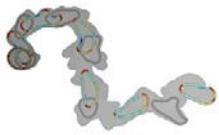
Physics 131- Fundamentals of Physics for Biologists I



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10/15/2012

Electrical forces

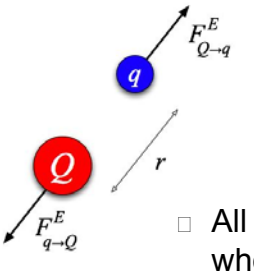
Movie: Volcanoe lighning

Outline

- Calculating with Coulomb's law
- Electric Fields

Conductors and Insulators

- Insulators
  - In some matter, the charges they contain are bound and cannot move around freely.
  - Excess charge put onto this kind of matter tends to just sit there.
- Conductors
  - In some matter, charges in it can move around throughout the object.
  - Excess charge put onto this kind of matter redistributes itself or flows off (if there is a conducting path to ground).
- Unbalanced charges attract neutral matter (polarization)



Foothold idea: Coulomb's Law

- All objects attract each other with a force whose magnitude is given by

$$\vec{F}_{q\to Q} = \frac{k_C qQ}{r_{qQ}^2}\hat{r}_{q\to Q}$$

- k_C is put in to make the units come out right.

$$k_C = 9\times 10^9 \text{ N-m}^2/\text{C}^2$$

Making Sense of Coulomb's Law

- Changing the test charge
- **Changing the source charge**
- **Changing the distance**
- **Specifying the direction**
- **Use Subscripts!**

$$\vec{F}_{Q\to q} = \frac{k_C qQ}{R^2}\hat{r}_{Q\to q}$$

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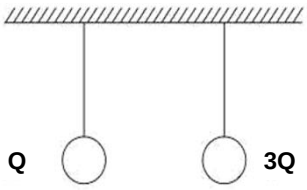
Two identical conductors hang from nonconducting strings.They are given charges $q_1 = Q$ and $q_2 = 3Q$.
After charging, the two strings make angles of θ_1 and θ_2 with the vertical.
How do the angles compare?

1. $\theta_1 > \theta_2$
2. $\theta_1 < \theta_2$
3. $\theta_1 = \theta_2$
4. You don't have enough information to tell.



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where does $1/r^2$ term in Coulomb's law come from?

- Demonstration: Charged Aluminum pans

Multiple charges

- Draw four objects, three with + charge, one with - charge in system schema. Ignore all other interactions.
- Which charge is q which one is Q

Total interactions

1. 4
2. 5
3. 6
4. 7
5. 8
6. 9
7. 10
8. 11
9. 12