SP211e-1111/3311 EXAM 3 1999 NAME: _____

1. a.) - c.) State Kepler's Laws clearly and completely in prose form.
   d.) Give the equation to compute the moment of inertia of a rigid body formed from a collection of point particles about a fixed axis plus a complete prose version.

2. a.) The average distance from the sun to the earth is 1.5×10^{11} m or 1.00 A.U. Mercury has an average distance from the sun of 0.39 A.U. Find the period of mercury's orbit. The earth's orbital period is 1 year.

   b.) Starting with the expression for centripetal acceleration and for the magnitude of the Universal Gravitation force between the earth and a satellite in a circular orbit of radius r, derive an expression for the satellite's kinetic energy in terms of G, the mass of the earth and the radius of the orbit.

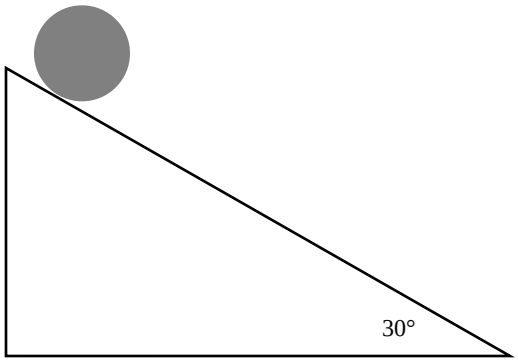
3.) **2-D COLLISION**. A ball m_1 of mass 5 kg traveling at $10\ {}^{m}/_{s}\ \hat{i}$ collides with a ball m_2 of mass 2 kg which is traveling at $-4\ {}^{m}/_{s}\ \hat{i}$. The post-collision velocity of m_1 is $\vec{v}_{1f} = 4\ {}^{m}/_{s}\ \hat{i} + 2\ {}^{m}/_{s}\ \hat{j}$.

   a. Find $\vec{v}_{2f}$. ?

   b. Is this an elastic collision ? Explain your response using relevant numerical values that you calculate. !

4. A carousel at an amusement park has a radius of 4 m and is turning at $0.40\ {}^{rad}/_{s}$ when the brake is engaged. The carousel then comes to rest with an angular acceleration of magnitude $0.05\ {}^{rad}/_{s^2}$.
   a. How long will it take the carousel to come to rest ?
   b. Through what angle will it turn as it comes to rest ?
   c. How fast is a child 3 m from the axis moving when the brake is applied ?
   d. What distance does that child travel as the carousel comes to rest ?

5.



A uniform cylinder of radius R and moment of inertia $^1/_2\ M\ R^2$ rolls down a 30° incline without slipping.
a. Find the acceleration of the cylinder.
b. Find the magnitude of the friction force.

HINT: TREAT THE TRANSLATION OF THE C.M. AND THE ROTATION ABOUT THE C.M. BY A NEWTON'S LAW 'METHOD'.