1. **Consider two concentric conducting thin spherical shells of radii R_1 and R_2. ($R_1 < R_2$). If a charge Q_1 is placed on the inner conductor and a charge Q_2 is placed on the outer conductor then show that the potential of the two conductors are given as $V_1 = K_{11}Q_1 + K_{12}Q_2$ and $V_2 = K_{21}Q_1 + K_{22}Q_2$ where K_{ij} are parameters dependent on the geometrical factors of the problem.**
   (a) **Determine them and verify that $K_{12} = K_{21}$.**
   (b) **Find the capacitance of the configuration in terms of K_{ij} and verify that this is what you expect for a spherical capacitor.**

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

3. **A point charge q is placed a distance a from the center of a grounded conducting sphere of radius R, $\quad a > R$.**
   (a) **In the method of images find the quantity and the position of the image charge. Justify that this image charge makes the potential of the whole conductor 0.**
   (b) **Find the force of attraction between the point charge and the sphere.**
   (c) **If the sphere was not grounded, what would be the potential of the sphere when the charge q is placed at the distance a from the center of the sphere?**

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. The points on the xy plane is maintained at potential $V_0 \sin(\alpha x + \beta)$. The potential goes to 0 as $z \to \pm\infty$. Find the potential at all the points above and below the xy plane.

6. Find the electric potential for $z \neq 0$ due to the infinite xy plane carrying a uniform charge density σ.
How can we get this potential by solving the two dimensional Laplace's equation

$$\frac{\partial^2 V}{\partial x^2} + \frac{\partial^2 V}{\partial z^2} = 0$$

by the variable separation method ?
(We can also start with the three dimensional Laplace's equation. But two is good enough to demonstrate the process.)