Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date:\_\_\_\_\_\_\_ Hour:\_\_\_\_\_\_\_

**Physics Notes: Chapter 16 ELECTRIC CHARGE AND STATIC ELECTRICITY** 2/24/15

**16.1 Electric Charge**

 Electrical energy is associated with electric charges. An electric charge is a property that causes subatomic particles such as \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to attract or repel each other. Two types of electric charges called positive and negative. Protons have a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ charge and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ have a negative charge.

In an \_\_\_\_\_\_\_\_\_\_, the positively charged \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is surrounded by a cloud of negatively charged \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. The number of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ equals the number of electrons which results in a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ atom.

If an atom has unequal numbers of protons and electrons, it will have a net \_\_\_\_\_\_\_\_\_\_\_\_\_. Since protons are trapped in the nucleus and do not move, an atom must \_\_\_\_\_\_\_\_\_ or \_\_\_\_\_\_\_\_\_ electrons in order to become charged. If it gains electrons, it becomes \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ charged. If an atom loses electrons, it becomes \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ charged.





**Measurement of Charge**

In 1909, Robert Millikan did an experiment in which he carefully measured tiny charges on oil droplets suspended in midair. He discovered that there was a minimum charge, or a *fundamental charge*, and that the charges on the droplets were all multiples of this minimum charge. This charge is called “e” and is the amount of charge of an electron or a proton.

The SI unit of electric charge is the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (C),. An electron or proton carries a very small charge, 1.602 x 10-19 C. It would take \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ electrons or protons to add up to a single Coulomb of charge.

**Static Electricity and Charging**

 Static electricity is the study of the distribution of electric charges, including how charge is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ between objects. Static means “not moving”; electric charge moving through wires is called “current electricity”. Net charges can be built up by friction, by \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, and by induction. Even though there is a charge transfer, the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ charge is the \_\_\_\_\_\_\_\_\_\_ before and after the transfer. This is known as the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**Charging by Friction**

 An example of charging by friction would be rubbing a balloon on your head. How is a net charge produced? The latex balloon \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ electrons \_\_\_\_\_\_\_\_\_\_ than your hair does, so the balloon picks up electrons and becomes \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_charged. Because your hair \_\_\_\_\_\_\_\_\_\_\_\_ electrons, it becomes \_\_\_\_\_\_\_\_\_\_\_\_\_\_ charged. Opposite charges \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ , so your hair and the balloon are attracted to each other.



Two balloons rubbed on hair will become negatively charged and will be attracted to the hair, which is positive.

If the balloons are hung next to each other, they repel because they both have a negative charge.

**Charging by Contact**

 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ something that has a charge can transfer the charge to you or from you to it. For example, if you touch a negatively charged rod to a metal ball, then then charge will distribute so the ball receives some of the negative charge (extra electrons). The rod will still be negative, but less so.

**Charging by Induction**

 As you walk across a carpet, you pick up extra \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, and have a negative charge. If you were to reach for a metal doorknob, electrons from your hand would repel electrons in the doorknob, leaving a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ charge on the part of the doorknob closest to your hand touched it. This transfer of charge without contact between materials is called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

In the diagram (a) to the right, the positively charged rod induces a separation of charge, by pulling \_\_\_\_\_\_\_\_\_\_\_ to the near side. In (b), connecting the sphere to the ground allows electrons to come up to balance the positive charge on the right. The electrons are then trapped when the sphere is disconnected from ground.

Notice that through induction, the *positive* rod is able to give the sphere a *negative* charge, without ever touching the sphere!

**Polarization through induction.**

When a charged object is brought near a neutral object, it can induce a separation of charge. The balloon in the diagram is negatively charged, and will cause \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in the wall to slightly to the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

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The protons will stay put because they are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. This results in the wall being slightly polarized, which means one side is more positive and one side is more negative.

 DRAW THE CHARGES IN THE WALL.

**16.2 Electric Forces**

 Opposite charges \_\_\_\_\_\_\_\_\_\_\_\_\_ each other. Like charges repel each other. Neutral charges are not attracted or repelled to either type of charge.

