

Physics 4B: Problem Set 5 Capacitance and More Energy

1. Derive the capacitance for a parallel plate capacitor.
2. Derive the capacitance for a spherical capacitor. (two conducting concentric spheres of radius R_1 and R_2)
3. Two parallel plate capacitors, C_1 and C_2 , are initially arranged such that only C_1 has an initial charge, Q_{i1} . C_2 is initially uncharged. They are then connected in parallel. Find the ratio of the initial energy to the final energy (after they have been connected).
4. A single capacitor, C , is initially charged with Q_i given. A dielectric is then inserted; the dielectric constant, κ . Find the change in the capacitor's energy as a consequence of this insertion and find the work done by an external applied force inserting the dielectric (at constant kinetic energy) to accomplish this.
5. A capacitor of value C is connected across a battery of voltage V . The capacitor is fully charged. While the cap is still connected to the battery a dielectric of constant κ is inserted. Find the new charge on the capacitor.
6. Using energy density, find the total energy associated with the electric field created from a uniformly charged dielectric sphere, radius R charge Q and show this value is equal to the work done to create it.