1. **Find the capacitance per unit length of two coaxial metal cylindrical tubes of radii a and b.**

2. **A chargeless region is bounded by two conducting surfaces.**

   (a) **If a charge Q_1 is placed on conductor 1 while 2 is chargeless the potential in the region is given by the function $\Phi_1(x, y, z)$. If a charge Q_2 is placed on conductor 2 while 1 is chargeless the potential in the region is given by the function $\Phi_2(x, y, z)$. Now if charge Q_1 is placed on conductor 1 and charge Q_2 is placed on 2 prove that the potential in the region will be given by the function $\Phi = \Phi_1 + \Phi_2$.**

   (b) **If conductor 1 is maintained at potential V_1 and 2 is grounded the potential in the region is given by the function $\Phi_1(x, y, z)$. If conductor 2 is maintained at potential V_2 and 1 is grounded the potential in the region is given by the function $\Phi_2(x, y, z)$. Now if conductor 1 is maintained at potential V_1 and conductor 2 is maintained at potential V_2 prove that the potential in the region will be given by the function $\Phi = \Phi_1 + \Phi_2$.**

   This result can be extended to a region bounded by any number of conductors.

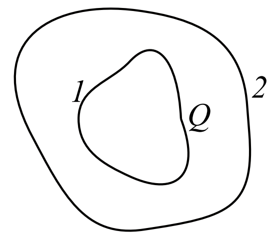
3. **A conducting sphere of radius a is concentrically surrounded by another conducting spherical shell of radius b.**

   (a) **A charge Q is placed on the inner conducting sphere. What will be the potential over the outer sphere.**

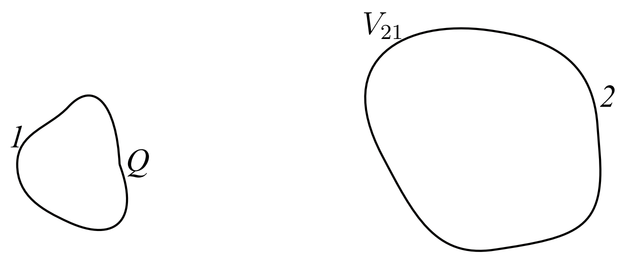
   (b) **Instead if the charge Q is placed over the outer shell, what will be the potential of the inner sphere?**

   (c) **How will your answer change if the shapes of the conductors were not spherical but arbitrary.**

   (d) **In general if we have two conducting surfaces S_1 and S_2, when a charge Q is placed on conductor 1, the potential on conductor 2 is found to be V_{21}. Whereas when the charge**



Q is placed on conductor 2 the potential on conductor 1 is found to be V_{12}. Prove that $V_{12} = V_{21}$.



4. **A metal sphere of radius R carrying a charge q is surrounded by a thick concentric metal shell of inner radius a and outer radius b. The shell carries no net charge.**

   (a) **Find the surface charge density σ at radius R, a and b.**

   (b) **Find the potential at the center, using infinity as the reference point.**

   (c) **If the outer surface $r = b$ is grounded how do the answers to part (a) and (b) change ?**

5. **Two infinitely long wires running parallel to the x axis carry uniform charge densities $+\lambda$ and $-\lambda$.**

   (a) **Find the potential at any point using the origin as the reference.**

   (b) **Show that the equipotential surfaces are circular cylinders. Locate the axis and radius of the cylinder corresponding to a given potential V_0.**