14 Electrostatics

Name_____

Worksheet A: Concepts & Calculations

Inquiry Physics

In the space to the left, write the answer that best completes each statement.

_____ 1. Each electron and each proton bears a net charge of _____ C.

A _____ 2. The proton has a _____ charge, while the electron has a _____ charge.

B _____

_____ 3. Under ordinary circumstances, an atom or molecule is electrically _____ .

A _____ 4. Most electric phenomena are due to the movements of _____ , which carry a _____ charge.

B _____

_____ 5. A neutral object becomes _____ charged if electrons are removed.

_____ 6. Unlike charges _____ one another.

_____ 7. A(n) _____ is a device used to detect the presence of a static charge.

_____ 8. Because they are poor _____ , rubber and plastic rods are used for electrostatic experiments.

_____ 9. The process of charging a neutral body by touching it with a charged body is called charging by _____ .

_____ 10. Charges added to a(n) _____ will immediately spread throughout it.

_____ 11. Charges added to one part of a(n) _____ will remain in that part.

_____ 12. A charged body of either sign will _____ a neutral body in which a charge separation is induced.

_____ 13. The quantity of charge on an object is measured in the unit called the ____ .

_____ 14. _____ first stated the law relating electrical forces to charge and distance.

A _____ 15. When a rubber rod is rubbed against fur, _____ are stripped from the _____ , giving the rod a net _____ charge.

B _____

C _____

A _____ 16. When a plastic rod is rubbed against cloth, _____ are stripped from the _____ , giving the rod a net _____ charge.

B _____

C _____

Show your work on the following problem, including your equation, units, and proper significant figures.

17. Two identical metal balls carry charges of +3.00 μC (+3.00×10^{-6} C) and –6.00 μC. Their centers are 1.00 m apart.

a) Compute the size of the electrical force between them.
(k = 9.00×10^{9} Nm^{2}/C^{2})

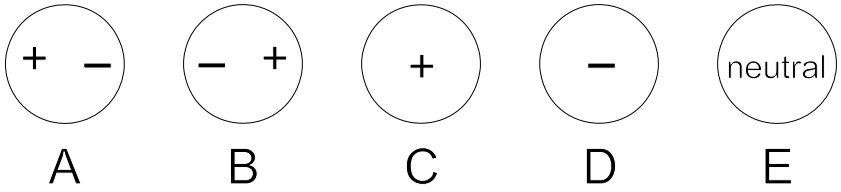
b) Was the force in part **a** attractive or repulsive?

c) The balls are allowed to touch each other, so that the electrons are free to move around between the balls, and then they are again placed 1.00 m apart. What is the new charge on each ball?

d) Compute the new electrical force between them.

e) Was the force in part **d** attractive or repulsive?

Below are five diagrams of a metal sphere which is insulated from the ground. The + and - signs indicate the sign of the *net* charge on the left and right sides of the sphere, or the overall charge. For each of the procedures described below, place the letter of the diagram that best represents the resulting *net* charge on each side of the sphere.



_____ 18. A positively charged rod is brought near, but not touching the left side of a neutral sphere.

_____ 19. A plastic rod is charged positively by rubbing it with felt. The ***felt*** is then touched to a neutral sphere and later removed.

_____ 20. A positively charged rod is brought near a neutral sphere, the sphere is charged by induction, and the rod is taken away.

_____ 21. A sphere is charged by conduction with a positive rod.

_____ 22. A negatively charged rod is brought near but not touching the right side of a neutral sphere.

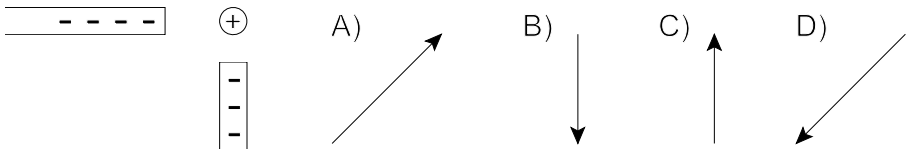
_____ 23. A positively charged rod is brought near the right side of a sphere that was already positively charged.

_____ 24. A person holding a ***metal*** rod touches it to a positively charged sphere.

In the space to the left, write the letter of the answer to the question.

_____ 25. Which atom pictured below is electrically neutral?

_____ 26. In which direction will the positively charged ball shown below move? The rods are equally charged.



_____ 27. A negatively charged rod is brought near the right hand side of two neutral metal spheres that are touching one another while insulated from the ground. The spheres are then separated and the rod is taken away. Which pair of spheres shows the correct signs of each sphere's net charge?