Neutral objects, though, can be polarized, with more negative charge on one side, and positive on another, so they can still be attracted to charged objects.

 Electric forces can attract or repel. The electric force between two objects depends on the amount of electric \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, as well as the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_between objects. As the objects get further from each other, the force decreases. If you double the distance, the force decreases to one fourth of what it was. If you triple the distance, the force decreases to one ninth of what it was. (22 = 4, and 32=9) This is similar to the gravitational force between objects. For example, a space shuttle is \_\_\_\_\_\_\_\_ affected by the Earth’s gravitational pull in outer space compared to the surface.

Double the distance, force drops to 25%

Double each charge, force gets 4 times as strong

Gravitational forces seem strong, but electric forces inside an atom are much stronger. If you charge a couple of pennies with a thousandth of a Coulomb, and put one 1 meter above the other, the electrical force between them would be hundreds of times greater than the weight of the pennies, and would shoot the top penny up into the air.

**Coulomb’s Law**

The force between two charges depends on the strength of the charges and r, the distance between their centers. $F=k\frac{q\_{1}q\_{2}}{r^{2}}$ k = 8.99 x 109 N∙m2/C2

 *The force is attractive if the sign is negative (opposite charges)*

 *and repulsive if the sign is positive (like charges).*

1) Calculate the electrical force between two objects which are 2.94m apart, and have

charges of +1.40 x 10-4C, and +3.50 x 10-4 Coulombs. Is the force attractive or repulsive?

2a) Calculate the force between two objects which are 36.2 cm apart, and have

charges of +1.40 x 10-3C, and -2.50 x 10-2 Coulombs. (Pay attention to the units!)

 b) If 1N equals 0.225 pounds, how many pounds of force would be pulling these objects together?

**Static Discharge**

**** Have you ever gotten a \_\_\_\_\_\_\_\_\_\_\_\_\_\_ from a doorknob or other object? That spark that you feel is a static discharge. Static discharge occurs when a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ for charges to travel suddenly forms. The \_\_\_\_\_\_\_\_ between you and the doorknob is the pathway. This shock can happen when you are \_\_\_\_\_\_\_\_\_\_\_\_\_ to another object and occurs less from farther away.

 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is a more dramatic form of static discharge. How does this occur? Charge can build up in a storm cloud from \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ between moving air masses. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ charge in the \_\_\_\_\_\_\_\_\_\_\_\_\_\_ part of the cloud induces a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ charge in the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ below the cloud. As the amount of charge in the cloud \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, the force of attraction between charges in the cloud and charges in the ground \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. (Remember, stronger electric forces increase attraction or repulsion between charges.) Eventually the \_\_\_\_\_\_\_\_becomes charged, forming a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ for electrons to travel from the cloud to the ground.

**16.3 Electric Fields**

 The \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ that an electric charge has on other charges in the \_\_\_\_\_\_\_\_\_\_\_\_\_ around it is the charge’s \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. The \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of an electric field depends on the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of charge that produces the field and the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ from the charge. In other words, small charge produces a \_\_\_\_\_\_\_\_\_\_\_\_\_\_ electric field. Electric fields can be represented with lines as shown below. Notice that the electric field of a positive charge points \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and the electric field of a negative charge points \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.





The density of electric field lines around these three objects reveals that the quantity of charge on C is greater than that on B which is greater than that on A. Also, as distance from the charge increases, the density of the lines decreases, representing a weaker field. The electric field is *inversely proportional to the square of the distance.*

The strength of a gravitational field indicates how much a certain mass will weigh. Earth’s gravitational field is 9.81 Newtons per kilogram at the surface, and gets weaker as you get farther from the earth’s center.

Electric fields are measured in Newtons per Coulomb, and give the force on each unit charge.

