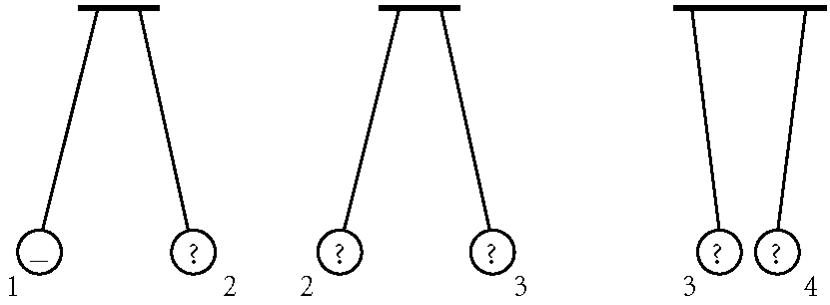
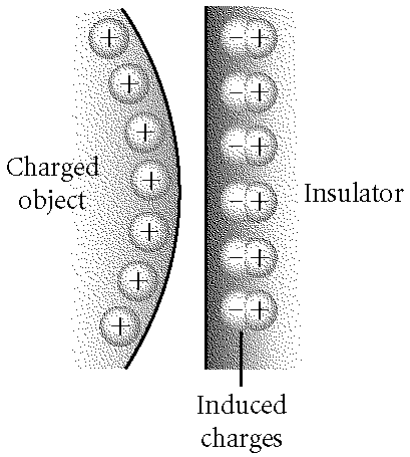
Electrostatic and Electric Potential - Sample Test

Multiple Choice
Identify the letter of the choice that best completes the statement or answers the question.

1. What happens when a rubber rod is rubbed with a piece of fur, giving it a negative charge?
   a. Protons are removed from the rod.
   b. Electrons are added to the rod.
   c. Electrons are added to the fur.
   d. The fur is left neutral.
2. A repelling force occurs between two charged objects when the charges are of
   a. unlike signs.
   b. like signs.
   c. equal magnitude.
   d. unequal magnitude.
3. Electric charge is
   a. found only in a conductor.
   b. conserved.
   c. found only in insulators.
   d. not conserved.
4. Charge is most easily transferred in
   a. nonconductors.
   b. conductors.
   c. semiconductors.
   d. insulators.



5. In the diagram shown above, the circles represent small balls that have electric charges. Ball 1 has a negative charge, and ball 2 is repelled by ball 1. Next, you see that ball 2 repels ball 3 and that ball 3 attracts ball 4. What is the electric charge on ball 4?
   a. Ball 4 may have either a positive or negative charge.
   b. Ball 4 has a negative charge.
   c. Ball 4 has a positive charge.
   d. It is not possible to determine the charge on ball 4.
6. Which statement is the *most* correct regarding electric insulators?
   a. Charges within electric insulators do not readily move.
   b. Electric insulators have high tensile strength.
   c. Electric charges move freely in electric insulators.
   d. Electric insulators are good heat conductors.
7. Both insulators and conductors can be charged by
   a. grounding.
   b. induction.
   c. polarization.
   d. contact.
8. Which of the following is *not* true for both gravitational and electric forces?
   a. The inverse square distance law applies.
   b. Forces are proportional to physical properties.
   c. Potential energy is a function of distance of separation.
   d. Forces are either attractive or repulsive.



