CSUC Fall Term

Physics 204A sections 5 and 6

<u>Fourth Exam</u>

Please complete the following problems on the blank sheets provided <u>using one side only</u>. Show all your work clearly and don't dwell too long on any one problem. Rather, complete first those that you understand better and return to any remaining problems at the end. Each problem is worth 20 points.
Be sure to work from <u>fundamental equations only</u> and indicate your derivations. When you are done please sign each sheet and number them, then staple them together and place them in the box provided. **No calculators and no notes of any kind are to be used. Please complete all your reasoning symbolically and express your solution as an algebraic expression.**

1) A particle of mass m and initial speed v_0 collides with and sticks to the edge of a uniform solid disk of mass M and radius R. If the disk is initially at rest and is pivoted about a frictionless axle through its center (perpendicular to the page):
(a) find the angular velocity of the system after the collision.
(b) find how much energy is lost in the collision.

2) A uniform solid disk of radius R and mass M is free to rotate on a frictionless pivot through a point on its rim. If it starts from rest with its center at the same height as the pivot:
(a) What is its angular acceleration both at the start *and* when its center is directly below the pivot ?
(b) What is its angular velocity both at the start *and* when its center is directly below the pivot ?
(c) What are the components of the reaction force of the pivot on the disk both at the start *and* when its center is directly below the pivot ?

3) Suppose that we hang from its rim a hoop of diameter 30cm and mass .4kg and set it swinging.
 a) Define the moment of inertia formally and find it for the given hoop. **b)** State the fundamental dynamical equation of rotational motion. **c)** Now apply the equation to this problem carefully inserting all the specifics as far as you know them. **d)** In the limit of small displacements solve the equation of motion and identify the **period of the motion**.

4) A spool of string of radius R and mass M is unwound under a constant force F.
Assuming that the spool rolls *without slipping:*
(a) What is the acceleration of the center of mass ?
(b) What is its center of mass velocity after rolling a distance d ?
(c) What is the frictional force?

5 A ballistic pendulum consists of a simple uniform rod of mass M and length L hanging vertically at rest. A blob of putty of mass m is shot horizontally at speed v so that it collides with and sticks to the lower hanging end of the rod at its lowest point. Find the maximum angle that the rod now swings through as it swings upward recoiling. (HINT: this is quite like what we *actually* performed in lab) (20 points)