Rigid Body Dynamics, SG2150

Hand in assignments, batch 1, HT 2013

Due Monday 16/9

1) A straight circular homogeneous cylinder of radius R and mass m moves down an incline that makes an angle α with the horizontal. Consider two cases:
a) The static friction is large enough to prevent sliding.
b) Sliding occurs and the coefficient of kinetic friction is μ.
Find the acceleration of the center of mass of the cylinder down the incline in these two cases.

2) Solve Problem 1.8 at the end of Chapter 1, page 15, in Dynamics of Bodies. Also determine the mass ratio m/M that gives the largest net rotation.

3) Assume that a rigid body is rotated from a reference orientation (where the Euler angles are zero) to a different orientation with Euler angles given by:

$$\psi = 45°, \ \theta = 30°, \ \varphi = x°,$$

where x is found as follows: let d be the number of the day of the month that you are born, then find the number of degrees x from $x = 15 + d$.
Write a program that calculates the resulting rotation matrix. Also find the rotation angle ϕ and the unit vector $(\cos\alpha_1, \cos\alpha_2, \cos\alpha_3)$ of the rotation axis for this rotation. Hint: you need formulas of Chapter 2, especially (2.29) and symmetry and anti symmetry of matrices. Use Matlab or Maple or whatever.

4) Solve Problem 3.5 at the end of Chapter 3, page 55-56, in Dynamics of Bodies.