MECH 211

Fall 2003

Test 3

Due by 5:00 pm Wednesday December 17, 2003.

Show all work. Any force existing in an equation must also be denoted on an appropriate free body diagram. Clearly indicate final answers.

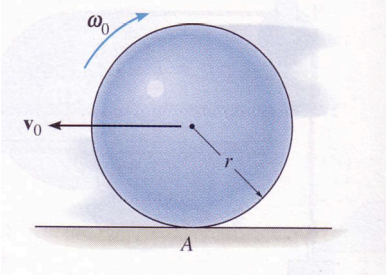
This test is taken under the Rice Honor Code system. You may consult only the textbook (Pytel and Kiusalaas), notes that you have personally taken, and any material downloaded from the course website. You may use a calculator, including programmable calculators. The test must be taken during a 3 hour period, with an optional 30 minute break.

Date and time started:_____

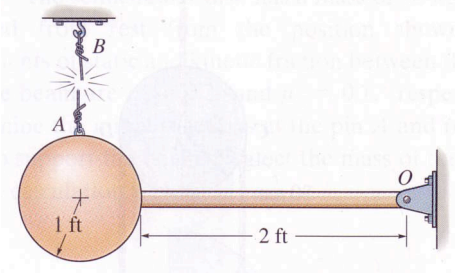
Date and time finished:_____

Pledge:_____

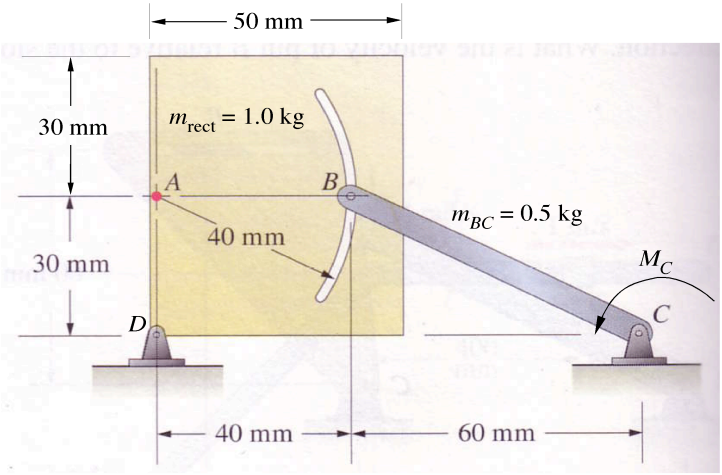
1. The uniform spherical ball has a weight W and radius r and is thrown onto a rough surface with a velocity v_0 parallel to the surface as shown. Determine the amount of backspin ω_0 that the ball must be given initially such that it stops spinning at the same instant in time that it stops translating along the surface. Do not neglect gravitational forces for this problem. (10 points)



2. The pendulum consists of a uniform 30-lb sphere and a uniform 10-lb slender rod. (a) Compute the reactions at pin O just after the cord AB is cut. (b) Determine the velocity (a vector) of the center of the sphere and the reactions at pin O when the rod makes an angle of 45° with the horizontal. Do not neglect gravitational forces for this problem. (15 points)



3. The uniform slender rod BC is driven by the applied couple M_C such that the angular velocity of rod BC is constant and equal to 2 rad/s counterclockwise. The pin at B slides in the frictionless circular slot. The mass of the rod is 0.5-kg and the mass of the rectangular plate is 1.0-kg. Determine all reaction forces acting at points D, B and C including the applied couple M_C. Neglect gravitational forces in this problem. Hints: (1) you will need to determine both the angular velocity and angular acceleration of the rectangular plate. (2) Neglect the material removed from the slot when determining the moment of inertia of the rectangular plate, i.e. assume that it is a uniform rectangular plate. (3) The acceleration of point B with respect to the plate can have both normal and tangential components with respect to the slot. (20 points)



Moments of inertia about the center of mass for a:

Uniform sphere: $\frac{2}{5}mR^2$, where R is the radius of the sphere

Uniform slender rod: $\frac{1}{12}mL^2$, where L is the length of the rod

Uniform rectangular plate: $\frac{1}{12}m\left(b^2+h^2\right)$, where b and h are the base and height of the rectangle