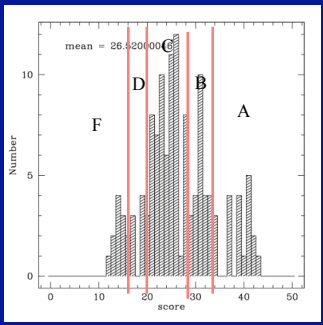
Test results

Grades posted in cabinet and online

If you are not properly registered then come see me for your grade



Clicker Question:

A kilogram of peaches have more skin area than a kilogram of

A: blueberries

B: grapes

C: grapefruits

D: Each has the same skin area

Clicker Question:

If a satellite's radial velocity is zero at all times its orbit must be:

A: elliptical

B: circular

C: geosynchronous

D: parabolic

Clicker Question:

If the Earth had no Moon then what would happen to the tides?

A: There would be no tides

B: The tides would occur less often

C: The tides would occur more often

D: The tides would not be as strong but would occur with the same frequency

Electricity

- One of the fundamental forces of nature
- Important to understand natural phenomena
- Incredibly useful for technology. For example?

Electricity

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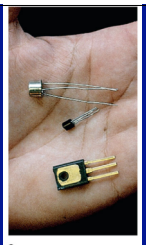
- Important to understand natural phenomena
- Incredibly useful for technology
  - lights (starting with Thomas Edison), TV, projectors, ...
  - electric motors, fans, pumps, ...
  - electric heaters, ovens, ...
  - computers, phones, ipods, ...
  - batteries

Figure 22.4

Figure 22.5



a

b

http://science.howstuffworks.com/st-elmo-fire.htm

http://www.youtube.com/watch?v=O0z2Jw29iuU&NR=1

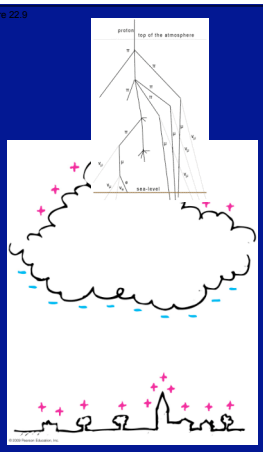
Figure 22.9

How Lightning Forms

- Charge seperation due to collisions + freezing
- Strong electric field is produced
- Positive current is induced on the ground
- air is ionized - breaks down
- step leaders reach down
- streamers rise up from the ground
- connection occurs
- current flows from the cloud to the ground.

4,000,000 times a day!

Figure 22.9



How Lightning Forms

Research shows that a seed charge is needed.

Might come from a cosmic ray air shower

The Electrical Force

- Coulomb's Law

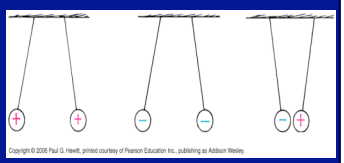
$$F = k\frac{q_1 q_2}{r^2}$$

- Compare to Gravity

$$F = G\frac{m_1 m_2}{r^2}$$

  - $k = 9$ Trillion $N \cdot m^2/C^2$
  - $G = 6.67 \times 10^{-11}\ N \cdot m^2/kg^2$

  $k/G \sim 10^{20}$

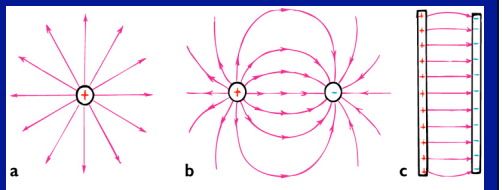


Like electric charges repel and opposites attract.

DEMO - charged spheres

Electric Fields

- Permeate all of space
  - Convention: represents force felt by a positive test charge



Electric field lines begin at positive charges and terminate at negative charges (or at infinity).

