1. (20%) A turntable rotates with a constant angular elocity ω about a perpendicular axis through O. The position of a point P which is moving relative to the turntable is given by

$$r = xi + yj$$

where the unit vectors i and j are fixed in the turntable. Solve for the absolute velocity and acceleration of P in terms of its motion relative to the turntable.
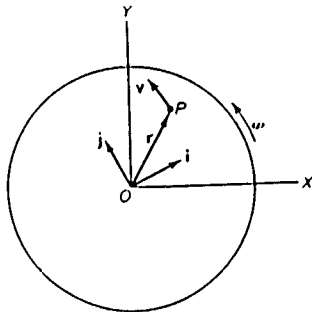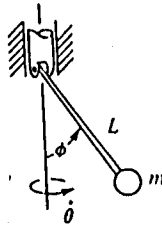

Figure 1:

Figure 2:

2. (20%) (a) Write the equation of motion for the spherical pendulum whose plane of oscillation rotates about the vertical as shown. The mass of the bob is m, and the length of the massless rod is L. (b) Integrate the equation of motion for the ϕ direction. What does the constant of integration physically represent?

3. (10%)

   (a) What is the difference between inertia and linear momentum?

   (b) Define angular impulse

4. (15%) Seven feet above a horizontal floor, a microphone is suspended from three wires. Assuming that the system S of all forces as shown in Fig. 4, that the wires are straight and that S is a zero system (i.e. in equilibrium), determine the magnitude of F_3 by writing and solving a single scalar equation.

5. (15%) A uniform, solid half-cylinder C of weight W rests on a horizontal support S and is attached to a wall by means of a horizontal string (see Fig. 5). Determine the reaction of S on C.
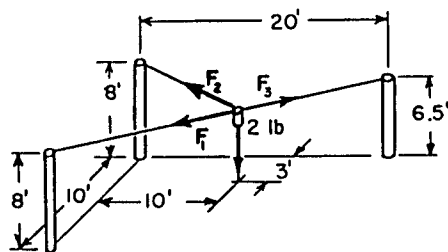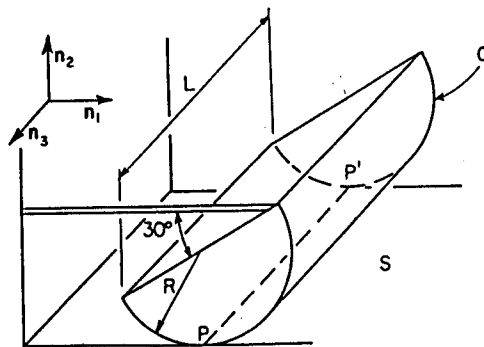

Figure 4:

Figure 5: