1. A sphere of radius $R$ carries a charge density $\rho(r) = kr$ (where $k$ is a constant). Find the energy of the configuration. Check your answer by calculating it in at least two different ways.

2. Consider three different charges with values: $+2q$, $+q$, and $-q$ placed in three different configurations

(a) $+2q$ $+q$ $-q$
(b) $-q$ $+2q$ $+q$
(c) $+q$ $-q$ $+2q$

Which of the three configurations has the minimum energy?

3. Two spherical cavities, of radii $a$ and $b$, are hollowed out from the interior of a (neutral) conducting sphere of radius $R$ (see the figure). At the center of each cavity a point charge is placed ($q_a$ and $q_b$).

(a) Find the surface charge densities $\sigma_a$, $\sigma_b$, and $\sigma_R$
(b) What is the field outside the conducting sphere?
(c) What is the field in each cavity?
(d) What is the force on $q_a$ and $q_b$?
(e) Which of these answers would change if a third charge $q_c$ were brought near the conducting sphere?
4. On a disk of radius $a$ and thickness $e$, such as $e \ll a$ (see the figure), there is a constant charge density $\rho$. Find the electric potential and the electric field at the point $P$ located a distance $z$ above the center of the disk. Also, calculate the work needed to move a charge $Q$ from infinity to point $P$.

5. A point charge $q$ is at the center of an uncharged spherical conducting shell of inner radius $a$ and outer radius $b$. How much work would it take to move the charge out to infinity (thorough a tiny hole drilled in the shell)?