Electric Fields

Part One

1

The Electric Field

- Electric Field (E-field)
  - An area around any electrical charge causing an electric force on other charges around it.
- Michael Faraday
  - developed the concept of an e-field surrounding a charge in all directions. If a second charge is placed in the field, it will interact with the field at that point

2

Electric Field Intensity

- To find the intensity of an electric field we use :

$$E = \frac{F}{q}$$

  - q is usually a (+) test charge
  - Units of N/C

3

Electric Field Sample Problem

- What is the electric field that is acting on a positive 4.0 x 10^{-5} C charge if it experiences a 0.60 N force?

$$E = \frac{F}{q} = \frac{.6}{4 \times 10^{-5}} = 15{,}000 \text{ N/C}$$

Answer: 1.5 x 10^4 N/C

4

Electric Field Sample Problem

- What is the force applied to a 5.0 x 10^{-9} C charge by a 1500 N/C electric field?

$E = \frac{F}{q} \Rightarrow 1500 = \frac{F}{5 \times 10^{-9}}$

$(1500)(5 \times 10^{-9}) = F$

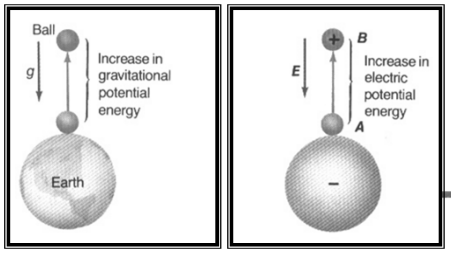
$F = 7.5 \times 10^{-6}$ N $\Rightarrow$ (+) $\Rightarrow$ REPULSIVE

Answer: 7.5 x 10^{-6} N repulsive force

5

Applications of E-Fields

- Electric potential energy
  - To pull unlike charges away from each other, you must do work
  - Like gravitational PE, when you do work on an object, you increase its energy



6

Electric Potential Difference

- Commonly known as voltage
- Units of J/C or Volt (V)
- find using :

$$\Delta V = \frac{W}{q} \text{ or } \frac{\Delta PE}{q}$$

7

Applications of E-Fields

- Electric potential energy
  - Like Gravitational PE, Electric PE is based on an arbitrary reference point
  - We are mainly concerned with the differences in potential energy
  - Voltmeters are used to find potential differences

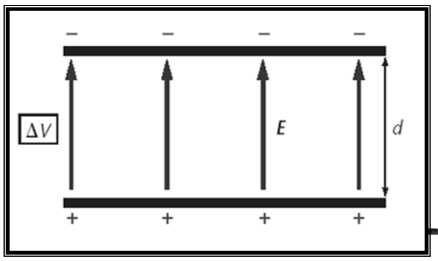
8

Electric Potential in a uniform E-Field

- The potential difference between two points in an electric field depends on
  - the E-field strength
  - the distance between the points

Such that

$$\Delta V = Ed$$



9

Sample Problem

- Two charged parallel plates are 0.04 m apart. The electric field between them is 625 N/C.
  - What is the electric potential difference between the plates?
  - What work will you do to move a proton from the negative plate to the positive plate?

10

Sample Problem (cont.)

- d = 0.04 m E = 625 N/C

$V = Ed$

$= (625)(.04)$

$= 25\ V$

$V = \frac{W}{q}$

$25 = \frac{W}{1.6 \times 10^{-19}}$

$W = 25(1.6 \times 10^{-19})$

$= 4 \times 10^{-18}\ J$

Answer: 25 V, 4.0 x 10^{-18} J

11