Section: 21–1 Topic: Charge Type: Factual

1. Electric charges of the same sign
   A) also have the same magnitude.
   B) attract each other.
   C) repel each other.
   D) exert no forces on each other.
   E) None of these is correct.
   Ans: C

Section: 21–1 Topic: Charge Type: Factual

2. Electric charges of the opposite sign
   A) also have the same magnitude.
   B) attract each other.
   C) exert no forces on each other.
   D) repel each other.
   E) None of these is correct.
   Ans: B

Section: 21–1 Topic: Charge Type: Factual

3. Electrons
   A) are about 2000 times more massive than protons.
   B) are about 2000 times less massive than protons.
   C) have 2000 times the charge of protons.
   D) have 1/2000 the charge of protons.
   E) can have any amount of charge.
   Ans: B

Section: 21–1 Topic: Charge Type: Factual

4. Protons
   A) are about 2000 times more massive than electrons.
   B) are about 2000 times less massive than electrons.
   C) have 2000 times the charge of electrons.
   D) have 1/2000 the charge of electrons.
   E) can have any amount of charge.
   Ans: A

Section: 21–1 Topic: Charge Type: Factual

5. Experimental evidence indicates that
   A) charge is quantized and conserved.
   B) charge is quantized but not conserved.
   C) charge is conserved but not quantized.
   D) charge is neither quantized nor conserved.
   E) None of these answers is correct.
   Ans: A

Section: 21–1 Topic: Charge Type: Factual

6. An electron (q = +e) and a positron (q = +e) can combine to give off two gamma rays. The net change in the algebraic sum of the charges is
   A) +2e B) zero C) −2e D) +e E) −e
   Ans: B

Section: 21–1 Topic: Charge Type: Numerical

7. How many electrons must be transferred to a body to produce a charge of 125 nC?
   A) 1.25×10^{-7}
   B) 1.60×10^{-19}
   C) 1.28×10^{12}
   D) 3.45×10^{11}
   E) 7.81×10^{11}
   Ans: E

Section: 21–1 Topic: Charge Type: Numerical

8. If an object is determined to have a negative charge of 160 nC, you can conclude that the object has an excess of
   A) 10^{9} electrons
   B) 10^{10} electrons
   C) 10^{11} electrons
   D) 10^{12} electrons
   E) 10^{13} electrons
   Ans: D

Section: 21–1 Topic: Charge Type: Numerical

9. A particular nucleus of the element erbium contains 68 protons and 90 neutrons. What is the total number of electrons in the neutral erbium atom?
   A) 90 B) 158 C) 22 D) 68 E) None of the above
   Ans: D

Section: 21–1 Topic: Charge Type: Numerical

10. A particular nucleus of the element erbium contains 68 protons and 90 neutrons. What is the total charge of the erbium nucleus?
    A) zero
    B) 1.4×10^{-17} C
    C) 2.5×10^{-17} C
    D) 1.1×10^{-17} C
    E) 3.5×10^{-18} C
    Ans: D

Section: 21–2 Topic: Conductors and Insulators Type: Conceptual

11. Which of the following statements about conductors and insulators is NOT correct?
    A) Charges can move freely in conductors.
    B) Charges can move freely in insulators.
    C) In conductors, one or more of the outer electrons from an atom is no longer bounded to the atom.
    D) In insulators, all the electrons from an atom are bounded to the atom.
    E) Charges in both conductors and insulators can become polarized, i.e., one end has charges of one sign and the other end has charges of opposite sign.
    Ans: B

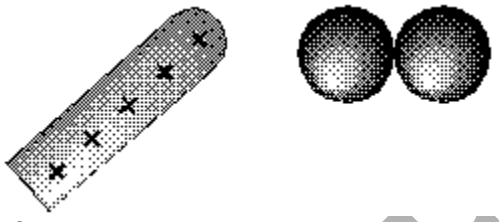
Section: 21–2 Topic: Conductors and Insulators Type: Conceptual

12. Two small spheres attract one another electrostatically. This can occur for a variety of reasons. Which of the following statements must be true?
    A) at least one sphere is charged
    B) neither is charged
    C) both are charged
    D) both have the same charge
    E) None of these is correct.
    Ans: A

Section: 21–2 Topic: Conductors and Insulators Type: Conceptual

13. Two small spheres repel one another electrostatically. Which of the following statements must be true?
    A) both have the same charge
    B) neither is charged
    C) both are charged
    D) at least one sphere is charged
    E) they are oppositely charged
    Ans: A

Section: 21–2 Topic: Conductors and Insulators Type: Conceptual

14. 

