Cutnell/Johnson Physics

Classroom Response System Questions

Chapter 18 Electric Forces and Electric Fields

Interactive Lecture Questions

18.1.1. A brass key has a net positive charge of $+1.92 \times 10^{-16}$ C. Approximately, how many electrons must be added to the key to make it electrically neutral?

a) 770

b) 960

c) 1200

d) 1800

e) 2100

18.1.2. Can an object carry a charge of 2.4×10^{-19} C?

a) Yes, if the object is a conductor.

b) Yes, if the object has electrons or protons.

c) Yes, if the object is an insulator.

d) No, because objects do not have charge.

e) No, because charge is quantized.

18.1.3. The smallest charge on a single particle has been measured to be 1.60×10^{-19} C. What can we conclude from the fact that no smaller charges have been measured but multiples of this charge have been measured?

a) Charge is quantized.

b) Electrons are conserved.

c) Charge is conserved.

d) Electrons have the smallest unit of charge.

e) Charge is the same as mass.

18.2.1. Complete the following statement: When a glass rod is rubbed with silk cloth, the rod becomes positively charged as

a) negative charges are transferred from the rod to the silk.

b) negative charges are transferred from the silk to the rod.

c) positive charges are created on the surface of the rod.

d) positive charges are transferred from the silk to the rod.

e) positive charges are transferred from the rod to the silk.

18.2.2. Glass is a very good electrical insulator. How is then possible that a glass rod can be charged by rubbing it with cloth?

a) When the rod is rubbed, it becomes an electrical conductor.

b) Although the rod is an insulator, any excess charge will slowly be conducted away.

c) When the rod is rubbed, the part of the rod that is in contact with the cloth becomes electrically conductive.

d) Because the rod is an insulator, any charge that is transferred to the surface of the rod has difficulty moving.

e) None of the above answers are correct.

18.4.1. An initially electrically neutral conducting sphere is placed on an insulating stand. A negatively-charged glass rod is brought near, but does not touch the sphere. Without moving the rod, a wire is then attached to the sphere that connects it to earth ground. The rod and wire are then removed simultaneously. What is the final charge on the sphere?

a) negative

b) positive

c) neutral

d) It has a fifty percent chance of having a positive charge and a fifty percent chance of having a negative charge.

18.4.2. An initially electrically neutral conducting sphere is placed on an insulating stand. A positively-charged glass rod is brought near, but does not touch the sphere. Without moving the rod, a wire is then attached to the sphere that connects it to earth ground. The rod and wire are then removed simultaneously. The sphere is subsequently found to have a negative charge. From the outcome and results of this experiment, what can we conclude about the charging process?

a) Positive charges move freely from the sphere to the ground.

b) Negative charges move freely from the ground to the sphere.

c) Both positive charges and negative charges are moving freely.

d) More experimentation needs to be done before the sign of moving charges can be determined.

18.4.3. Three identical conducting spheres on individual insulating stands are initially electrically neutral. The three spheres are arranged so that they are in a line and touching as shown. A negatively-charged conducting rod is brought into contact with sphere A. Subsequently, someone takes sphere C away. Then, someone takes sphere B away. Finally, the rod is taken away. What is the sign of the final charge, if any, of the three spheres?

	A	B	C
a)	+	+	−
b)	+	−	+
c)	+	0	−
d)	−	+	0
e)	−	−	−
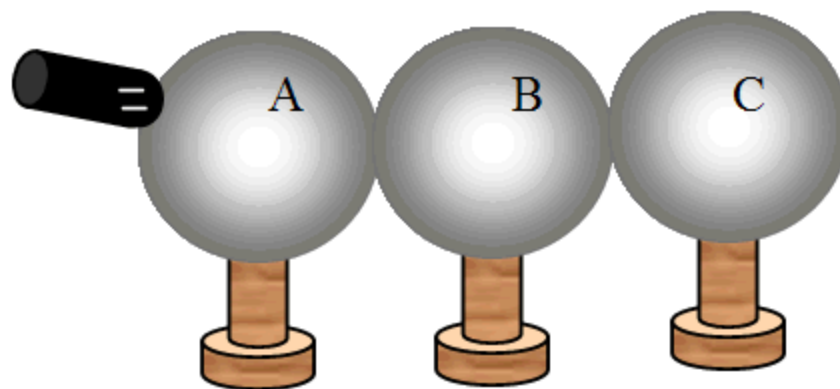
18.4.4. Consider the conducting spheres labeled A, B, and C shown in the drawing. The spheres are initially charged as shown on the left, then wires are connected and disconnected in a sequence shown moving toward the right. What is the final charge on sphere A at the end of the sequence?
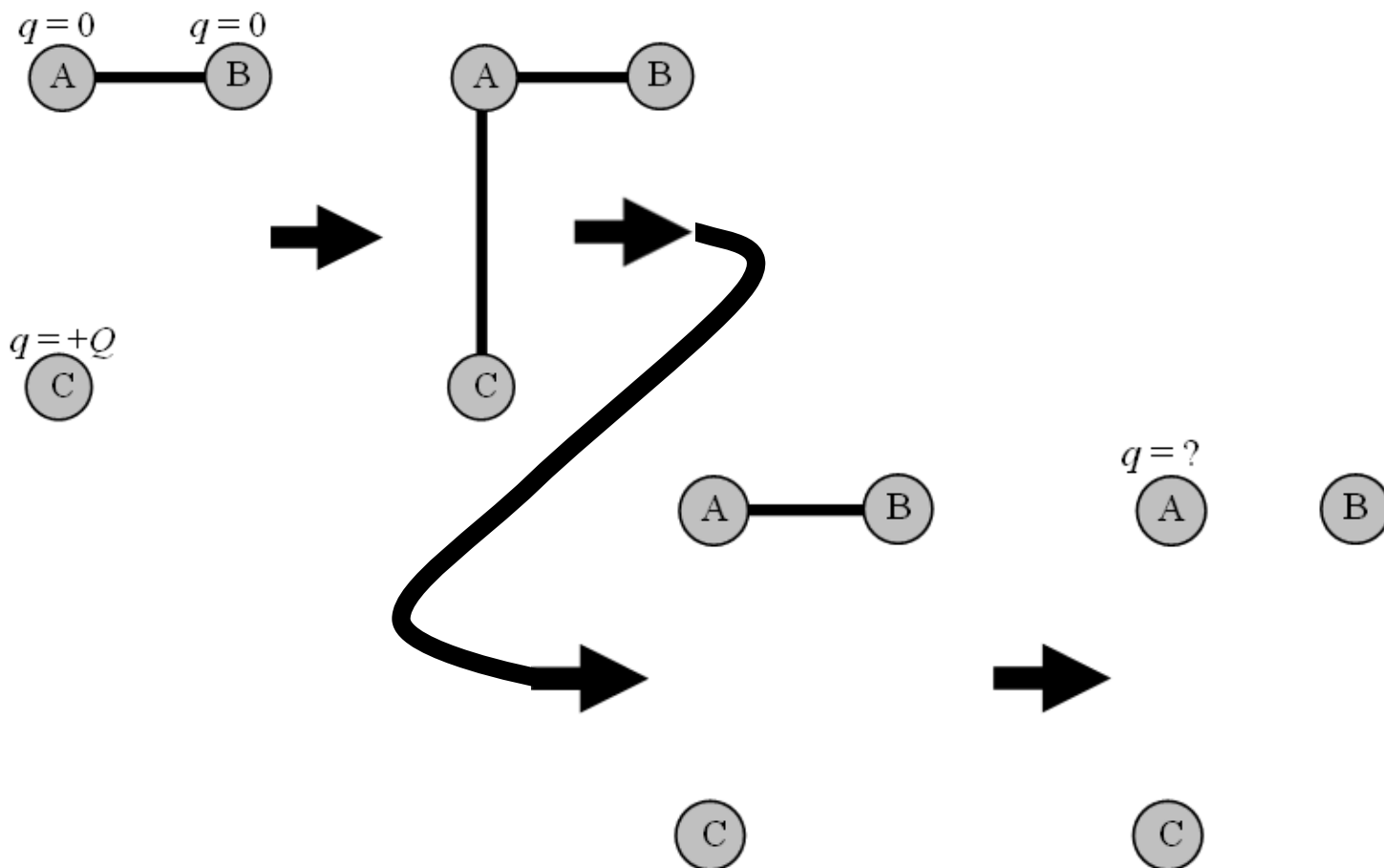
a) $+Q$

