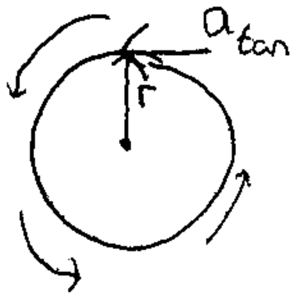
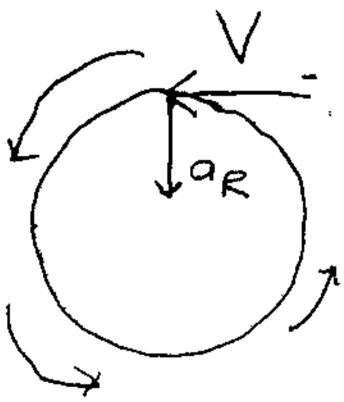
113.



α is out of page $\quad a_t = \frac{a}{r}\, r = a$ ✓
(right angles)

$a_{tan} \perp r$ ✓

$a_{tan} \perp \alpha$ ✓



ω is out of page

$$a_R = \frac{V^2}{r} = (V)\left(\frac{V}{r}\right) = \frac{V^2}{r}$$ ✓

(right angles)

a_R is $\perp$ to V ✓

a_R is $\perp$ to ω ✓

13. $\tau = (r_y F_z - r_z F_y)\hat{i} + (r_z F_x - r_x F_z)\hat{j} + (r_x F_y - r_y F_x)\hat{k}$

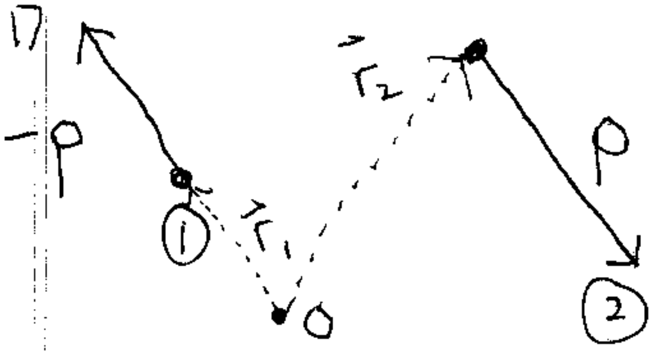
$r = (0, 8m, 6m) \quad F = (\pm 2.4, -3)\,kN$
$(F_z = 0)$

$\tau = (-6m)(-3kN)\hat{i} + (6m)(\pm 2.4kN)\hat{j}$

$-(8m)(\pm 2.4kN)\hat{k}$

$= +18\,kNm\,\hat{i} \pm 14.4\,kNm\,\hat{j} \mp 19.2\,kNm\,\hat{k}$

11-17



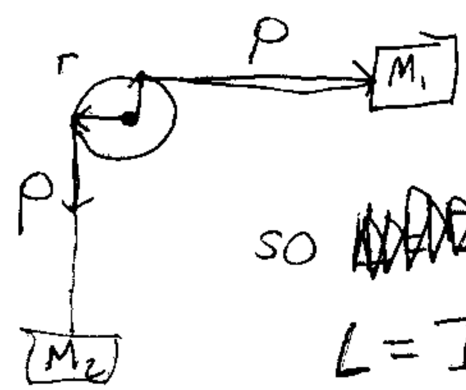
$$\vec{L} = (\vec{r}_1 \times \vec{p}_1) + (\vec{r}_2 \times \vec{p}_2) \quad (\vec{p}_1 = -\vec{p}_2)$$

so $\vec{L} = (\vec{r}_1 \times \vec{p}_1) + (-\vec{r}_2 \times \vec{p}_1)$

so $L = (\vec{r}_1 - \vec{r}_2) \times \vec{p}_1$

note $\vec{r}_1 - \vec{r}_2$ is independent of orign
it is only distance between them pointing from
r_2 to r_1

11-25. a)



