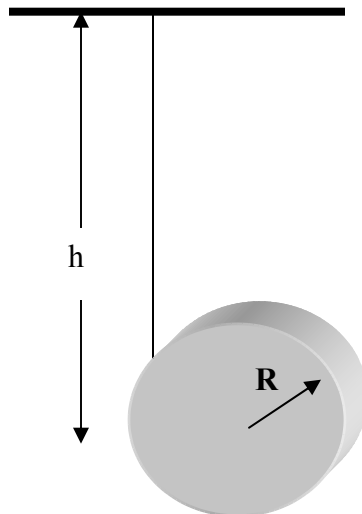


PHYSICS 2A/SAMPLE EXAM 3

SHOW ALL WORK IN COMPLETE DETAIL. NO CREDIT WILL BE GIVEN IF NO WORK IS SHOWN!

1. A 20-kg mass moving at 2.0 m/s along the x-axis collides with a stationary 12-kg mass. After the collision the 20-kg mass is moving at 1.0 m/s in a direction that makes an angle of $\alpha = 30^\circ$ with its initial direction. (10 pts)
 - a) Calculate the final velocity of the 12-kg mass. Assume the surface on which the masses move is frictionless.
 - b) Is the collision elastic or inelastic?
2. A string is wound around a uniform disk of radius R and mass M . The disk is released from rest with the string vertical and its top end tied to a fixed bar as shown below. (10 pts)



- a. Show that the tension in the string is one-third the weight of the disk.
 - b. Show that the acceleration of the center of mass is $2g/3$.
 - c. Show that the speed of the center of mass is $(4gh/3)^{1/2}$.
 - d. Verify your answer in part (c) by using conservation of energy.
3. A uniform rod is released from its vertical position onto a flat surface. Find the speed of the tip of the rod when it strikes the surface. (10 pts)
4. A turntable of radius 25 cm and rotational inertia of 0.0154 kg m^2 is spinning freely at 22.0 rpm about its central axis, with a 19.5 g mouse on its outer edge. The mouse walks from the edge to the center. (10 pts)
 - a. Calculate the new angular speed of the turntable.
 - b. Calculate the change in kinetic energy of the turntable-mouse system.
 - c. Did the energy increase, decrease, or remained the same? Explain.
5. Calculate the vertical launch speed required to get a rocket to an altitude of 1100 km. (10 pts)