Electromagnetic Field

Problems

Problem 1
A long cylindrical capacitor contains two insulating layers. Find and plot electric field intensity $E$ and electric potential $\varphi$ in the capacitor as a function of distance from the axis. Electric permittivity of inner dielectric layer $\varepsilon_1=5\varepsilon_0$. Electric permittivity of outer dielectric layer is $\varepsilon_0$. Voltage between inner cylinder of radius $r_1=9.2$ cm and outer cylinder of radius $r_3=18.4$ cm is $U=120$ kV. Radius $r_2=13.8$ cm.

Problem 2
Find capacitance of the capacitor in Problem 1. The length of the capacitor $l=2.4$ m.

Problem 3
Find the largest allowable voltage for capacitor in Problem 1. Electric field intensity should not exceed the value $E_{1a}=6$ kV/mm in the inner dielectric and the value $E_{2a}=3$ kV/mm in the outer dielectric.

Problem 4
Find and plot electric field intensity $E$ and electric potential $\varphi$ in the parallel plate two-layer capacitor as a function of distance from the left plate. Insulation between the plates consists of a dielectric layer of relative permittivity $\varepsilon_r=3.5$ and a layer of air. Voltage between the plates $U=110$ V. Distance between the plates $d=0.12$ mm.

Problem 5
Three electric charges: $Q_1=-0.3$ mC, $Q_2=0.9$ mC, $Q_3=0.9$ mC are located in 3-dimentional space in points: $P_1(1m, 1m, 1m)$, $P_2(2m, 3m, 4m)$, $P_3(3m, 2m, 4m)$, respectively. Find the force acting on charge $Q_1$.

Problem 6
Find capacitance of the capacitor in Problem 4. Surface area of the plate $S=600$ cm.