Electricity

Chapter 20A

Electrostatic Activities Video & worksheet.

Go to Study Place and download the Electrostatic Force activities worksheet.

http://somup.com/cF6elPnVza (2:59)

The teacher will walk you through the activities (4 total), showing the videos, the PHET simulation, and videos.

Based on the Electrostatic Activities Video & worksheet.

1. How many charges exist?

2. How do “like” charges affect each other?

3. How do “unlike” charges affect each other?

4. What conditions need to exist in order to get maximum static electricity? [*Consider why in the winter you get static shocks, but rarely in the summer*.] Why?

5. What phenomenon in nature does the Van Der Graaf machine simulate?

Based on the Electrostatic Activities Video & worksheet.

1. How many charges exist? ***Two: positive and negative***

2. How do "like" charges affect each other? ***Like charges repel***

3. How do "unlike" charges affect each other? ***Unlike charges attract***

4. What conditions need to exist in order to get maximum static electricity? [*Consider why in the winter you get static shocks, but rarely in the summer.*] Why?
   Dry conditions allow the best static electricity since humidity absorbs charge

5. What phenomenon in nature does the Van Der Graaf machine simulate?
   Lightning, which is also based on opposite charges building up and attracting each other

Charging by Contact

A Van de Graaff generator builds a charge on a metal sphere. Touching the sphere transfers charge by contact. The sphere is still charged, but its net charge is reduced.

Focus Questions

LESSON QUESTION

1. Define & explain aspect of electric force (charged ions, forces of attraction & repulsion, Coulomb's Law, Electric Fields).
2. Understand component of electric current and be able to calculate each related to Ohm's Law (voltage, current, resistance).
3. Distinguish between induction and conduction related to transfer of charges.


Electric Force

Electric Force

- How would you describe the force that such a bolt can produce?

- Where does such a force originate?

http://somup.com/cFX2YInjch (0:18)

Do you think there is a force involved in the video clip with the cow? What kind of force?

If you have ever been "shocked" by a fence, describe the feeling …

[push or pull]

cow electric fence

Ion

A charged atom or particle containing an excess or deficiency of electrons.

Positive ions have LOST electrons.

Negative ions have GAINED electrons.

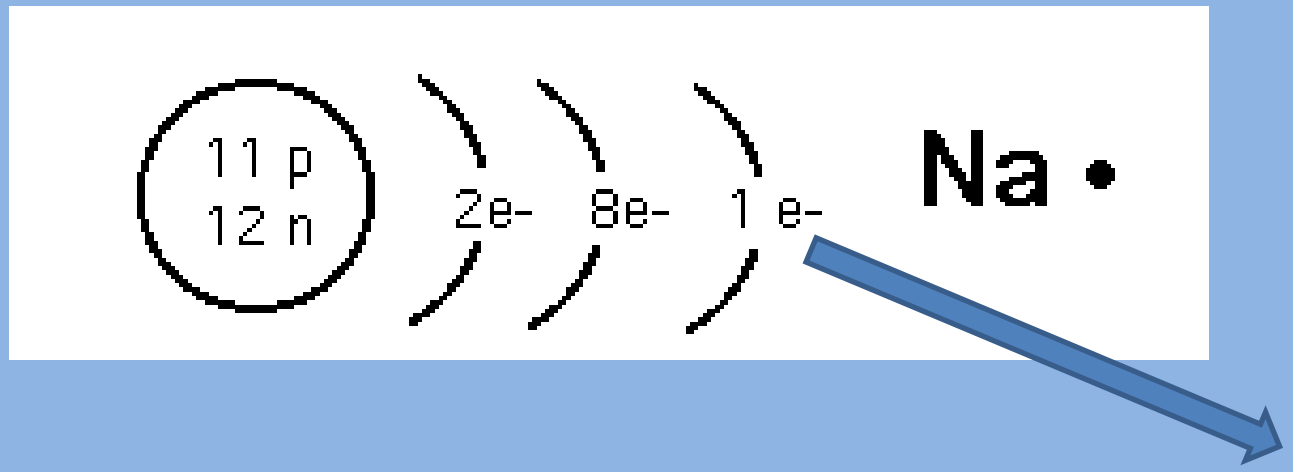
All of these symbols represent given elements of the periodic table which have lost or gained electrons to become **ions**.

Na^{+1} Mg^{+2}

Al^{+3} N^{-3}

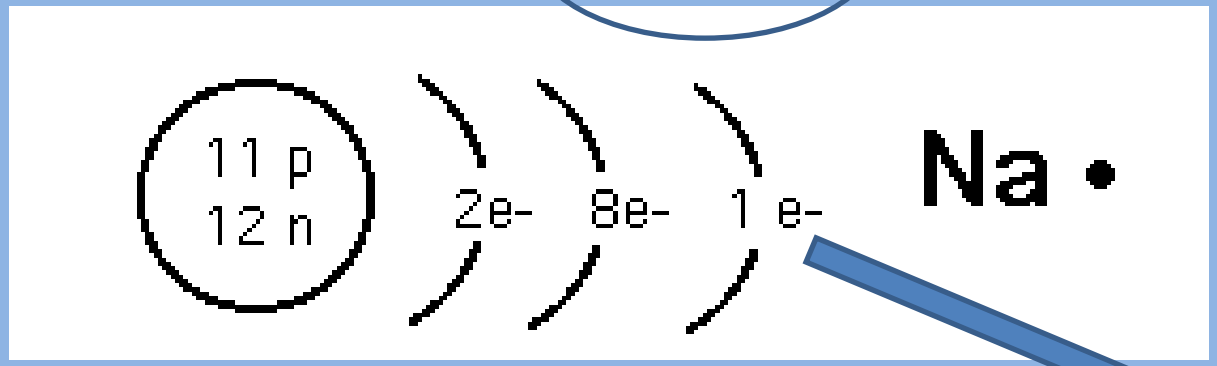
O^{-2} Cl^{-1}

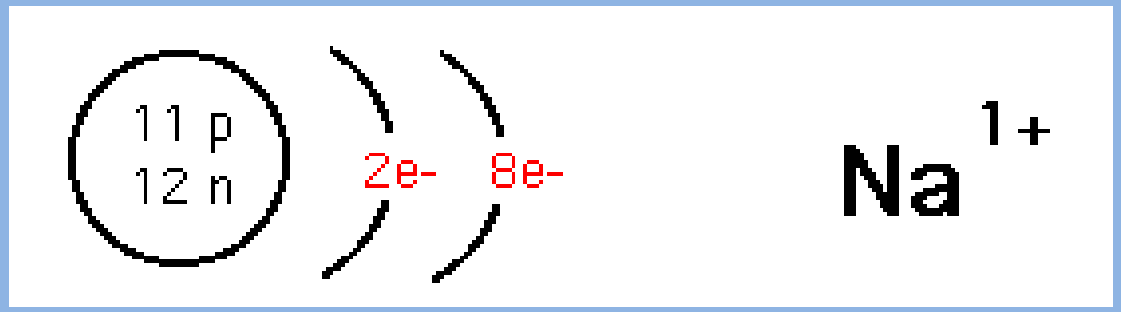
If an atom loses electrons what kind of **ion** is produced, positive or negative?



TRY IT

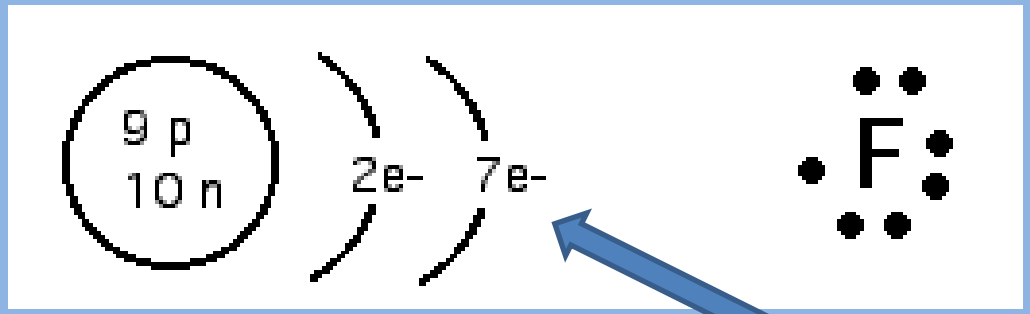
If an atom loses electrons what kind of **ion** is produced, positive or negative?





TRY IT

If an atom GAINS electrons what kind of **ion** is produced, positive or negative?



