \sim 1.1$ beats per sec

45) short wavelength is related to beats

$\omega_{Beat} = (7-6) = 1$ rad/s

so $f = 1/2\pi = .16$ Hz

$K_{Beat} = 1 \quad \lambda = 2\pi/k = 2\pi$

so with wavelength of 2π a node occurs every 2 sec

56) $V = \sqrt{F_T/\rho} = f\lambda = f\left(\frac{nL}{2}\right)$

so $f = \frac{2}{nL}\sqrt{F_T/\rho}$ $\quad n, L, F_T$ are const

so $f \sim (\text{Const}) \frac{1}{\sqrt{\rho}}$ $\Rightarrow$

so $\frac{f_1}{f_2} = \frac{\sqrt{\rho_2}}{\sqrt{\rho_1}}$ or $\frac{\rho_2}{\rho_1} = \frac{f_1^2}{f_2^2}$

$\frac{196^2}{294^2} = .44 = \frac{294^2}{440^2} = \frac{440^2}{659^2}$

62) $20000\ Hz / (27.5\ Hz) = 727$

Ch 18 - 4, 7, 27, 32, 36, 45, 49, 57, 69, 82

4 $\frac{dV}{dt} = Av$ $\quad \frac{250\ L}{4\ min} = \pi (2.5cm)^2 V$

$250\ L = 250 \times 10^3\ cm^3$

$V = \frac{250 \times 10^3\ cm^3}{240s\ \pi (2.5cm)^2} = 53\ cm/s$

7) $.5L / 30\ min = (.01cm)^2 \pi V_1 = (.1cm)^2 \pi V_2$

$\frac{500\ cm^3}{1800s} = \pi (1 \times 10^{-4}\ cm^2) V_1 = \pi (1 \times 10^{-2}\ cm^2) V_2$

$V_1 = 880\ cm/s \quad V_2 = 8.8\ cm/s$

27)  $P = P_0 + \rho g h$

$$P_w = 1.01\times10^5\,Pa + \frac{1000\,Km}{m3}(9.8\,m/s^2)(26\,m)$$

$$P_{water} = 356\times10^3\,Pa$$

$$P_{oil} = P_0 + \left(\frac{880\,Km}{m3}\right)(9.8\,m/s^2)(30\,m)$$

$$P_{oil} = 360\times10^3\,Pa$$

so force → $F = PA$ $\quad A = 1m^2$

$$F_T - F_B = 4\times10^3\,N$$

32) P_0 is at 760 mm = 101000 Pa

so $P_G = \pm\rho_{Mercury}\, g\,(30\,mm) =$

$$= \pm\left(\frac{13600\,kg}{m3}\right)(9.8\,m/s^2)(.03\,m)$$

$$\simeq \pm 4000\,Pa$$

so high Pressure ~ 105000 Pa
Low Pressure ~ 97000 Pa

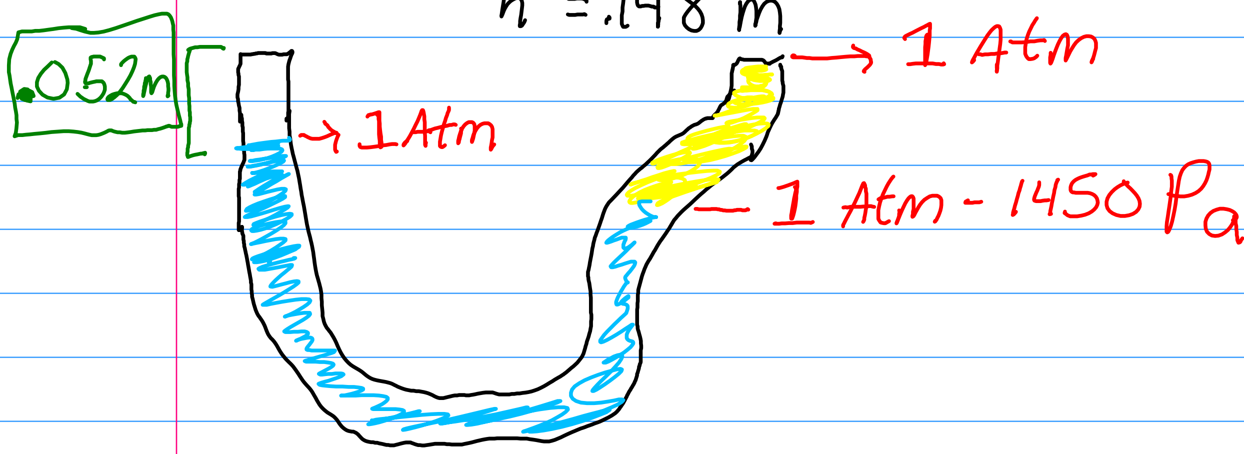
36 $P_{Gas} = -\rho g h = -\left(\frac{739\,kg}{m3}\right)(9.8\,m/s^2)(.20\,m)$

$$= -1450\,Pa$$

36) cont.

