1 (19%) Charge is distributed uniformly throughout the volume of a solid sphere of radius R. The volume charge density is ρ. (Expression in ρ, ε_0, R)
(a) Write an expression for the electric field $E(r)$ when $r < R$? (6%)
(b) Write an expression for the electric field $E(r)$ when $r > R$? (6%)
(c) If $V(\infty) = 0$, write an expression for the electric potential $V(r)$ when $r > R$? (7%)

2 (27%) In Fig. Q2, a 1.34 kg ball is connected by means of two massless strings, each of length L=1.70 m, to a vertical, rotating rod. The strings are tied to the rod with separation d=1.70 m and are taut. The tension in the upper string is 35 N.
(a) Please find the tension in the lower string.
(b) what is the magnitude of the net string force $\vec{F}_{net,str}$ on the ball?
(c) Please find the speed of the ball.

3 (27%) A uniform spherical shell of mass M = 5.0 kg and radius R = 10.0 cm can rotate about a vertical axis on frictionless bearings (Fig. Q3). A massless cord passes around the equator of the shell, over a pulley of rotational inertia $I = 3.0\times10^{-3}$ kg·m^2 and radius r = 5.0 cm, and is attached to a small object of mass m = 0.60 kg. There is no friction on the pulley's axle; the cord does not slip on the pulley. When it fallen 80 cm after being released from rest, (Rotational inertia for a thin spherical shell about any diameter is $I = \frac{2}{3}MR^2$)
(a) what is the speed of the object?
(b) what is the force form the cord?
(c) what is the rotational kinetic energy of the spherical shell?

4 (27%) For a stepladder shown in Fig. Q4, sides AC and CE are each 2.44 m long and hinged at C. Bar BD is a tie-rod 0.762 m long, halfway up. A man weighing 80 kg climbs 1.8 m along the ladder. Assuming that the floor is frictionless and neglecting the mass of the ladder.
(a) Find the tension in the tie-rod between BD,
(b) Find the magnitude of the force on the ladder from the floor at A,
(c) Find the magnitude of the force on the ladder from the floor at E.

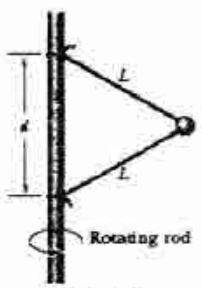

Fig. Q2

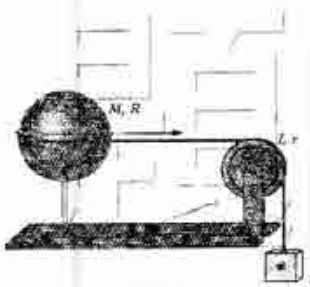

Fig. Q3

Fig. Q4