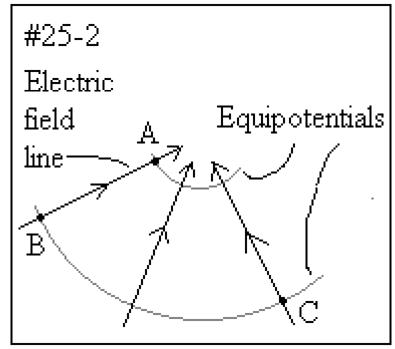
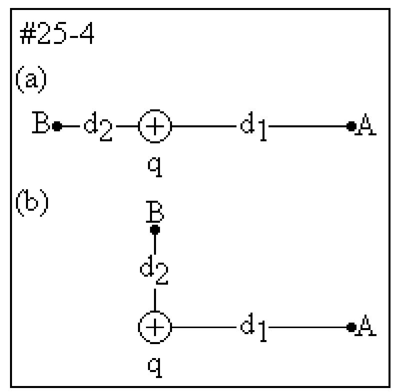
Phsx 2220 - Homework #3

25-1. The electric potential difference between the ground and a cloud in a particular thunderstorm is 1.2×10^9 V. What is the magnitude of the change in the electric potential energy (in multiples of the electron-volt) of an electron that moves between the ground and the cloud?

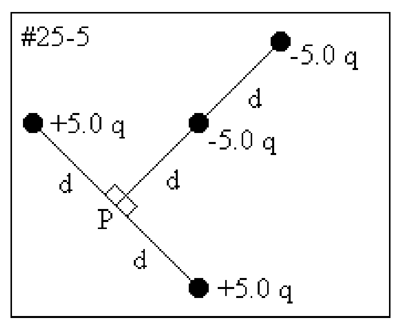


25-2. When an electron moves from A to B along an electric field line in the figure at right, the electric field does 3.94×10^{-19} J of work on it. What are the electric potential differences (a) $V_B - V_A$, (b) $V_C - V_A$, and (c) $V_C - V_B$?

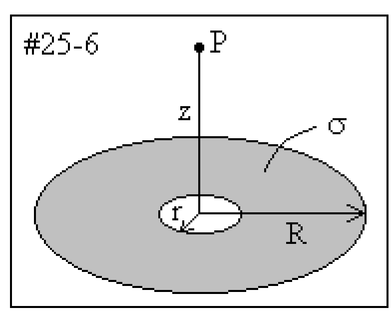
25-3. An infinite nonconducting sheet has a surface charge density $\sigma = 0.10\ \mu C/m^2$ on one side. How far apart are equipotential surfaces whose potentials differ by 50 V?



25-4. Consider a point charge $q = 1.0\ \mu C$, point A at distance $d_1 = 2.0$ m from q, and point B at distance $d_2 = 1.0$ m. (a) If these points are diametrically opposite each other, as in the top figure at right, what is the electric potential difference $V_A - V_B$? (b) What is that electric potential difference if points A and B are located as in the bottom figure at right?



25-5. In the figure at right, what is the net potential at point P due to the four point charges, if V = 0 at infinity?

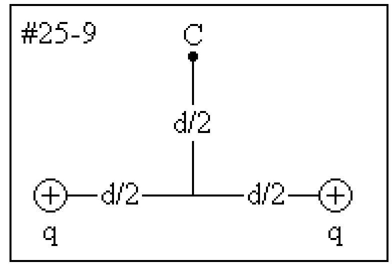


25-6. The figure at right shows a ring of outer radius R and inner radius r = 0.200 R; the ring has a uniform surface charge density σ. With V = 0 at infinity, find an expression for the electric potential at point P on the central axis of the ring, at a distance z = 2.00 R from the center of the ring.

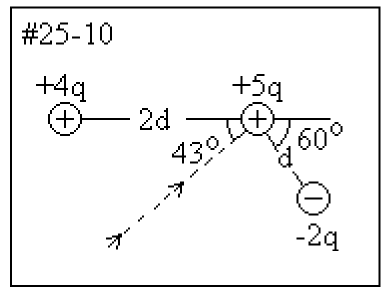
25-7. Two large parallel metal plates are 1.5 cm apart and have equal but opposite charges on their facing surfaces. Take the potential of the negative plate to be zero. If the potential halfway between the plates is then +5.0 V, what is the electric field in the region between the plates?

25-8. The electric potential at points in an xy plane is given by $V = (2.0\ V/m^2)x^2 - (3.0\ V/m^2)y^2$. What are the magnitude and direction of the electric field at point (3.0 m, 2.0 m)?

25-9. Two charges q = +2.0 μC are fixed in space a distance d = 2.0 cm apart, as shown at right. (a) With V = 0 at infinity, what is the electric potential at point C? (b) You bring a third charge q = +2.0 μC from infinity to C. How much work must you do? (c) What is the potential energy U of the three-charge configuration when the third charge is in place?



25-10. In the figure at right, how much work is required to bring the charge of +5q in from infinity along the dashed line and place it as shown near the two fixed charges +4q and -2q? Take d = 1.40 cm and $q = 1.6 \times 10^{-19}$ C.



25-11. Calculate (a) the electric potential established by the nucleus of a hydrogen atom at the average distance of the circulating electron $r = 5.29 \times 10^{-11}$ m), (b) the electric potential energy of the atom when the electron is at this radius, and (c) the kinetic energy of the electron, assuming it to be moving in a circular orbit of this radius centered on the nucleus. (d) How much energy is required to ionize the hydrogen atom (that is, to remove the electron from the nucleus so that the separation is effectively infinite)? Express all energies in electron-volts.

25-12. A charge of -9.0 nC is uniformly distributed around a ring of radius 1.5 m that lies in the yz plane with its center at the origin. A point charge of -6.0 pC is located on the x axis at x = 3.0 m. Calculate the work done in moving the point charge to the origin.