

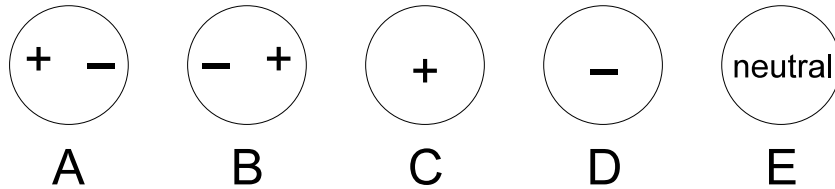
14 Electrostatics

Name _____

Worksheet: Charge Movement and Distributions; Coulomb's Law

AP Physics B

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.



- _____ 1. A positively charged rod is brought near, but not touching the left side of a neutral sphere.
- _____ 2. A plastic rod is charged positively by rubbing it with felt. The *felt* is then touched to a neutral sphere and later removed.
- _____ 3. A positively charged rod is brought near a neutral sphere, the sphere is charged by induction, and the rod is taken away.
- _____ 4. A sphere is charged by conduction with a positive rod.
- _____ 5. A negatively charged rod is brought near but not touching the right side of a neutral sphere.
- _____ 6. A positively charged rod is brought near the right side of a sphere that was already positively charged.
- _____ 7. A person holding a *metal* rod touches it to a positively charged sphere.

COULOMB'S LAW

Two point charges q_1 and q_2 separated a distance d apart will attract or repel each other with a force given by the formula below, called Coulomb's law. The constant k is taken to be $9.00 \times 10^9 \text{ Nm}^2/\text{C}^2$.

$$F = \frac{kq_1q_2}{d^2}$$

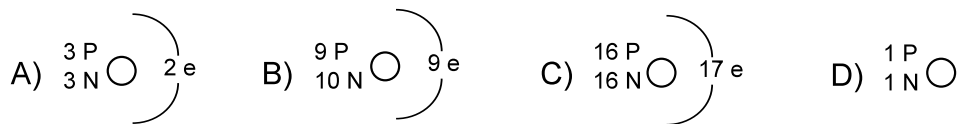
- 8. Two identical tiny metal balls carry charges of +3.00 nanocoulombs and - 12.0 nanocoulombs. Their centers are 3.00 cm apart.
 - a) Compute the force between them and specify its effect (state if it is attractive or repulsive).

 - b) The balls are now touched together and then separated to 3.00 cm. What is the new charge on each ball?

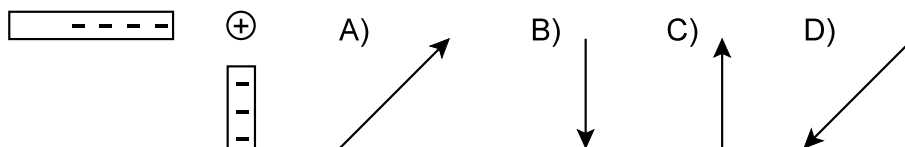
 - c) Calculate the magnitude and also specify the effect of the forces on each ball, given what occurred in part b.

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

- _____ 9. Which atom pictured below is electrically neutral?



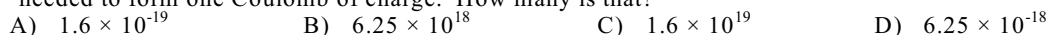
- _____ 10. In which direction will the positively charged ball shown below move? The rods are equally charged.



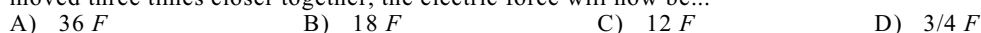
- _____ 11. A negatively charged rod is brought near the right hand side of two neutral metal spheres that are touching one another while insulated from the ground. The spheres are then separated and the rod is taken away. Which pair of spheres shows the correct signs of each sphere's net charge?



- _____ 12. 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?



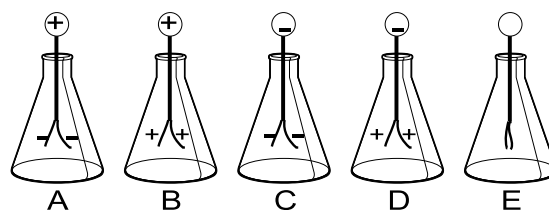
- _____ 13. Two objects exert an electric force of size F on each other. If the charge on each object is doubled and they are moved three times closer together, the electric force will now be...



- _____ 14. Two objects a certain distance apart each have a charge of positive four microCoulombs ($+4 \times 10^{-6} \text{ C}$ or $+4 \mu\text{C}$) which creates a repulsive force of size F on each object. If $+2 \mu\text{C}$ of charge is transferred from one object to the other, the repulsive force will now be...



- _____ 15. Which of the leaf electrosopes shows the proper leaf and net charge arrangements when a charged plastic rod is brought close to but not touching a neutral 'scope?



The Leyden Jar

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.

- _____ 16. 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
- _____ 17. 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
- _____ 18. 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

