

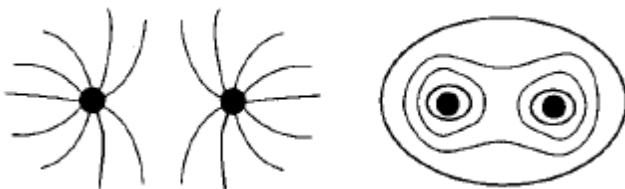
Workshop module 4 - Physics 142, Fall 2014

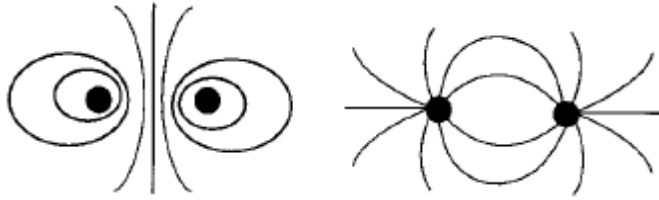
- 1) A thin wire segment with charge $+Q$ uniformly distributed along its length, L , is lying on the x -axis with its midpoint at the origin. Calculate the electric potential at a point P on the x axis, where $P > L/2$. From the electric potential, calculate the electric field. Use limiting cases to confirm that the form of the potential and the electric field that you have calculated make sense.
- 2) Two parallel conductive plates of area A are separated by a distance d , where d is much smaller than the length and width of the two plates. Equal and opposite electric charges are placed on the two plates. One plate carries a positive charge distributed uniformly with area charge density σ . The other plate carries a negative charge distributed uniformly with area charge density $-\sigma$. How much work does it take to move the two plates so the separation between them is $2d$?
- 3) Tandem van de Graff accelerators are used to accelerate nuclear particles to high energies. Beams of these particles can be used to study nuclear reactions and nuclear structure. Another use for such beams is the treatment of cancerous tumors. It turns out charged particles lose energy as they interact with matter by ionizing the medium they pass through. One of the more fortunate aspects of this energy loss is that most of the energy is dumped right at the end of the particle's path. If one tunes the energy of a particle beam so that the average range of the particle through the body is just sufficient to reach the tumor, most of the energy is released in the tumor, destroying only the tissue you would like to destroy. Cool, huh?!

A tandem van de Graff accelerator consists of a negative ion source at ground (zero potential), a positively charged high voltage terminal, and an electron stripping foil. A negative ion from the source is accelerated toward the positive high voltage terminal. As the ion passes through the thin stripping foil, all the electrons are removed, leaving only the bare positive nucleus. This nucleus is now accelerated (repelled) by the positive high voltage terminal.

If a He^- ion is accelerated from ground through a potential difference of 20 million volts, stripped of all its electrons to form the He^{++} ion, and then accelerated again from +20 million volts to ground, what is its final kinetic energy?

- 4) Choose the diagram that corresponds to lines of constant potential around an electric dipole where the electric charges that make up the dipole are given by the positions of the large black dots. Justify your answer briefly to the right of the drawing.





- 5) A non-conducting wire forms a circle with radius R in the x - y plane centered at the origin. A charge of $+3Q$ is placed uniformly on the region of the wire ranging from the negative y -axis counter-clockwise to the negative x -axis. A charge of $-Q$ is placed uniformly on the region of the wire ranging from the negative x -axis counter-clockwise to the negative y -axis. Calculate the electrostatic potential at point P .

