X3.7e2 205

PHYS-205(7) (Kaldon-21297) **Name** _____
WMU - Winter 2001
Exam 3 - 100,000 points + 20,000 ☆ points `http://homepages.wmich.edu/~kaldon/`

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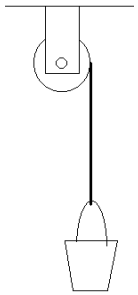
State Any Assumptions You Need To Make – Show All Work – Circle Any Final Answers
Use Your Time Wisely – Work on What You Can – Be Sure to Write Down Equations
Feel Free to Ask Any Questions ☐☆2a ☐☆2b ☐☆2c ☐☆2e

Spinning and Falling and Crashing and Spilling… (50,000 points)

1.) (a) A bucket (m = 5.00 kg) is hanging at rest from a 1.00 m length of cable (Y = 10×10^{10} N/m² , square cross-section A = 4.00×10^{-6} m²). How much does the cable stretch?



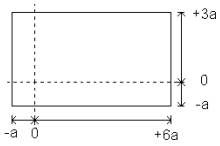
(b) The cable is wrapped around a solid cylinder (m = 12.5 kg , R = 0.200 m). Draw the Free Body Diagram of the bucket and the Free Rotation Diagram of the cylinder.

(c) Find the acceleration of the bucket if the brake on the cylinder is released. *We are neglecting the mass of the cable in this problem.*

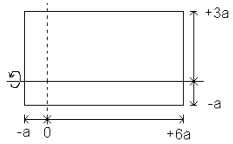
(d) The bucket starts off at rest 12.5 meters above the ground. If the brake on the cylinder is released and the unwinding cable does not slip on the cylinder, find the speed of the bucket just before it hits the ground.

(e) What is the angular speed of the cylinder just before the bucket hits the ground?

We're A Bit Off-Center Here Today (25,000 points)

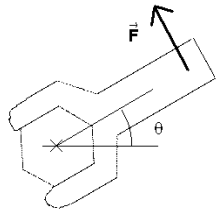


2.) ☆(a) A plate of mass *m* has sides of *4a* and *7a*. Find the center of mass coordinates x_{cm} by integrating $x_{cm} = \frac{1}{M}\int x\,dm$, using the *x*- and *y*-axes as shown.



☆(b) A plate of mass *m* has sides of *4a* and *7a*. Find the moment of inertia *I* of the plate about the *x*-axis as shown, by integrating $I = \int r^2 dm$.

☆(c) A torque $\vec{\tau}$ to tighten a bolt consists of a force being applied at a distance of 30.0 cm (0.300 m) from the axis of rotation. As the bolt gets tighter, it gets harder and harder to turn the bolt, so the force as a function of angle is given by F = C θ , where C is some constant with appropriate units. If the total work done by applying this torque through two complete revolutions is 1500. J, then find C.



(d) Which way does the torque $\vec{\tau}$ in (c) points? *Use Right Hand Rule to explain your answer.*

☆(e) Show that the equation $\theta(t) = A\cos(\omega t) + B\sin(\omega t)$ satisfies the rules for a rotational Simple Harmonic Motion (S.H.M.) – that is, show that $\alpha = -C\theta$, where *C* is some constant you will find.