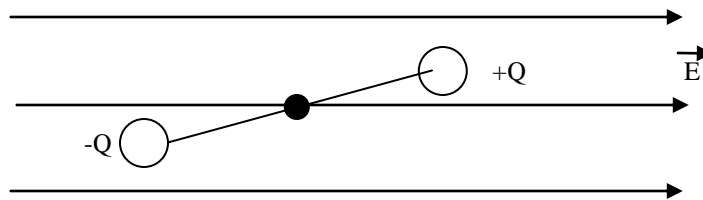


## Workshop module 1 - Physics 142, Fall 2010

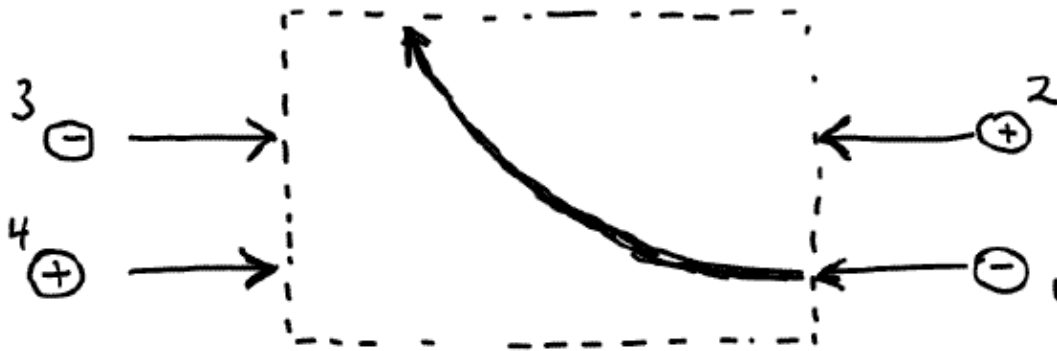
- Remember the Clinton years? My sources inside the White House tell me that Monica and Bill misled Congress and the public about what really went on behind closed doors. My source says the scandal was a cover-up. They were too embarrassed to tell what really happened. According to what I can gather, Monica and Bill share a fascination with electrostatics. Their time alone was spent running little experiments. Apparently, they were confused about the results of one experiment. I hope you can explain it.
  - Monica rubbed a plastic cigar case with the skirt of her blue silk dress. This left a positive net charge on the plastic cigar case. (Note: single, fine cigars often come in metal or plastic containers, roughly shaped like the cigar.)
  - Monica held the plastic case near a metal, conducting cigar case (held in the air by a nonconducting string) but did not touch the case.
  - While the charged, plastic cigar case was in this position, Bill touched the metal cigar case and removed his hand.
  - Monica removed the plastic case from the proximity of the metal one.
  - Then she held the edge of her blue skirt near the metal cigar case (but not touching).
  - What effect did the blue skirt have on the hanging metal cigar case? Please explain your reasoning.
- A charged insulator and an uncharged metal object
  - always repel one another
  - exert no electrostatic force on one another
  - always attract one another
  - may attract or repel, depending on the sign of the charge on the insulator
- An electric dipole dumbbell consists of  $+Q$  and  $-Q$ , each of mass  $M$ , are held separate by a massless, rigid rod of length  $A$ . Assume the radius of the charges is negligible compared to the length of the rod. The rod is fixed about its center but is free to rotate in a plane. The system is located in a uniform electric field with the  $E$  field vectors in the plane of rotation of the dumbbell. Show that for small values of the angle between the direction of the dipole (or rod) and the electric field, the system exhibits simple harmonic motion. Obtain an expression for the period of oscillation of this dipole-dumbbell.



4.

The figure below shows the path of a negatively charged particle (1) through a rectangular region of uniform electric field.

- Indicate the direction of the electric field in the rectangular region on the drawing. Indicate to the right of the drawing why you have chosen the direction you chose for the electric field.
- Roughly sketch the paths that would be taken by particles (2), (3) and (4) as they pass through the rectangular region.



5.

In the figure below, what electric charge can be placed at point P to insure that there is zero net electrostatic force on  $Q_3$ ? Let the distance between  $Q_1$  and  $Q_3$  (as well as between  $Q_2$  and  $Q_3$ ) be 1 m. The distance between  $Q_3$  and P is 1.4 m. ( $1 \mu\text{C} = 10^{-6} \text{ C}$ ,  $k = 9 \times 10^9 \text{ Nm}^2/\text{C}^2$ )

