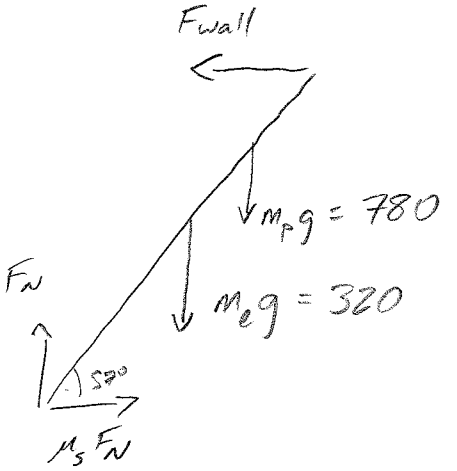
Physics 10154 - Exam #8A

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 7.0-meter long, uniform 320 Newton ladder rests against a smooth wall, making an angle with the ground of 57° above the horizontal. The coefficient of static friction between the ladder and the ground is 0.45. How far up the ladder can a 780 Newton worker climb before the ladder slips?



$$\Sigma F_x = \mu_s F_N - F_{wall} = 0$$

$$\Sigma F_y = F_N - 320 - 780 = 0$$

$$F_N = 1100\ N$$

$$\mu_s F_N = 495\ N = F_{wall}$$

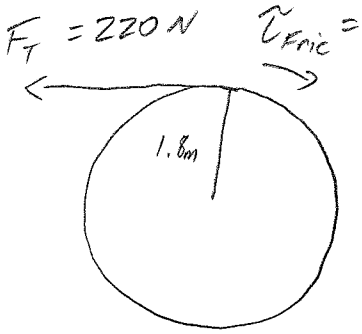
$$\Sigma \tau = -(3.5)(320)\sin 147^\circ - x(780)\sin 147^\circ + (7.0)(495)\sin 123^\circ = 0$$

$$\Sigma \tau = -610 - 425x + 2906 = 0$$

$$2295 = 425x$$

$$\boxed{x = 5.4\ m}$$

2. A 350-kg merry-go-round starts at rest and is accelerated uniformly by a thin rope wrapped around the perimeter. The rope has a pulling tension of 220 Newtons and is tangent to the rim of the merry-go-round, which has a radius of 1.8 meters. There is a frictional torque of 160 N-m acting on the merry-go-round. After 5.0 seconds, what is the angular speed of the merry-go-round?



$$I = \tfrac{1}{2} M R^2$$

$$= \tfrac{1}{2}(350)(1.8)^2 = 567\ kg\ m^2$$

$$\Sigma\tau = \tau_T + \tau_F = I\alpha$$

$$\Sigma\tau = +(1.8)(220)\sin 90^\circ - 160 = 567\alpha$$

$$236 = 567\alpha$$

$$\alpha = 0.416$$

$\Delta\theta$

$\omega_0 = 0$

$\omega = ?$

$\alpha = 0.416$

$t = 5.0$

$$\omega = \omega_0 + \alpha t$$

$$= \boxed{2.1\ rad/s}$$