Physics 231: Test 3: Name:

Show your work. **Box your answers (no box is a 3pt deduction)**. No graphing calculators or other electronic communication devices allowed. There are at least 150pts to earn here. Answers must be given proper units and vector notation where appropriate. Thanks and enjoy!

[Problem 1][15pts] A wheel rotates through 5.1 rad in 1.8 s as it is brought to rest with constant angular acceleration. Determine the wheel's initial angular speed before braking began.

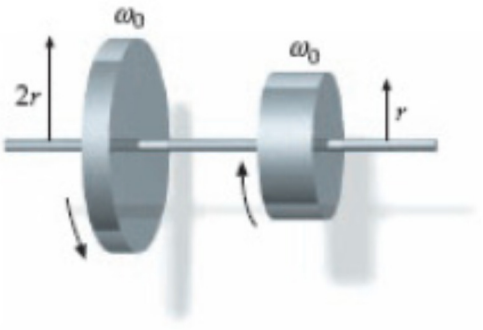
[Problem 2][20pts] The moment of inertia for a rod mass M of length L about one of its ends is $\frac{1}{3}ML^2$. Suppose a rod of mass $M = 2.0\ kg$ of length 2.0m rotates about a point 0.5m from one of its endpoints. If the rotational energy of the rod is $100\ J$ then what is the angular velocity of the rod?

[Problem 3] [15pts] A solid sphere has moment of inertia $I = \frac{9}{16}MR^2$. If this sphere rolls without slipping down an inclined plane of length L and inclination angle θ then find the speed as it reaches the base of the plane as a function of both L and θ.

[Problem 4][10pts] A net-force of $\vec{F} =< 10, 0, -3 > N$ is applied to a solid body at the point (1,2,3)m. Find the torque on the body with respect to the origin (0,0,0)m.

[Problem 5] [25pts] A mass $M_1 = 10\ kg$ hangs off the left of a pulley with moment of inertia $I = 2.0\ kg\ m^2$ and radius $R = 8.0\ cm$. A second mass $M_2 = 30\ kg$ hangs off the right of the pulley. What is the acceleration of the system? What is the tension T_1 in the rope where M_1 hangs?

[Problem 6] [15pts] Two disks of identical mass but different radii (*r* and 2*r*) are spinning on frictionless bearings at the same angular speed ω_0 , but in opposite directions. The two disks are brought slowly together. The resulting frictional force between the surfaces eventually brings them to a common angular velocity. Find the final angular velocity ω_f.



[Problem 7] [15pts] Note: $M_{earth} = 5.97 \times 10^{24} kg$, $R_{earth} = 6.38 \times 10^{6} m$ and $G = 6.673 \times 10^{-11}\ Nm^2/kg^2$. A satellite with a mass of $m = 270\ kg$ moves in a circular orbit $8.00 \times 10^{7} m$ above the Earth's surface. What is the speed of the satellite?

[Problem 8][15pts] A mass of $2.0\ kg$ is attached to an essentially massless spring which causes the mass to have the equation of motion $x(t) = 10\ sin(6t)$. (in kg, m and s). Find:

(a.) period (b.) angular frequency (c.) total energy for the system.

[Problem 9][20pts] Consider binary star system is a pair of stars which orbit a common center. Suppose the stars are identical with mass m_o orbit in a common orbital plane and suppose they orbit in a circle a distance 2L from each other. What is the speed of the stars orbit?

[Problem 10][20pts] The Kanagy clan makes its home on a distant planet of mass M with three moons. Suppose the moons are identical with mass m_o orbit in a common orbital plane and suppose they orbit in a circle a distance L from each other. What is the speed of the lunar orbits?