    If you bring a positively charged insulator near two uncharged metallic spheres that are in contact and then separate the spheres, the sphere on the right will have
    A) no net charge.
    B) a positive charge.
    C) a negative charge.
    D) either a positive or negative charge.
    E) None of these is correct.
    Ans: B

Section: 21–2 Topic: Conductors and Insulators Type: Conceptual

15.

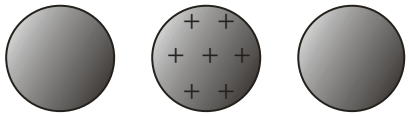
If you bring a negatively charged insulator near two uncharged metallic spheres that are in contact and then separate the spheres, the sphere on the right will have

A) no net charge.
B) a positive charge.
C) a negative charge.
D) either a positive or negative charge.
E) None of these is correct.

Ans: C

Section: 21–2 Topic: Conductors and Insulators Type: Conceptual

16.



A uniformly positively charged spherical conductor is placed midway between two identical uncharged conducting spheres. How would the charges in the middle sphere be distributed?

A) The positive charges stay uniformly distributed on the surface of the middle sphere.
B) There are more positive charges near the top and bottom of the sphere compared to the sides next to the two other spheres.
C) There are more positive charges near the sides of the spheres that are next to the other two spheres compared to the other regions of the sphere.
D) There are more positive charges near the front and back of the sphere compared to the sides next to the two other spheres.
E) None of these is correct.

Ans: C

Section: 21–3 Topic: Coulomb's Law Type: Numerical

17. A positive charge of 63.0 nC is 15.0 cm from a negative charge of 45.0 nC. The force on one of the charges due to the other is approximately

A) 1.13×10^{-3} N
B) 1.13×10^{-7} N
C) 1.02×10^{7} N
D) 1.25×10^{-13} N
E) 1.02×10^{-6} N

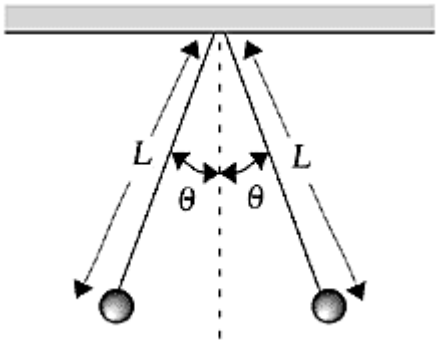
Ans: A

Section: 21–3 Topic: Coulomb's Law Type: Numerical

18. A positive charge of 94.0 nC is 12.0 cm from a negative charge of 53.0 nC. The force on one of the charges due to the other is approximately
A) 1.13 mN B) 0.373 mN C) 3.11 mN D) 1.25 mN E) 1.02 μN
Ans: C

Section: 21–3 Topic: Coulomb's Law Type: Numerical

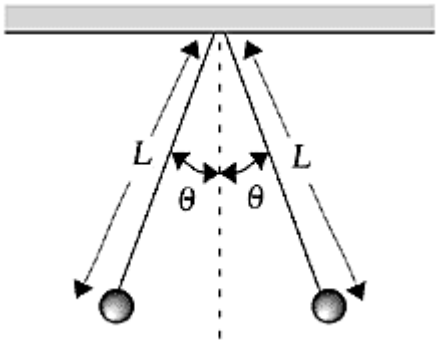
19.



Two small spheres, each with mass m = 5.0 g and charge q, are suspended from a point by threads of length L = 0.30 m. What is the charge on each sphere if the threads make an angle θ = 20º with the vertical?
A) 7.9×10^{-7} C
B) 2.9×10^{-7} C
C) 7.5×10^{-2} C
D) 6.3×10^{-13} C
E) 1.8×10^{-7} C
Ans: B

Section: 21–3 Topic: Coulomb's Law Type: Numerical

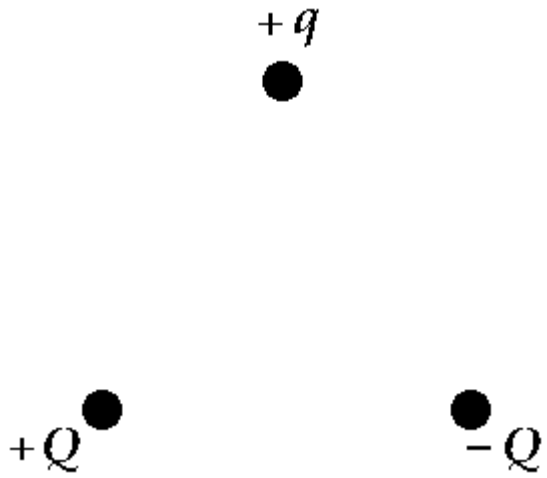
20.