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

1. Calculate the electric field at a distance of 1.34 m from a point charge of +1.87 mC

2. What would be the size and direction of the force on a test charge of 7.81 nC at that point?

**Questions**

1. When does an object have a net charge?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

2. If an atom gains 2 electrons, what is its net charge?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ If an atom loses 3 electrons, what is its net charge?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

3. What is an electric field?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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4. What two factors can affect the strength of an electric field?

 a)

b)

5. In what three ways can charge be transferred?

 a)

b)

c)

6. Is it likely that static discharge would occur if you were 10 feet from a doorknob?\_\_\_\_\_

What must be formed in order for static discharge to occur?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

7. What is the relationship between the strength of electric force and the amount of charge?

What is the relationship between electric force and the distance between charges?

8. When a balloon is rubbed on dry hair, what net charge does it gain?\_\_\_\_\_\_\_\_\_\_\_\_\_\_ What net charge does the dry hair gain?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Name:\_\_\_KEY\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date:\_\_\_\_\_\_\_ Hour:\_\_\_\_\_\_\_

**Physics Notes: Chapter 16 ELECTRIC CHARGE AND STATIC ELECTRICITY** 2/24/15

**16.1 Electric Charge**

 Electrical energy is associated with electric charges. An electric charge is a property that causes subatomic particles such as \_\_protons\_\_ and \_\_electrons\_\_\_ to attract or repel each other. Two types of electric charges called positive and negative. Protons have a \_\_positive\_\_ charge and \_\_\_\_\_\_\_electrons\_\_\_\_\_\_\_\_\_\_ have a negative charge.

In an \_\_atom\_\_\_\_, the positively charged \_\_nucleus\_\_\_\_\_ is surrounded by a cloud of negatively charged \_\_\_\_\_electrons\_\_\_\_\_. The number of \_\_\_\_\_protons\_\_ equals the number of electrons which results in a \_\_\_neutral\_\_ atom.

If an atom has unequal numbers of protons and electrons, it will have a net \_\_charge\_\_\_. Since protons are trapped in the nucleus and do not move, an atom must \_gain\_\_\_ or \_lose\_\_ electrons in order to become charged. If it gains electrons, it becomes \_\_\_\_\_\_negatively\_\_\_\_\_\_\_\_\_ charged. If an atom loses electrons, it becomes \_\_\_\_\_\_positively\_\_\_\_\_\_ charged.





**Measurement of Charge**

In 1909, Robert Millikan did an experiment in which he carefully measured tiny charges on oil droplets suspended in midair. He discovered that there was a minimum charge, or a *fundamental charge*, and that the charges on the droplets were all multiples of this minimum charge. This charge is called “e” and is the amount of charge of an electron or a proton.

The SI unit of electric charge is the \_\_Coulomb\_\_\_\_ (C). An electron or proton carries a very small charge, 1.602 x 10-19 C. It would take \_\_\_\_6.24 x 1018\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ electrons or protons to add up to a single Coulomb of charge. $\frac{1C}{1.602 x 10^{-19}\frac{C}{e}}=6.24 x 10^{18}e$

**Static Electricity and Charging**

 Static electricity is the study of the distribution of electric charges, including how charge is \_\_\_\_\_\_\_\_transferred\_\_\_\_\_\_\_\_\_\_ between objects. Static means “not moving”; electric charge moving through wires is called “current electricity”. Net charges can be built up by friction, by \_\_contact\_\_\_\_\_\_, and by induction. Even though there is a charge transfer, the \_\_\_\_\_\_total\_\_\_\_\_\_\_ charge is the \_\_\_\_same\_\_\_ before and after the transfer. This is known as the \_\_conservation of charge\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**Charging by Friction**

 An example of charging by friction would be rubbing a balloon on your head. How is a net charge produced? The latex balloon \_\_attracts\_\_\_ electrons \_\_more\_\_\_ than your hair does, so the balloon picks up electrons and becomes \_\_\_\_\_\_\_\_negatively\_\_\_\_charged. Because your hair \_\_loses\_\_\_ electrons, it becomes \_\_\_positively\_\_\_ charged. Opposite charges \_\_attract\_\_\_\_\_\_\_ , so your hair and the balloon are attracted to each other.



Two balloons rubbed on hair will become negatively charged and will be attracted to the hair, which is positive.

