1. Find the component of the acceleration vector $\vec{a}$ in cylindrical coordinates. (20%)
2. Show that the gravitational self-energy(energy of assembly piecewise form infinity) of a uniform sphere of mass M and radius R is $U = -\frac{3}{5}\frac{GM^2}{R}$. (20%)
3. A geodesic is a line that represents the shortest path between any two points when the path is restricted to a particular surface. Find the geodesic on a sphere. (20%)
4. A bead slides along a smooth wire bent in the shape of a parabola $z = cr^2$ (Figure 1). The bead rotates in a circle of radius R when the wire is rotating about its vertical symmetry axis with angular velocity ω. Find the value of c. (20%)
5. The effect of the Coriolis force on the motion of a pendulum produces a precession, or rotation with time of the plane of oscillation. Describe the motion of this system, called a Foucault pendulum. (20%)

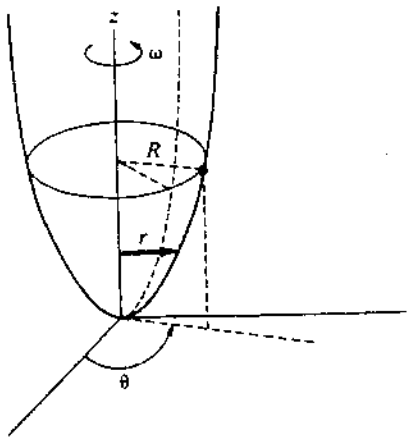

Figure 1