- **Review Problems for the 2nd Midterm Exam Material:**

Note the answers are not supplied. Previously in class, I have shown you how to proceed. I expect you to work out the details yourself individuallly or as part of a group. Some problems on the exam will be similar to those below, you should be prepared to solve some problems that are somewhat different in what is given the problem and what is asked for you to obtain. In any case, it is highly recommended that you make sure you come to the exam with a complete understanding of these problems. I have no doubt your efforts will be rewarded.

Problem #1:
PART A: Calculate the center-of-mass of the array of point masses indicated below. Use the XY coordinate system indicated on the diagram. The smaller two masses are m=2 kg each and the two largest masses are M=3 kg. The four masses are connect by very light, rigid pieces of wire.
PART B: Calculate the moment of inertia about the vertical axis.

PART C: Calculate the moment of inertia about the horizontal axis.

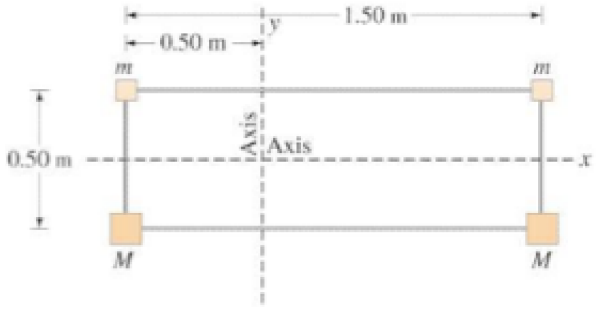
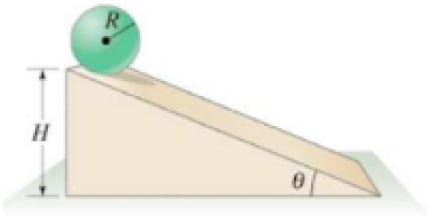


FIGURE 8–43 Problem 31.

Problem #2: A cylinder having a moment of inertia I=(1/2)MR^2 rolls down an incline as pictured below:

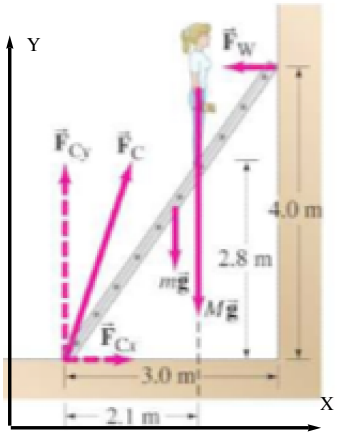


Calculate the angular velocity of the cylinder when it reaches the bottom of the inclined plane.
Take H = 7 m, M = 0.25 kg, R = 0.5 m, and $\theta = 30°$. Do NOT use Newton's laws of motion.

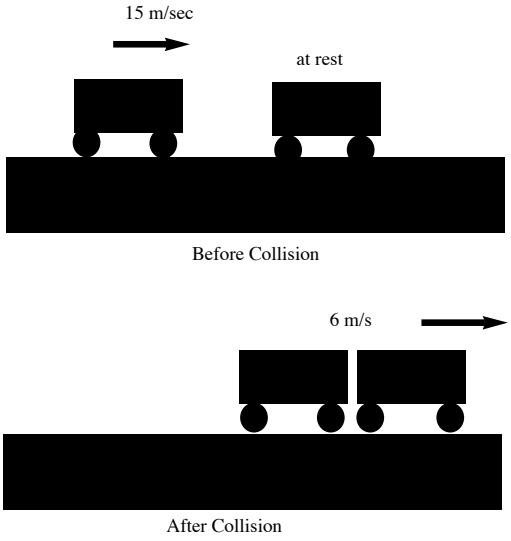
Note that if you need the moment of inertia of a cylinder or sphere (for example) on the exam, then the formula for this will be supplied to you on the exam sheet.

Problem #3: A figure skater can increase her spin rotation rate from an initial rate of 0.75 Rev every 2 seconds to a final rate of 3.5 Rev/sec. If her initial moment of inertia was $\mathbb{I}_0$=4.0 kg-m^2 what is her final moment of inertia $\mathbb{I}_f$? She physically accomplishes this increase rotation rate by moving her arms closer to her body.

Problem #4: Consider a painter on a ladder as indicated in the picture below. The mass of the ladder is m=7 kg and the mass of the painter is M=62 kg. Suppose the coefficient of friction is 0.6 between the floor and ladder. Assume there is no friction force between the ladder and the wall. How high up the ladder can the painter climb in the y-direction? Can the painter climb up the maximum possible of Y=4.0 m?



Problem #5: A 1200 kg boxcar traveling at 15.0 m/s strikes a second boxcar at rest. The two stick together and move off with a speed of 6.0 m/s. What is the mass of the second car? How much kinetic energy is lost in the collision?

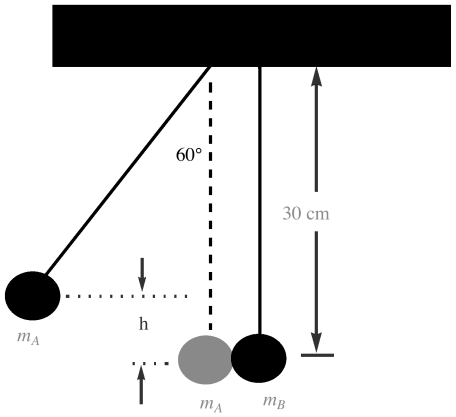


Problem #6: Two balls of equal mass masses $m_A = 0.04\,\text{kg}$ and $m_B = 0.04\,\text{kg}$ are suspended as show in the diagram below. The ball m_A is pulled away to a 60° angle with the vertical and released.

(a) What is the velocity of the ball m_A just before impact?

(b) What will be the maximum height ball m_B after the elastic collision? Describe what happens to ball m_A as a result of the

collision.



Problem #7: Calculate the angular velocity of the Earth as it orbits the Sun and give your answer in Rad/sec. The known fact is that the period for the Earth about the Sun is T=365 days/Rev.

Problem #8: A wheel 0.5 meter in diameter accelerates uniformly from 120 rpm to 370 rpm in 3.0 seconds. How far will a point on the edge of the wheel have traveled in meters in this time?

Problem #9: A rotating merry - go - round makes one complete revolution in 6.0 seconds (a) What is the linear speed of a child seated 1.4 meter from the center? (b) What is her radial acceleration?

Problem #10: How much work is required to stop an proton that has a mass m=1.67 × 10^{-27} kg and is moving with a speed 1.90 × 10^{6} of m/s?

Problem #11: Newton's second law of motion is not valid in a rotating coordinate system. The centrifugal force is a fictional force which is included in the usual Newton's second law of motion so it works in rotating coordinate systems. The centrifugal force is in the outward radial direction while the centripetal force is in the inward radial direction. The centripetal force is a real force like for example gravity.

TRUE or **FALSE** (Circle One)

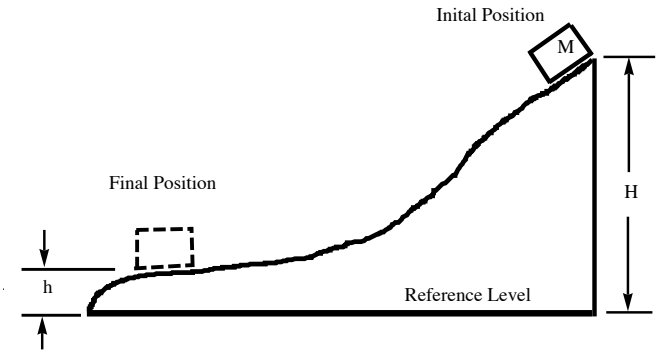
Problem #12: Con Edison sells electricity by charging a $0.119 per KiloWattHour. The KiloWattHour a unit of

POWER or **ENERGY** (Circle the correct answer)

Problem #13: Radians and Degrees are two different units used to measure angular distance θ. The Degree measurement of the size of an angle is independent of the size of the radius of the circular motion AND so too is the radian measure of an angle independent of the size of the radius of the circular motion."

TRUE or **FALSE** (Circle One)

Problem #14: Suppose a mass slides down a hill as pictured below. Suppose the M=5 kg mass is released from rest at the top of the hill which is a height H=3.5 meters above the reference level. How fast is the mass going when it reach the bottom of the hill which is h=1.7 meters above the reference level? Assume there is no friction force. Do not use Newton's laws of motion to solve this problem.



Problem #15: Consider the point P on the circular object which is undergoing rotational motion and is pictured below. The point P is a fixed distance R from the center of the circle. Suppose the tangential velocity of the point P increases. Circle all of the following that are TRUE.

(a) The angular velocity increases.
(b) The angular acceleration is not zero.
(c) A torque must have been applied to the circle.
(d) A tangential force must have been applied to the circle.
(e) The radial acceleration increases.