If the balloons are hung next to each other, they repel because they both have a negative charge.

**Charging by Contact**

 \_\_\_Touching\_\_\_\_\_\_ something that has a charge can transfer the charge to you or from you to it. For example, if you touch a negatively charged rod to a metal ball, then then charge will distribute so the ball receives some of the negative charge (extra electrons). The rod will still be negative, but less so.

**Charging by Induction**

 As you walk across a carpet, you pick up extra \_\_\_\_electrons\_\_\_\_\_, and have a negative charge. If you were to reach for a metal doorknob, electrons from your hand would repel electrons in the doorknob, leaving a \_\_\_\_\_positive\_\_\_\_ charge on the part of the doorknob closest to your hand touched it. This transfer of charge without contact between materials is called \_\_\_charging by induction\_\_\_\_\_\_\_\_\_\_.

In the diagram (a) to the right, the positively charged rod induces a separation of charge, by pulling \_electrons\_\_\_\_ to the near side. In (b), connecting the sphere to the ground allows electrons to come up to balance the positive charge on the right. The electrons are then trapped when the sphere is disconnected from ground.

Notice that through induction, the *positive* rod is able to give the sphere a *negative* charge, without ever touching the sphere!

**Polarization through induction.**

When a charged object is brought near a neutral object, it can induce a separation of charge. The balloon in the diagram is negatively charged, and will cause \_\_\_\_\_\_\_electrons\_\_\_\_\_ in the wall to slightly to the \_\_\_\_\_right\_\_\_\_\_.

+ - +-

+ - -

+ - +-

-+ - +

+ + -

- + -+

* -

 - - -

- - -

-

The protons will stay put because they are \_\_\_\_\_trapped\_\_\_\_\_\_\_ in the \_\_\_\_\_\_\_\_\_nucleus\_\_\_\_\_\_\_\_\_\_. This results in the wall being slightly polarized, which means one side is more positive and one side is more negative.

 DRAW THE CHARGES IN THE WALL.

 More positive close to the balloon, more negative away from balloon.

 Total number of positives and negatives are EQUAL!

**16.2 Electric Forces**

 Opposite charges \_\_attract\_\_ each other. Like charges repel each other. Neutral charges are not attracted or repelled to either type of charge.

Neutral objects, though, can be polarized, with more negative charge on one side, and positive on another, so they can still be attracted to charged objects.

 Electric forces can attract or repel. The electric force between two objects depends on the amount of electric \_\_\_charge\_\_\_\_\_\_\_\_\_, as well as the \_\_\_distance\_\_\_ between objects. As the objects get further from each other, the force decreases. If you double the distance, the force decreases to one fourth of what it was. If you triple the distance, the force decreases to one ninth of what it was. (22 = 4, and 32=9) This is similar to the gravitational force between objects. For example, a space shuttle is \_\_less\_ affected by the Earth’s gravitational pull in outer space compared to the surface.

Double the distance, force drops to 25%

Double each charge, force gets 4 times as strong

Gravitational forces seem strong, but electric forces inside an atom are much stronger. If you charge a couple of pennies with a thousandth of a Coulomb, and put one 1 meter above the other, the electrical force between them would be hundreds of times greater than the weight of the pennies, and would shoot the top penny up into the air.

**Coulomb’s Law**

The force between two charges depends on the strength of the charges and r, the distance between their centers. $F=k\frac{q\_{1}q\_{2}}{r^{2}}$ k = 8.99 x 109 N∙m2/C2

 *The force is attractive if the sign of the force is negative (opposite charges)*

 *and repulsive if the sign is positive (like charges).*

1) Calculate the electrical force between two objects which are 2.94m apart, and have

charges of +1.40 x 10-4C, and +3.50 x 10-4 Coulombs. Is the force attractive or repulsive?

 Force = 51.0 Newtons, repulsive (like charges)

2a) Calculate the force between two objects which are 36.2 cm apart, and have

charges of +1.40 x 10-3C, and -2.50 x 10-2 Coulombs. (Pay attention to the units!)

