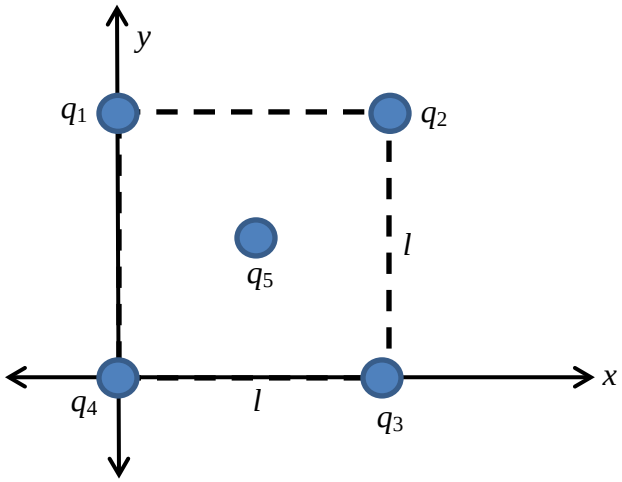
Homework: Ch. 19

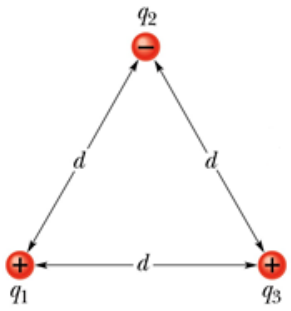
1. Why it is possible to define an electric potential in a region of space that contains an electrostatic field?

2. What is the electric potential energy of two electrons separated by 2.00 m? What about if the separation is 2.00 μm?

3. Four point charges are located at the corners of a square with each side of length l = 5.0 cm. A fifth charge is placed exactly in the center of the square, as shown in the figure below. Assuming that $q_1 = q_2 = +2.0$ μC, charge $q_3 = q_4 = +1.0$ μC, and $q_5 = -2.0$ μC, what is the electric potential due to all the charges at the location of charge q_5?

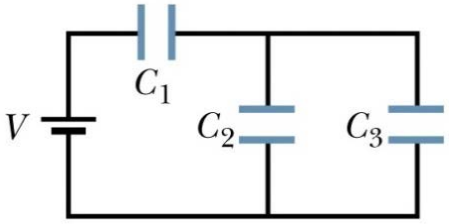


4. Suppose you want to setup the arrangement of charges shown in the figure. Charge 1 is located at the origin of a coordinate system and all the charges have the same magnitude of q but with signs indicated in the figure.
   a. Would it take more work to bring charge q_2 in from infinity first or charge q_3? Why?
   b. Determine how much works is required to set up the arrangement of charges shown. Assume that q = 2.50 nC, d = 6.00 cm, and that the particles are initially infinitely far apart and at rest.



5. How many 1.0 μF capacitors must be connected in parallel to store a charge of 1.00 C with a potential of 110 V across the capacitors?

6. In the figure to the right, identify which capacitors are in series and which are in parallel.

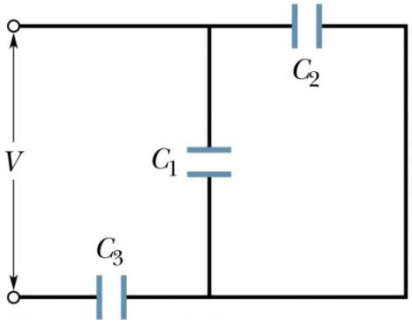


7. For the figure in the previous problem, determine the charge and potential difference across each capacitor assuming that V = 10.0V and the capacitance is 10.0 μF for all the capacitors.

8. A 100.0 pF capacitor is charged to a potential difference of 50.0 V and the charging battery is disconnected. The capacitor is then connected in parallel with a second (initially uncharged) capacitor. If the potential difference across the first capacitor drops to 35.0 V, what is the capacitance of this second capacitor?

9. A certain parallel-plate capacitor is filled with a dielectric for which κ = 5.5. The area of each plate is 0.034 m^2, and the plates are separated by 2.0 mm. The capacitor will fail (short out and burn up) if the electric field between the plates exceeds 200 kN/C. What is the maximum energy that can be stored in the capacitor?

10. The figure shows three capacitors with capacitance C_1 = 10.0 μF, C_2 = 5.0 μF, and C_3 = 15.00 μF.
    a. Find the equivalent capacitance for the combination.
    b. Assuming that V = 20.0 V. Determine the charge and potential across all capacitors.
    c. What is the potential energy stored in C_3?



11. An air filled parallel-plate capacitor has a capacitance of 1.3 pF. The separation of the plates is doubled, and wax is inserted between them. The new capacitance is 2.6 pF. Find the dielectric constant of the wax.

12. You are given the circuit to the right. Assume that $C_1 = C_2 = C_4$ = 10.0 μF, $C_3 = C_6$ = 20.0 μF, and C_5 = 5.0 μF. What is the equivalent capacitance for this combination?