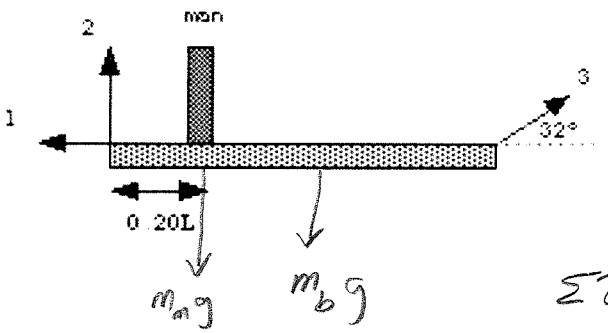
Physics 10154 - Exam #8C

Answer the following two questions. Be sure to clearly indicate your answer with a circle or box. Show all work. If I cannot see how you arrived at an answer, I will deduct points!

1. A uniform 35-kg plank of length L is supported by three (helpfully numbered) ropes as shown below. A 75-kg man stands 1/5 (0.20 L) from one end as shown. What is the tension in each of the three ropes?



$$\Sigma F_x = F_3 \cos 32^\circ - F_1 = 0$$

$$\Sigma F_y = F_2 + F_3 \sin 32^\circ - m_m g - m_b g = 0$$

$$\Sigma \tau = \tau_m + \tau_b + \tau_3 = 0$$

$$\tau_m = -(.20L)(75)(9.8)\sin 90$$

$$\tau_b = -(.50L)(35)(9.8)\sin 90$$

$$\tau_3 = +L F_3 \sin 32^\circ$$

$$\Sigma \tau = -147L - 171.5L + F_3 L \sin 32^\circ = 0$$

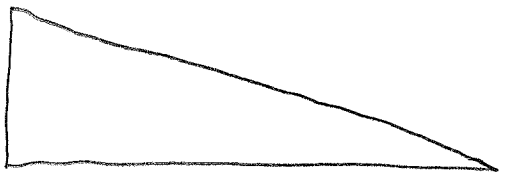
$$\boxed{F_3 = 600\ N}$$

$$F_1 = F_3 \cos 32^\circ = \boxed{510\ N}$$

$$F_2 = (75)(9.8) + (35)(9.8) - 600 \sin 32^\circ$$

$$= \boxed{760\ N}$$

2. A uniform sphere starts from rest at the top of a 3.5-meter long ramp inclined 15° above the horizontal. Ignoring any frictional forces, how long (in seconds) does it take for the sphere to reach the bottom of the ramp?



$h = 3.5 \sin 15°$

$= 0.905\ m$

$$\Sigma W_F = W_{grav} = \tfrac{1}{2}mv^2 + \tfrac{1}{2}I\omega^2 - 0$$

$$mgh = \tfrac{1}{2}mv^2 + \tfrac{1}{2}\left(\tfrac{2}{5}MR^2\right)\frac{v^2}{R^2}$$

$$mgh = \tfrac{1}{2}mv^2 + \tfrac{1}{5}mv^2$$

$$gh = \tfrac{7}{10}v^2$$

$$v = \sqrt{\tfrac{10}{7}gh} = 3.56\ m/s$$

$\Delta s = 3.5$

$v_0 = 0$

$v = 3.56$

$a = ?$

$t = ?$

$3.5 = \tfrac{1}{2}(0 + 3.56)\,t$

$\boxed{t = 2.0\ s}$