 F = -2.40 x 106 N (attractive)

 b) If 1N equals 0.225 pounds, how many pounds of force would be pulling these objects together?

F = 540,000 pounds!

**Static Discharge**

**** Have you ever gotten a \_\_shock\_\_\_\_\_ from a doorknob or other object? That spark that you feel is a static discharge. Static discharge occurs when a \_\_pathway\_\_\_\_\_\_\_\_ for charges to travel suddenly forms. The \_spark\_ between you and the doorknob is the pathway. This spark can happen when you are \_\_\_close\_\_\_\_ to another object and but is less likely when you are farther away.

 \_\_\_Lightning\_\_\_\_\_ is a more dramatic form of static discharge. How does this occur? Charge can build up in a storm cloud from \_\_\_friction\_\_\_ between moving air masses. \_\_\_\_\_\_\_Negative\_\_\_ charge in the \_\_\_\_lower\_\_\_ part of the cloud induces a \_\_\_positive\_\_\_\_\_\_ charge in the \_\_ground\_\_\_\_\_\_ below the cloud. As the amount of charge in the cloud \_\_\_increase\_\_, the force of attraction between charges in the cloud and charges in the ground \_\_\_increase\_\_\_\_\_\_. (Remember, stronger electric forces increase attraction or repulsion between charges.) Eventually the \_\_air\_\_\_ becomes ionized, forming a \_\_\_\_pathway\_\_\_ for electrons to travel from the cloud to the ground.

**16.3 Electric Fields**

 The strength of a gravitational field indicates how much a certain mass will weigh. Earth’s gravitational field is 9.81 Newtons per kilogram at the surface, and gets weaker as you get farther from the earth’s center. A bigger mass is affected more by the gravitational field, and has a bigger force (weight).

The \_\_effect\_\_ that an electric charge has on other charges in the \_\_space\_\_\_\_\_ around it is the charge’s \_\_electric field\_\_\_\_\_. The \_\_\_\_\_strength\_\_\_\_ of an electric field depends on the \_\_\_\_amount\_\_\_\_ of charge that produces the field and the \_\_\_\_distance\_\_\_\_\_ from the charge. In other words, small charge produces a \_\_small\_\_\_\_\_ electric field. Electric fields can be represented with lines as shown below. Notice that the electric field of a positive charge points \_\_\_\_outward\_\_\_\_\_\_\_ and the electric field of a negative charge points \_\_\_\_inward\_\_\_\_\_\_\_. The lines show the force on a proton!





The density of electric field lines around these three objects reveals that the quantity of charge on C is greater than that on B which is greater than that on A. Also, as distance from the charge increases, the density of the lines decreases, representing a weaker field. The electric field is *inversely proportional to the square of the distance.*

The strength of a gravitational field indicates how much a certain mass will weigh. Earth’s gravitational field is 9.81 Newtons per kilogram at the surface, and gets weaker as you get farther from the earth’s center. A bigger mass is affected more by the gravitational field, and has a bigger force (weight),

Electric fields are measured in Newtons per Coulomb, and give the force on each unit charge.

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

1. Calculate the electric field at a distance of 1.34 m from a point charge of +1.87 mC

2. What would be the size and direction of the force on a test charge of 7.81 nC at that point?

**Questions**

1. When does an object have a net charge?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

2. If an atom gains 2 electrons, what is its net charge?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ If an atom loses 3 electrons, what is its net charge?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

3. What is an electric field?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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4. What two factors can affect the strength of an electric field?

 a)

b)

5. In what three ways can charge be transferred?

 a)

b)

c)

6. Is it likely that static discharge would occur if you were 10 feet from a doorknob?\_\_\_\_\_

What must be formed in order for static discharge to occur?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

7. What is the relationship between the strength of electric force and the amount of charge?

What is the relationship between electric force and the distance between charges?

8. When a balloon is rubbed on dry hair, what net charge does it gain?\_\_\_\_\_\_\_\_\_\_\_\_\_\_ What net charge does the dry hair gain?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_