Massachusetts Institute of Technology *Spring Term 2005*

8.02X Electricity and Magnetism

Practice Quiz #2b

Problem 1 (30 points)

In lecture, you saw a demo with a parallel plate capacitor with capacitance C_0. The capacitor was connected to an ideal power supply with an output voltage ΔV and charged to a charge Q. The capacitor was disconnected from the power supply, still carrying the same charge Q. Then the distance between the plates was increased by a factor of 2.

(a) How big is the potential difference between the capacitor plates after they have been moved apart?

(b) How big is the stored electrical energy in the capacitor after the plates have been moved apart?

(c) Explain how energy was conserved when moving the plates apart (1 sentence).

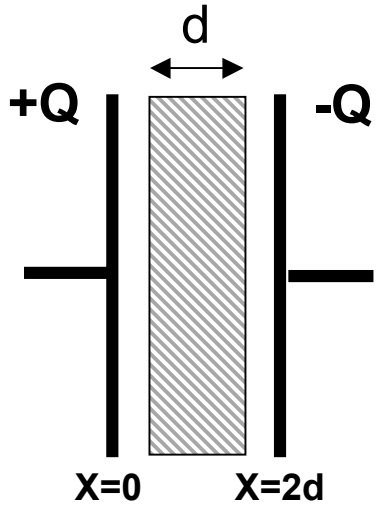
(d) Suppose we had not disconnected the power supply before moving the plates apart. How big would the stored energy be after the plates have been moved apart in this case?

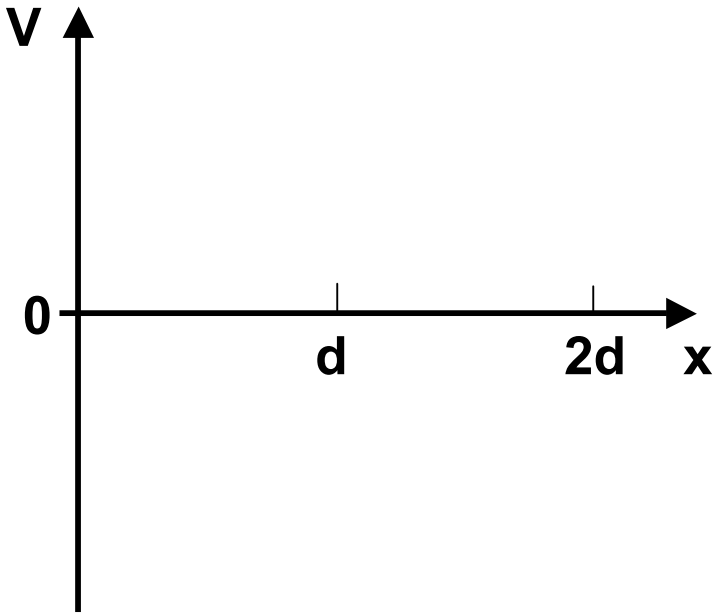
Problem 2 (20 points)

Shown below is the cross-section of a parallel plate capacitor with distance 2*d between the plates. The capacitor is given a charge Q using a power supply and then disconnected from the power supply. Then a dielectric with thickness d and dielectric constant K=2 is inserted between the plates.

(a) Does the stored energy increase, decrease or stay the same when the dielectric is inserted?

(b) On the graph below, draw a qualitative sketch of the electric potential between the capacitor plates as a function of x between x=0 and x=2d. At which value of x did you choose to set V=0?





Problem 3 (30 points)

Shown below is the schematic setup of the EF experiment, including the HVPS and the two multimeters. The multimeters have a resistance of 20MOhm. Suppose MMM1 measures 400V just before the foil jumps. We define the negative terminal of the HVPS to be at a potential of 0V.

(a) What is the potential of washer 1 before the foil jumps and connects the two washers?

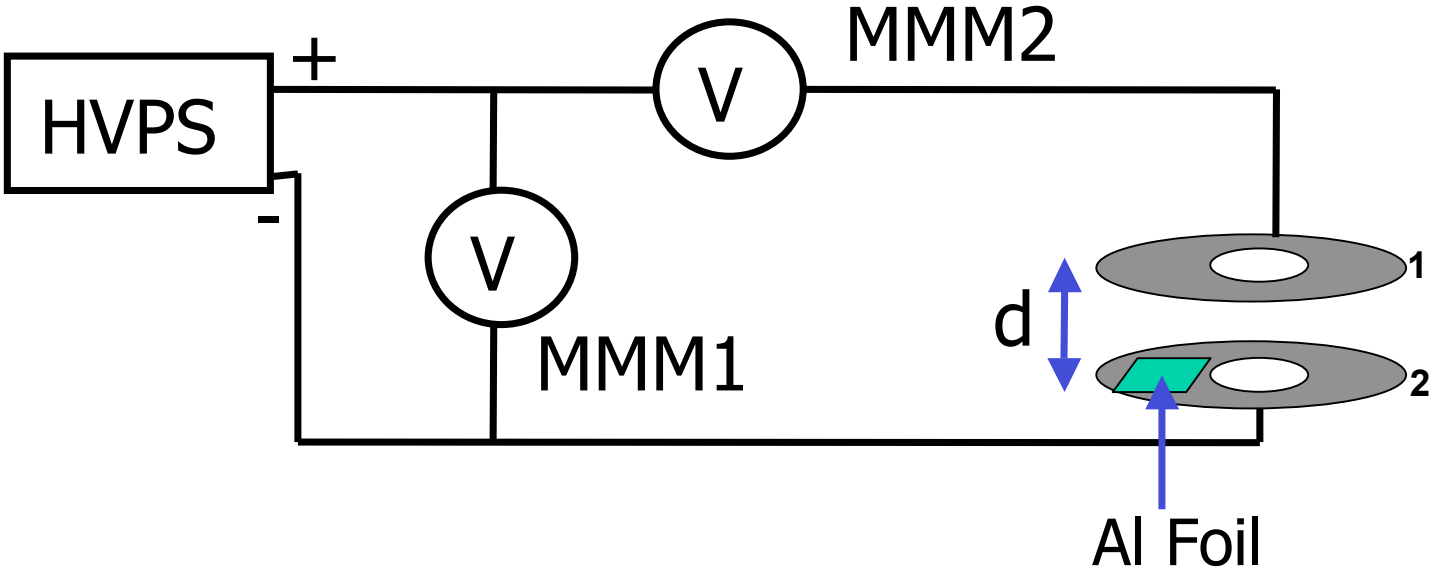
(b) What is the reading of MMM2 before the foil jumps?

(c) After the foil jumps, the reading of MMM1 drops to 380V. What is the potential of washer 1 now?

(d) What is the reading of MMM2, after the foil has jumped?

(e) Explain why the reading of MMM1 dropped after the foil jumped.

(f) Assume the experiment was repeated with the distance between the washers doubled to 2*d. At which reading of MMM1 would the foil jump in this case? Explain your answer.



Problem 4 (20 points)

Shown below is a simple circuit consisting of a pair of light bulbs, connected in series to an ideal power supply providing a constant 'voltage' $\Delta V = 12V$.

(a) Assume bulb 1 is rated as a 36W bulb at 12V, i.e. it will consume 36W of electrical power if connected to a 12V power supply. What is its resistance?

(b) Assume bulbs 1 and 2 are identical. In the circuit below, which one would burn brighter or would they show the same brightness?

(c) Assume bulb 1 is rated as a 36W bulb and bulb 2 as a 72W bulb. Which one would burn brighter (i.e. consume more power) in the circuit below, or would they both show the same brightness? Explain your answer.