

In-class problems, Mon Feb 24, 2020

22.6 22.7, point charge and dipole in an electric field

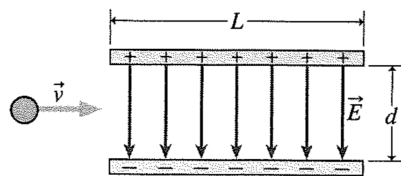
1. Beams of high speed protons can be produced in ‘guns’ using electric fields to accelerate the protons.

(a) What acceleration would a proton experience if the gun’s electric field were $2.00 \times 10^4 \text{N/C}$?

(b) What speed would the proton attain if the field accelerated the proton through a distance of 1.00cm?

(*HRW 22-47*). Note: In X-ray equipment, electrons are often accelerated using similar “guns” to hit targets (often tungsten) in order to create X-rays.

2. You’re working on the design of an ink jet printer. Ink drops of mass m , speed v , and charge q enter a region of uniform electric field E between two charged plates. The plates have length L and are separated by a distance d . The drops enter midway between the plates, and the electric field deflects them.



Find the maximum electric field for which drops can still get through without hitting either plate. Provide an expression using the given variables (m, v, q, L, d)

(*Wolfson 20-81*) $E_{max} = mdv^2/qL^2$

3. A neutral water molecule (H_2O) in its vapor state has an electric dipole moment of $6.2 \times 10^{-39} \text{C} \cdot \text{m}$. Model the dipole as having effective charges of $+e$ and $-e$. (The effective charge is less, since H and O share the electrons.)

How far apart are the positive and negative charge?

(*Wolfson 20-30*)

4. An electric dipole consists of charges of magnitude $+2e$ and $-2e$, separated by 0.78nm. It is in an electric field of strength $3.4 \times 10^6 \text{N/C}$. Calculate the magnitude of the torque on the dipole with the dipole moment is

- (a) parallel to
- (b) perpendicular to
- (c) antiparallel to

the electric field. Add a sketch.

(*HRW 22-56*)

Due Tue Feb 25, 2020, beginning of class

recap E (extra-credit)

Review your notes, problems from class, problems from Expert TA.

1. Identify a problem from electric fields that you’d like to revisit. Provide the entire problem statement, and whatever diagrams go with it.
2. Repeat.
3. Repeat.