Two small spheres, each with mass m = 3.0 g and charge q, are suspended from a point by threads of length L = 0.22 m. What is the charge on each sphere if the threads make an angle θ = 15º with the vertical?
A) 0.79 μC B) 2.9 μC C) 75 mC D) 6.3 μC E) 0.11 μC
Ans: E

Section: 21–3 Topic: Coulomb's Law Type: Conceptual

21.



Three charges $+q$, $+Q$, and $-Q$ are placed at the corners of an equilateral triangle as shown. The net force on charge $+q$ due to the other two charges is

A) vertically up.
B) vertically down.
C) zero.
D) horizontal to the left.
E) horizontal to the right.

Ans: E

Section: 21–3 Topic: Coulomb's Law Type: Numerical

22. Charges q_1 and q_2 exert repulsive forces of 10 N on each other. What is the repulsive force when their separation is decreased so that their final separation is 80% of their initial separation?

A) 16 N B) 12 N C) 10 N D) 8.0 N E) 6.4 N

Ans: A

Section: 21–3 Topic: Coulomb's Law Type: Numerical

23. Charges q_1 and q_2 exert repulsive forces of 15 N on each other. What is the repulsive force when their separation is increased so that their final separation is 160% of their initial separation?

A) 1.3 N B) 5.9 N C) 9.8 N D) 8.7 N E) 6.4 N

Ans: B

Section: 21–3 Topic: Coulomb's Law Type: Numerical

24. Two positive charges (+8.0 mC and +2.0 mC) are separated by 300 m. A third charge is placed at distance r from the +8.0 mC charge in such a way that the resultant electric force on the third charge due to the other two charges is zero. The distance r is

A) 0.25 km B) 0.20 km C) 0.15 km D) 0.13 km E) 0.10 km

Ans: B

Section: 21–3 Topic: Coulomb's Law Type: Numerical

25. Three charges are located at 100-m intervals along a horizontal line: a charge of –3.0 C on the left, +2.0 C in the middle, and +1.0 C on the right. What is the resultant force on the 1.0 C charge due to the other two?

A) 1.1×10^6 N to the right
B) 1.1×10^6 N to the left
C) 2.5×10^6 N to the right
D) 2.5×10^6 N to the left
E) 4.5×10^7 N to the right

Ans: A

Section: 21–3 Topic: Coulomb's Law Type: Numerical

26. Point charges of 4.0×10^{-8} C and -2.0×10^{-8} C are placed 12 cm apart. A third point charge of 3.0×10^{-8} C halfway between the first two point charges experiences a force of magnitude

A) 4.5×10^{-3} N
B) 2.0×10^{-3} N
C) 1.5×10^{-3} N
D) zero
E) 5.0×10^{-3} N

Ans: A

Section: 21–1 Topic: Charge Type: Factual

27. A proton is about 2000 times more massive that an electron but they both have charges of the same magnitude. The magnitude of the force on an electron by a proton is ____ the magnitude of the force on the proton by the electron.

A) 2000 times greater than
B) equal to
C) 2000 times less than
D) negligible compared to
E) None of these answers is correct.

Ans: B

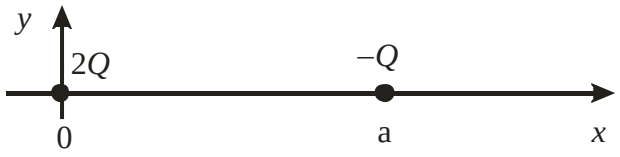
Section: 21–3 Topic: Coulomb's Law Type: Numerical

28. The Coulomb's force between a proton and an electron is 2.27×10^{39} times greater than the gravitational force. If the two forces were equal, what should the size of the elementary charge be

A) 1.60×10^{-19} C
B) 3.36×10^{-39} C
C) 1.23×10^{-77} C
D) 2.27×10^{-39} C
E) 4.41×10^{-40} C

Ans: B

Section: 21–3 Topic: Coulomb's Law Type: Conceptual

29. 

