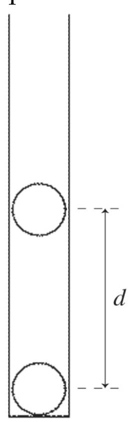
1) Electrically neutral objects cannot exert an electrical force on each other, but they can exert a gravitational force on each other.
A) True
B) False

2) A negatively–charged plastic rod is brought close to (but does not touch) a neutral metal sphere that is connected to ground. After waiting a few seconds, the ground connection is removed (without touching the sphere), and after that the rod is also removed. The sphere is now
A) positively charged.
B) negatively charged.
C) neutral.

3) Two tiny beads are 25 cm apart with no other charges or fields present. Bead A carries 10 μC of charge and bead B carries 1 μC. Which one of the following statements is true about the magnitudes of the electric forces on these beads?
A) The force on A is 100 times the force on B.
B) The force on A is 10 times the force on B.
C) The force on B is 100 times the force on A.
D) The force on B is 10 times the force on A.
E) The force on A is exactly equal to the force on B.

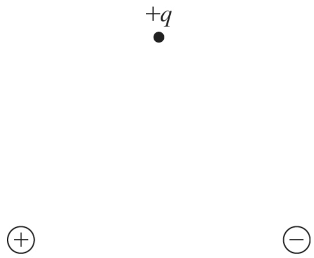
4) A small charged plastic ball is vertically above another charged small ball in a frictionless test tube as shown in the figure. The balls are in equilibrium a distance d apart. If the charge on each ball is doubled, the equilibrium distance between the balls in the test tube would become



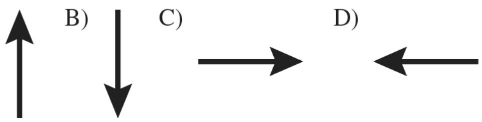
A) $8d$.
B) $4d$.
C) $\sqrt{2}\,d$.
D) $2d$.
E) $d/4$.

5) Two point charges, Q_1 and Q_2, are separated by a distance R. If the magnitudes of both charges are halved and their separation is also halved, what happens to the electrical force that each charge exerts on the other one?
A) It increases by a factor of 4.
B) It increases by a factor of 16.
C) It increases by a factor of 8.
D) It remains the same.
E) It increases by a factor of 2.

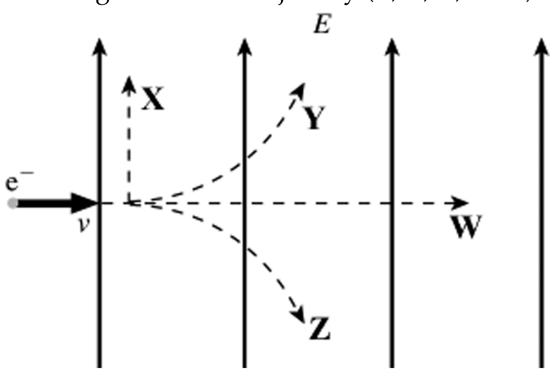
6) Two equal and opposite charges are a small distance apart, forming an electric dipole. A positive charge $+q$ is placed above these charges, as shown in the figure, equidistant from both of them. Which diagram below best gives the direction of the net force the dipole exerts on the charge $+q$?



A) B) C) D)



7) An electron is initially moving to the right when it enters a uniform electric field directed upwards, as shown in the figure. Which trajectory (**X**, **Y**, **Z**, or **W**) will the electron follow in the field?

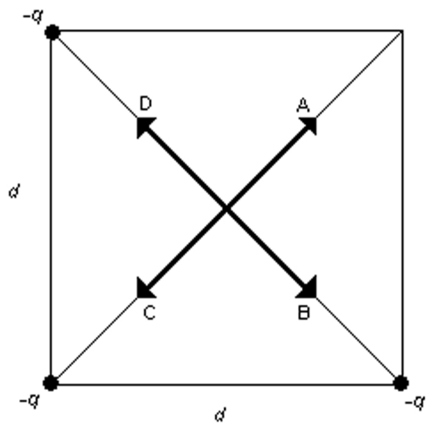


A) trajectory **W** B) trajectory **X** C) trajectory **Y** D) trajectory **Z**

8) The electric field at point P due to a point charge Q a distance R away from P has magnitude E. In order to double the magnitude of the field at P, you could

