1.) Two different dielectrics each fill the space between the plates of a parallel plate capacitor as shown below. The first dielectric has a width of $d_1$ and the second dielectric has a width of $d_2$. Find the capacitance of the system in terms of $K_1$, $K_2$, the area.
2a.) A thin circular ring of radius $R$ has $+Q/2$ uniformly distributed on the top half and $-Q/2$ on the bottom half. What is the value of electric potential at a point $P$, some distance $x$ away from its center? [10 points]

b.) What is the electric field $(E_x, E_y, E_z)$ at a point $P$, some distance $x$ away from the ring’s center? [15 points]
3.) Suppose you have a thick conducting spherical shell of outer radius $r_o$ and inner radius $r_1$. The shell has a total net charge $Q$ and within its cavity is a point charge $q$. What is the charge on (a) the inner surface of the shell and (b) the outer surface of the shell? [5 points]

c) What is the electric field for $0 < r < r_1$? [5 points]
d) What is the electric field for $r > r_o$? [5 points]
e) What is the electric field for $r_1 < r < r_o$? [5 points]
4.) Find the following currents $I_1$, $I_2$, $I_3$. [20 points]
5) A quarter circular loop of wire carries a current $I$. Using the Biot-Savart Law, what is the magnetic field at the point $C$? [10 points]
6) A pair of long straight parallel thin wires (each of radius \( r \)), are a distance \( d \) apart and carry a current in opposite directions. Ignoring the field within each wire, calculate the inductance per unit length \( (L/h) \) [Note: \( h \) is very large] [15 points]
Extra Credit: The electric potential for a specific system is given as:

\[ V = \frac{by}{(a^2 + y^2)} + xyz + z \frac{1}{(b^2 + x^2)^2} \]

What is the electric field \((E_x, E_y, E_z)\)? [Note: a and b are constants] [10 points]