TRY IT

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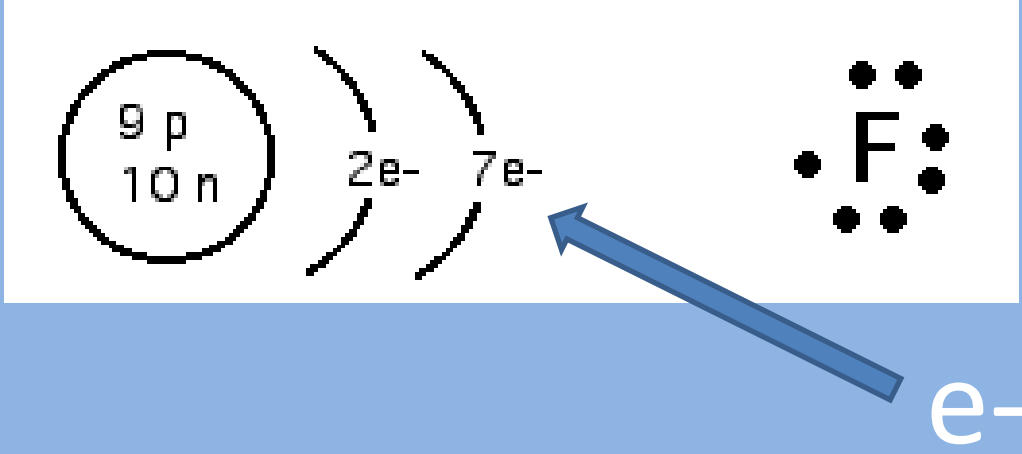
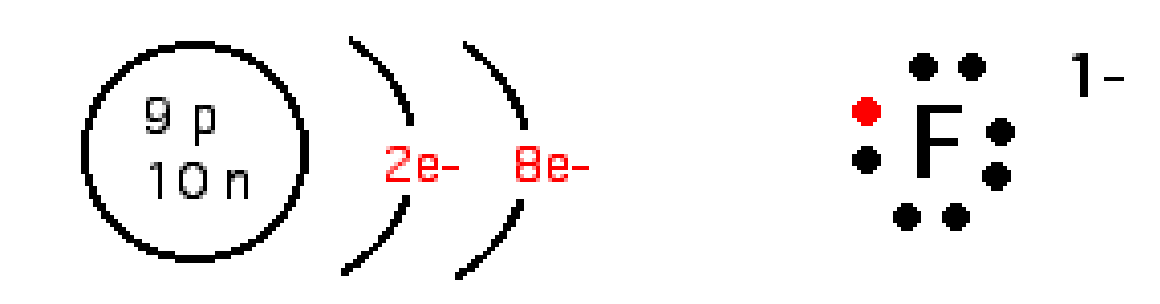