b) $+ Q/2$

c) $+ Q/3$

d) $+ Q/4$

e) $+ Q/8$

$q=0$ $q=0$

A —— B

$q=+Q$
C

A —— B
|
C

$q=+Q$
C

A —— B

C

$q=?$
A   B

C

18.4.5. Consider the conducting spheres labeled A, B, and C shown in the drawing. The spheres are initially charged as shown on the left, then wires are connected and disconnected in a sequence shown moving toward the right. What is the final charge on sphere C at the end of the sequence?

a) $+Q$

b) $+Q/2$

c) $+Q/3$

d) $+2Q$

e) $+3Q$

$q=+2Q$ $q=0$

A   B

$q=+Q$

C

A ——— B

C

A   B

C

A   B

C

A   B

A   B

$q=?$

C
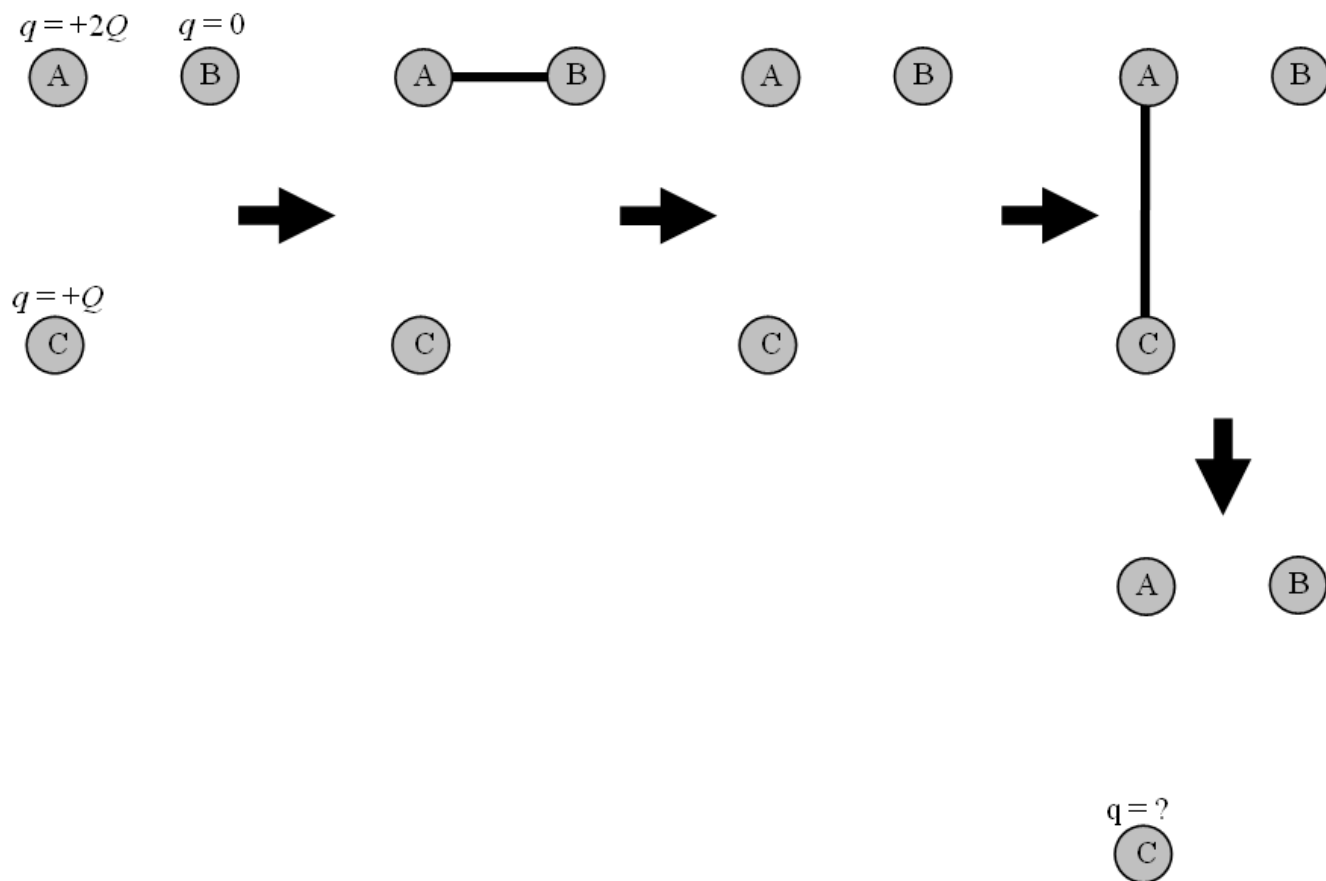
18.5.1. Three insulating balls are hung from a wooden rod using thread. The three balls are then individually charged via induction. Subsequently, balls A and B are observed to attract each other, while ball C is repelled by ball B. Which one of the following statements concerning this situation is correct?

a) A and B are charged with charges of opposite signs; and C is charged with charge that has the same sign as B.

b) A and B are charged with charges of the same sign; and C is electrically neutral.

