8.02X Electricity and Magnetism

Practice Quiz #2a
Problem 1 (25 points)

Shown below is a circuit consisting of a power supply with an output voltage $\Delta V$ and three identical light bulbs. *For all answers, explain your reasoning in one or two sentences.*

(a) Which of the bulbs will burn most brightly or will they all show the same brightness?

(b) Suppose bulb 2 was replaced with a bulb with twice the power rating. Would bulbs 1 and 3 burn brighter, less bright or be unaffected? Explain your reasoning.
Problem 2 (25 points)

A glass plate with dielectric constant $K=2$ is inserted into a parallel plate capacitor with area $A$ and distance $d_0$ between plates. Using a power supply, the capacitor is charged to a charge $Q$. The power supply is NOT disconnected.

(a) What is the energy stored in the capacitor?

(b) The separation between the plates is increased to $d=2d_0$, but the glass plate remains in the same position. What is $U_{\text{stored}}$ now?
Problem 3 (25 points)

In one of the lecture demos, a large capacitor was charged using a power supply with an output voltage of 4000V and internal resistance of 10kOhm. Assume that at times $t < 0$ the capacitor is completely uncharged. Then the switch is moved to position a to charge the capacitor.

(a) Sketch how the charge $Q$ on the capacitor will change as a function of time for $t < 0$.

(b) At which time $t$ will the power delivered by the power supply be maximal? Explain in one or two sentences.

(c) What is the maximum power provided by the power supply?
\[ V = 4000 \text{ V} \]

\[ C = 100 \mu \text{F} \]

\[ R = 0.4 \Omega \]

\[ r = 10k\Omega \]

\[ \Delta V = 4000 \text{ V} \]

thin wire with

\[ R = 0.4 \Omega \]
Problem 4 (25 points)

Shown below is a schematic view of experiment EF. Assume the foil jumps at a potential difference between the plates of 300V. For questions (a) and (b), give the (approximate) reading of MM1 and MM2 in Volts (assume MM1 and MM2 have identical characteristics).

(a) What are the readings of MM1 and MM2, immediately after the foil jumps and connects the two washers?

(b) What are the readings of MM1 and MM2, immediately before the foil jumps and connects the two washers?

(c) Determine the electric force on the foil for a potential difference $\Delta V < 400$ V (i.e. before the foil jumps). The foil carries charge $Q$, the distance between washers is $d$. 
HVPS

Al Foil
(mass m, charge Q)