Massachusetts Institute of Technology *Spring Term 2005*

8.02X Electricity and Magnetism

Problem Set 4

Issued: **Thu, Feb 24**
Due: **Fri, Mar 4 4PM <- note Date + Time!**

Reading suggestions (from Young & Freedman)

Fri, 2/25 : Electric Potential, Capacitance:23-4,24-1
Mon, 2/28: Energy Storage in Capacitors, Dielectrics:24-3, 24-4
Wed, 3/2: Capacitors in Circuits:24-2
Fri, 3/4: Conductors and Insulators, EF Experiment 25-1

Homework Problems (30 points total)

Problem 1 (8 points) Two point-like charges Q_1 = 1C and Q_2 = -1C are separated by a distance of 1m. Suppose in an x-y coordinate system Q_1 sits at (-0.5m, 0) and Q_2 sits at (+0.5m,0).

(a) What is the force on charge Q_1 due to Q_2?
(b) Find the minimum of the x-component of the field between $-0.5\ m < x < 0.5m$. What is the magnitude of the field in units of [V/m]?.
(c) Draw graphs of the x-component and y-component of the total electric field $E_x(x,y)$ and $E_y(x,y)$ vs x between $-0.5m < x < 0.5m$ for y=0, y=-10cm, y=+10cm (the three curves for each component can be combined into one graph, if properly labeled).
(d) Sketch the electric field of this charge configuration using fieldlines. Does this sketch correspond to the graphs from (c)?

Problem 2 (8 points) Two point-like charges Q_1 = 1C and Q_2 = -2C sit at x_1= -0.5m and x_2= +0.5m along the x-axis of some coordinate system.

a. Draw a graph the electric potential due to Q_1, Q_2 separately and the total electric potential from x = -2m to x = +2m.
b. How could one approximate the total potential of Q_1+Q_2 for distances $x >> 1m$?
c. Draw a graph of the potential energy for a charge Q_3 of –0.1C in the potential created by Q_1 andQ_2 between $-2m < x < 2m$

Problem 3 (6 points) Young&Freedman, Problem 24-60
Problem 4 (8 points) Young&Freedman, Problem 24-71

Note that check-off and experiment write-up (FROM BOTH PARTNERS) for experiment 'HVPS' are due on Fri, 3/4. HVPS questions have been provided in a separate document. There will be 2 bonus points for HVPS on 2/28 and 1 bonus point on 3/1.