for water P_G = same $- 1450\,Pa = \left(\frac{1000\,kg}{m^3}\right)\left(9.8\,m/s^2\right)h'$

$h' = .148\ m$



45) $F_B = \rho_f V_{obj_{imm}} g$

F_B / mg

$F_B - mg = 0$

$F_B = mg$

so $\rho_f V_{obj_{imm}} \cancel{g} = \rho_{obj} V_{TOT_{obj}} \cancel{g}$

so $\dfrac{\rho_{ice}}{\rho_f} = \dfrac{V_{obj\,imm}}{V_{TOT}} = \dfrac{920\,kg/m^3}{1025\,kg/m^3}$

$= .898$

so 898 % below water

$$\frac{10.2}{100} = \frac{(30m)(400m)(400m)}{V_{TOT}}$$

$$V_{TOT} = 4.7 \times 10^7 \, m^3 !$$

$\rho = m/V$ so $m = \rho V = 4.35 \times 10^{10}$ Kg!

49) $F_B = mg$

$$\rho_{Air} V_{Balloon} \cancel{g} = m\cancel{g} = (m_B + m_w)\cancel{g}$$

$$\left(\frac{1.2 \text{ kg}}{m^3}\right) \tfrac{4}{3}\pi R^3 = (\rho_{He}) \tfrac{4}{3}\pi R^3 + .154 \text{ kg}$$

$$\frac{1.02 \text{ Kg}}{m^3}\left(\tfrac{4}{3}\pi R^3\right) = .154 \text{ Kg}$$

$$R = .33 \, m$$

57) $F_B = \rho_{fluid} V_{immersed} \, g$

$$F_B = mg$$

$$\rho_{fluid} (\cancel{\pi} R^2)_{imm} \cancel{\ell} \cancel{g} = \rho_{obj} (\cancel{\pi} R^2_{TOT}) \cancel{\ell} \cancel{g}$$

$$\frac{R^2_{imm}}{R^2_{TOT}} = \frac{\rho_{wood}}{\rho_{water}} = .6 \quad \text{so} \quad \frac{R_{imm}}{R_{TOT}} = \sqrt{.6} = .77$$

$\Rightarrow$

23.1° Above Water

(.23)(30cm) = 6.9 cm above ...

69) $P_T + \frac{1}{2}\rho V_T^2 + \cancel{\rho g y_T} = P_B + \frac{1}{2}\rho V_B^2 + \cancel{\rho g y_B}$

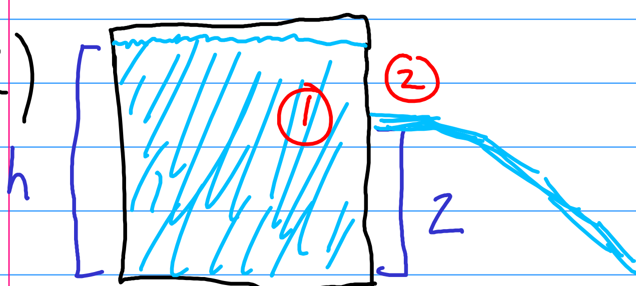
$y_T = y_B$

$P_B - P_T = \frac{1}{2}\rho V_T^2 - \frac{1}{2}\rho V_B^2$

$= \frac{1}{2}(1.2\,kg/m^3)\left(120^2 m/s - 115\,m^2/s\right)$

$\Delta P = 2200\,Pa$

$\Delta P A = F = (2200\,Pa)(8) = 1.76 \times 10^4\,N$

82) 

$V_1 \simeq 0$ $\quad h_1 = h_2 \quad P_1 = P_0 + \rho g(h-z)$

$P_2 \simeq Atm = P_0$

so $P_1 + \cancel{\frac{1}{2}\rho V_1^2} + \cancel{\rho g y_1} = P_2 + \frac{1}{2}\rho V_2^2 + \cancel{\rho g y_2}$

$\cancel{P_0} + \cancel{\rho} g(h-z) = \cancel{P_0} + \frac{1}{2}\cancel{\rho} V_2^2$

so $V_2^2 = (h-z)g(2)$ $\Longrightarrow$

so $V_{2} = \sqrt{2g(h-z)}$ horizontal

now projectile

$$Z = \Delta y = \cancel{V_{oy}t} + \tfrac{1}{2}gt^2$$

① $z = \frac{1}{2}gt^2$ ② $\Delta x = V_2 t$

① $t = \sqrt{\frac{2z}{g}}$ ② $\Delta x = \sqrt{2\cancel{g}(h-z)}\sqrt{\frac{2z}{\cancel{g}}}$

so $\Delta x = 2\sqrt{z(h-z)}$

to find max, take derivative with respect to z

$$\Delta x_{max} \rightarrow \frac{d\Delta x}{dz} = 0$$

$$0 = \frac{2}{\sqrt{z(h-z)}}\left(\frac{1}{2}\right)(h-2z)$$

when $z = \frac{1}{2}h$ this will be 0

$$\Delta x_{max} = 2\sqrt{\tfrac{1}{2}h(h-\tfrac{1}{2}h)} = h!$$