Homework set 3 (David K. Cheng, Fundamentals of Engineering Electromagnetics)

P. 3-1 The cathode-ray oscilloscope (CRO) shown in Fig. 3-2 is used to measure the voltage applied to the parallel deflection plates.

    a) Assuming no breakdown in insulation, what is the maximum voltage that can be measured if the distance of separation between the plates is h?

    b) What is the restriction on L if the diameter of the screen is D?

    c) What can be done with a fixed geometry to double the CRO's maximum measurable voltage?

P. 3-4 Three point chares $Q_1 = -9(\mu C), Q_2 = 4(\mu C)$, and $Q_3 = -36(\mu C)$ are arranged on a straight line,. The distance between Q_1 and Q_3 is 9 (cm). It is claimed that a location can be selected for Q_2 such that each charge will experience a zero force. Find this location.

P. 3-7 A line charge of uniform density ρ_l forms a semicuircle of radius b in the upper half xy-plane. Determine the magnitude and direction of the electric field intensity at the center of the semicircle.

P. 3-8 A spherical distribution of charge $\rho = \rho_0\left[1 - \left(R^2/b^2\right)\right]$ exists in the region $0 \le R \le b$. This charge distribution is concentrically surrounded by a conducting shell with inner radius $R_i(> b)$ and outer radius R_0. Determine $\mathbf{E}$ everywhere.

P. 3-11 Determine the work done in carrying a $+5(\mu C)$ charge from $P_1(1,2,-4)$ to $P_2(-2,8,-4)$ in the field $\mathbf{E} = \mathbf{a}_x y - \mathbf{a}_y x$

    a) along the parabola $y = 2x^2$, and

    b) along the straight line joining P_1 and P_2

P. 3-12 A finite line charge of length L acarrying uniform line charge density ρ_l is coincident with the x-axis.

    a) Determine V in the plane bisecting the line charge.

    b) Determine $\mathbf{E}$ if ρ_l directly by applying Coulomb's law.

    c) Check the answer in part (b) with $-\nabla \mathbf{V}$.