c) A is electrically neutral; and C is charged with charge that has the same sign as B.

d) B is electrically neutral; and C is charged with charge that has the same sign as A.

e) … Choices a and c are both possible configurations.
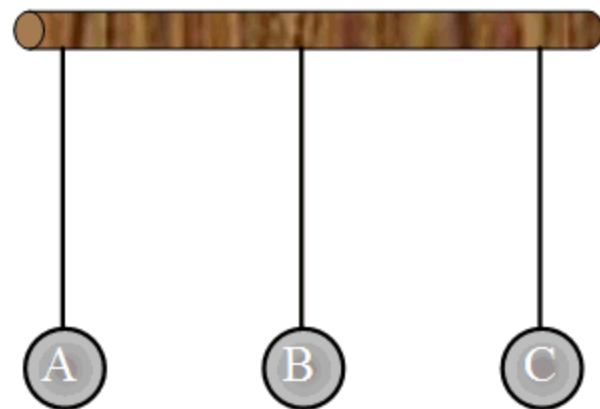
18.5.2. Two objects separated by a distance r are each carrying a charge $-q$. The magnitude of the force exerted on the second object by the first is F. If the first object is removed and replaced with an identical object that carries a charge $+4q$, what is the magnitude of the electric force on the second object?

a) $4F$

b) $2F$

c) F

d) $F/2$

e) $F/4$

18.5.3. Two objects, **A** with charge $+Q$ and **B** with charge $+4Q$, are separated by a distance r. The magnitude of the force exerted on the second object by the first is F. If the first object is moved to a distance $2r$ from the second object, what is the magnitude of the electric force on the second object?
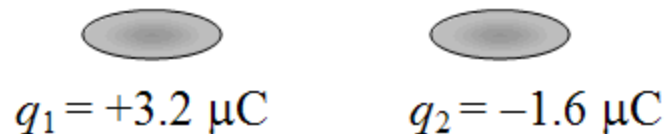
a) zero newtons

b) $2F$

c) F

d) $F/2$

e) $F/4$

18.5.4. Consider the two charges shown in the drawing. Which of the following statements correctly describes the direction of the electric force acting on the two charges?

$q_1 = +3.2 \ \mu C$ $q_2 = -1.6 \ \mu C$

a) The force on q_1 points to the left and the force on q_2 points to the left.

b) The force on q_1 points to the right and the force on q_2 points to the left.

c) The force on q_1 points to the left and the force on q_2 points to the right.

d) The force on q_1 points to the right and the force on q_2 points to the right.

18.5.5. Consider the two charges shown in the drawing. Which of the following statements correctly describes the magnitude of the electric force acting on the two charges?

$q_1 = +3.2 \ \mu C$ $q_2 = -1.6 \ \mu C$
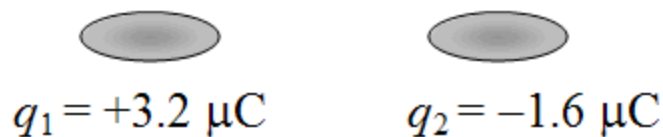
a) The force on q_1 has a magnitude that is twice that of the force on q_2.

b) The force on q_2 has a magnitude that is twice that of the force on q_1.

c) The force on q_1 has the same magnitude as that of the force on q_2.

d) The force on q_2 has a magnitude that is four times that of the force on q_1.

e) The force on q_1 has a magnitude that is four times that of the force on q_2.

18.5.6. Two point charges are stationary and separated by a distance R. Which one of the following pairs of charges would result in the largest repulsive force?

a) $-2q$ and $+4q$

b) $-3q$ and $-2q$

c) $+3q$ and $-2q$

d) $+2q$ and $+4q$

e) $-3q$ and $-q$

18.5.7. A charged particle is located at the center of a uniformly charged hollow sphere. What is the net electrostatic force on the charged particle?

a) The net electrostatic force on the particle will be zero newtons because all of the charges on the sphere are either repelled or attracted to the particle, so they exert no force on it.

b) The net electrostatic force on the particle will be zero newtons because the vector sum of all of the forces on it due to the charges on the sphere is zero, so they exert no net force on it.

c) The net electrostatic force on the particle will be the least at the center, but its magnitude will be greater than zero newtons.

d) The net electrostatic force on the particle will be positive if the particle and sphere have opposite signs and negative if they have the same sign.

e) The net electrostatic force on the particle will be negative if the particle and sphere have opposite signs and positive if they have the same sign.

18.5.8. A charged particle is located at a distance $R/2$ from the center of a uniformly charged hollow sphere of radius R. What is the net electrostatic force on the charged particle?

a) The net electrostatic force on the particle will be zero newtons because the vector sum of all of the forces on it due to the charges on the sphere is zero, so they exert no net force on it.

b) The net electrostatic force on the particle will be larger than that which would be exerted if the particle was at the center of the sphere.

c) The net electrostatic force on the particle will be smaller than that which would be exerted if the particle was at the center of the sphere.

d) The net electrostatic force on the particle will be positive if the particle and sphere have opposite signs and negative if they have the same sign.

e) The net electrostatic force on the particle will be negative if the particle and sphere have opposite signs and positive if they have the same sign.

18.5.9. Three plates may be charged positively or negatively or be electrically neutral. In the drawing shown, plate A is attracted by both plates B and C. What occurs if plates B and C are brought close together?
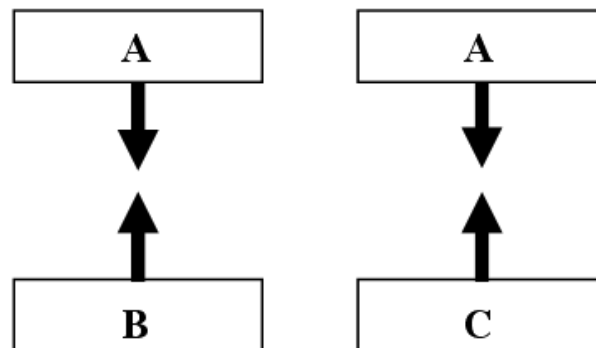

a) B and C would be attracted to one another.

b) B and C would be repelled by one another.

c) B and C would exert no force on each other.

d) There is too little information given to make a conclusion.

18.5.10. Three plates may be charged positively or negatively or be electrically neutral. In the drawing shown, plate A is repelled by both plates B and C. What occurs if plates B and C are brought close together?
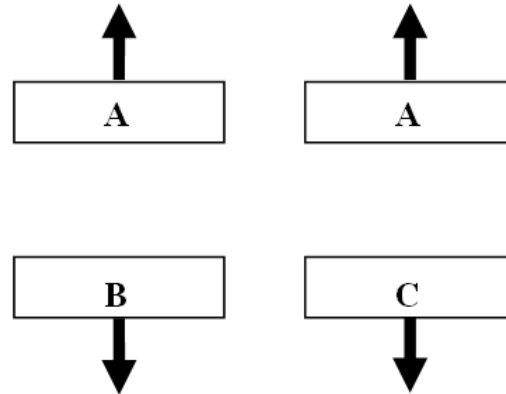
a) B and C would be attracted to one another.

b) B and C would be repelled by one another.

c) B and C would exert no force on each other.

d) There is too little information given to make a conclusion.

