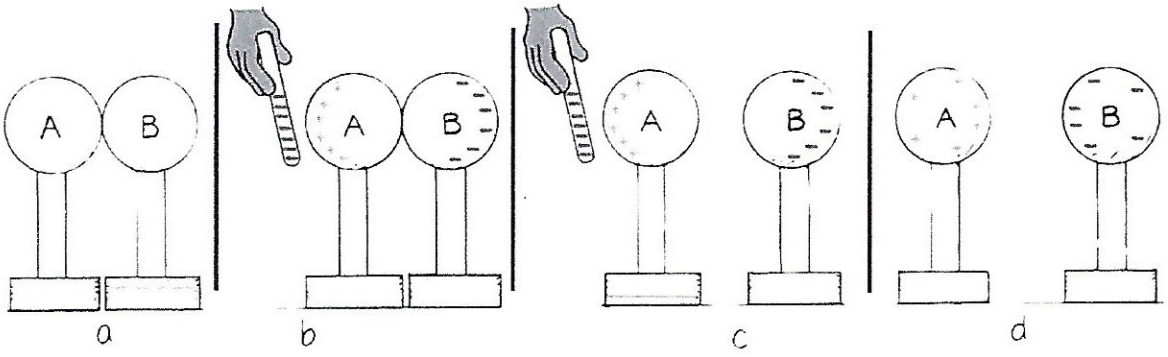
Name _____

1. Explain why there is no net charge in a neutral atom.
a neutral atom has equal numbers of protons (+) and electrons (−)
2. If a rubber rod is rubbed by a piece of fur, the rubber becomes negative charged and the fur becomes positive charged.
3. What is the principle of conservation of charge?
charge cannot be created or destroyed – just moved
4. Classify each of the following by writing *F* if it is an example of charging an object by friction and *C* if it is an example of charging an object by contact.

F a. sliding across the seat of an automobile
F b. scuffing your shoes as you walk across a rug
C c. touching a charged rod to a metal sphere
F d. combing your hair with a plastic comb
C e. touching your hand to a slightly charged metal plate

5. One object charges a second object by contact. Describe what will happen to the charge on the second object in each of the cases below.
   a. The second object is a good conductor.
   It becomes the same charge as the first object
   b. The second object is a poor conductor.
   The charge all stays in the first object – 2nd object doesn't get charged

Use the figure below to answer Questions 31–33.



6. Why do the positive and negative charges separate in part (b)?

negatives are repelled from negative rod

7. *Why do the positive and negative charges spread out on each on the spheres in part (d)?*

charges spread out evenly over an object

8. Why is the process illustrated in the figure an example of charging by induction?

The rod never touches the objects

9. The ground is a practically infinite reservoir for electric charge.

10. Describe what causes lightning to occur during thunderstorms.

charges separate in a cloud; opposite charge is induced in the ground; electrons jump from (-) to (+)

11. Is the following sentence true or false? A lightning rod placed above a building repels electrons in the air to prevent leaking of the charge onto the ground.- False

12. What are the three ways objects can become electrically charged?

a. Friction
b. Contact
c. Induction

Electric Charge

1. A lightning bolt has a charge of 20 C. Howmany electrons make up the bolt?

$Q = ne \qquad 20 = n(1.602\times10^{-19}) \qquad n = 1.2\times10^{20}$

2. An electroscope has a charge of 1.2 μC. How many electrons pass through your fingers as you ground this electroscope?

$1.2\times10^{-6} = n(1.602\times10^{-19}) \qquad n = 7.5\times10^{12}$

3. A charged rod has an excess of 6.4×10^8 electrons which it shares equally with a pith ball when they touch. What is the charge on the pith ball?

half of electrons on each $\frac{1}{2}(6.4\times10^8) = 3.2\times10^8$

$Q = ne$

$Q = (3.2\times10^8)(1.602\times10^{-19}) = 5.1\times10^{-11}$ C

4. Calculate the electrostatic force between a proton and an electron which are 1×10^{-10} m apart.

$F = \frac{k(Q_1)(Q_2)}{r^2} = \frac{(9\times10^9)(+1.602\times10^{-19})(-1.602\times10^{-19})}{(1\times10^{-10})^2} = -2.3\times10^{-8}$ N

5. A pith ball with a charge of +6.0 μC is placed 12 cm from another ball with a charge of -4.3 μC.

a) Which ball has an excess of electrons? negative one $(-4.3\mu C)$

i) How many electrons in excess does it have?

$Q = ne \qquad -4.3\times10^{-6} = n(-1.602\times10^{-19}) \qquad n = 2.7\times10^{13}$

b) Which ball has a deficit of electrons? positive one $(+6\mu C)$

ii) How many electrons in deficit does it have?

$6.0\times10^{-6} = n(1.602\times10^{-19}) \qquad n = 3.7\times10^{13}$

c) What is the force acting between the two balls?

$F = \frac{kQ_1Q_2}{r^2} = \frac{(9\times10^9)(-4.3\times10^{-6})(6\times10^{-6})}{(.12)^2} = -16$ N

d) Is the force attractive or repulsive?

attractive

6. A charge of 17.0 μC is placed 15.0 cm from a second charge. The force of attraction between the two is 21.4 N. Caclculate the second charge.

$F = \frac{kQ_1Q_2}{r^2} \qquad 21.4 = \frac{(9\times10^9)(17\times10^{-6})Q_2}{(.15)^2}$

$Q_2 = 3.15\times10^{-6}$ C

7. a) Calculate the electric force holding an electron in orbit ($r = 0.53 \times 10^{-10}$ m) around a proton.

$F = \frac{(9\times10^9)(1.602\times10^{-19})(-1.602\times10^{-19})}{(.53\times10^{-10})^2} = 8.2\times10^{-8}$ N

b) Calculate the gravitational force between the same proton and electron. (mass of electron = 9.11×10^{-31} kg and mass of proton = 1.67×10^{-27} kg)

$F_G = \frac{G m_1 m_2}{r^2} = \frac{(6.67\times10^{-11})(9.11\times10^{-31})(1.67\times10^{-27})}{(.53\times10^{-10})^2} = 3.6\times10^{-47}$ N

c) Which force is more significant within the atom, electrostatic or gravitational?

Electrostatic is much larger

8. How many electrons make up a charge of 30.0 μC?

$Q = ne$ $\quad 30.0 \times 10^{-6} = n\,(1.602 \times 10^{-19})$

$n = 1.9 \times 10^{14}$

9. Two charged smoke particles exert a force of 0.042 N on each other. What will the force if they are moved so they are only half as far apart?

$F = \frac{k Q_1 Q_2}{r^2}$ $\quad \frac{k Q_1 Q_2}{(\frac{1}{2})^2} \Rightarrow$ 4x bigger

$(4)(.042) = .168\,N$

10. What is the magnitude of the electric force of attraction between an iron nucleus (26 protons) and its innermost electron if the distance between them is 1.5×10^{-12} m?

$$F = \frac{(9 \times 10^9)(26 \times 1.602 \times 10^{-19})(-1.602 \times 10^{-19})}{(1.5 \times 10^{-12})^2} = .0027\,N$$

11. A person scuffing her feet on a wool rug on a dry day accumulates a net charge of -60 μC. How many excess electrons does this person get, and by how much does her mass increase?

$Q = ne$

$60 \times 10^{-6} = n\,(1.602 \times 10^{-19})$

$n = 3.7 \times 10^{14}$