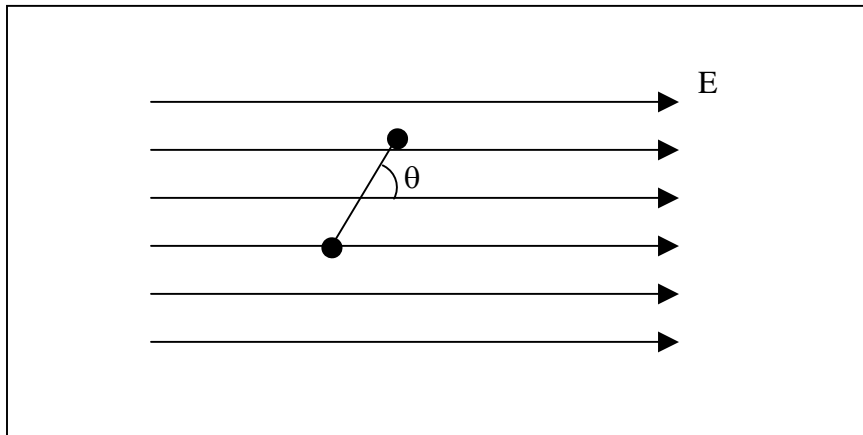


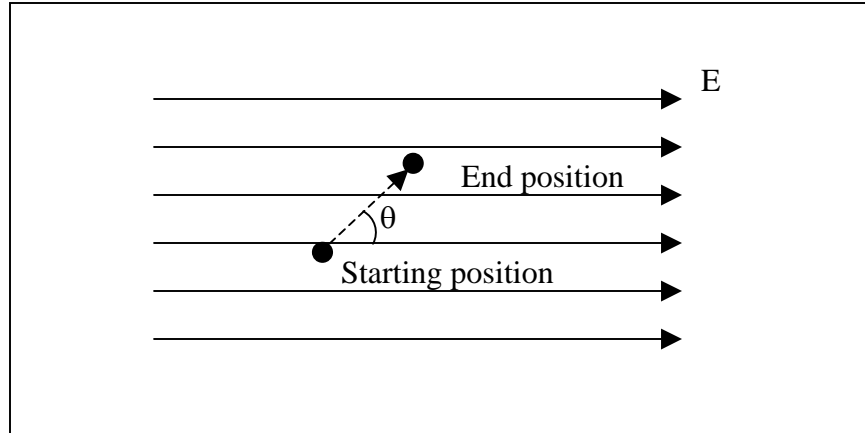
Physics 206b

Homework Assignment V
September 21, 2007

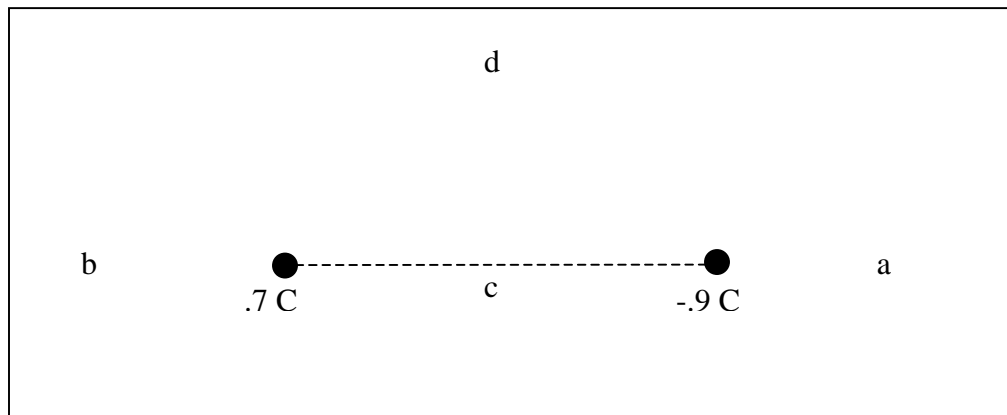
1. Recall that the definition of the dipole moment p is $p \equiv Qd$. This is obtained by having a charge of $+Q$ and a charge of $-Q$ separated by a distance d . (Note that in chemistry the dipole moment is called μ .) A molecule of sodium chloride has a dipole moment of 3×10^{-29} *Coulomb·meters*. Consider the charges giving rise to the dipole moment of this molecule to be the charge on the proton and electron, respectively.
- If the axis (the line connecting the two atoms) of such a molecule makes an angle of 1.1 radians with respect to an electric field of $\vec{E} = 1 \times 10^5 \frac{\text{Volts}}{\text{meter}} \hat{x}$, as shown, what is the total torque on the molecule?
 - What is the angular acceleration of such a molecule in such a field at the stated angle?



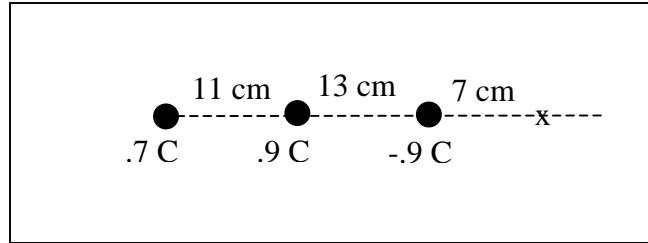
2. A proton in a constant electric field of $\vec{E} = 1 \times 10^5 \frac{\text{Volts}}{\text{meter}} \hat{x}$ is moved 3 cm at an angle of .9 radians relative to the field, as shown. How much work is done in the motion?



3. An electron is released from rest very far away from a proton whose position is fixed. When the electron is 1 mm away from the proton, what is its speed?
4. Electrons in the “gun” of a television set are thermionically emitted from a filament. They are accelerated through a potential difference of 4 kV. Neglecting their initial speed, what speed will the electrons have after the acceleration?
5. Two charges lie on the x axis, as shown. The one on the right is -0.9 C and the one on the left is 0.7 C . They are separated by 37 cm. What is the electric potential at the following points:
- 10 cm to the right of the charge on the right?
 - 10 cm to the left of the charge on the left?
 - The point on the x axis midway between the two charges?
 - The point 12 cm in the \hat{y} direction directly “above” the midpoint between the charges?



6. Three charges are in the configuration shown below.
- What is the potential energy stored in the configuration?
 - How much work would be required to move a charge of $.3 \text{ C}$ to the position marked "x" from a large distance away?
 - Assume the $.3 \text{ C}$ charge has a mass of 5 grams. With what speed would it have to be thrown to get it to the position marked "x" if thrown from a large distance away?



- Calculate the total capacitance of a pair of parallel plates separated by air. Consider the plates to be circular with a radius of 1 cm. Take the separation between them to be $1/2 \text{ mm}$.
- What is the maximum charge that could be put on the above capacitor if the dielectric strength of air is $3 \frac{\text{kV}}{\text{mm}}$?
- Now, the gap in the capacitor above is filled with paper (see table 19.1 in your text), which has a dielectric strength of $8 \frac{\text{kV}}{\text{mm}}$. What is the maximum charge that could be put on the capacitor in this case? What voltage difference would that require?