A charge 2*Q* is located at the origin while a second charge −*Q* is located at x = a. Where should a third charge be placed so that the net force on the charge is zero?

A) x < 0
B) 0 < x < a
C) x > a
D) x < 0 or 0 < x < a
E) 0 < x < a or x > a

Ans: C

Section: 21–3 Topic: Coulomb's Law Type: Conceptual

30. The force between two very small charged bodies is found to be *F*. If the distance between them is doubled without altering their charges, the force between them becomes

A) *F*/2 B) 2*F* C) *F*/4 D) 4*F* E) $1/F^2$

Ans: C

Section: 21–3 Topic: Coulomb's Law Type: Conceptual

31. The force between two very small charged bodies is found to be *F*. If the distance between them is tripled without altering their charges, the force between them becomes

A) 9*F* B) 3*F* C) *F*/3 D) *F*/9 E) $1/F^3$

Ans: D

Section: 21–3 Topic: Coulomb's Law Type: Numerical

32. Two electrons are separated by a distance of 1.6 nm. Each experiences an electrostatic force of approximately

A) 9.0×10^{9} N
B) 1.1×10^{-32} N
C) 9.0×10^{20} N
D) 1.0×10^{-22} N
E) 9.0×10^{-11} N

Ans: E

Section: 21–3 Topic: Coulomb's Law Type: Conceptual

33. Coulomb's law and Newton's law of gravitation both involve which of the following?

A) the mass of the particle
B) the charge on the particle
C) permeability
D) permittivity
E) the inverse-square law

Ans: E

Section: 21–3 Topic: Coulomb's Law Type: Factual

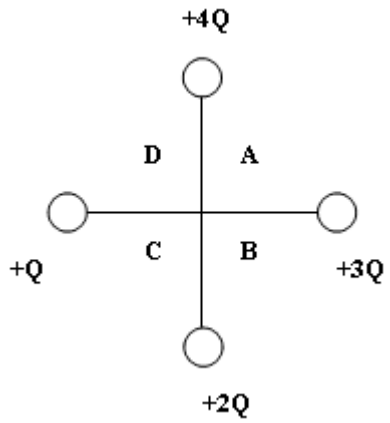
34. Which of the following statements is not true?
A) In nature, electric charge is conserved.
B) The force of repulsion between two like charges is directly proportional to the product of the square of the charges.
C) The force of repulsion between two like charges is inversely proportional to the square of the distance separating the charges.
D) Unlike charges attract each other.
E) Like charges repel each other.
Ans: B

Section: 21–3 Topic: Coulomb's Law Type: Numerical

35. A particular nucleus of the element plutonium contains 94 protons and 150 neutrons. What is the magnitude of the force from the nucleus on a single electron that is at a distance of 0.563×10^{-12} m from the plutonium nucleus?
A) 4.27×10^{15} N
B) 3.85×10^{-14} N
C) 6.83×10^{-2} N
D) 6.42 N
E) 1.09×10^{-1} N
Ans: C

Section: 21–3 Topic: Coulomb's Law Type: Conceptual

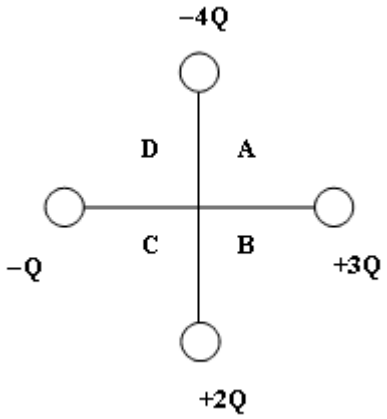
36.



If a charge of +2*Q* were placed at the origin (the crossing point of the vertical and horizontal lines) of the above figure, into which quadrant would it feel a net force?
A) A B) B C) C D) D E) None, it feels no net force.
Ans: C

Section: 21–3 Topic: Coulomb's Law Type: Conceptual

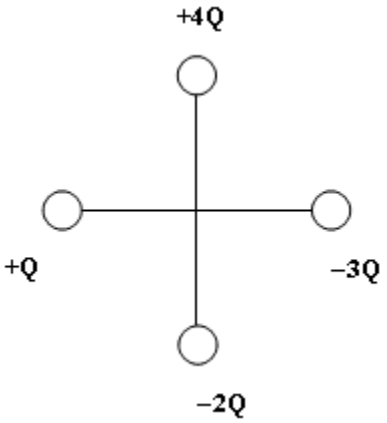
37.



