Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Period \_\_\_\_\_\_\_\_\_\_\_\_

**Unit 7 Review- Static Electricity**

**Essential Skills that will be tested**

|  |  |
| --- | --- |
| 7-1 | Student can identify all of the variables and their units for this unit (FE, k, q, r) |
| 7-2 | Students can determine type of charge or amount of charge on an object based on its interactions with other objects.  |
| 7-3 | Students can use Coulomb's Law to determine the electric force on an object or how it changes. |
| 7-4 | Students know charged particles are sources of electric fields and are subject to the forces of the electric fields from other charges. (ca 5e) |
| 7-5 | Students know that positive charges go from high potential to low potential whereas negative charges move from low potential to high potential when in an electric field and no work is done by an external force. |

**Questions- (this is only a partial review- use your worksheets and notes as well)**

1. Fill in the following table information.

|  |  |  |  |
| --- | --- | --- | --- |
| Variable Name | Variable Symbol | Unit Name | Unit Symbol |
| charge | Q | Coulomb | C |
| electric force | Fe | Newton | N |
| distance of separation | R or d | Meter | M |
| Coulomb’s Constant | K | - | Nm2/C3 |

1. Which of the following are true of static charges? Choose all that apply.
	1. Like charges repel.
	2. Like charges attract.
	3. Opposite charges repel.
	4. Opposite charges attract.
	5. A positively charged object has lost electrons.
	6. A positively charged object has gained protons.
	7. A negatively charged object has lost protons.
	8. A negatively charged object has gained electrons.
2. Identify the following objects as being either ...

|  |  |  |
| --- | --- | --- |
| a. positive | b. negative | c. neutral |

If there is no conclusive evidence, then select all that could be true.

|  |  |
| --- | --- |
| **Description of Object** | **a, b, or c?** |
|  |  |
| 1. An object possesses more neutrons than electrons.
 |  \_\_\_\_\_\_\_­­\_abc\_\_\_\_\_\_\_\_\_\_\_\_ |
| 1. A formerly neutral object that just lost some electrons.
 |  \_\_\_\_\_\_\_­­\_\_\_\_a\_\_\_\_\_\_\_\_\_\_\_\_ |
| 1. A formerly neutral object that just gained some electrons.
 |  \_\_\_\_\_\_\_­­\_\_\_b\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| 1. An object which attracts a negatively-charged balloon.
 |  \_\_\_\_\_\_\_­­\_\_\_\_ac\_\_\_\_\_\_\_\_\_\_ |
| 1. An object which attracts neutral paper bits and attracts a negatively-charged balloon.
 |  \_\_\_\_\_\_\_­­\_\_a\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| 1. An object which attracts neutral attracts paper bits and repels a negatively-charged balloon.
 |  \_\_\_\_\_\_\_­­\_\_b\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| 1. An object which attracts a negatively-charged balloon and attracts a positively-charged balloon.
 |  \_\_\_\_\_\_\_­­\_\_\_\_c\_\_\_\_\_\_\_\_\_\_\_\_ |
| 1. An object which attracts a charged balloon (balloon A) which is attracted to a negatively-charged balloon (balloon B).
 |  \_\_\_\_\_\_\_­­\_\_\_\_\_\_bc\_\_\_\_\_\_\_\_ |
| 1. An object which attracts a balloon (balloon C) which is repelled by a negatively-charged balloon (balloon D).
 |  \_\_\_\_\_\_\_­­\_\_\_ac\_\_\_\_\_\_\_\_\_\_\_ |
| 1. An object which repels a balloon (balloon E) which is repelled by a positively-charged balloon (balloon F).
 |  \_\_\_\_\_\_\_­­\_\_\_\_\_a\_\_\_\_\_\_\_\_\_\_\_ |
| 1. An object around which the electric field vector is directed inwards.
 |  \_\_\_\_\_\_\_­­\_\_\_b\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| 1. An object around which the electric field vector is directed outwards.
 |  \_\_\_\_\_\_\_­­\_\_\_\_a\_\_\_\_\_\_\_\_\_\_\_\_ |