TRY IT

What happened to each of the atoms to become **ions?**

Na^{+1}

Mg^{+2}

Al^{+3}

N^{-3}

O^{-2}

Cl^{-1}

What happened to each of the atoms to become **ions?**

Na^{+1} lost 1 e-

Mg^{+2} lost 2 e-

Al^{+3} lost 3 e-

N^{-3} gained 3 e-

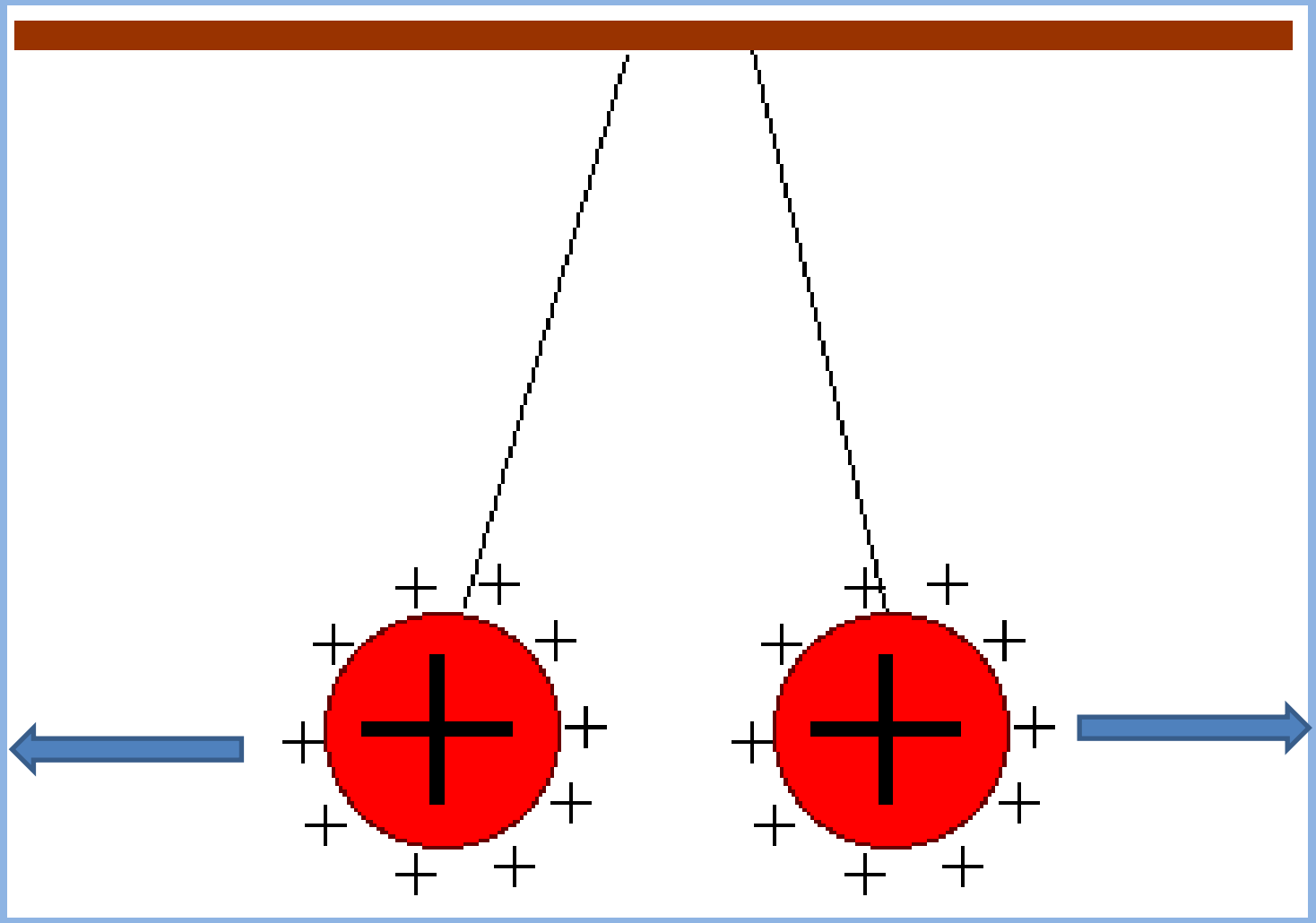
O^{-2} gained 2 e-

Cl^{-1} gained 1 e-

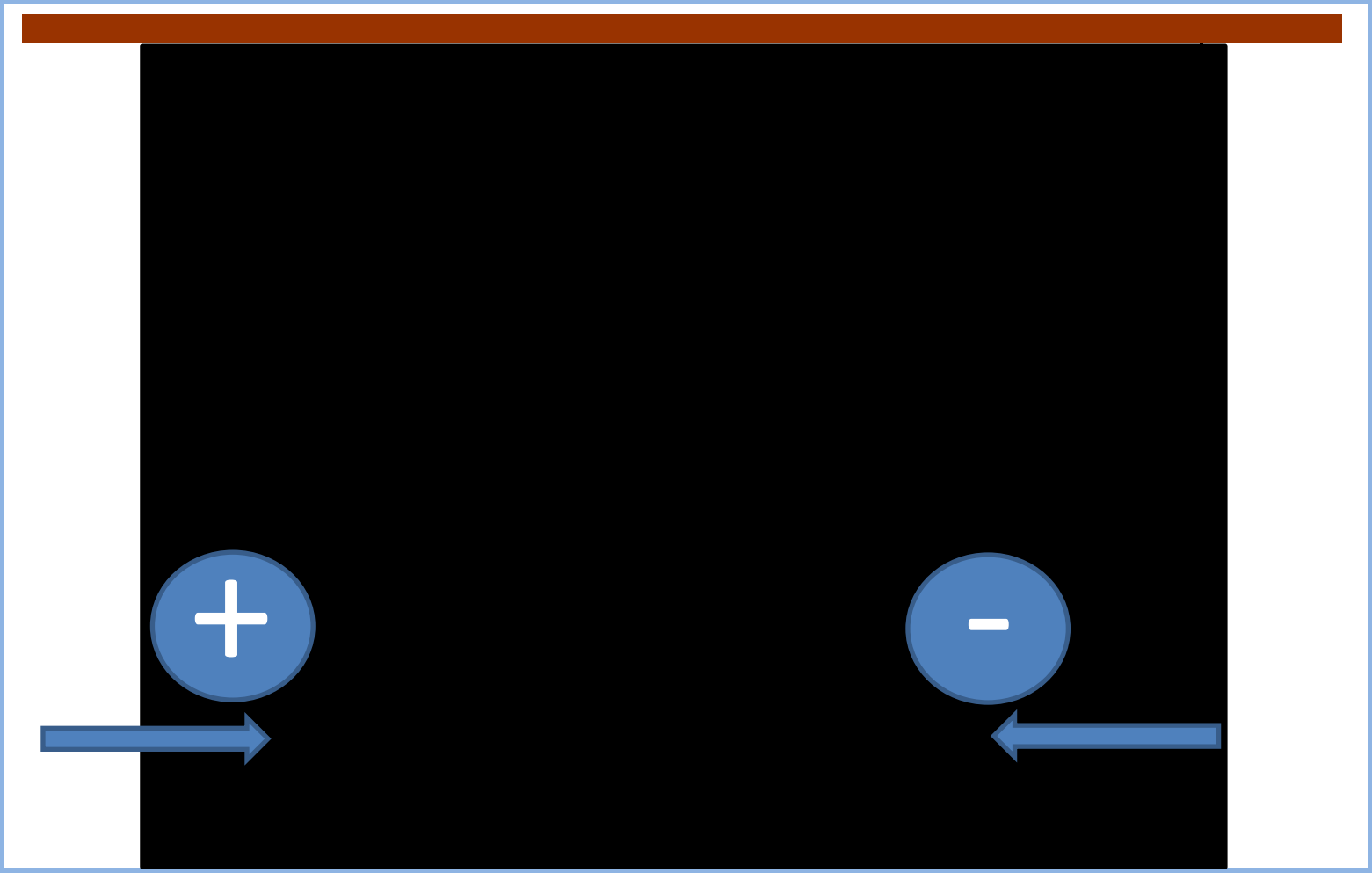
Electric Force

A push or pull in nature based on the electrical charges between objects.

"Like" charges produce **electric forces** of repulsion.



“Unlike” charges produce **electric forces** of attraction.

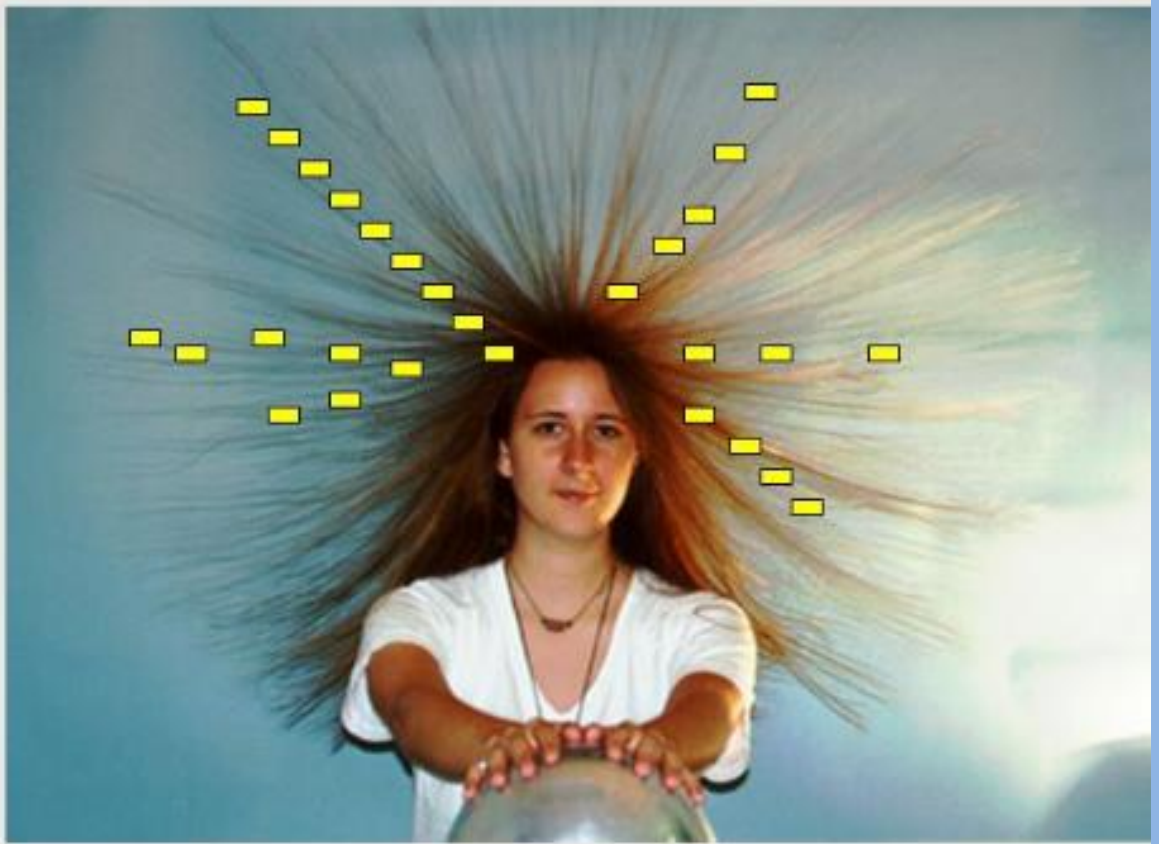


What kind of Electric Force is this?

What kind of Electric Force is this?

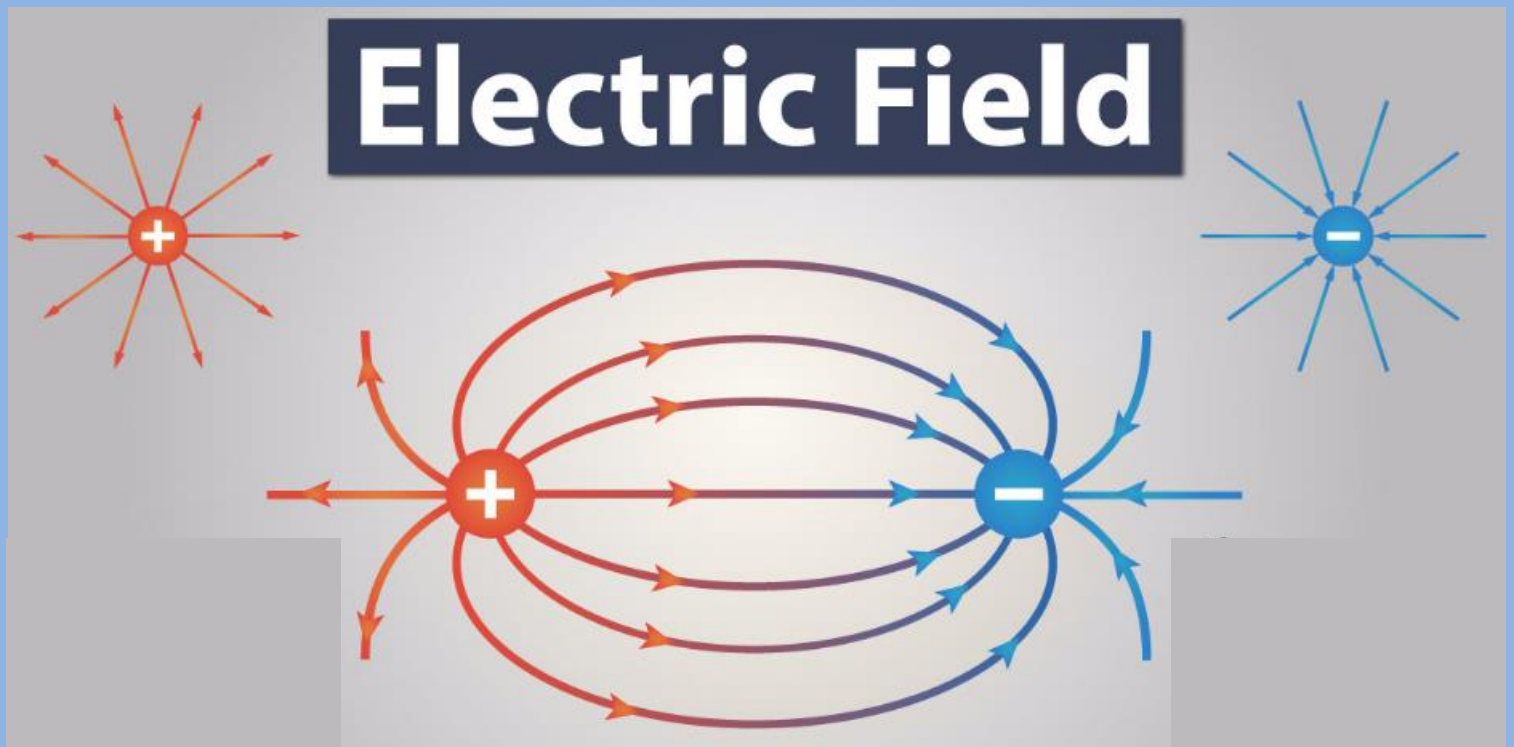
Effect of Van De Graaf

Hair is pushed apart as all the electrons on the hair repel each other.