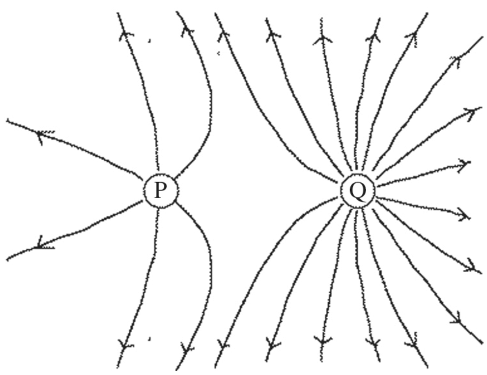
A) reduce the distance to $R/2$.
B) double the charge to $2Q$.
C) double the charge to $2Q$ and at the same time reduce the distance to $R/2$.
D) double the distance to $2R$.
E) reduce the distance to $R/4$.

9) Three equal negative point charges $-q$ are placed at three of the corners of a square of side d as shown in the figure. Which one of the arrows shown represents the direction of the net electric field at the center of the square?



A) A B) B C) C D) D

10) The figure shows electric field lines arising from two small charged particles P and Q. Consider the following two statements:
(i) The charge on P is smaller than the charge on Q.
(ii) The electrostatic force on P is smaller than the force on Q.
Which of the above statements are true?

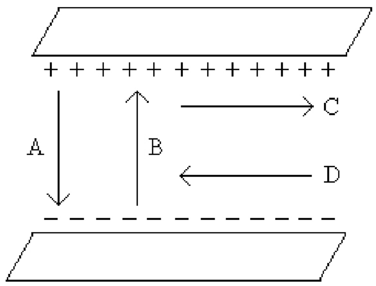


A) Only (i) is true.
B) Only (ii) is true.
C) Both (i) and (ii) are true.
D) Neither (i) nor (ii) is true.

11) A conductor is placed in a steady external electric field. Which of the following statements are correct for this situation? (There could be more than one correct choice.)
A) The surface of the conductor is neutral.
B) All the free electrons go to the surface of the conductor.
C) The electric field just outside the surface of the conductor is perpendicular to the surface.
D) The electric field is zero inside the conductor.
E) None of the above statements are correct.

12) A solid aluminum cube rests on a wooden table in a region where a uniform external electric field is directed straight upward. What can we say concerning the charge on the top surface of the cube?
A) The top surface is neutral.
B) The top surface is charged positively.
C) The top surface is charged negatively.
D) The top surface's charge cannot be determined without further information.

13) Which one of the arrows shown in the figure best represents the direction of the electric field between the two uniformly charged metal plates?



A) A B) B C) C D) D E) No choices

14) How many electrons are necessary to produce 1.0 C of negative charge? ($e = 1.60 \times 10^{-19}$ C)

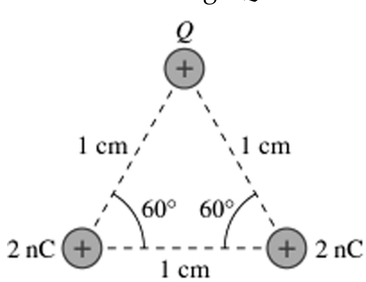
15) If a charge generator builds a negative static charge of $-7.00\ \mu C$, how many electrons are transferred to it during this process. ($e = 1.60 \times 10^{-19}$ C)

16) The force of attraction that a $-40.0\ \mu C$ point charge exerts on a $+108\ \mu C$ point charge has magnitude 4.00 N. How far apart are these two charges? ($k = 1/4\pi\varepsilon_0 = 8.99 \times 10^9\ N \cdot m^2/C^2$)

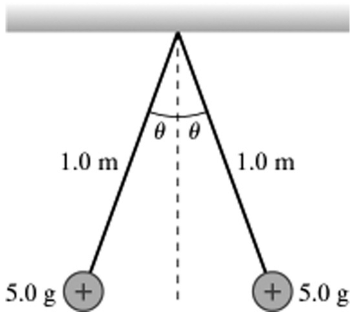
17) Two tiny beads, each of mass 3.2 g, carry equal–magnitude charges. When they are placed 6.4 cm apart and released in outer space, they begin to accelerate toward each other at 538 m/s^2. What is the magnitude of the charge on each bead? ($k = 1/4\pi\varepsilon_0 = 9.0 \times 10^9\ N \cdot m^2/C^2$)

18) The three point charges $+4.0\ \mu C$, $-5.0\ \mu C$, and $-9.0\ \mu C$ are placed on the x–axis at the points $x = 0$ cm, $x = 40$ cm, and $x = 120$ cm, respectively. What is the x component of the electrostatic force on the $-9.0\ \mu C$ charge due to the other two charges? ($k = 1/4\pi\varepsilon_0 = 9.0 \times 10^9\ N \cdot m^2/C^2$)

