S11 PHY114 Problem Set 4

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1. An isolated capacitor C_1 carries a charge Q_0. It is then connected by conducting wires to a second capacitor C_2 which was previously uncharged. What is the charge on each capacitor now?

2.

(i) How much energy is needed to transfer a small amount of charge dQ from one plate of a capacitor to the other, if the potential difference between the plates is V?

(ii) By thinking of the charge on the capacitor as built up from zero to Q in small increments, what is the energy of a capacitor with charge Q? The capacitance C is constant. Express this energy in terms of C and the final voltage V.

3. Recently there have been advances in developing capacitors with very large capacitances of thousands of Farads. They also have a small internal resistance.

(i) How much electrical energy is stored in a 1200 Farad capacitor charged to 12 Volts?

(ii) It is found that the time it takes for half the charge in this capacitor to be discharged is $0.52s$. What is the resistance ?

4. Using the formula for the energy of a parallel plate capacitor, derive a formula for the energy density of the electric field. Assume that the capacitor is made of two parallel conducting plates, each of area A, separated by at a distance d of empty space.

5. A $2.8k\Omega$ and $3.7k\Omega$ resistor are connected in parallel; this combination is then connected in series with a $1.8k\Omega$ resistor. What is the maximum voltage that can be applied across this network if the power dissipated in any one resistor cannot exceed one Watt ?