1. In the technique of the electrical impedance imaging, the body is assumed to be a three concentric layers with conductivities σ1, σ2, σ3 as shown in Figure 1. A current density $J = M*\cos(\theta)$ A/m^2 is applied to the surface of the body. Find the potential distribution functions inside the body.

2. Consider two infinite parallel plates with a separation d and with the right-side plate at a potential V relative to the left-side plate. A positron enters the region between two plates through a small hole in the left-side plate. What initial velocity must the positron have in order to just reach the plate at potential V? Determine the positron position as a function of time. (Note: the properties of positron is the same as the electron except it contains positive charges.)

3. Consider a ring of charge radius a, center at the origin, and lying in the xy plane as shown in Figure 2. The charge distribution around the ring is given by $q_t = q_1*\cos(2\phi) + q_2*\sin(\phi)$ coulombs per meter. Use the multipole expansion method to obtain the first three terms in the expression for potential distribution for r >> a.

4. A charge distribution ρ(r) is placed inside a conducting sphere of radius a. The electric field is given by $E_r = A*r^4$ for $r \leq a$, and $E_r = A*r^{-2}$ for $r > a$. Find the charge distribution ρ(r) within the sphere and the surface charge ρ_s on the surface of the sphere.

5. According to the electrophysiology, the action potential may be evoked in a neuron by electrical, mechanical, or chemical stimulation, and transmits down to other neurons. The action potential is some kind of local current flowing through the nerve cell membrane and represents the activity of the neuron. Can we measure the action potential at a distance? Describe the method based upon the electromagnetic theorems.

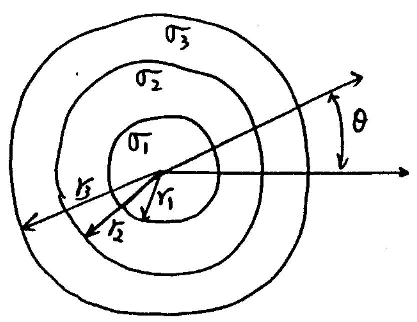

Figure 1.

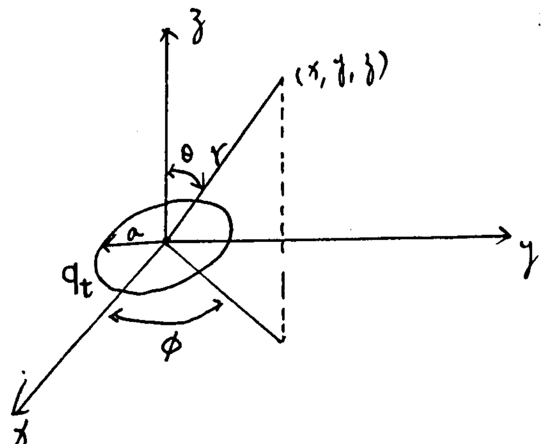

Figure 2.