18.5.11. As shown in the drawing, a positively charged particle remains stationary between particles A and B. The positively charged particle is one-quarter the distance between the two other particles, as shown. What can be concluded from the situation?
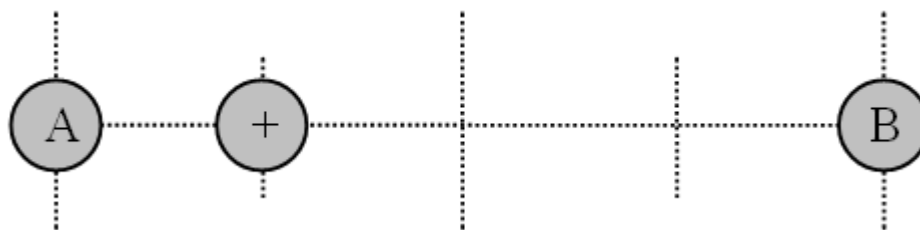
a) The charge on A must be four times as large as the charge on B.

b) The charge on A must be sixteen times as large as the charge on B.

c) The charge on A must be one-half as large as the charge on B.

d) The charge on A must be one-fourth as large as the charge on B.

e) The charge on A must be one-sixteenth as large as the charge on B.

18.5.12. Two particles are separated by a distance d. Particle A has a charge $+Q$ and particle B has a charge $+3Q$. At what distance from particle A along the line connecting particles A and B would you place a third charged particle such that no net electrostatic force acts on it?

a) $d/3$

b) $d/2$

c) $d/4$

d) $d/6$

e) $d/9$

18.6.1. A positively-charged object is released from rest in a region containing a uniform electric field. Which one of the following statements concerning the subsequent motion of the object is correct?

a) The object will remain motionless.

b) The object will accelerate to some constant speed and move in the direction of the electric field.

c) The object will accelerate to some constant speed and move in the direction opposite that of the electric field.

d) The object will experience a constant acceleration and move in the direction of the electric field.

e) The object will experience a constant acceleration and move in the direction opposite that of the electric field.

18.6.2. Two negatively-charged objects are located on the x axis, equally distant from the origin as shown. Consider the electric field at the point P_1. How will that electric field change if a third object with a charge $+q$ is placed at point P_2? Note: the point P_2 is the same distance from the origin as the point P_1 and the magnitude of each of the charges is the same.
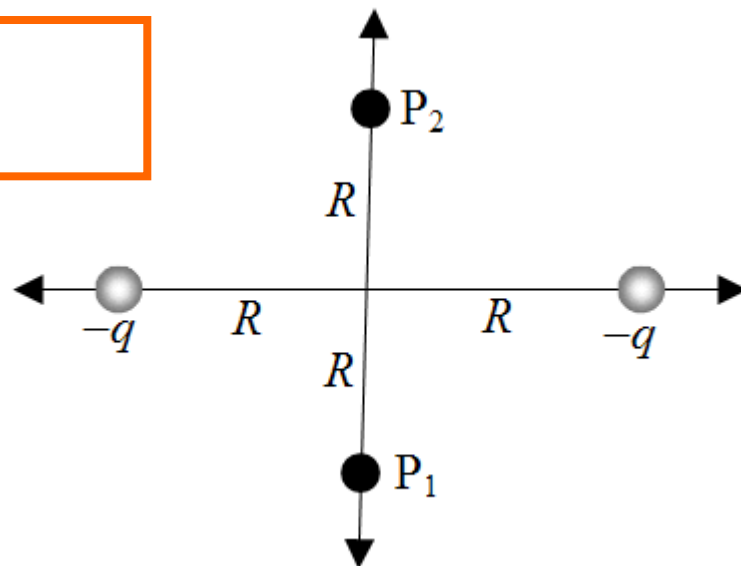
a) The magnitude of the electric field will decrease by 25%.

b) The magnitude of the electric field will increase by 25%.

c) The magnitude of the electric field will decrease by 50%.

d) The magnitude of the electric field will increase by 50%.

e) The magnitude of the electric field will increase by 100%.

18.6.3. At a distance of one centimeter from an electron, the electric field strength has a value E. At what distance is the electric field strength equal to $E/2$?
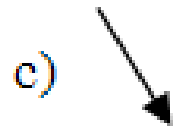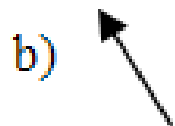
a) 0.5 cm

b) 1.4 cm

c) 2.0 cm

d) 3.2 cm

e) 4.0 cm

18.7.1. Consider the drawing, where the solid lines with arrows represent the electric field due to the charged object. An electron is placed at the point P and released at rest. Which of the following vectors represents the direction of the force, if any, on the electron?

a) The electric force will be zero newtons.

b)

c)

d)

e)
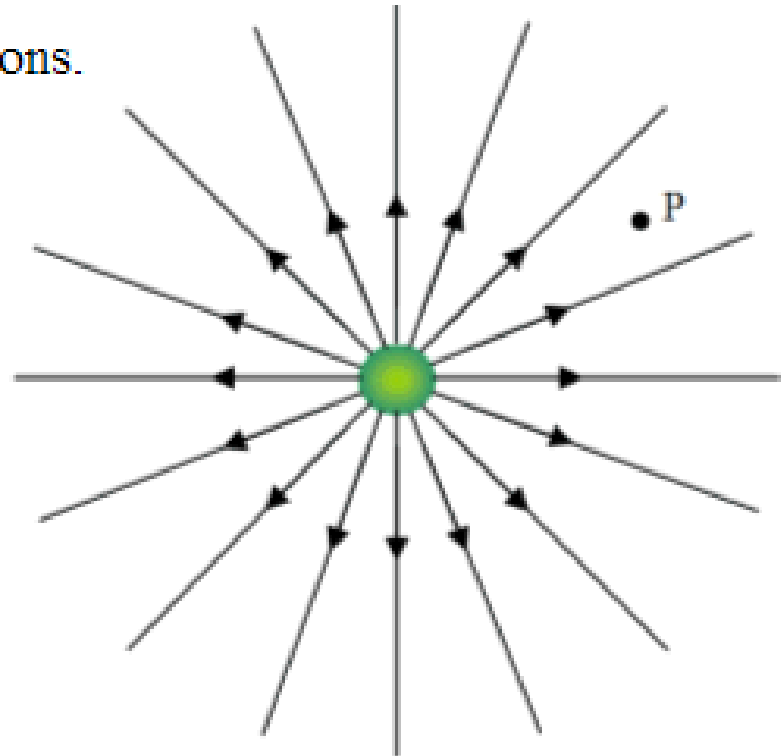
18.7.2. The plates of a parallel plate capacitor are connected to a battery. Each plate has an area A. One plate has a net charge of $+q$. What is the magnitude of the electric field outside the capacitor? Note: ignore end effects at the edges of the capacitor.