If a charge of +2*Q* were placed at the origin (the crossing point of the vertical and horizontal lines) of the above figure, into which quadrant would it feel a net force?
A) A B) B C) C D) D E) None, it feels no net force.
Ans: D

Section: 21–3 Topic: Coulomb's Law Type: Numerical

38.



If all the charges are 15 cm from the origin (the crossing point of the vertical and horizontal lines) in the above figure and $Q = +3.0\ \mu C$, then calculate the magnitude of the net force on a charge of +*Q* placed at the origin.
A) 22.8 N B) 10.2 N C) 26.0 N D) 187 N E) none of the above
Ans: C

Section: 21–4 Topic: The Electric Field Type: Factual

39. A proton is moving horizontally north in an electric field that points vertically upward. The electric force on the proton is
A) zero. B) upward. C) downward. D) to the west. E) to the east.
Ans: B

Section: 21–4 Topic: The Electric Field Type: Factual

40. An electron is moving horizontally east in an electric field that points vertically upward. The electric force on the proton is
A) zero. B) upward. C) downward. D) to the west. E) to the east.
Ans: C

Section: 21–4 Topic: The Electric Field Type: Factual

41. The SI units of electric fields can be expressed as
A) C/m^2 B) C/s C) V · C D) N E) V/m
Ans: E

Section: 21–4 Topic: The Electric Field Type: Numerical

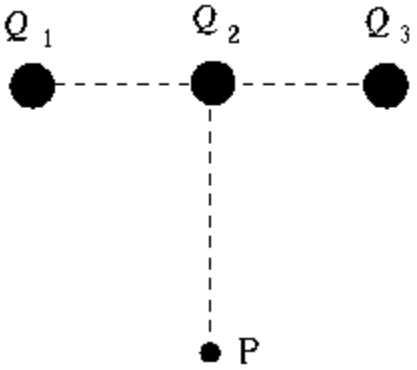
42. Three charges are located at 100-m intervals along a horizontal line: a charge of –3.0 C on the left, 2.0 C in the middle, and 1.0 C on the right. What is the electric field $\vec{E}$ on the horizontal line halfway between the –3.0 C and 2.0 C charges?
A) 2.2×10^7 N/C to the left
B) 1.8×10^7 N/C to the right
C) 1.8×10^7 N/C to the left
D) 3.2×10^6 N/C to the right
E) 4.0×10^6 N/C to the left
Ans: C

Section: 21–4 Topic: The Electric Field Type: Conceptual

43. A positive charge that is in an electric field $\vec{E}$ experiences a force that is
A) perpendicular to $\vec{E}$.
B) zero because the speed is zero.
C) in the direction opposite to $\vec{E}$.
D) in the same direction as $\vec{E}$.
E) None of these is correct.
Ans: D

Section: 21–4 Topic: The Electric Field Type: Numerical

44.



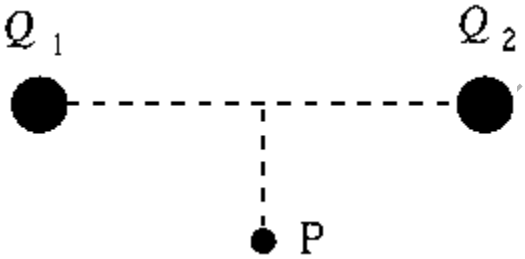
Three charges Q_1, Q_2, and Q_3, each equal to 6.4×10^{-19} C, are in a straight line. The distance between neighboring charges is 60 nm. The magnitude of the electric field at P, which is 80 nm from Q_2 on a line at right angles to the line between Q_1 and Q_3, is

A) 1.2×10^{-8} N/C
B) 16 N/C
C) 2.0 N/C
D) 1.9×10^{10} N/C
E) 1.2×10^{8} N/C

Ans: D

Section: 21–4 Topic: The Electric Field Type: Numerical

45.



Two charges Q_1 and Q_2 are 8.0 cm apart. Charge Q_1 = 5.0 nC and Q_2 = –5.0 nC. The magnitude of the electric field at point P, 3.0 cm from the midpoint of the line joining Q_1 and Q_2, is

A) 2.9×10^{5} N/C
B) 2.9×10^{4} N/C
C) 3.6×10^{5} N/C
D) 0.29 kN/C
E) 3.6×10^{6} N/C

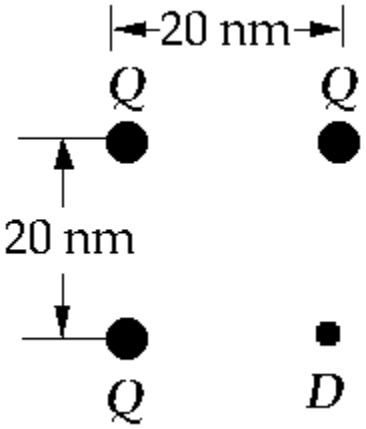
Ans: B

Section: 21–4 Topic: The Electric Field Type: Conceptual

46. Two charges of the same magnitude and sign are placed a certain distance apart. There is only one point in space near them where the electric field is zero. Which, if any, of the following statements about that point is true?
A) It cannot be on the line joining the charges.
B) It must be on the line joining the charges and between the charges.
C) It must be on the line joining the charges but not between the charges.
D) Its position depends on the size of the charges.
E) None of these is correct.
Ans: B

Section: 21–4 Topic: The Electric Field Type: Numerical

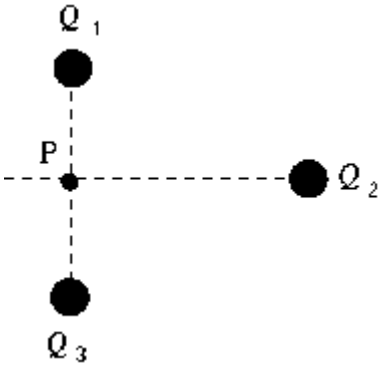
47.



Three charges, each of $Q = 3.2 \times 10^{-19}$ C, are arranged at three of the corners of a 20-nm square as shown. The magnitude of the electric field at D, the fourth corner of the square, is approximately
A) 1.4×10^{7} N/C
B) 1.0×10^{11} N/C
C) 3.6×10^{10} N/C
D) 30 N/C
E) 1.8×10^{7} N/C
Ans: A

Section: 21–4 Topic: The Electric Field Type: Conceptual

48.



Three positive and equal charges Q_1, Q_2, and Q_3 are at the corners of an equilateral triangle as shown. Point P is at the midpoint of the line between Q_1 and Q_3. The electric field at P is

A) zero.
B) not zero and is directed along the line from P to Q_3.
C) not zero and is directed along the line from P to Q_2.
D) not zero and is directed along the line from Q_1 to Q_2.
E) None of these is correct.

Ans: E

Section: 21–4 Topic: The Electric Field Type: Numerical

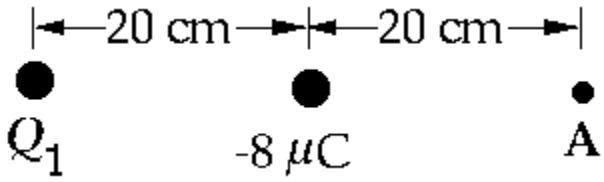
49. An electric field with a magnitude of 6.0×10^4 N/C is directed parallel to the positive y axis. A particle with a charge $q = 4.8 \times 10^{-19}$ C is moving along the x axis with a speed $v = 3.0 \times 10^6$ m/s. The force on the charge is approximately

A) 8.6×10^{-8} N perpendicular to the xy plane.
B) 2.9×10^{-14} N in the y direction.
C) 8.6×10^{-8} N in the x direction.
D) zero.
E) 2.9×10^{-14} N in the x direction.

Ans: B

Section: 21–4 Topic: The Electric Field Type: Numerical

50.



The electric field at point A is zero. What is charge Q_1?

A) +32 μC
B) –32 μC
C) The field cannot be zero at A for any value of Q_1.
D) +16 μC
E) –16 μC
Ans: A

Section: 21–4 Topic: The Electric Field Type: Conceptual

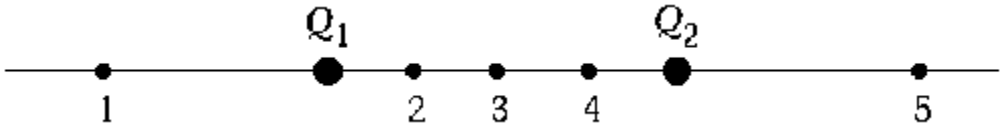
51. The direction of the electric field at a point is the same as
A) the force on a neutron placed at that point.
B) the force on a proton placed at that point.
C) the force on an electron placed at that point.
D) the force on a hydrogen molecule placed at that point.
E) None of these is correct.
Ans: B

