

X3.5c

205

PHYS-205 (5) (Kaldon-19298)

Name _____

WMU - Spring 2000

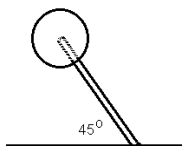
Exam 3 - 100,000 points + 20,000 ☆ points

<http://homepages.wmich.edu/~kaldon/>

6/08/2000*Rev.0 4/01/02r1

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

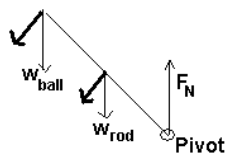
Can Physics Be Art? (35,000 points)



1.) An artist creates a new statue for WMU. It consists of a solid cylinder of radius 0.305 m and length 1.00 m, and mass 85.0 kg – attached to a solid rod 1.52 m long of mass 55.0 kg, as shown. The rod is attached to a bracket mounted on the ground.
 (a) Draw the Free Body Diagram of the rod & cylinder statue and (b) set up *but do not solve* the Sum of Forces equations.

(c) Draw a Free Rotation Diagram of the rod & cylinder statue. Is there a problem with this diagram? How might you solve it? *Hint: What if the rod were longer?*

If you set the pivot at the base, there must be something to provide a *negative* torque to kill the rotation.

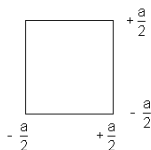


(d) Find the Moment of Inertia of the statue about an axis parallel to the center of the cylinder, that goes through the bracket mounted on the ground.

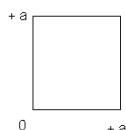
(e) Why must the bracket exert a torque on the rod to keep the statue from falling over? *Short answer!*

Odds and Ends (30,000 points)

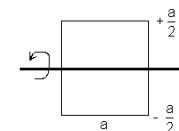
2.) ☆(a) A plate of mass $m = 5.00$ kg has sides $a = 0.480$ m. Find the center of mass coordinate x_{cm} by integrating $x_{cm} = \frac{1}{M} \int x dm$.



☆(b) A plate of mass $m = 5.00$ kg has sides $a = 0.480$ m. Find the center of mass coordinate y_{cm} by integrating $y_{cm} = \frac{1}{M} \int y dm$.

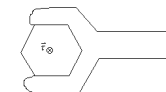


☆(c) A plate of mass $m = 5.00$ kg has dimensions $a = 0.480$ m. Find the moment of inertia I of the plate about an axis along the mid-line as shown, by integrating $I = \int r^2 dm$.



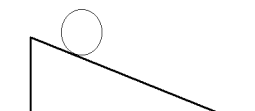
(d) If a bolt is tightened clockwise, then does $\vec{\tau}$ point *into* or *out* of the paper? Use *Right Hand Rule* to explain your answer.

☆(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 magnitude of the torque as a function of angle is given by $\tau = C \theta^3$ 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 .



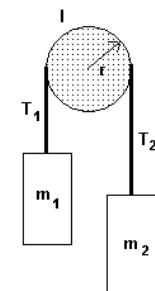
Ends and Odds (35,000 points)

3.) A hollow ball of mass 0.838 kg and radius 0.135 m starts out on at rest an inclined plane 0.400 m above the ground. (a) Find the speed of the ball at the bottom of the ramp if there is no friction and the ball slides without rotating.



(b) Find the speed of the ball at the bottom of the ramp if there is friction and the ball rotates without sliding.

(c) A real pulley, made of a 1.50 kg solid disk 0.150 m in *diameter*, is attached to two masses, $m_1 = 10.0$ kg and $m_2 = 15.0$ kg, which are initially at rest. Find the acceleration of the two masses, a_1 and a_2 , and the angular acceleration of the pulley, α .



(d) Find θ and ω of the pulley after 2.00 seconds. *If you did not get an answer to (c), use $\alpha = 1.23 \text{ rad/s}^2$.*

(e) John is driving his brand new 1125 kg sports car at 25.2 m/s. While trying to figure out how the CD player works, he plows into Jane's new 1850 kg four-door, which is parked on the side of the road. In a totally inelastic collision, how fast does the wreck travel?