9. The figure shown above demonstrates charging by
   a. grounding. b. induction. c. polarization. d. contact.
10. Two point charges, initially 1 cm apart, are moved to a distance of 3 cm apart. By what factor do the resulting electric and gravitational forces between them change?
    a. 9 b. 3 c. $\frac{1}{3}$ d. $\frac{1}{9}$
11. Two positive charges, each of magnitude q, are on the y-axis at points $y = +a$ and $y = -a$. Where would a third positive charge of the same magnitude be located for the net force on the third charge to be zero?
    a. at the origin b. at $y = 2a$ c. at $y = -2a$ d. at $y = -a$
12. Where is the electric field of an isolated, uniformly charged, hollow metallic sphere greatest?
    a. at the center of the sphere
    b. at the sphere's inner surface
    c. at infinity
    d. at the sphere's outer surface
13. If an irregularly shaped conductor is in electrostatic equilibrium, charge accumulates
    a. where the radius of curvature is smallest.
    b. where the radius of curvature is largest.
    c. evenly throughout the conductor.
    d. in flat places.
14. What occurs when two charges are moved closer together?
    a. The electric field doubles.
    b. Coulomb's law takes effect.
    c. The total charge increases.
    d. The force between the charges increases.
15. Resultant force on a charge is the ____ sum of the individual forces on that charge.
    a. scalar b. vector c. individual d. negative
16. Electric field strength depends on
    a. charge and distance.
    b. charge and mass.
    c. Coulomb constant and mass.
    d. elementary charge and radius.
17. Which is the *most* correct statement regarding the drawing of electric field lines?
    a. Electric field lines always connect from one charge to another.
    b. Electric field lines always form closed loops.
    c. Electric field lines can start on a charge of either polarity.
    d. Electric field lines never cross each other.
18. A conductor that is in electrostatic equilibrium has an electric field inside the conductor that
    a. depends on the radius of the conductor.
    b. is zero.
    c. is greatest near the conductor's surface.
    d. is parallel to the surface of the conductor.

19. Which of the following is *not* a characteristic of electrical potential energy?
    a. It is a form of mechanical energy.
    b. It results from a single charge.
    c. It results from the interaction between charges.
    d. It is associated with a charge in an electric field.
20. When a capacitor discharges,
    a. it must be attached to a battery.
    b. charges move through the circuit from one plate to the other until both plates are uncharged.
    c. charges move from one plate to the other until equal and opposite charges accumulate on the two plates.
    d. it cannot be connected to a material that conducts.
21. What effect will be produced on a capacitor if the separation between the plates is increased?
    a. It will increase the charge.
    b. It will decrease the charge.
    c. It will increase the capacitance.
    d. It will decrease the capacitance.
22. Increasing the potential difference between the plates of a capacitor will produce what effect on the capacitor?
    a. It will increase the charge on each plate.
    b. It will decrease the charge on each plate.
    c. It will increase the capacitance.
    d. It will decrease the capacitance.
23. When a positive charge moves in the direction of the electric field, what happens to the electrical potential energy associated with the charge?
    a. It increases.
    b. It decreases.
    c. It remains the same.
    d. It sharply increases, and then decreases.
24. Two positive point charges are initially separated by a distance of 2 cm. If their separation is increased to 6 cm, the resultant electrical potential energy is equal to what factor multiplied by the initial electrical potential energy?
    a. 3 b. 9 c. $\frac{1}{3}$ d. $\frac{1}{9}$

Problem

25. Two point charges having charge values of 2.0 μC and –4.0 μC, respectively, are separated by 1.5 cm. What is the value of the mutual force between them? ($k_C = 8.99 \times 10^9$ N•m^2/C^2)
26. Two equal charges are separated by 3.7×10^{-10} m. The force between the charges has a magnitude of 2.37×10^{-3} N. What is the magnitude of q on the charges? ($k_C = 8.99 \times 10^9$ N•m^2/C^2)
27. Two point charges are 4.0 cm apart and have values of 30.0 μC and –30.0 μC, respectively. What is the electric field at the midpoint between the two charges? ($k_C = 8.99 \times 10^9$ N•m^2/C^2)
28. A 0.75 μF capacitor holds 6.0 μC of charge on each plate. How much potential energy is stored in the capacitor?
29. When an electron ($q = -1.6 \times 10^{-19}$ C) moves 0.10 m along the direction of an electric field with a strength of 3.0 N/C, what is the magnitude of the potential difference between the electron's initial and final points?