a) $\dfrac{q\varepsilon_0}{A}$

b) $\dfrac{q}{A\varepsilon_0}$

c) $\varepsilon_0 A q$

d) q

e) zero N/C

18.7.3. An electron traveling horizontally to the right enters a region where a uniform electric field is directed downward. What is the direction of the force exerted on the electron once it has entered the field?

a) upward

b) downward

c) to the right

d) to the left

e) The force is zero newtons.

18.7.4. Consider the electric field lines shown in the drawing. Which of the
following statements correctly describes this situation?

a) The electric field is due to a
positively charged particle.

b) The electric field is due to a
negatively charged particle.

c) The electric field is due to a
positively charged particle and
a negatively charged particle.

d) The electric field is due to
particles that are both charged
either positively or negatively.
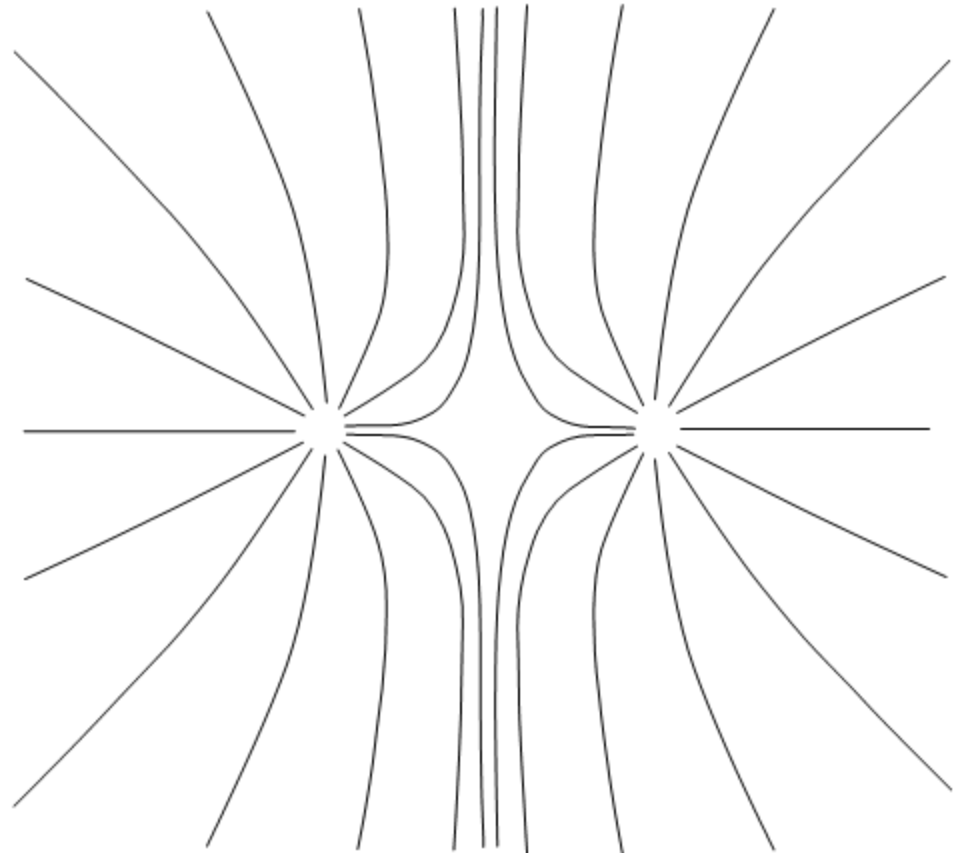
18.7.5. Consider the electric field lines shown in the drawing. Which of the following statements correctly describes this situation?

a) A and B are both positively charged particles.

b) A and B are both negatively charged particles.

c) A is a positively charged particle and B is a negatively charged particle.

d) B is a positively charged particle and A is a negatively charged particle.
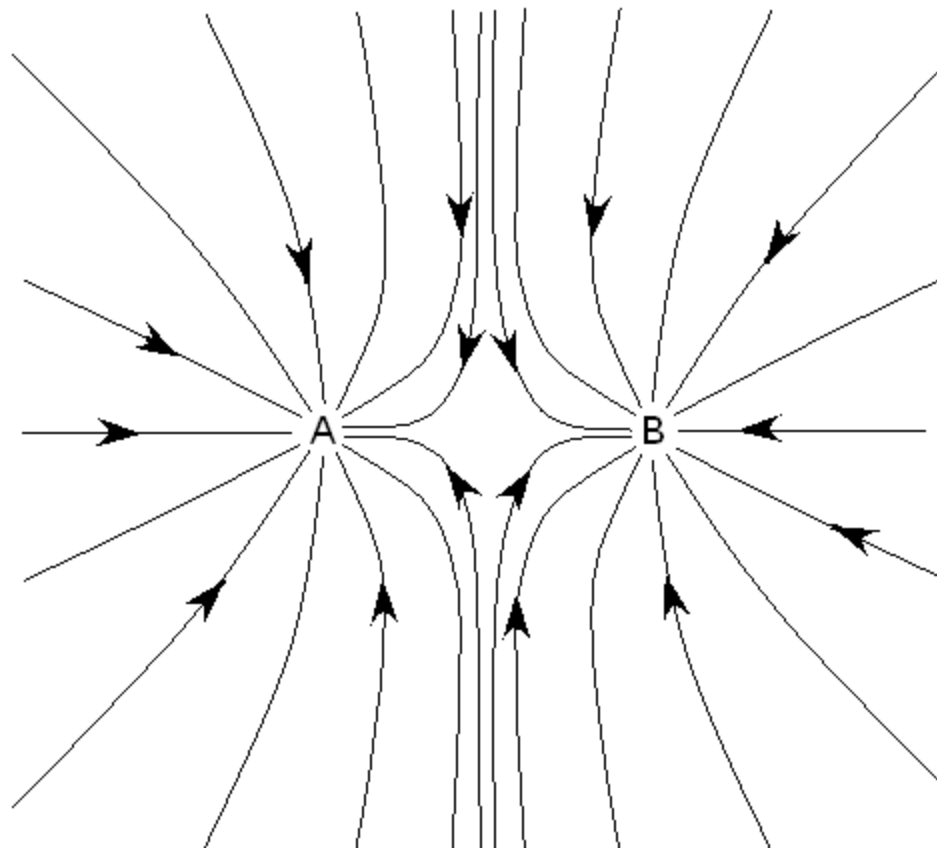
18.7.6. Four charges are located on the corners of a square as shown in the drawing. What is the direction of the net electric field at the point labeled P?

a) toward the upper left corner of the square

b) toward the middle of the right side of the square

c) toward the middle of the bottom side of the square

d) toward the lower right corner of the square
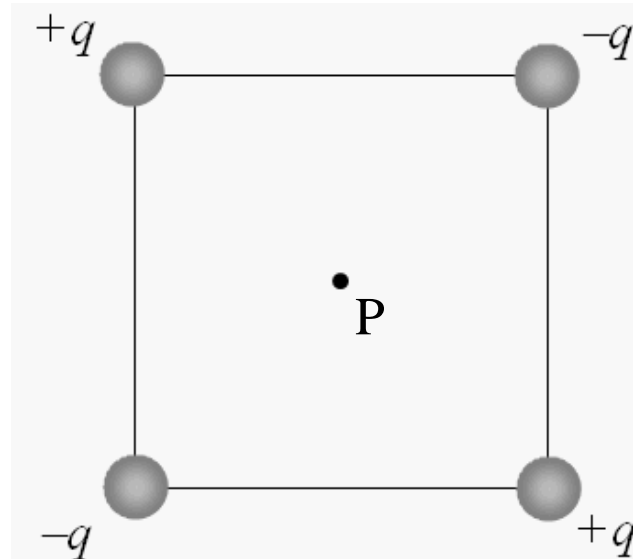
e) There is no direction. The electric field at P is zero N/C.

18.7.7. Four charges are located on the corners of a square as shown in the drawing. What is the direction of the net electric field at the point labeled P?

a) toward the upper left corner of the square

b) toward the middle of the right side of the square

c) toward the middle of the bottom side of the square

d) toward the lower right corner of the square

e) There is no direction. The electric field at P is zero N/C.
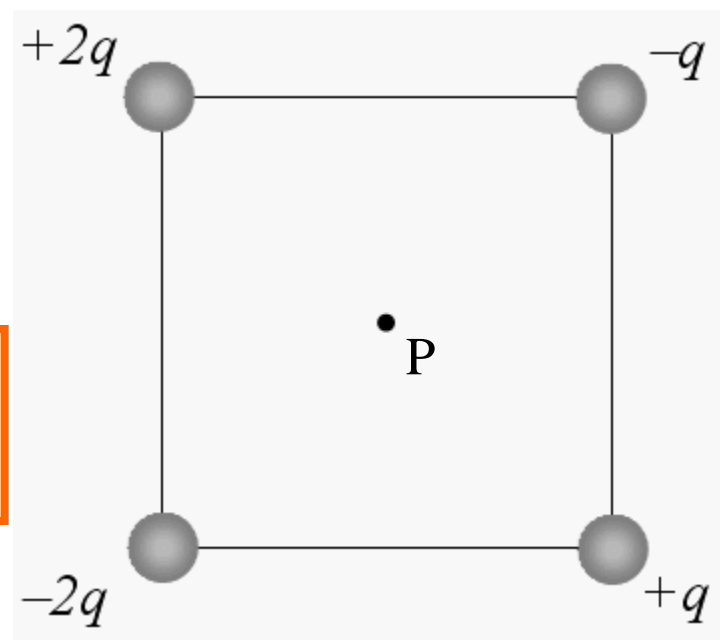
18.7.8. A positively charged object is located to the left of a negatively charged object as shown. Electric field lines are shown connecting the two objects. The five points on the electric field lines are labeled A, B, C, D, and E. At which one of these points would a test charge experience the largest force?
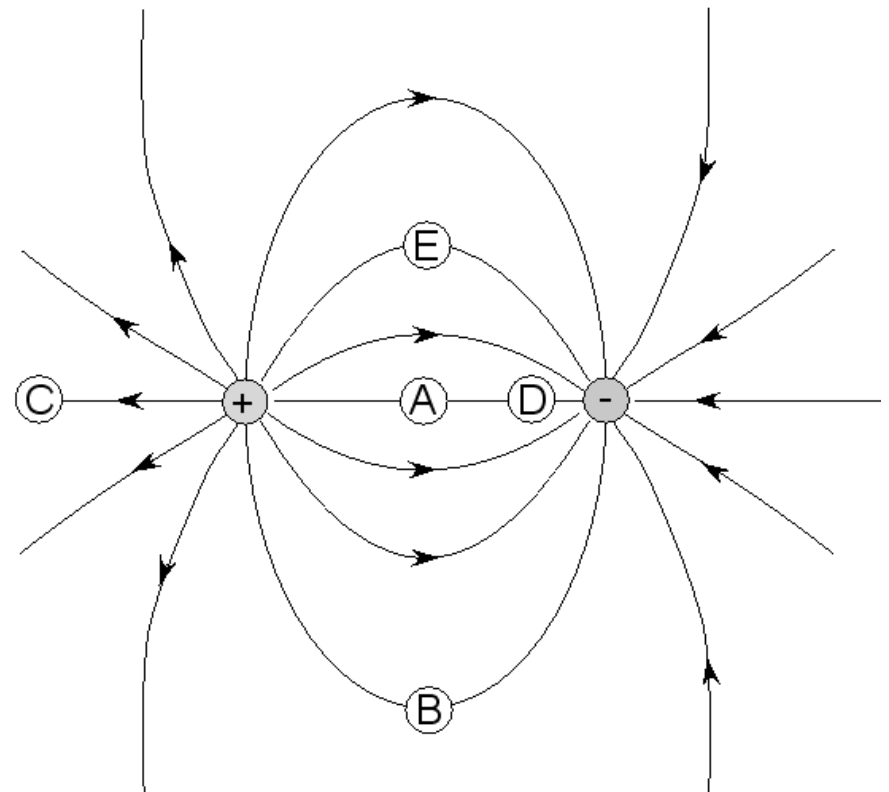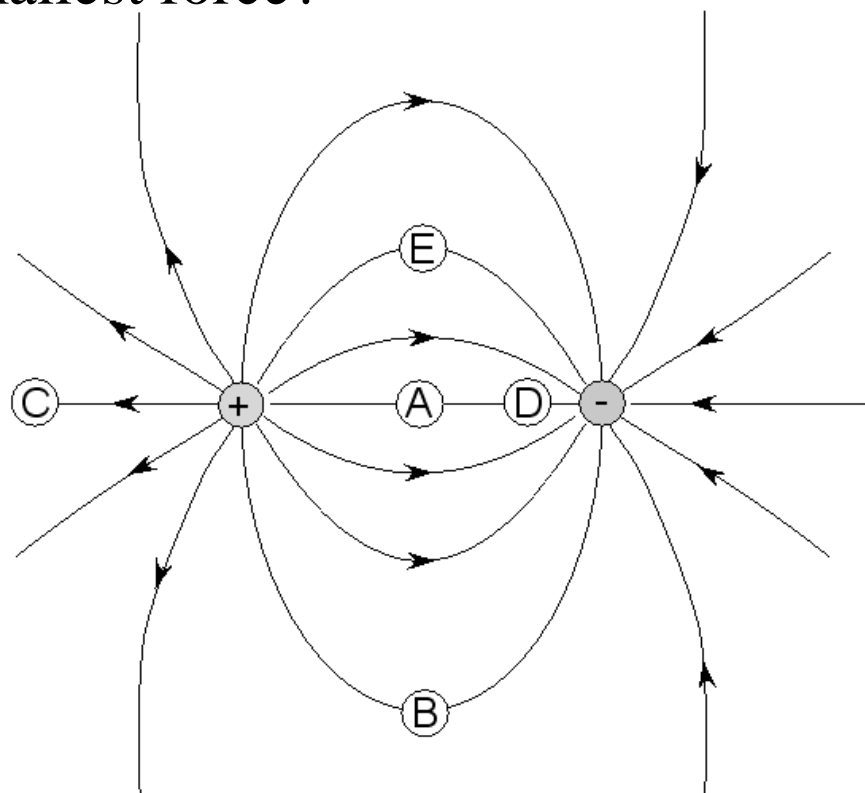
a) A

b) B

c) C

d) D

e) E

18.7.9. A positively charged object is located to the left of a negatively charged object as shown. Electric field lines are shown connecting the two objects. The five points on the electric field lines are labeled A, B, C, D, and E. At which one of these points would a test charge experience the smallest force?

a) A

b) B

c) C

d) D

e) E

18.7.10. A positively charged object is located to the left of a negatively charged object as shown. Electric field lines are shown connecting the two objects. The five points on the electric field lines are labeled A, B, C, D, and E. At which one of these points would a test charge experience the largest force?
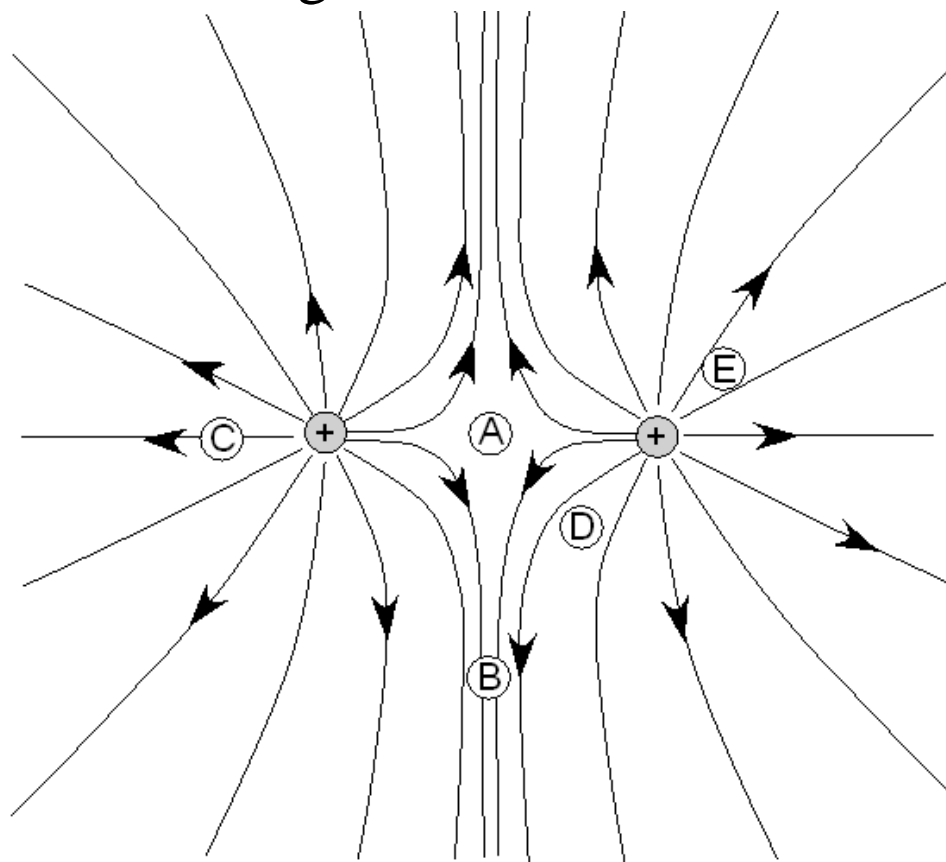
a) A

b) B

c) C

d) D

e) E

18.7.11. A positively charged object is located to the left of a negatively charged object as shown. Electric field lines are shown connecting the two objects. The five points on the electric field lines are labeled A, B, C, D, and E. At which one of these points would a test charge experience the smallest force?
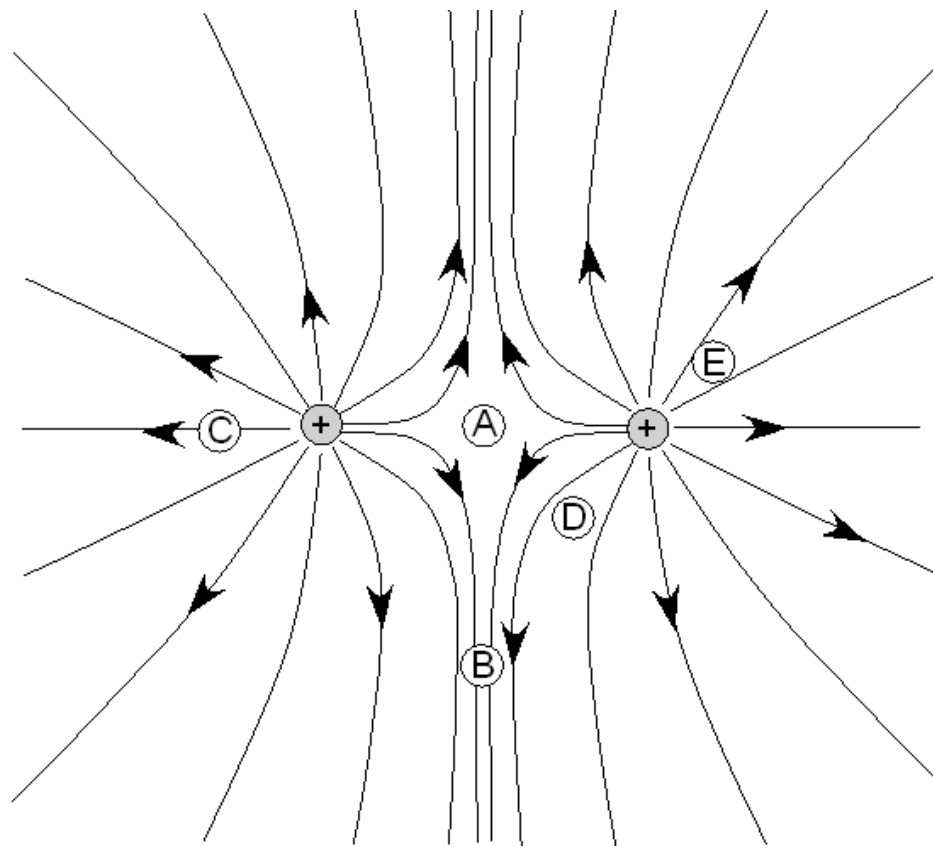
a) A

b) B

c) C

d) D

e) E

18.8.1. The drawing shows a hollow conducting sphere with a net positive charge uniformly distributed over its surface. A small negatively-charged object has been brought near the sphere as shown. What is the direction of the electric field at the center of the sphere?
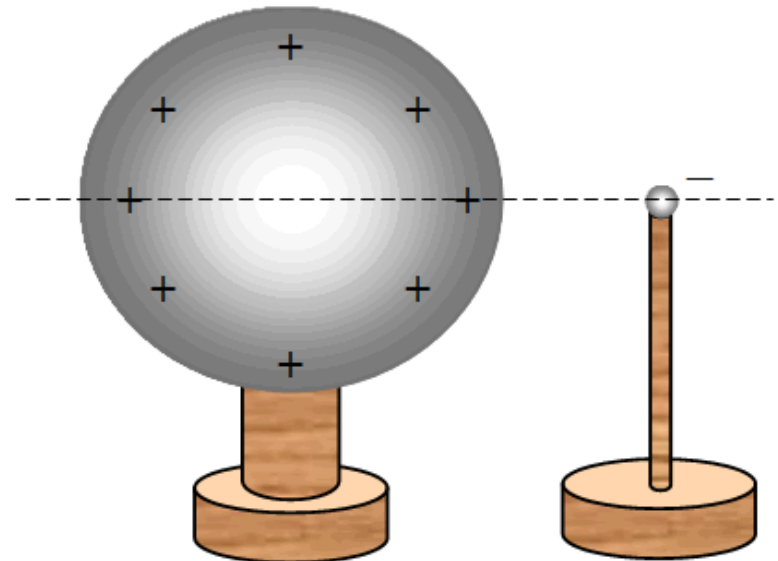
a) There is no electric field at the center of the sphere.

b) to the left

c) to the right

d) upward

e) downward

18.9.1. Gauss' law may be written: $\Phi_E = \sum (E\cos\phi)\Delta A = \dfrac{q}{\varepsilon_0}$.
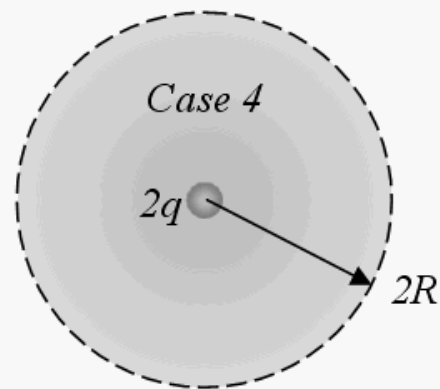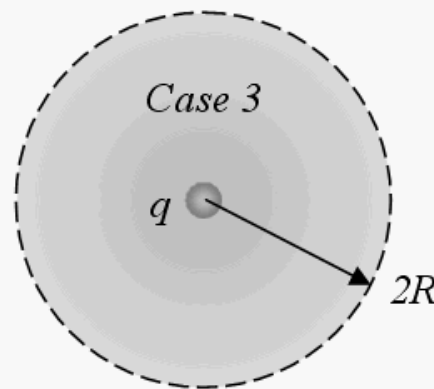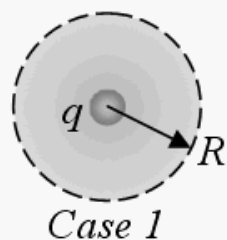
Which of the following statements concerning the charge q is true?

a) The charge q is the sum of all charges present.

b) The charge q is the sum of all charges on the Gaussian surface.

c) The charge q is the sum of all charges inside the Gaussian surface.

d) The electric field due to q is zero inside the Gaussian surface.

18.9.2. When you calculate the electric flux through a Gaussian surface, of what are you determining the flow through the surface?

a) charge

b) electric current

c) electric energy

d) electric force

e) None of the above answers are correct.

18.9.3. Consider the five situations shown. Each one contains either a charge q or a charge $2q$. A Gaussian surface surrounds the charged particle in each case. Considering the electric flux through each of the Gaussian surfaces, which of the following comparative statements is correct?

Case 1 — q, R
Case 2 — $2q$, R
Case 3 — q, $2R$
Case 4 — $2q$, $2R$

a) $\Phi_2 = \Phi_4 > \Phi_1 = \Phi_3$

b) $\Phi_1 = \Phi_3 > \Phi_2 = \Phi_4$

c) $\Phi_2 > \Phi_1 > \Phi_4 > \Phi_3$

d) $\Phi_3 = \Phi_4 > \Phi_2 = \Phi_1$

e) $\Phi_4 > \Phi_3 > \Phi_2 > \Phi_1$

18.9.4. When a particle with a charge Q is surrounded by a spherical Gaussian surface, the electric flux through the surface is Φ_S. Consider what would happen if the particle was surrounded by a cylindrical Gaussian surface or a Gaussian cube. How would the fluxes through the cylindrical Φ_{Cyl} and cubic Φ_{Cubic} surfaces compare to Φ_S?

a) $\Phi_S = \Phi_{Cubic} > \Phi_{Cyl}$

b) $\Phi_S > \Phi_{Cyl} = \Phi_{Cubic}$

c) $\Phi_S = \Phi_{Cyl} = \Phi_{Cubic}$

d) $\Phi_S < \Phi_{Cubic} < \Phi_{Cyl}$

e) $\Phi_S > \Phi_{Cubic} > \Phi_{Cyl}$

18.9.5. A spherical Gaussian surface of radius R is surrounding a particle with a net charge q. If the spherical Gaussian surface is replaced by a cube, under what conditions would the electric flux through the sides of the cube be the same as through the spherical surface?

a) under all conditions

b) if the sides of the cube are of length R

c) if the sides of the cube are of length $2R$

d) if the diagonals of the cube are of length $2R$

e) under no conditions