Figure 22.19

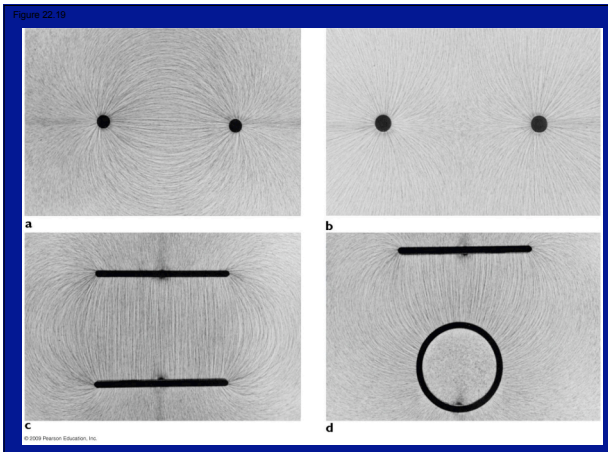


Figure 22.16

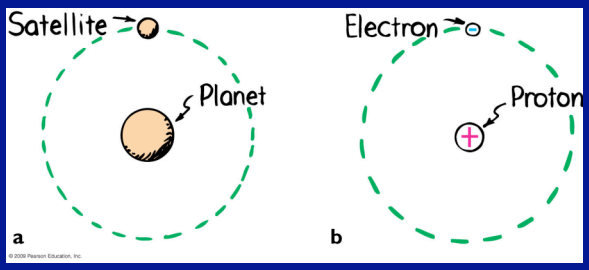


Figure 22.11A

Modern View of Hydrogen Atom

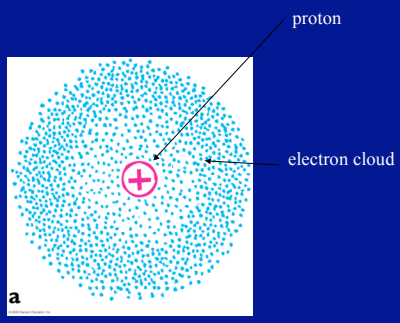
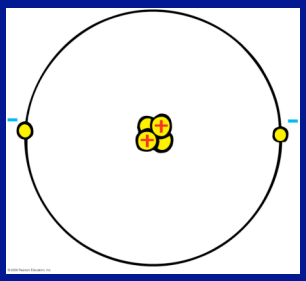


Figure 22.2



What type of atom is this?

What is its net charge?

Clicker Question:

Lightning never strikes twice in the same place. True or False?

A: True

B: False

Clicker Question:

Two spheres with opposite charges feel an attractive force when held 10 cm apart. How does the force change when the distance between them is doubled?

A: stays the same

B: increases by a factor of 2

C: decreases by a factor of 2

D: decreases by a factor of 4

Clicker Question:

Which of the following materials is the best conductor of electricity?

A: water

B: iron

C: wood

D: glass

Conductors and Insulators

- What feature of metals makes them good conductors of heat?
- Does this also explain the electrical conductivity of metals?

Conductors and Insulators

- What feature of metals makes them good conductors of heat?
  - Loosely bound outer electrons.
- Does this also explain the electrical conductivity of metals?
  - Yes. Electrons in a metal flow in an applied electric field.
- Insulators are materials in which the outer electrons are tightly bound
  - Poor conductors of both heat and electricity
    - Cork, rubber, glass, etc.

- Why does a balloon stick to the wall if you first rub it against your clothes?

Static Electricity and Conservation of Charge

- Electrons in your clothes are loosely bound => dislodged
  - Charge is conserved
    - Balloon – net negative charge
  - But wall is electrically neutral, so why does balloon stick?

Static Electricity and Conservation of Charge

- Electrons in your clothes are loosely bound => dislodged
  - Charge is conserved
    - Balloon – net negative charge
  - But wall is electrically neutral, so why does balloon stick?
    - Balloon polarizes surface molecules in wall
      - Opposites attracted, likes repelled
      - Net charge of wall is still zero