Section: 21–4 Topic: The Electric Field Type: Conceptual

52. Two point charges of unknown magnitude and sign are a distance *d* apart. If the electric field strength is zero at a point between them on the line joining them, you can conclude that
A) the charges are equal in magnitude but opposite in sign.
B) the charges are equal in magnitude and have the same sign.
C) the charges are not necessarily equal in magnitude but have opposite signs.
D) the charges are not necessarily equal in magnitude but have the same sign.
E) there is not enough information to say anything specific about the charges.
Ans: D

Section: 21–4 Topic: The Electric Field Type: Conceptual

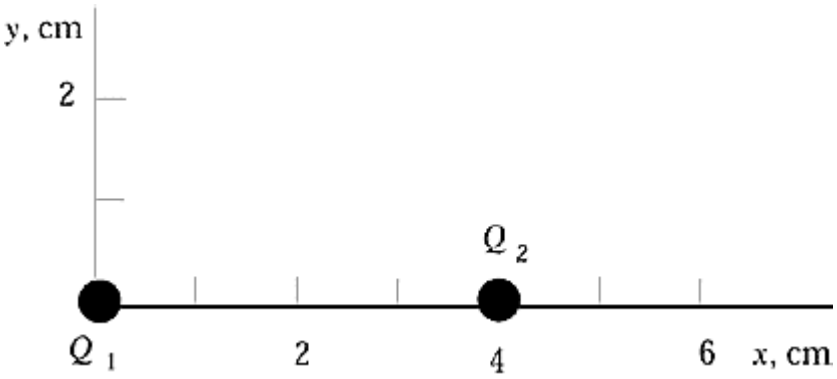
53.



Charges $Q_1 = -q$ and $Q_2 = +4q$ are placed as shown. Of the five positions indicated by the numbered dots, the one at which the electric field $\vec{E}$ is zero is
A) 1 B) 2 C) 3 D) 4 E) 5
Ans: A

Section: 21–4 Topic: The Electric Field Type: Conceptual

54.



In the diagram, Q_1 = 6.0 μC and Q_2 = –6.0 μC. The electric field at point (2, 0) is

A) in the positive *x* direction.
B) in the negative *x* direction.
C) in the positive *y* direction.
D) in the negative *y* direction.
E) zero at this point.

Ans: A

Section: 21–4 Topic: The Electric Field Type: Numerical

55. A particular nucleus of the element plutonium contains 94 protons and 150 neutrons. What is the magnitude of the electric field at a distance of 0.563×10^{-12} m from the nucleus?

A) 6.81×10^{17} N/C
B) 4.27×10^{17} N/C
C) 2.40×10^{5} N/C
D) 3.83×10^{5} N/C
E) none of the above

Ans: B

Section: 21–4 Topic: The Electric Field Type: Conceptual

56. Two charges Q_1 and Q_2 are a distance d apart. If the electric field is zero at a distance of 3d/4 from Q_1 (towards Q_2), then what is the relation between Q_1 and Q_2?

A) $Q_1 = Q_2/9$ B) $Q_1 = 9Q_2$ C) $Q_1 = Q_2/3$ D) $Q_1 = 3Q_2$ E) $Q_1 = 4Q_2/3$

Ans: B

Section: 21–4 Topic: The Electric Field Type: Conceptual

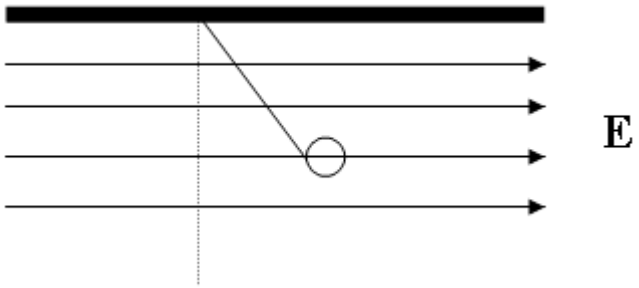
57. Two charges Q_1 and Q_2 are distance d apart. If the electric field is zero at distance $3d/2$ from Q_1 and $d/2$ from Q_2, along the line joining Q_1 and Q_2, then what is the relation between Q_1 and Q_2?