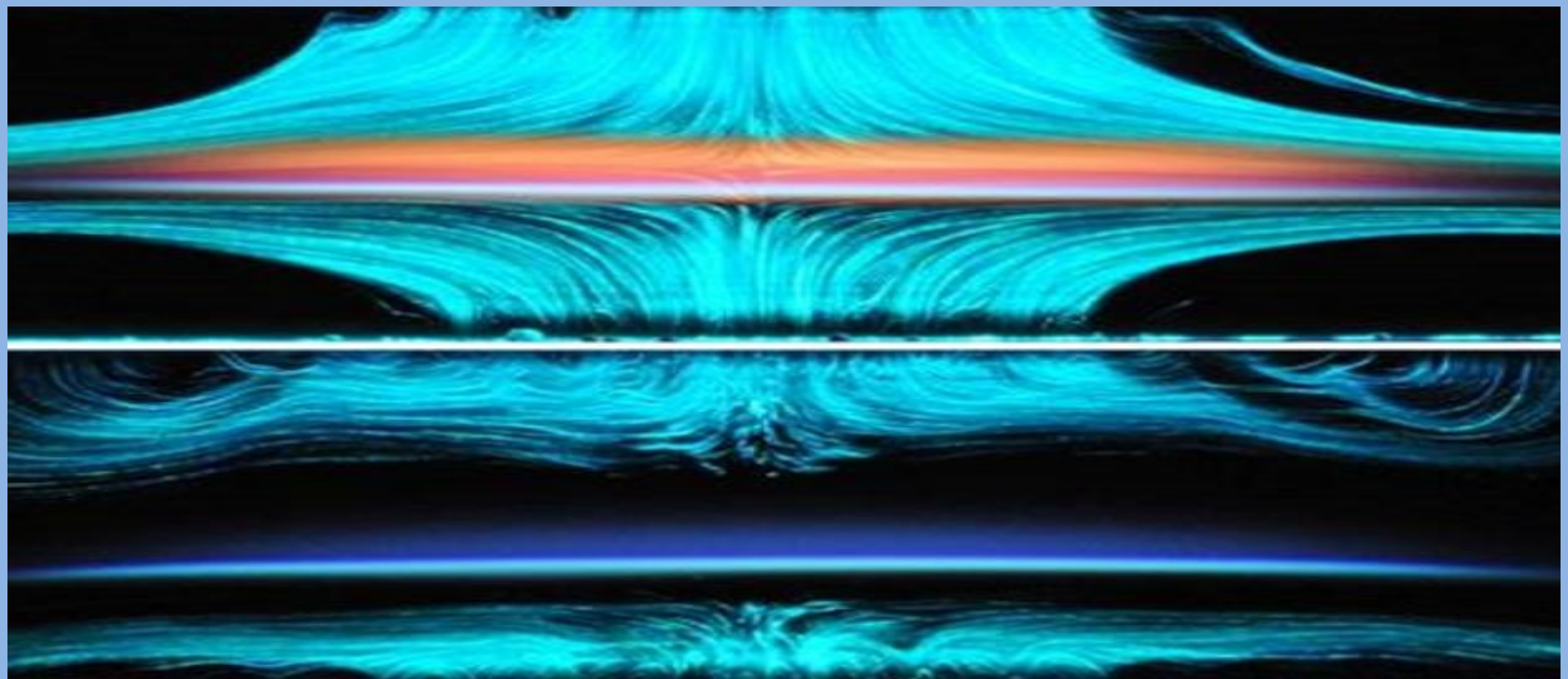
Electric Field

A force applied to or around a charged atom, molecule or object.

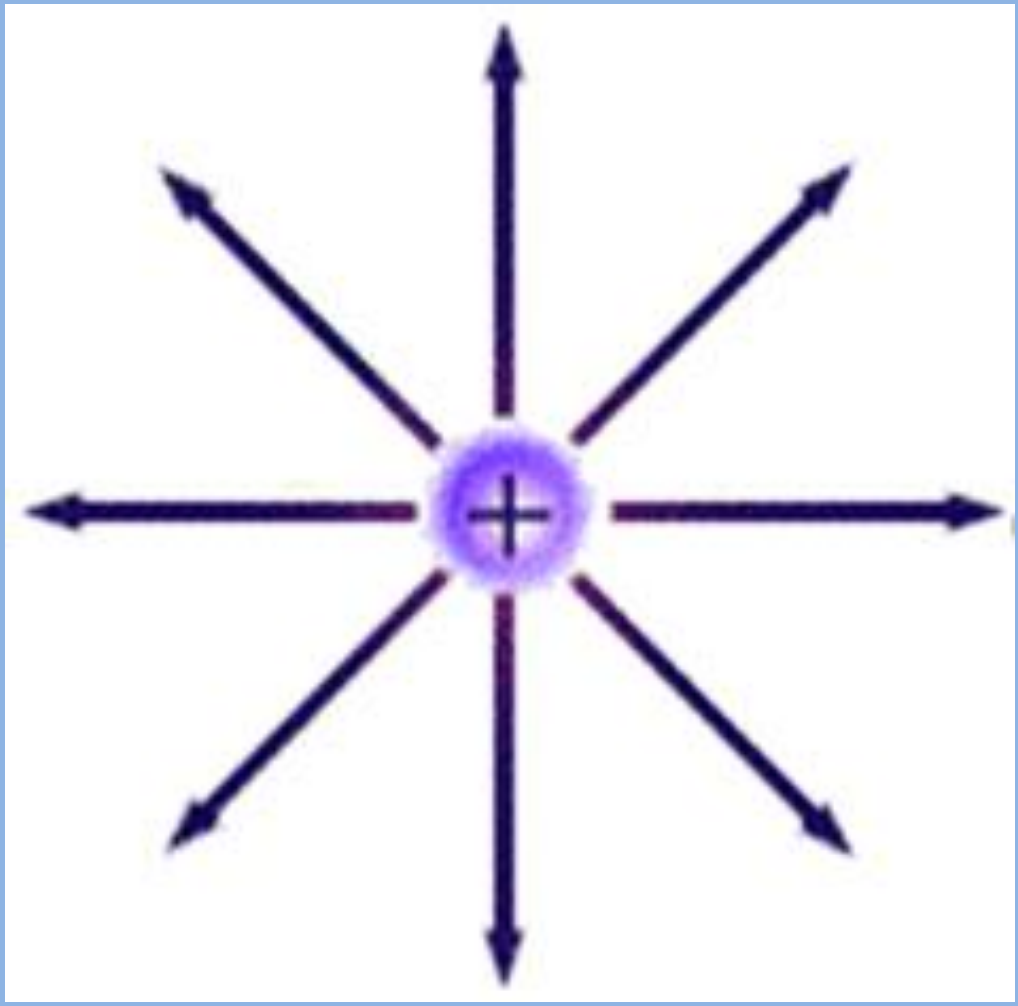


Electric Field

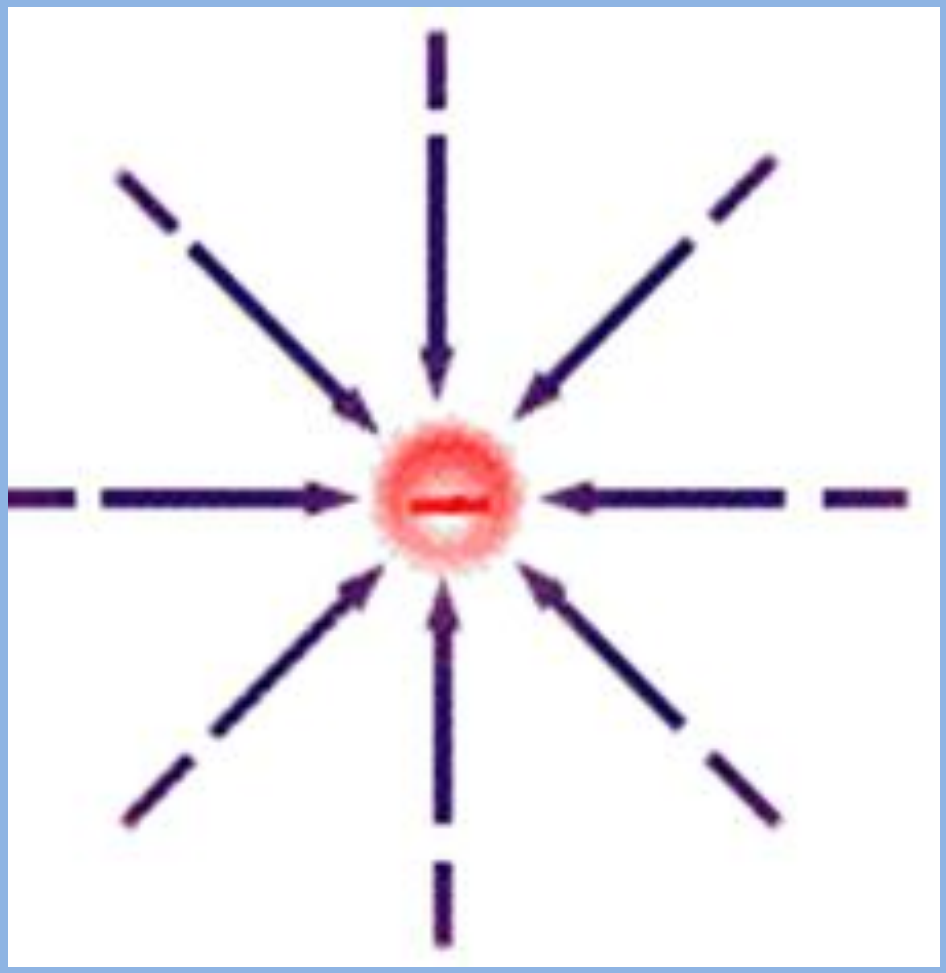
It can be considered an “aura” surrounding charged objects and is a storehouse of electric energy.