$p = mV$

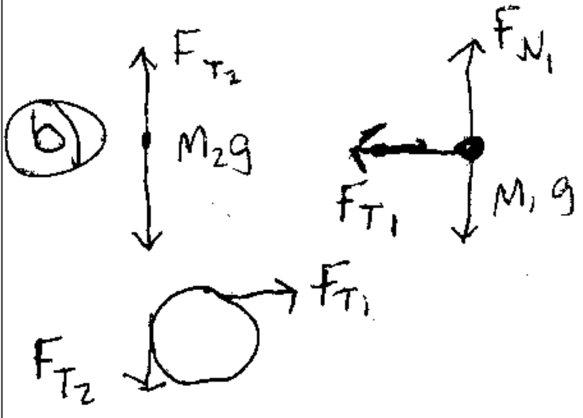
so

$$L = I\omega + rm_2V - rm_1V$$

ccw ccw cw

$$L = I\frac{V}{r} + rm_2V - rm_1V$$

b)

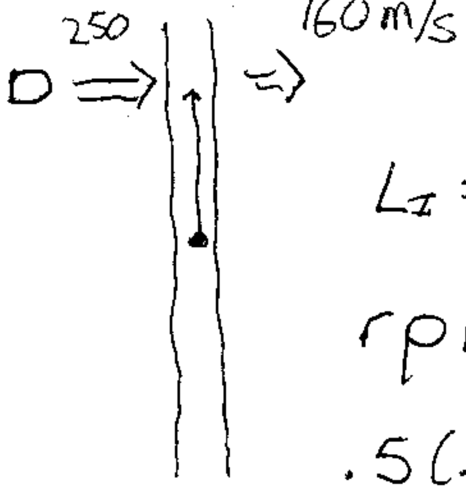


$$m_1a = F_{T_1}$$

$$m_2a = m_2g - F_{T_2}$$

$$\frac{Ia}{r} = rF_{T_2} - rF_{T_1}$$

11-36)



$L_I = L_f$

$r p_{B_i} = r p_{B_f} + I\omega$

$.5(.003\,kg)(250\,m/s)$

$= (.5)(.003\,kg)(160\,m/s) + \frac{1}{12}(.3\,kg)\,1m^2 \; \omega$

$I \Downarrow$

$.375\,\frac{kg\,m^2}{s} = .24\,\frac{kg\,m^2}{s} + (.025\,kg\,m^2)\,\omega$

$\omega = 5.2\,rad/s$

38. $L_I = L_f$

$(670\,kg\,m^2)(2\,rad/s) = I\omega' + m_p(2.5m)^2\omega'$

$I\omega$

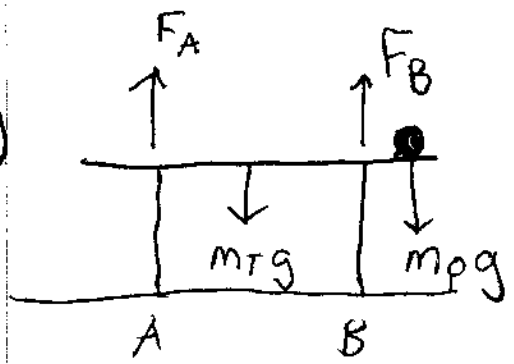
$1340\,\frac{kg\,m^2}{s} = (670\,kg\,m^2 + 344\,kg\,m^2)\,\omega'$

$\omega' = 1.32\,rad/s$

$KE_i = \frac{1}{2}I\omega^2 = 1280\,J$

$KE_f = \frac{1}{2}(1014\,kg\,m^2)(1.32\,rad/s)^2 = 880\,J$

12-9)



Assume table tips so
$F_A \to 0$ (No Normal force)

$\Sigma F = 0 \qquad F_B - m_T g - m_p g = 0N$

$\Sigma \tau = 0$ (Fixed Axis At F_B)