19) As shown in the figure, three charges are at the vertices of an equilateral triangle. The charge Q is 6.7 nC, and all the other quantities are accurate to two significant figures. What is the magnitude of the net electric force on the charge Q due to the other two charges? ($k = 1/4\pi\varepsilon_0 = 9.0 \times 10^9\ N \cdot m^2/C^2$)

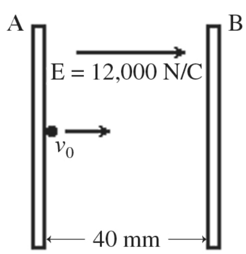


20) The figure shows two tiny 5.0-g spheres suspended from very light 1.0-m-long threads. The spheres repel each other after each one is given the same positive charge and hang at rest when $\theta = 4.1°$. What is the charge on each sphere? ($k = 1/4\pi\varepsilon_0 = 9.0 \times 10^9\ \mathrm{N \cdot m^2/C^2}$)



21) A small 0.050-kg insulating sphere carries a charge of −60 μC and is hanging by a vertical silk thread from a fixed point in the ceiling. An external uniform vertical electric field is now applied. If the applied electric field has a magnitude of 3000 N/C and is directed downward, what is the tension in the silk thread? ($k = 1/4\pi\varepsilon_0 = 9.0 \times 10^9\ \mathrm{N \cdot m^2/C^2}$)

22) A pair of charged conducting plates produces a uniform field of 12,000 N/C, directed to the right, between the plates. The separation of the plates is 40 mm. An electron is projected from plate A, directly toward plate B, with an initial speed of $v_0 = 2.0 \times 10^7$ m/s. What is the speed of the electron as it strikes plate B? ($e = 1.6 \times 10^{-19}$ C, $m_{\text{electron}} = 9.11 \times 10^{-31}$ kg)



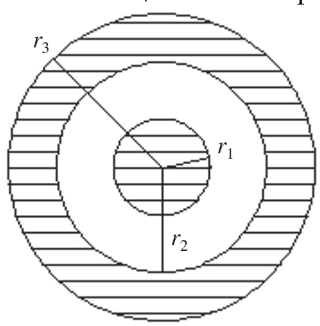
23) A particle with a charge of +4.0 μC has a mass of 5.0 g. What magnitude electric field directed upward will exactly balance the weight of the particle?

24) A thin spherical copper shell of radius 9.5 cm carries an excess charge of −4.2 nC. How many excess electrons are on (a) the outer surface of the shell, and (b) the inner surface? ($e = 1.60 \times 10^{-19}$ C)

25) A spherical conductor of radius 2.0 mm carries a charge of 7.1 nC. What is the magnitude of the electrical field at 6.0 mm from the center of the sphere? ($k = 1/4\pi\varepsilon_0 = 9.0 \times 10^9\ \mathrm{N \cdot m^2/C^2}$)

26) In the figure, a conducting sphere of radius $r_1 = 0.050$ m is placed at the center of a spherical conducting shell of inner radius $r_2 = 0.100$ m and outer radius $r_3 = 0.140$ m. The inner sphere carries an excess charge of –4.0 nC. The outer spherical shell carries a net excess charge of 3.0 nC. Calculate the magnitude of the electric field at the following distances r from the center of the spheres. ($k = 1/4\pi\varepsilon_0 = 9.0 \times 10^9 \text{ N} \cdot \text{m}^2/\text{C}^2$)

(a) $r = 0.075$ m (in the air space between spheres),
(b) $r = 0.120$ m (in the metal of the spherical shell), and
(c) $r = 0.200$ m (outside the spherical shell).



Answer Key
Testname: CH16_ELECTRIC_CHARGE

1) B
2) A
3) E
4) D
5) D
6) C
7) D
8) B
9) C
10) A
11) B, C, D
12) B
13) A
14) 6.3×10^{18}
15) 4.38×10^{13}
16) 3.12 m
17) 890 nC
18) 0.41 N
19) 2.1×10^{-3} N
20) 89 nC
21) 0.31 N
22) 1.5×10^{7} m/s
23) 1.2×10^{4} N/C
24) (a) 2.60×10^{10} electrons (b) zero
25) 1.8×10^{6} N/C
26) (a) 6.4×10^{3} N/C (b) 0 N/C (c) 2.2×10^{2} N/C