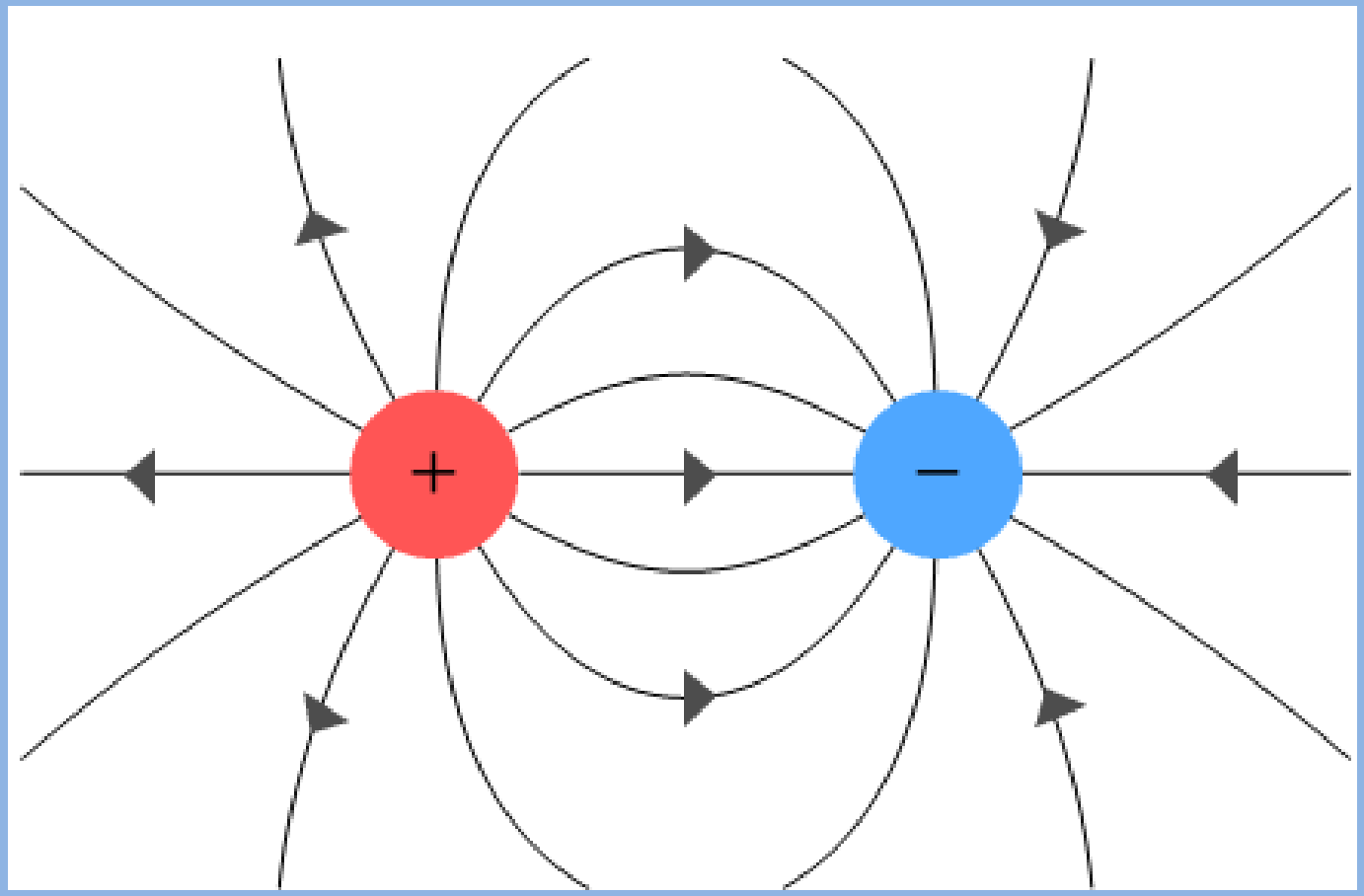
An electric field moves away from a positive charge.



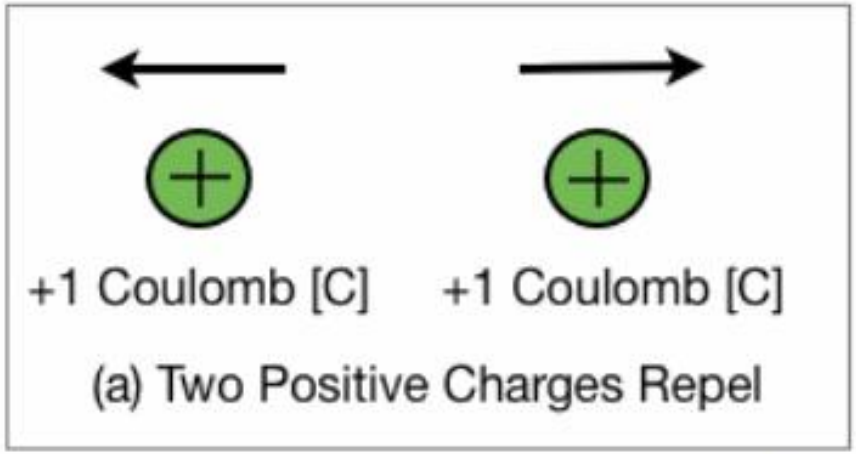
An electric field moves towards a negative charge.

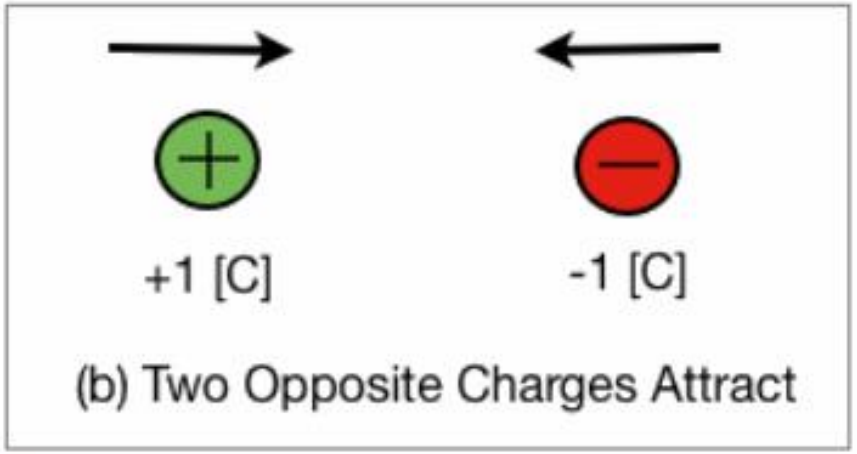


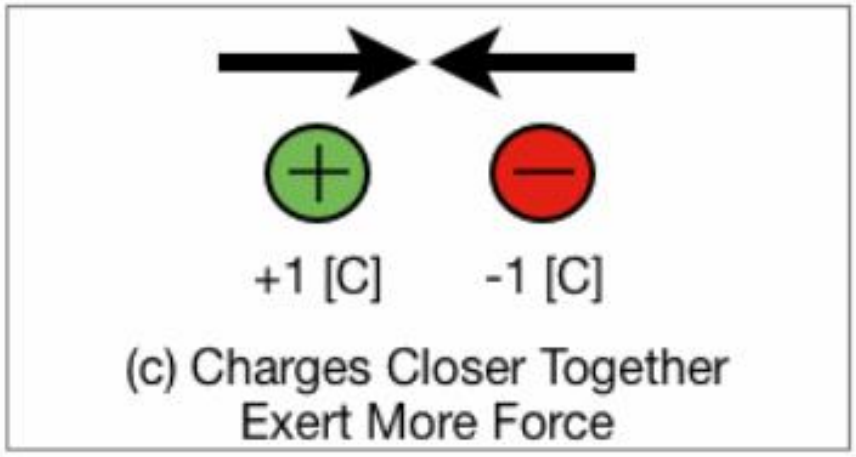
The direction of the **electric field** is from the positive charge toward the negative charge.