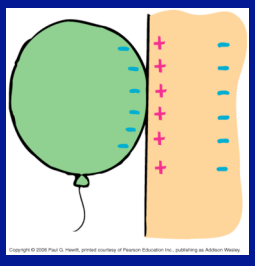


Figure 22.11B

Electric Dipole Moment

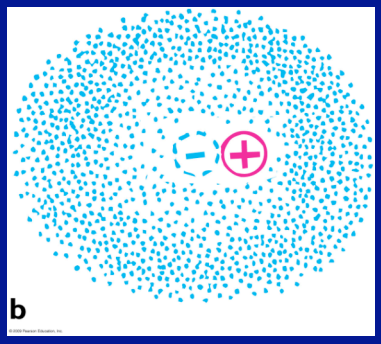


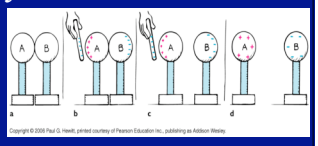
Figure 22.3

Electrons can be easily knocked off some materials and transfered to others

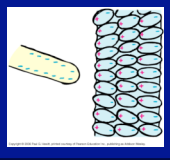
DEMO charging a rod

Charging by Induction

- A charged rod, brought near two conducting spheres in contact, will cause charges to separate.
  - Separating the spheres leaves each with an equal and opposite net charge
    - Conservation of charge
  - No contact with rod required
    - Electric Field
  - Process is called induction



A charge rod brought close to a conductor induces a charge, while the same rod brought near an insulator polarizes the surface atoms.



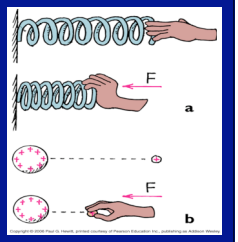
Potential Energy vs. Electric Potential

- A charged object has P.E. because of its location in an electric field

$$\text{electric potential} = \frac{\text{electric potential energy}}{\text{charge}}$$

  - Dividing by charge => electric potential only property of electric field
  - Voltage

$$1 \text{ volt} = 1 \frac{\text{Joule}}{\text{Coulomb}}$$



Work is required to bring like charges together. Twice the charge = twice the work.

Figure 22.30

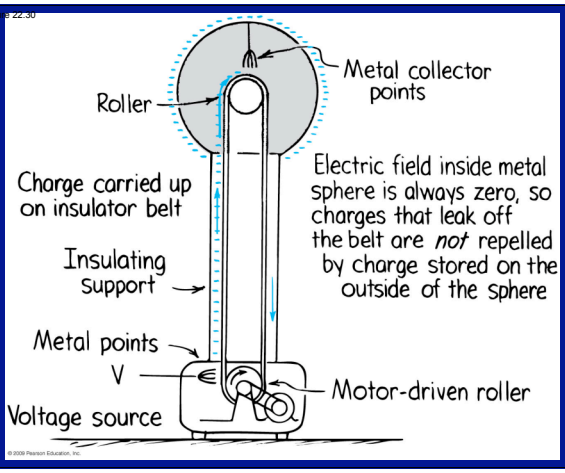


Figure 22.31

DEMO
Van de Graaf generator

Figure 22.21

Static Charge Distributions

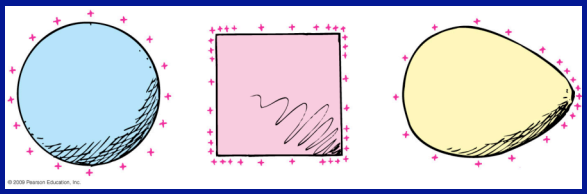
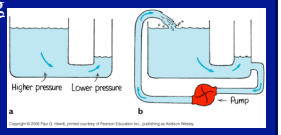


Figure 22.4

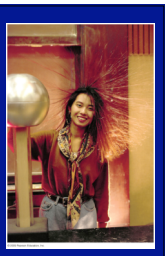
Voltage Sources

- Charge flows from one end of a conductor to the other as long as they are at different electric potentials
  - Current requires a potential difference or *voltage*
    - Acts like an "electrical pump" which keeps charge flowing
      - Batteries, generators, etc.
  - Similar to heat flow from hot to cold ends of a conductor
    - Ceases when temperatures equalize



Water will flow from a higher reservoir to a lower one. Once the water levels are equal, the flow stops. A pump can yield a continuous flow by maintaining a pressure difference.

Clicker Question:



What makes somebody's hair stand out when they touch the charged sphere?

A: Free protons try to spread out as far as they can.

B: Free electrons try to spread out as far as they can

C: Hair is highly conductive so the electrons travel down it more readily.

D: Actually has nothing to do with charge.

Clicker Question:

Is it possible to charge something up without making physical contact with another charged body?

A: Yes

B: No

C: Can't say.