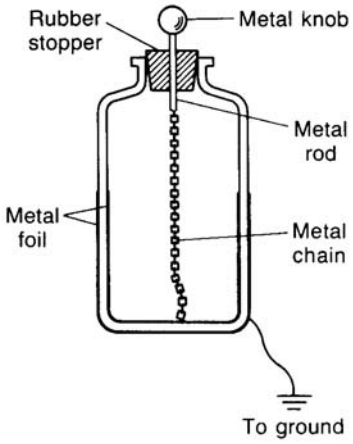
_____ 28. Using the amount of charge of a single electron or proton, one can determine how many such particles would be needed to form one Coulomb of charge. How many is that?
A) 1.6×10^{-19} B) 1.6×10^{19} C) 6.25×10^{-18} D) 6.25×10^{18}

_____ 29. Two objects exert an electric force of size *F* on each other. If the charge on each object is doubled, the electric force will now be...
A) ¼ *F* B) *F* C) 2 *F* D) 4 *F*

_____ 30. Two objects exert an electric force of size F on each other. If the objects are moved three times closer together (so *d* is being reduced), the electric force will now be...
A) 1/3 *F* B) 3 *F* C) 1/9 *F* D) 9 *F*

Critical Thinking

Electric charges can be collected in a glass jar; this device is a type of *capacitor*. The diagram shows a Leyden jar. It is made by covering the inner and outer surfaces of a glass jar with separate pieces of metal foil. A metal rod, with a metal knob at the end, protrudes through the top of the jar, and a metal chain connected to the rod touches the metal foil inside the jar.



A rubber rod is rubbed with fur and touched to the metal knob on top of the Leyden jar.

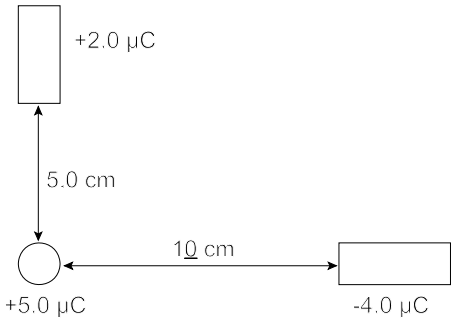
_____ 31. What is the charge on the metal foil on the **inside** of the jar?
A) positive B) negative
C) there will be no charge on that piece of foil

_____ 32. What is the charge on the metal foil on the **outside** of the jar?
A) positive B) negative
C) there will be no charge on that piece of foil

_____ 33. If a person (who was insulated from the ground) touched one finger to the metal knob, and another finger to the metal foil on the outside of the jar (don't try this at home!), _____ would flow through them from the _____ to the _____ .
A) electrons, knob, outer foil B) electrons, outer foil, knob
C) protons, knob, outer foil D) protons, outer foil, knob

The following problem will show you how to apply vector math to electrostatic forces.

34. A rubber rod with a negative 4.0 μC (-4.0×10^{-6} C) charge is 10 cm east of a pith ball with a positive charge of 5.0 μC. A plastic rod with a positive 2.0 μC charge is 5.0 cm north of the pith ball.



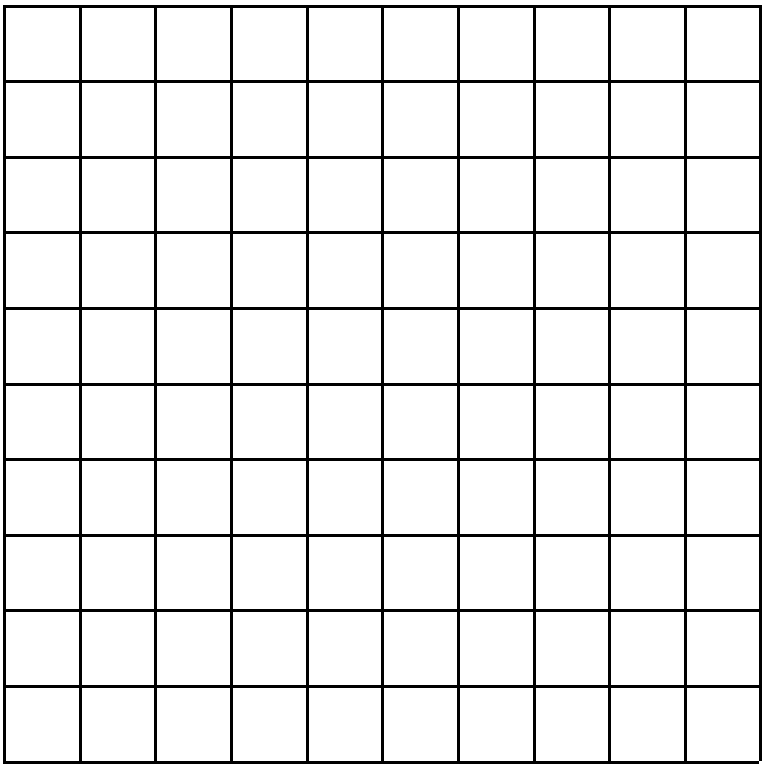
a. Use Coulomb's Law to find the magnitude of the electric force between the rubber rod and the pith ball. SHOW ALL WORK

b. What is the compass direction of the rubber rod's push/pull on the pith ball? _____

c. Use Coulomb's Law to find the magnitude of the electric force between the plastic rod and the pith ball.
SHOW ALL WORK

d. What is the compass direction of the plastic rod's push/pull on the pith ball? _____

e. Use the centimeter axes below to sketch and add the force vectors on the pith ball. Indicate the scale you are using and indicate the size and direction of the resultant force vector. *(see answer below)*
MAKE SURE EACH VECTOR, INCLUDING THE RESULTANT, HAS AN ARROWHEAD



Scale:
Each box equals _____ N

Resultant force in newtons:

_____

Resultant direction:
(specify degrees and compass headings)

_____

ANSWER:
40 N at 63° S of E

