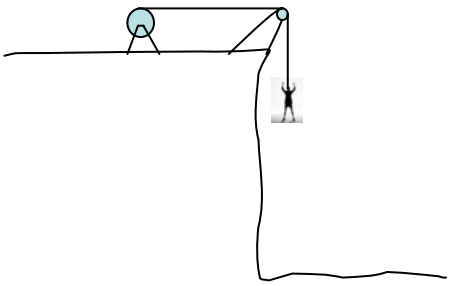
PH 203 Phase-Line Writ 3, Fall 03 **Name**_____
Lesson 36 / 50 Marks / 30 minutes **Section**_____**, G Hour**
AUTHORIZED REFERENCES: Calculator, Physics Reference Card

Wt. **No.**

35 1. LT Derring Do has the mission to conduct a reconnaissance along the bottom of a cliff. He had planned to rappel to the bottom of the cliff, but forgot his snaplinks. He devises a controlled-fall device made from a 55 gallon drum packed tightly with rocks. He mounts the drum on a coaxial metal pole and wraps his 120 foot rope around the drum. He then runs the rope over a massless, frictionless pulley that hangs over the edge of the cliff. LT Do ties the rope onto himself and steps horizontally off of the cliff. Model the drum as a solid cylinder with a mass of 729 kg, a radius of 36.4 cm, and a length of 117 cm. LT Do has a mass of 95.2 kg. Calculate how fast he is moving when he hits the ground 20.5 m below. Neglect friction effects on the axle of the drum.



$v = 9.12 m/s$

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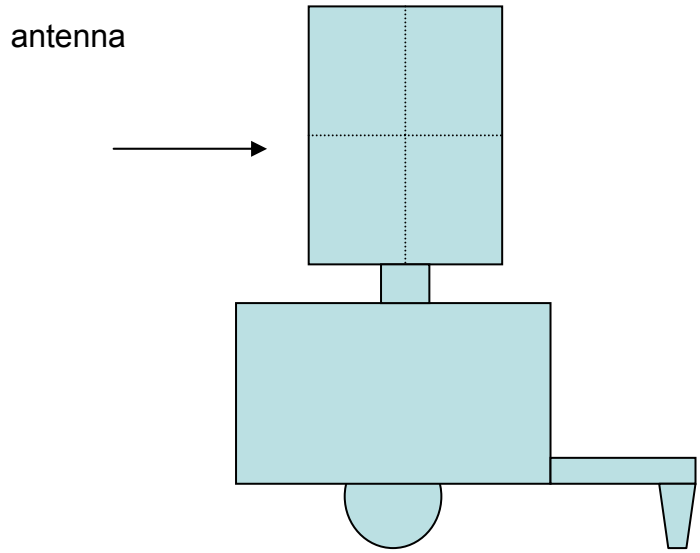
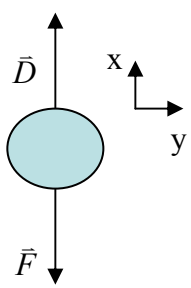
15 2. A counter-battery radar antenna is essentially a large rectangular plate that rotates on an axis parallel to its two longest sides and located along the center-line of the plate. Your counter-battery radar is engaged by an enemy machine gun at long range. The 95.6 g bullets appear to have exceeded their effective range and instead of penetrating completely through the radar dish they lodge in the surface. Surprisingly, your radar still functions but seems to be slightly sluggish in its traversing motions. You count 2 rounds stuck in the surface of the dish at distances of 4.05 cm right, and 9.72 cm left of the axis of rotation, and at distances from the center of the face of the plate of 10.6 cm above, and 13.2 cm below, respectively. Calculate the change in the moment of inertia of the antenna caused by these bullets.



$$\Delta I = 1.06 \times 10^{-3} kg \cdot m^2$$

Bonus (5 Marks): Calculate the terminal speed of an object of mass m and cross sectional area A moving through a fluid of density ρ due to a constant force of magnitude F.



$$\sum F_{ext,x} = ma_x$$

$$D - F = ma_x$$

note: $a_x = 0$ at terminal speed

$$\frac{1}{2} C\rho A v_t^{\,2} = F$$

$$v_t = \sqrt{\frac{2F}{C\rho A}}$$