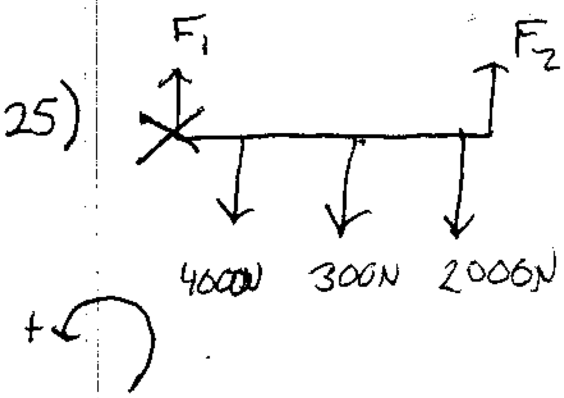
$$(.6m)(m_T g) - X(m_p g) = 0$$

distance From Leg B

$$X = \frac{.6(m_T g)}{m_p g} = \frac{.6(20kg)}{(66kg)} = .18m$$

so person is .62 meters from edge

25)



① $F_1 + F_2 - 4000N - 3000N - 2000N = 0$

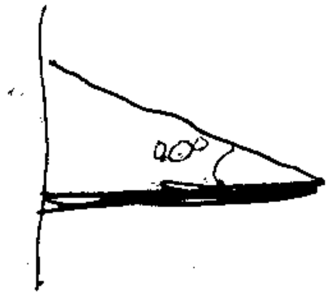
$\tau = 0$ fixed axis At F_1

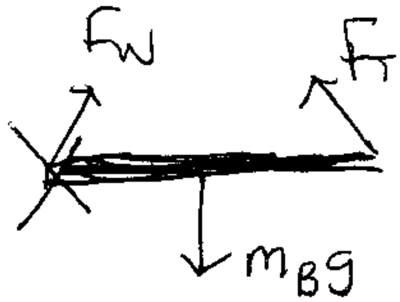
$$(-2m)(4000N) - 8m(3000N) - 9m(2000N) + 10m\,F_2 = 0$$

$$F_2 = 4400N$$

$$F_1 = 9000N - 4400N = 4600N$$

12-26





Beam has Length L ① $F_{W_y} + F_{T_y} - m_B g = 0$

+ ② $F_{W_x} - F_{T_x} = 0$

③ $-\left(L/_2\right) m_B g + F_{T_y}(L) = 0$

$F_{T_y} = F_T \sin 40^\circ$ $F_{T_x} = F_T \cos 40^\circ$

③ $F_{T_y} = \dfrac{m_B g}{2} = 147\ N$ so $F_T = \dfrac{147\ N}{\sin 40^\circ}$

$= 229\ N$

① $F_{W_y} = 294\ N - 147\ N = 147\ N$

② $F_{W_x} = F_{T_x} = (229\ N)\cos 40^\circ = 175\ N$

Notice symmetry F_W is also at 40°

(ch 13-5)

$$S.G. = \frac{\rho_x}{\rho_w} \qquad V = \frac{m}{\rho} = \frac{63.44g}{1g/cm^3} =$$

$$63.44 cm^3$$

$$\rho_x = \frac{53.78g}{63.44cm^3} = .85 g/cm^3$$

so $s.g = .85$

11) $P_A = 18 Atm = 1.81 \times 10^6 Pa$

$$\frac{F}{A} = 1.81 \times 10^6 Pa$$

so $F = (1.81 \times 10^6 Pa)(\pi(.1225m)^2)$

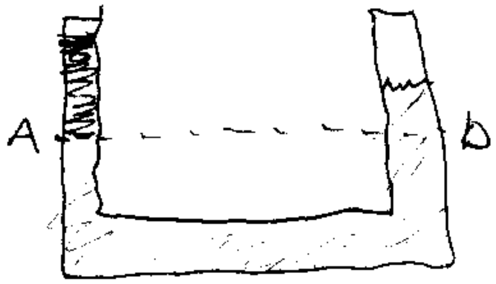
$= 8.57 \times 10^4 N \Rightarrow 8.74 \times 10^3 kg$

oops! I guess one must use 17

because Pressure differential is whats important

Press $\Uparrow$ 18 Atm $\Downarrow$ 1 Atm Air $\Delta P = 17 Atm$

15.



