X3.6d 205

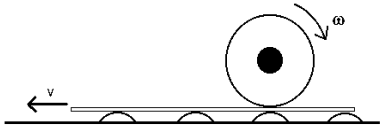
PHYS-205(6) (Kaldon-40534) **Name** _____
WMU-Fall 2000
Exam 3 - 100,000 points + 20,000 ☆ points

11/16/2000•Rev.6

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

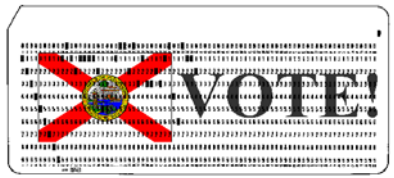
"And Now We Take You To Palm Beach County, Florida…" (50,000 points)

1.) (a) Suppose you suddenly have 400,000 computer punch card ballots to run through a counting machine. Each card ($m = 0.000454\ kg$) has to move 20.0 cm (0.200 m) in 1.00 seconds. A spinning drive wheel of 6.00 cm diameter (0.0600 m) moves the cards along. Find the angular velocity, ω, of the drive wheel.

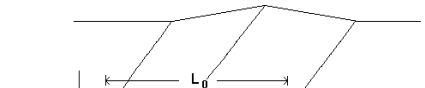


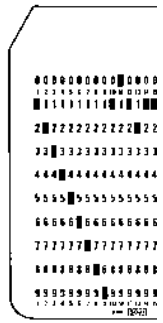
(b) The solid drive wheel has a mass of 50.0 grams (0.0500 kg). Find the rotational kinetic energy of the drive wheel. *If you did not get an answer to (a), use $\omega = 20.0\ rad/sec$.*

(c) Suddenly a card jams in the machine and the system automatically stops. Find the angular acceleration α to bring the drive wheel to a stop in a single rotation. *If you did not get an answer to (a), use $\omega_0 = 20.0\ rad/sec$.*

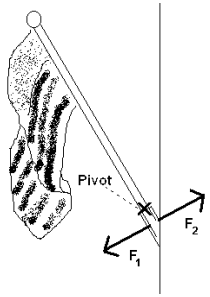


(d) One of the problems with the ballots in parts of Florida is *chads* – the small bits of the cards that are supposed to be punched out. If you just push on a region of the card, you may stretch the material as shown in the illustration – let us assume that this is a tension force problem, with $T = 10.0\ N$. Consider a card that is $0.100\ mm = 0.000100\ m$ thick, where the size of the stretched region is $L_0 = 2.00\ mm = 0.00200\ m$ and $2.00\ L_0$ deep. The material is depressed by $d = 0.250\ mm = 0.000250\ m$. Find the Young's Modulus, Y_m, of the card material.



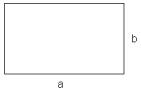


(e) A U.S. flag hangs from a bracket wall. The flag and pole provide a positive torque, $\tau = 30.0\ N \cdot m$, about a pivot point at the end of the bracket. To keep the flag from falling, a force perpendicular to the flagpole is applied *7.00 cm* from the pivot point. Determine if this force is F_1 or F_2, and then find the magnitude of this force.



So You Think You've Got Star Problems? When I Was A Kid… (50,000 points)

2.) ☆(a) A plate of mass m = 6.00 kg has dimensions a = 1.50 m and b = 0.720 m. Find the center of mass coordinate x_{cm} by integrating $x_{cm} = \frac{1}{M}\int x\,dm$.



☆(b) A plate of mass m = 6.00 kg has dimensions a = 1.50 m and b = 0.720 m. Find the moment of inertia *I* of the plate about an axis along the left edge as shown, by integrating $I = \int r^2 dm$.

☆(c) A simple harmonic oscillator has an acceleration given as $a(t) = 1.00 m/s^2\left(\cos(\omega t)\right)$. Find *x(t).*

(d) Bob weighs 981 N on the surface of the Earth. What would his weight be on the planet Mercury? $M_M = 3.18 \times 10^{23}$ kg , $R_M = 2.43 \times 10^{6}$ m , $g = 9.81$ m/s² , $G = 6.67 \times 10^{-11}$ N·m²/kg².

☆(e) A torque $\vec{\tau}$ to tighten a bolt consists of a force being applied at a distance from the axis of rotation. As the bolt gets tighter, it gets harder and harder to turn the bolt, so the torque as a function of angle is given by $\tau = \sqrt{C\theta}$, 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.