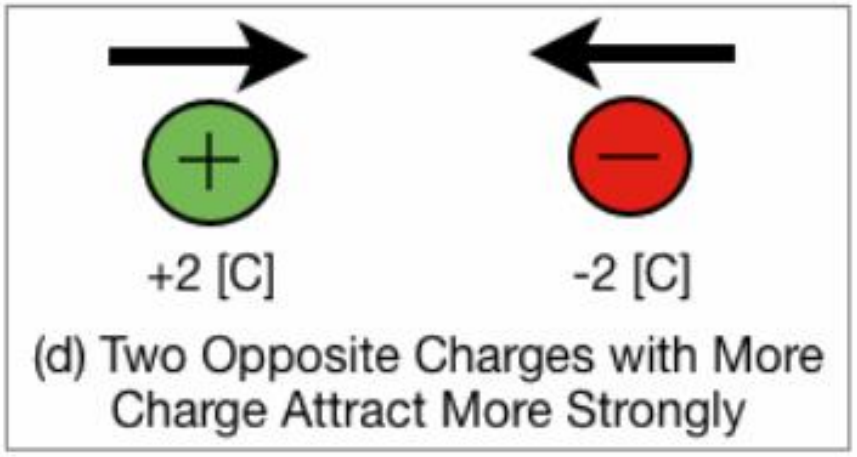


What determines the strength of an electric field?









What determines the strength of an electric field?

- The SIZE of the electric charges (direct relationship)
- The DISTANCE between the charges (inverse relationship)

Coulomb's Law

$$f = kq_1q_2/d^2$$

The force is directly related to charge and inversely related to the square of the distance between them.

Late at night, and without permission, Reuben would often enter the nursery and conduct experiments in static electricity.

Beaker's Ode to Joy (1:41)

http://somup.com/cFX2YDnjcj

1. For a positive single charge, the electric field: a) moves away from the charge b) moves toward the charge c) does not move at all d) does not apply to this statement

2. If a proton at a particular distance from a charged particle is attracted by a given force, by how much does the attractive force increase when the proton is three times closer to the charged particle? a) it remains the same b) it doubles c) it is three times greater d) it is nine times greater

3. The Van Der Graaf generator simulates what phenomenon of nature?
a) circuitry b) electrostatic repulsion c) lightning d) Ohm's Law of Conduction

4. If someone grabs an electric fence which term best describes the current flow?
a) induction c) conduction
b) electrostatic attraction d) supercharger

1. For a positive single charge, the electric field: a) moves away from the charge
2. If a proton at a particular distance from a charged particle is attracted by a given force, by how much does the attractive force increase when the proton is three times closer to the charged particle? d) it is nine times greater
   $f \propto 1/d^2$
3. The Van Der Graaf generator simulates what phenomenon of nature? c) lightning
4. If someone grabs an electric fence which term best describes the current flow?
   c) conduction … transferring charge by CONTACT

QUICK CHECK

1. A charged particle is called.
2. What kind of electric force would “like” charges exert on each other?
3. Explain how an object would gain a positive charge.
4. The balloon is rubbed by a silk cloth and brought near a pile of small paper punches. Define how each of these factors is involved:

   a) Friction –
   b) conduction …
   c) induction …

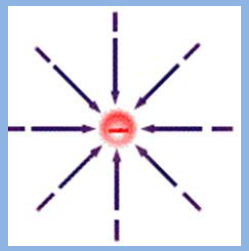
5. Draw an electric field around a negative point charge.

QUICK CHECK

1. A charged particle is called an Ion
2. What kind of electric force would “like” charges exert on each other? Repulsion
3. Explain how an object would gain a positive charge. The object would have to lose electrons.
4. The balloon is rubbed by a silk cloth and brought near a pile of small paper punches. Define how each of these factors is involved:

   a) Friction – rubbing the balloon with silk
   b) conduction … transferring charge by CONTACT
   c) induction … transferring charge WITHOUT contact

5. Draw an electric field around a negative point charge.



Electric Current

Current is the rate of flow of electric charges. What causes current to flow?

Electric Current

Voltage (a difference in potential) causes current to flow. Factors of current are described by Ohm's Law:

$$V = IR$$

Voltage = current x resistance

Volts = amps x ohms

V = A x Ω

Components of Electric Current

Current:

Amount of flow of e-
(*e.g. water*)

Voltage:

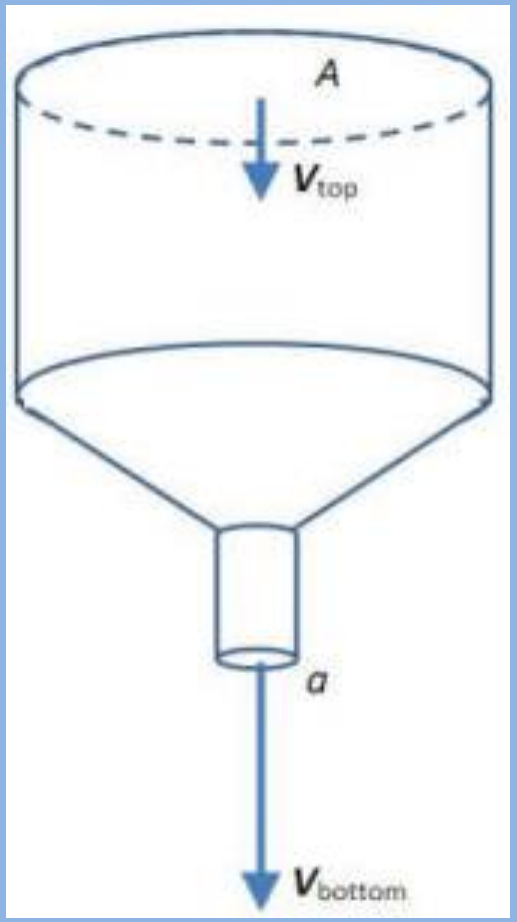
The potential of flow
(*e.g. height of falls*)

Components of Electric Current

Resistance:

The smaller opening (bottom) has much more resistance (produces more heat) than the larger (top) part.

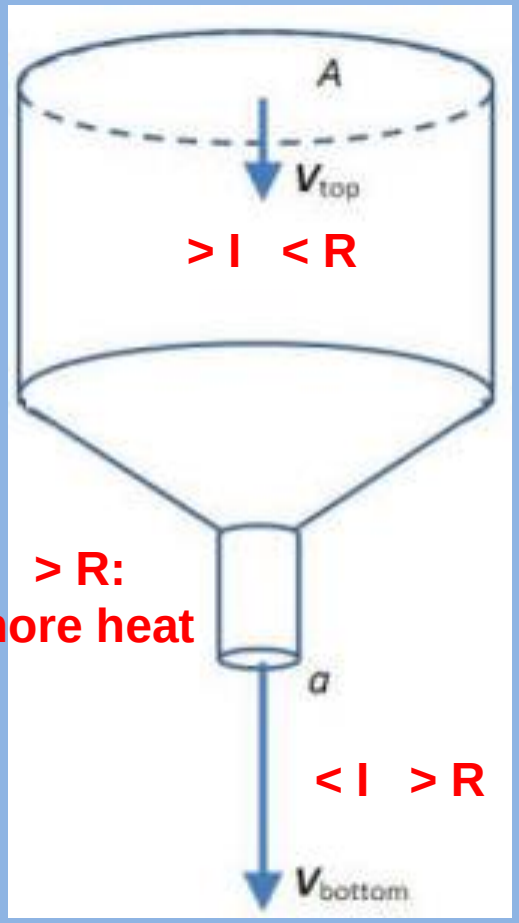
How are current and resistance related?



Components of Electric Current

The higher the resistance (bottom part), the LOWER the current potential.

The lower the resistance (top part), the GREATER the current potential.



Types of Electric Current

Current is the flow of charged particles.