$P_b = P_a$

$P_b = P_o + \rho_w g(.178\,m)$

$= (1.01\times10^5 Pa) + \left(\frac{1000 kg}{m^3}\right) g (.178 m)$

$P_b = 1.027\times10^5\ Pa = P_a$

Pascals

$P_a = 1.027\times10^5\ Pa = 1.01\times10^5\ Pa + \rho_x g(.272)$

$\rho_x \simeq \frac{650 kg}{m^3}$

27) $F_b = \rho_{fluid} V_{obj\ sub}\, g = (1.67 kg) g$

$V_{obj} = \frac{1.67 kg}{1000 kg/m^3} = 1.67\times10^{-3}\ m^3$

so $\rho = \frac{7.85 kg}{1.67\times10^{-3} m^3} = 4700 kg/m^3$

(13-34) $F_B = \rho_{fluid} V_{\substack{obj \\ sub}}\, g$

$$= \frac{1025\,kg}{m^3}\left(65\,L\right)\left(9.8\,m/s^2\right)\left(\frac{1000\,mL}{L}\right)\left(\frac{1m}{100cm}\right)^3$$

$$653\,N$$

$$m_d g = (63\,kg)(9.81\,m/s^2) = 618\,N$$

will float! $F_B > m_D g$

43 $AV = const$

$$\pi\,(.15\,m)^2 (V) = \frac{(9.2\,m)(5\,m)(4.5\,m)}{12\,m}\left(\frac{1\,m}{60\,s}\right)$$

$$V = 4.0\,m/s$$

45) $P + \frac{1}{2}\rho v^2 + \rho g h = const$ height here

top of tank: $V \sim 0$ $P = 1\,Atm$ $h = 0$

bottom: $P = 1\,Atm$ (Air hole) $h = -4.6\,m$

$$\cancel{P_T} = \cancel{P_B} + \tfrac{1}{2}\rho V_B^2 + \rho g(-4.6\,m)$$

$$\tfrac{1}{2}V_B^2 = g(4.6\,m) \rightarrow V_B = 9.5\,m/s$$

51) P is ~~same~~ Not same
h is a same
V is different

$$P_T + \tfrac{1}{2}\rho V_T^2 + \cancel{\rho g h} = P_B + \tfrac{1}{2}\rho V_B^2 + \cancel{\rho g h}$$

$$P_T - P_B = \tfrac{1}{2}\rho V_B^2 - \tfrac{1}{2}\rho V_T^2 = \tfrac{1}{2}\rho\left(V_B^2 - V_T^2\right)$$

$$\rho_{Air} = \left(\frac{1.29\,kg}{m^3}\right)$$

$$P_B - P_T = \tfrac{1}{2}\left(\frac{1.29\,kg}{m^3}\right)\left((340\,m/s)^2 - (290\,m/s)^2\right)$$

$\Uparrow F$ $$= 2.0 \times 10^4\ Pa = \frac{F}{A}$$

so $F = 1.75 \times 10^6\ N$.

55) $P_1 \sim Atm$ $P_2 \sim Atm$ $h_1 = 0$

$$A_1 V_1 = A_2 V_2 \qquad \tfrac{1}{2}\rho_w V_1^2 = \tfrac{1}{2}\rho_w V_2^2 + \rho_w g h$$

$$V_2 = \frac{A_1}{A_2} V_1 \quad \text{so}$$

therefore $\tfrac{1}{2}V_1^2 = \tfrac{1}{2}\dfrac{A_1^2 V_1^2}{A_2^2} + gh$

so $\tfrac{1}{2}V_1^2\left(1 - \dfrac{A_1^2}{A_2^2}\right) = gh$

52) Bonus

h is same $\quad V_{Air} \sim 0 \quad V_{hur} = 300 km/h$

$$P_{Air} = P_{hurricane} + \frac{1}{2} \rho_{Air} V_{hur}^2$$

$$P_{Air} - P_{hurricane} = \frac{1}{2} \left(\frac{1.29\ kg}{m^3} \right) \left(\frac{300 km}{hr} \right)^2 \left(\frac{1000}{3600} \right)^2$$

conversion

$= 4500\ PA.$ (Pressure differential)