1. A sphere of radius $R$ that carries a charge $Q$ is placed inside a conducting shell of inner radius $a$ and outer radius $b$. The sphere is hanging from the top of the shell thanks to an insulator wire as shown in the figure. By means of a mechanical impulse the sphere starts to oscillate like a pendulum without touching the shell. Assuming that the shell is a perfect conductor, find the electric field in the region outside the conducting shell. Under which conditions will the sphere stop moving?

![Diagram of a sphere and a conducting shell](image)

2. Consider two parallel-plate capacitors of identical construction except that the distance between the plates is $d$ for one of them (capacitor $A$), and $2d$ for the other (capacitor $B$). Initially, the switch $S$ is open and capacitor $A$ has a charge $q$. At some time, $S$ is closed, so that the capacitors are connected.

(a) What are the final charges $q_A$ and $q_B$ on the capacitors?

(b) What is the energy of in the initial and the final configurations? Anything to comment on the result?

![Diagram of two capacitors with a switch](image)
3. A grounded conducting sphere of radius \( R \) is placed in the interior of a spherical surface of radius \( d \) that carries a surface charge density \( \sigma \). Find the electric field everywhere. Is the field continuous everywhere?

4. Two semi-infinite grounded conducting planes meet at right angles. In the region between them, there is a point charge \( q \) situated as shown in the figure.
   
   (a) Set up the image configuration and calculate the potential in this region. What charges do you need and where should they be located?
   
   (b) What is the force on \( q \)?
   
   (c) How much work did it take to bring \( q \) in from infinity? Suppose the planes met at some angle other than 90°; would you still be able to solve the problem by the method of images? If not, for what particular angles does the method work?