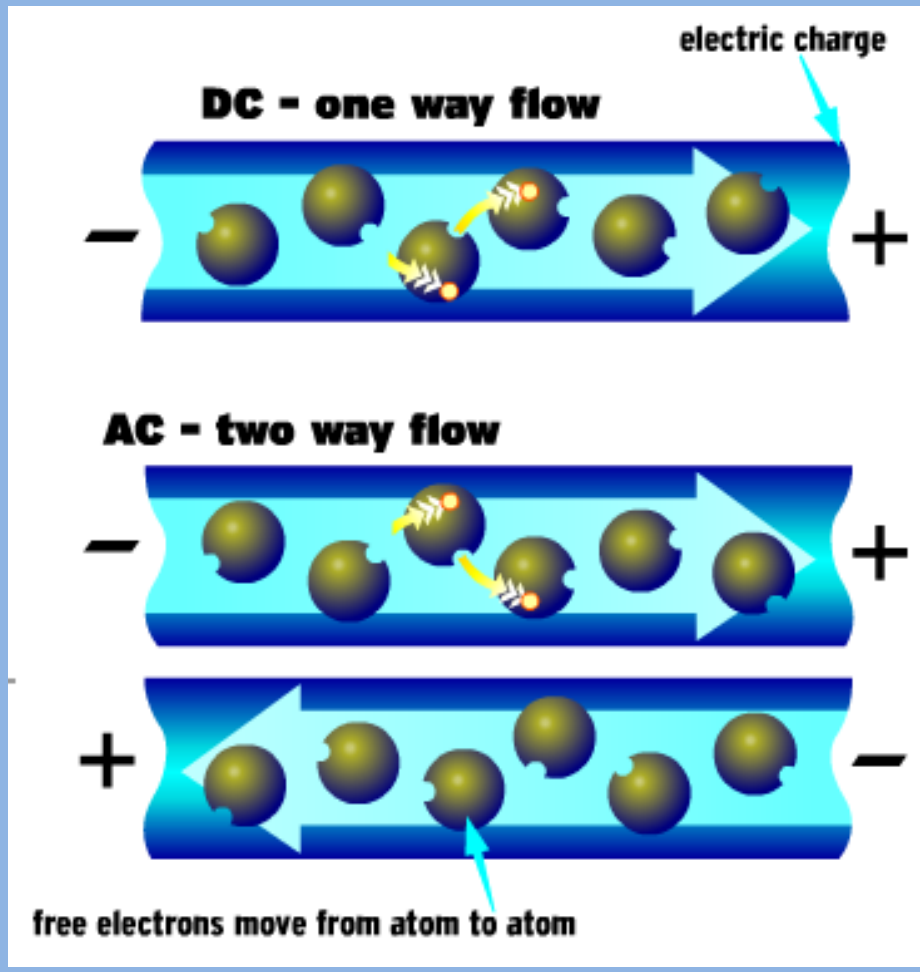
There are two types of current:

DC (direct current)

- Flows in one direction
- e.g. Batteries

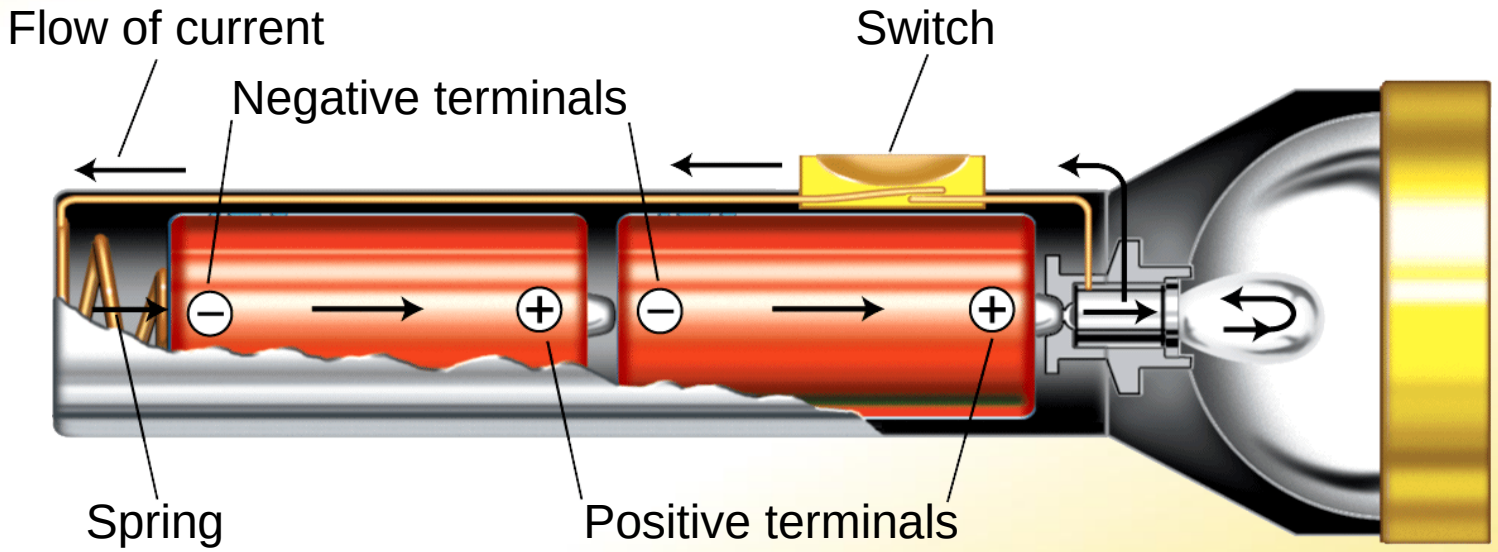
AC (alternating current)

- Flows in opposite direction
- e.g. appliances, vehicles



Electric Current

A complete path is required for charge to flow in a flashlight. Batteries must be placed so that charge can flow from negative to positive, passing through the bulb.

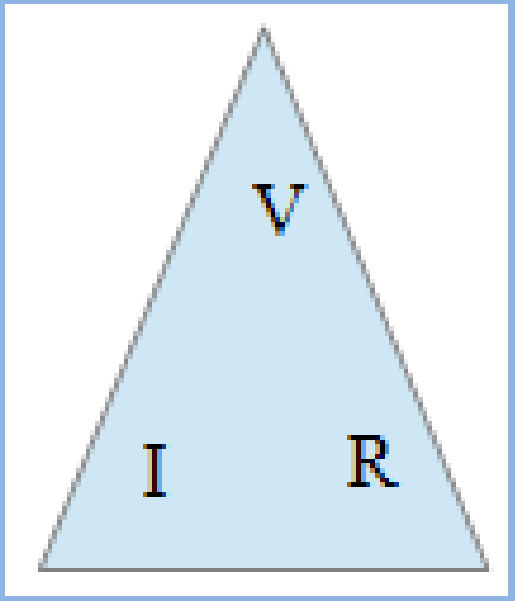


Calculating with Ohm's Law

Voltage (V) = current (I) x resistance (R)

Volts = amps x ohms

Solve for each variable:



Calculating with Ohm's Law

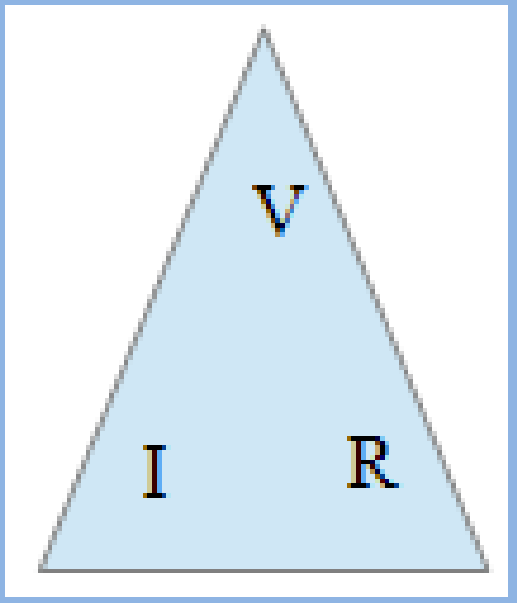
$$V = IR$$

Voltage = current x resistance

Volts = amps x ohms

$$I = V / R$$

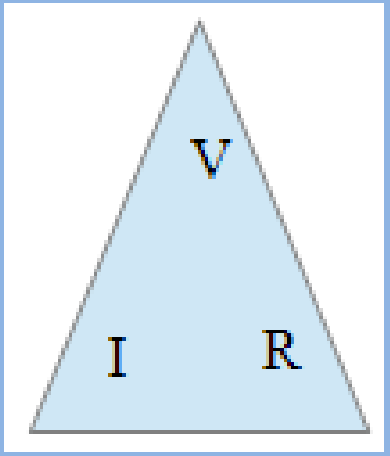
$$R = V / I$$



Calculating with Ohm's Law

QUICK CHECK

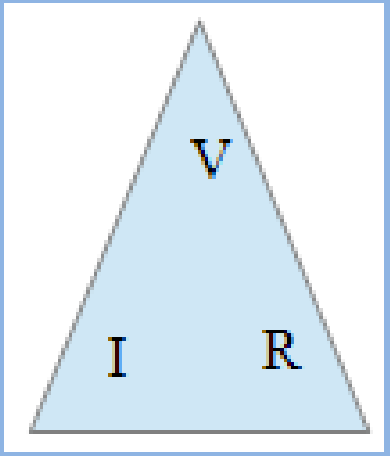
The current through a 10 ohm resistor connected to a 120 V power supply is:



A 20 ohm resistor has 5 A of current flowing through it. What is the voltage across the resistor?

Calculating with Ohm's Law

The current through a 10 ohm resistor connected to a 120 V power supply is:



I = V / R

I = 120 V / 10 Ω

I = 12 A = 12 amps

A 20 ohm resistor has 5 A of current flowing through it. What is the voltage across the resistor?

