Traditional: 08-03
Themed: 05-04

Electric Fields

Contact vs. Field Forces

- Two kinds of forces: contact and field
  - Contact is everyday (push or pull)
  - Field is mysterious: how does gravity know I'm there? How does electron know proton is there?
- Microscopic level: ALL forces are field forces

Electric field vs. Gravitational field

- Right now: Are you in Mars gravitational field? Earth's? Which does the Martian Rover feel? Why?
- Rub PVC pipe against fur. What happens as you change how close they are? What affects the field strength? (charge and what else)

Electric field vs. Gravitational field

- Gravitational field strength depends on how much mass you have + how close to earth (or mars).
- Electrical field strength depends on how much charge and how close charged object**s** are.

What is an electrical field?

- Region in space that would exert a force should an electrically charged object enter that space
  - Example: AREA around electrically charged PVC pipe. (Uncharged PVC pipe = zero electric field)
- Does it matter how close to the pipe?

Vectors

- Electric fields have a direction (push a charged object, right, left, up, etc.)
- Electric fields have a magnitude (strength)
- Vectors are things that simultaneously have both a direction and a magnitude. Examples:
  - The wind is coming from the west at 25 mph
  - I grew up 15 miles SE of here
  - I push the cart to the right with 30 lb of force
  - The PVC pipe exerts a 7.5 mN electrical force up on the fur
- Look closely at each. Do each have BOTH a magnitude and direction?

Coulomb's law (force) vs. Electric Field

$$F = k\frac{q_1 q_2}{r^2}$$

$$E = \frac{F}{q} = k\frac{q}{r^2}$$

- Coulomb's law – measures force in N
- Electric field strength
  - Measured in N/C (since F/q)
  - A SINGLE charge sets up an electric field (takes TWO charges for there to be a force)

Mapping electric fields

- Standard for mapping: find out for all space, what a positive "test charge" would feel
- Use arrow to show electric field strength
  - Long arrow = strong force; short = weak
  - Direction of arrow shows direction positive charge would feel
- A negative charge would feel the same thing, just opposite direction
- Suggestion: Pretend you are a positive test charge (Helps you figure direction of field…See the charge, be the charge…I'm serious!)
- Multiple charges: Add effects from all charges (vector addition: parallelogram rule-opposite corners)
  - Coulomb says: twice as far = $1/4^{th}$ the force
- Try the examples in your packet