1. Consider the following statements given below and determine if the charge of Object A is:

|  |  |  |
| --- | --- | --- |
| a. positive | b. negative | c. neutral |

|  |  |
| --- | --- |
| **Description of Charging Method** | **a, b, or c?** |
| 1. Object A is charged by friction using animal fur. Animal fur has a greater electron affinity than object A.
 |  \_\_\_\_\_\_\_­­\_\_\_\_\_a\_\_\_\_\_\_\_\_\_\_\_ |
| 1. Object A is charged by conduction using a negatively charged object.
 |  \_\_\_\_\_\_\_­­\_\_\_\_\_b\_\_\_\_\_\_\_\_\_\_\_ |
| 1. Object A is charged by induction using a positively charged object.
 |  \_\_\_\_\_\_\_­­\_\_\_\_\_b\_\_\_\_\_\_\_\_\_\_\_ |
| 1. Object A is used to charge an aluminum plate by the method of induction. The aluminum plate acquires a positive charge.
 |  \_\_\_\_\_\_\_­­\_\_\_\_\_b\_\_\_\_\_\_\_\_\_\_\_ |
| 1. Object A is used to charge an aluminum plate by the method of induction. The aluminum plate acquires a negative charge.
 |  \_\_\_\_\_\_\_­­\_\_\_\_\_a\_\_\_\_\_\_\_\_\_\_\_ |
| 1. A rubber rod has a greater electron affinity than animal fur. The rubber rod is charged by friction with animal fur. The rubber rod is then used to charge Object A by the method of conduction.
 |  \_\_\_\_\_\_\_­­\_\_\_\_\_b\_\_\_\_\_\_\_\_\_\_\_ |
| 1. A rubber rod has a greater electron affinity than animal fur. The rubber rod is charged by friction with animal fur. The rubber rod is then used to charge Object A by the method of induction.
 |  \_\_\_\_\_\_\_­­\_\_\_\_\_a\_\_\_\_\_\_\_\_\_\_\_ |
| 1. A rubber rod has a greater electron affinity than animal fur. The rubber rod is charged by friction with animal fur. The rubber rod is then used to charge an aluminum pop can by the process of induction. The pop can is then contacted to object A.
 | \_\_\_\_\_\_\_­­\_\_\_\_\_\_a\_\_\_\_\_\_\_\_\_\_ |

1. The outer shell electrons in metals are not tightly bound to the nuclei of their atoms. They are free to roam throughout the material, moving from atom to atom. These materials are good \_\_\_\_.
	1. conductors b. insulators c. for nothing

For questions #6 and #7, consider the following situation. Connor Duct takes a **positively charged**  rubber rod and **touches** a metal sphere on an insulated stand as shown at the right. Draw the direction of electron flow.

Conduction: Same charge

Induction: opposite charges

1. The charge on the metal sphere will end up \_\_\_.
	1. neutral b. negative c. positive

1. The sphere acquires this charge because \_\_\_\_.
	1. electrons move from the rubber rod to the sphere
	2. electrons move from the sphere to the rubber rod
	3. protons move from the rubber rod to the sphere
	4. protons move from the sphere to the rubber rod
	5. the rubber rod creates a charge on the sphere
2. Which of the following charging methods work without ever touching the object to be charged to the object used to charge it? Choose all that apply.

|  |  |  |
| --- | --- | --- |
| a. charging by friction | b. charging by contact | c. charging by induction |

1. Charged balloons are used to induce a charge upon neutral metal pop cans. Identify the type of excess charge which would be present on cans G, H, I, J, K, L, M, N and P as shown in the diagrams below.

|  |  |  |
| --- | --- | --- |
| a. positive | b. negative | c. neutral |

|  |  |  |
| --- | --- | --- |
|   | **Diagram** | **Type of Charge on...** |
| I. | http://www.physicsclassroom.com/reviews/estatics/q22a.gif | G: \_\_+\_\_H: \_\_-\_\_ |
| II. | http://www.physicsclassroom.com/reviews/estatics/q22b.gif | I: \_\_\_-\_J: \_\_+\_\_ |
| II. | http://www.physicsclassroom.com/reviews/estatics/q22c.gif | K: \_+\_\_\_L: \_\_-\_\_M: \_+\_\_\_ |
| IV. |  | N: \_-\_\_ |
| V. |  | P: \_neutrual\_\_\_ |





1. In diagram IV of **Question #9**, the pop can acquires the charge that it does because \_\_\_.
	1. electrons move from the balloon to the pop can
	2. electrons move from the pop can to the balloon
	3. protons move from the balloon to the pop can
	4. protons move from the pop can to the balloon
	5. electrons move from the pop can to the hand (*ground*)
	6. electrons move from the hand (*ground*) to the pop can
	7. protons move from the pop can to the hand (*ground*)
	8. protons move from the hand (*ground*) to the pop can

1. A negatively charged balloon will be attracted to a neutral wooden cabinet due to polarization. Which one of the following diagrams best depict why this occurs?