V = I R

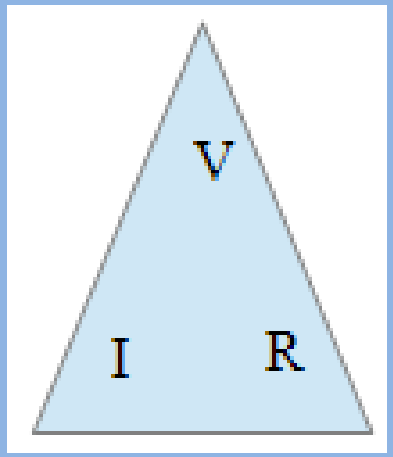
V = 5 A x 20 Ω

V = 100 V = 100 volts

Calculating with Ohm's Law

QUICK CHECK

When a 12 V battery is connected to a resistor, 2 A of current flow in the resistor. What is the resistance?



Calculating with Ohm's Law

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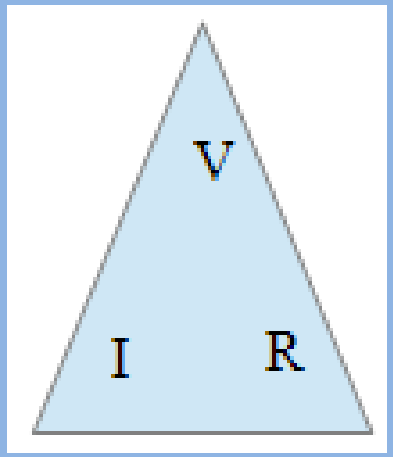
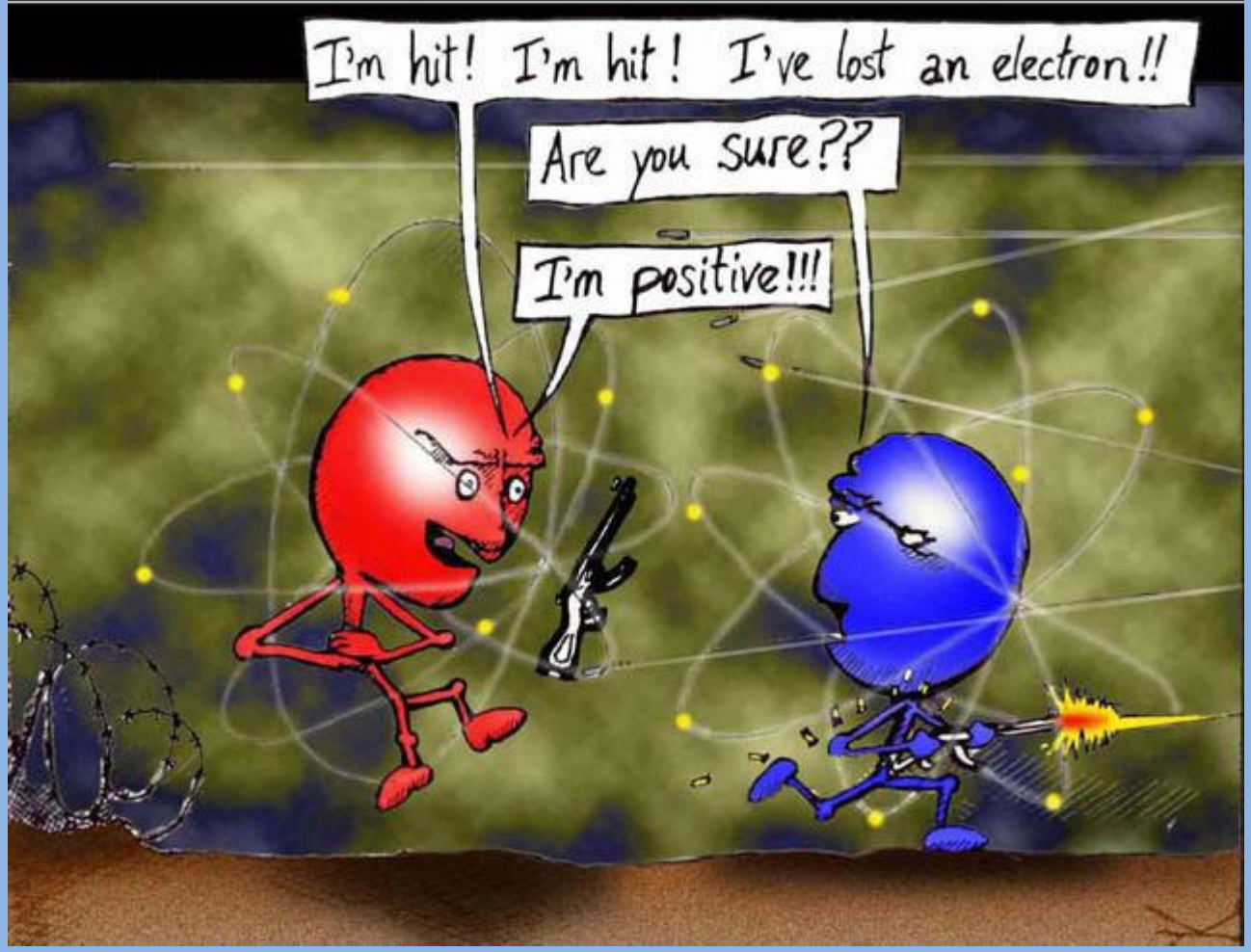


R = V / I

R = 12 V / 2 A

R = 6 Ω = 6 ohms



A neutron and proton walk into a bar … and say "ouch."

When they ordered soft drinks, the neutron asked, "how much?" The proton told him "for you, no charge."

Enrichment Worksheets

- Download the Electricity & Transmission PPT & Worksheet

http://somup.com/cFX2YFnjcQ

M & M's Jumping on a Cake!

Who'dda thunk? (0:39)

Assessment Questions

1. Which of the following would double the electric force between two charged objects?
   a. doubling the mass of the objects
   b. doubling the net charge of both objects
   c. doubling the net charge of one of the objects
   d. cutting the distance between the objects in half

Assessment Questions

1. Which of the following would double the electric force between two charged objects?
   a. doubling the mass of the objects
   b. doubling the net charge of both objects
   c. doubling the net charge (q) of one of the objects
   d. cutting the distance between the objects in half

   ANS: C $f = Kq_1q_2/d^2$

Assessment Questions

2. The attractive or repulsive effect an electric charge has on other charges in the space around it is the charge's
   a. electric force.
   b. electric field.
   c. static electricity.
   d. static discharge.

Assessment Questions

2. The attractive or repulsive effect an electric charge has on other charges in the space around it is the charge's
   a. electric force.
   b. electric field.
   c. static electricity.
   d. static discharge.

   ANS: B

Assessment Questions

3. An object becomes charged by induction when there is a
   a. transfer of electrons, as the object rubs against another object.
   b. transfer of charge, as it contacts another charged object.
   c. transfer of charge by motion of electrons within the object.
   d. a sudden movement of electric charge from another object.

Assessment Questions

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   a. transfer of electrons, as the object rubs against another object.
   b. transfer of charge, as it contacts another charged object.
   c. transfer of charge by motion of electrons within the object.
   d. a sudden movement of electric charge from another object.

   ANS: C

Assessment Questions

1. Which of the following materials is a good conductor of electric current?
   a. wood
   b. glass
   c. air
   d. iron

Assessment Questions

1. Which of the following materials is a good conductor of electric current?

   a. wood
   b. glass
   c. air
   d. Iron (metal)

   ANS: D

Assessment Questions

2. If a piece of wire has a certain resistance, which wire made of the same material will have a lower resistance?
   a. a hotter wire
   b. a thicker wire
   c. a longer wire
   d. a thinner wire

Assessment Questions

2. If a piece of wire has a certain resistance, which wire made of the same material will have a lower resistance?

   a. a hotter wire
   b. a thicker wire
   c. a longer wire
   d. a thinner wire

   ANS: B

Assessment Questions

3. What does the voltage between two points in an electric field represent?
   a. the total kinetic energy
   b. the difference in mechanical energy
   c. the difference in potential energy
   d. the electrical energy

Assessment Questions

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   a. the total kinetic energy
   b. the difference in mechanical energy
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   d. the electrical energy

   ANS: C

Assessment Questions

4. A 9-volt battery drives an electric current through a circuit with 4-ohm resistance. What is the electric current running through the circuit?

   a. 0.44 A

   b. 2.25 A

   c. 5 A

   d. 36 A

Assessment Questions

4. A 9-volt battery drives an electric current through a circuit with 4-ohm resistance. What is the electric current running through the circuit?

a. 0.44 A

b. 2.25 A

c. 5 A

d. 36 A

ANS: B

$$V = IR$$

Voltage = current x resistance

Volts = amps x ohms

$$I = V / R$$

$$I = 9\ V / 4\ \Omega$$

Assessment Questions

1. The two types of electric current are direct current and indirect current.

   True
   False

Assessment Questions

1. The two types of electric current are direct current and indirect current.

   True
   False

   ANS: F, alternating