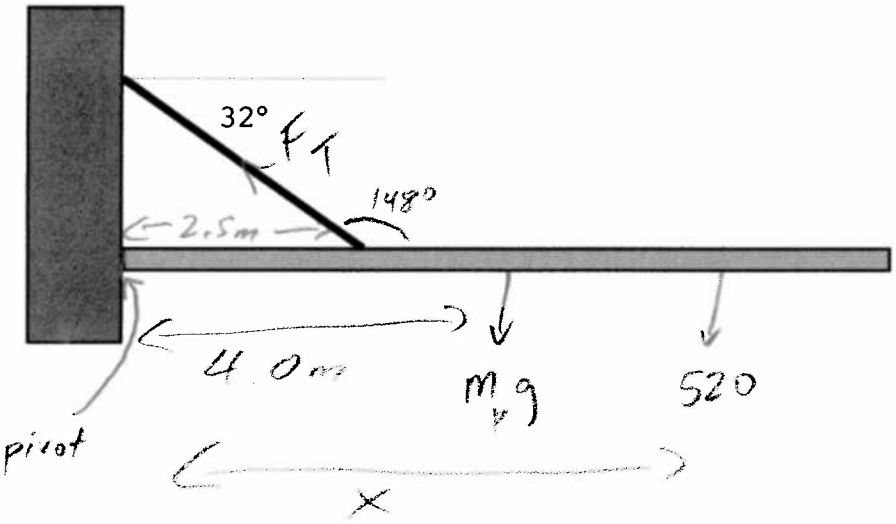
Physics 10154 - Exam #4a

Partial credit will be given provided you show all work and are solving parts of the problem correctly. Points will be deducted if you don't show your work (or if some parts are incorrect) even if you get the right answer. Clearly indicate your answer with a circle or box and remember to include correct units and significant figures.

1. (30 pts) An 8.0 meter long uniform, horizontal 450 N platform is attached to a wall at its left end and supported at a point 2.5 meters from the wall by a cable that makes an angle of 32° with the horizontal. This support cable can withstand a maximum force of 3800 Newtons. What is the maximum distance from the wall that you can place an object weighing 520 Newtons?



$$\Sigma\tau = \tau_T + \tau_{platform} + \tau_{520} = 0$$

$$+(2.5)(3800)\sin 148° - (4.0)(450)\sin 90 - x(520)\sin 90 = 0$$

$$+5034 - 1800 - 520x = 0$$

$$3234 = 520x$$

$$\boxed{x = 6.2\,m}$$

2. (30 pts) A 5.0 kg spherical ball of radius 15 cm is rolling without slipping up a ramp inclined 35° above the horizontal. Initially, it is turning at a rate of 3.0 rev/sec.

a) What is the kinetic energy of the ball? $\omega = 3.0 \frac{rev}{s} = 18.8 \frac{rad}{s}$

b) How far along the ramp does the ball roll before stopping?

a) $K = \frac{1}{2}mv^2 + \frac{1}{2}I\omega^2$ $\quad v = R\omega$

$= (.15)(18.8)$

$= \frac{1}{2}(5)(2.83)^2 + \frac{1}{2}(.045)(18.8)^2$ $\quad = 2.83 \text{ m/s}$

$= 20 + 7.95$ $\quad I = \frac{2}{5}MR^2 = .045$

$= \boxed{28 \text{ J}}$

b) $\Sigma W_{nc} = W_{grav} = \Delta K$

$-mgh = 0 - K_i$

$h = \frac{K_i}{mg} = \frac{28}{(5)(9.8)} = 0.57 \text{ m}$

$L = \frac{h}{\sin 35^\circ} = \boxed{1.0 \text{ m}}$

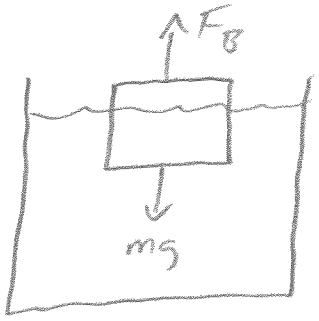
3. (40 pts) A ~~2250~~ 2100-kg wooden platform is 2.5 meters on a side and 0.50 meters tall, and it is placed in water.

a) What fraction of the platform is submerged in the water?

b) How many 85-kg people can stand on the platform before it sinks?

a) $V_0 = 2.5 \times 2.5 \times 0.5 = 3.125\ m^3$

$\rho_0 = \frac{2100}{3.125} = 672\ kg/m^3$



$\Sigma F_y = F_B - mg = 0$

$\rho_f V_f g - \rho_0 V_0 g = 0$

$\rho_f V_f g = \rho_0 V_0 g$

$\frac{V_f}{V_0} = \frac{\rho_0}{\rho_f} = \frac{672}{1000}$

$V_f = 0.672 V_0$, so platform is **67% submerged**

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b) $\Sigma F_y = F_B - mg - N(85)(9.8)$

If platform about to sink, $F_B = \rho_f V_0 g$

$= (1000)(3.125)(9.8)$

$F_B \qquad (2100)(9.8)$

$\Sigma F_y = 30625 - 20580 - 833N = 0$

$833N = 10045$

$N = 12$