1. The charge of one electron is -1.6 X 10-19 Coulombs. If a neutral object loses 1.5x106 electrons, then what will be its charge?

Q = (1.6 x 10-19 C)(1.5 x 106) = + 2.4 x 10-13 C

1. An object acquires a charge of -8 μC. How many electrons did it gain in order to obtain this charge?

# of electrons = (- 8 x 10-6 C)/(1.6 x 10-19 C) = 5 x 1013 electrons

1. A charge of q1 = 2 µC is interacting with a charge of q2 = 3 µC.
	1. Is this a repulsive or attractive force? How do you know?

Repulsive force, same type of charge

* 1. How does the size of the force on each charge compare? Why?

Same force…newton’s 3rd law…for every action force there is an equal and opposite reaction force

* 1. What happens to the force if we double the charge of q2?

Force doubles (directly related)

* 1. What happens to the force if we double the charge of q2 and triple the charge of q3?

Force goes up by a factor of 6 (2\*3 = 6)

* 1. What happens to the force if we quadruple the distance of separation between the charges?

Force decreases by a factor of 16 (42 = 16 and inversely related)

* 1. What happens to the force if we decrease the distance of separation by half?

Force increases by a factor of 4

* 1. What happens to the force if we double the charge q1 and q2 and decrease the distance of separation by a third?

Force increases by a factor of 36 (2\*3/(1/3)2) = 4/(1/9) = 36)

* 1. Calculate the magnitude of the force acting on q1 when the charges are separated by a distance of 2 m. (remember: 1 C = 106 µC). Follow the GUESS method.

0.0135 N (don’t forget to convert to coulombs! And plug-in K)

1. How is the direction of the electric field determined?

Based on the direction a small positive charge feels a force/behaves/interacts with an electric field.

1. Draw a diagram below to show the electric field around a positive point charge and a negative point charge.

Arrows should point away from your positive charge and towards your negative charge

1. A negatively-charged object creates an electric field which can be measured at various locations in the region about it. An electric field vector is drawn for point X. Use your understanding of the electric field - distance relationship to draw E vectors for points A - E. (The length of the arrow should be indicative of the relative strength of the E vector and the direction of the arrow should be indicative of the direction of the E field.)



1. Construct electric field lines around the following configuration of charges. Include at least six lines per charge.

|  |  |
| --- | --- |
|  |  |
|  |  |

1. Positive test charges move in \_\_\_\_\_\_the same\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ direction as the electric fields while negative test charges move in \_\_\_the opposite\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ direction as the electric field.
2. When a positive test charge is put in the vicinity of an electric field and gets to do what it wants to do, it will move from an area of \_\_\_high\_\_\_\_\_\_\_\_\_\_\_ potential to \_\_\_low\_\_\_\_\_\_\_\_\_\_\_\_\_ potential. As such, the electric potential energy will \_\_\_decrease\_\_\_\_\_\_\_\_\_\_\_\_. When a negative test charge is put in the vicinity of an electric field and gets to do what it wants to do it will move from an area of \_\_\_low\_\_\_\_\_\_\_\_\_\_\_\_\_ potential to \_\_\_\_\_high\_\_\_\_\_\_\_\_\_\_ potential. As such, the electric potential energy will \_\_\_\_\_\_increase\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. If you need a charge to do something that it does not want to do, you must apply a \_\_\_\_force\_\_\_\_\_\_\_\_\_\_\_\_\_\_ over a \_\_\_\_\_distance\_\_\_\_\_\_\_\_\_\_\_\_ which, in physics, is called doing \_\_\_work\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
3. The diagrams below show the direction of an electric field. A small negatively charged particle is placed in the electric field. For each diagram, indicate whether work must be done upon the charge to move it from point A to point B. Finally, indicate the point (A or B) with the greatest potential energy and the greatest electric potential.

