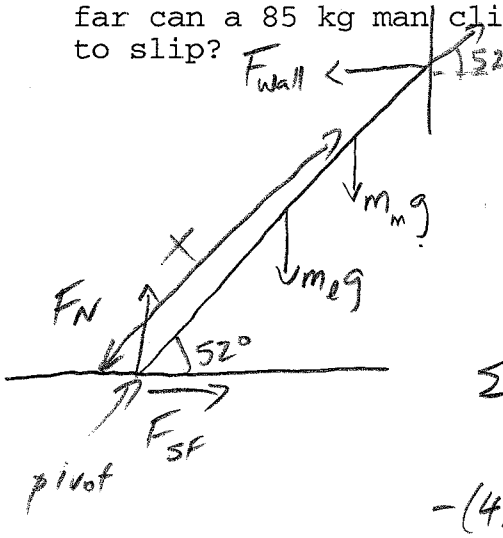
Physics 10154 - Exam #8C

Each problem is worth 50 points. 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. An 8.0 meter long, 25-kg uniform ladder rests against a smooth wall, making an angle of 52° above the horizontal. The coefficient of static friction between the ladder and the ground is 0.61. How far can a 85 kg man climb up the ladder before the ladder begins to slip?



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

$$\Sigma F_y = F_N - m_l g - m_m g = 0$$

$$\Sigma \tau = \tau_l + \tau_m + \tau_{wall} = 0$$

$$-(4.0)(25)(9.8)\sin 142^\circ - x(85)(9.8)\sin 142^\circ + (8.0)F_{wall}\sin 128^\circ = 0$$

or $-603.3 - 512.8x + 6.3F_{wall} = 0$

$$F_N = m_l g + m_m g = 1078\ N$$

$$(0.61)(1078) = F_{wall} = 658\ N$$

$$-603.3 - 512.8x + 6.3(658) = 0$$

$$3540 = 512.8x$$

$$\boxed{x = 6.9\ m}$$

2. A 65 kg woman stands at the center of a rotating 420-kg merry-go-round spinning at a rate of 0.75 rev/sec. Treat the merry-go-round as a uniform cylinder. If the woman walks out 1.8 meters to the edge of the merry-go-round, what is the new rotation speed (in rev/sec)?

$$I_{mgr} = \frac{1}{2}(420)(1.8)^2 = 680.4 \text{ kg} \cdot \text{m}^2$$

$$I_{w,i} = 0$$

$$I_{w,f} = (65)(1.8)^2 = 210.6$$

$$\omega_i = 0.75 \text{ rev/s}$$

$$I_{mgr}\omega_{mgr,i} + I_{w,i}\omega_{w,i} = I_{mgr}\omega_{mgr,f} + I_{w,f}\omega_{w,f}$$

$$(I_{mgr} + I_{w,i})\omega_i = (I_{mgr} + I_{w,f})\omega_f$$

$$(680.4 + 0)(0.75) = (680.4 + 210.6)\omega_f$$

$$\omega_f = \frac{680.4}{891.0}(0.75)$$

$$= \boxed{0.57 \text{ rev/s}}$$