A) $Q_1 = 9Q_2$ B) $Q_1 = -Q_2/9$ C) $Q_1 = Q_2/3$ D) $Q_1 = -3Q_2$ E) $Q_1 = -9Q_2$

Ans: E

Section: 21–4 Topic: The Electric Field Type: Numerical

58.



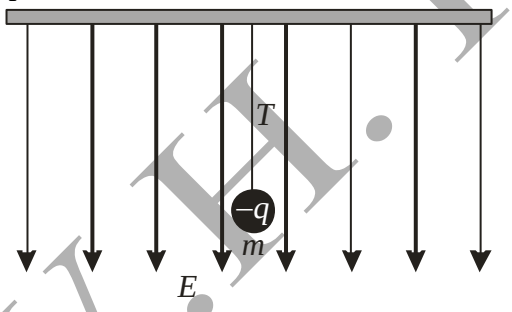
A bob of mass m (m = 0.500 g), and charge magnitude Q (Q = 50.0 μC) is held by a massless string in a uniform electric field E. If the bob makes an angle of 10.0 degrees with the vertical, then calculate the magnitude of the electric field E and the sign of the bob charge Q.

A) 1.73×10^1 N/C and Q is positive.
B) 9.81×10^1 N/C and Q is negative.
C) 9.81×10^1 N/C and Q is positive.
D) 1.73×10^1 N/C and Q is negative.
E) 1.80×10^{-1} N/C and Q is positive.

Ans: A

Use the picture for the next two problems.

A conducting sphere has a net charge of $-q$ and of mass m is suspended from the ceiling by a light string. A uniform electric field E is applied vertical down on the sphere.



Section: 21–4 Topic: The Electric Field Type: Conceptual

59. The tension T in the string is ____ the weight mg.

A) less than
B) equal to
C) greater than
D) dependent on the strength of E in relation to
E) insufficient information to tell

Ans: A

Section: 21–4 Topic: The Electric Field Type: Numerical

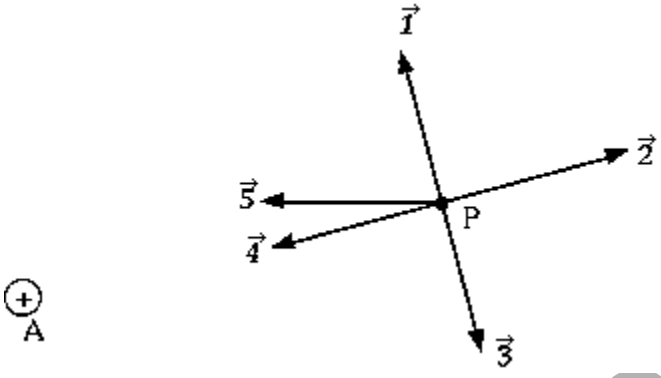
60. If $m = 1$ g, $q = 1$ μC and $E = 5000$ N/C, the tension T in the string is

A) 5×10^{-3} N
B) 9.81×10^{-3} N
C) 4.81×10^{-3} N
D) 1.48×10^{-2} N
E) 0

Ans: C

Section: 21–5 Topic: Electric Field Lines Type: Factual

61.



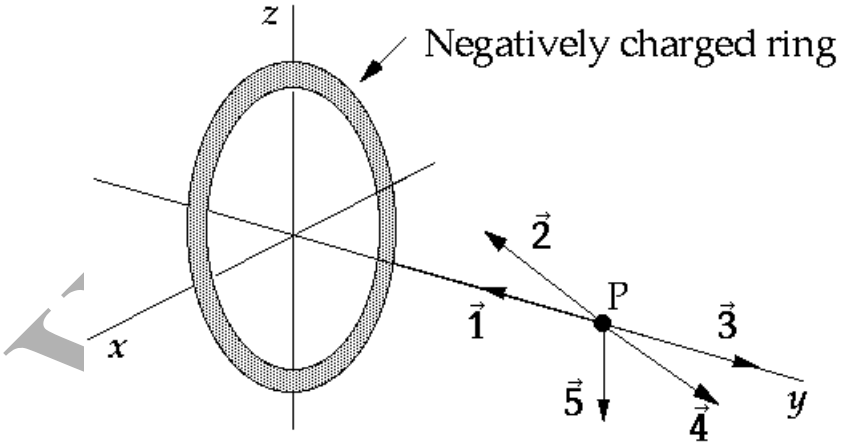
A small positive charge is located at A. The vector that gives the direction of the electric field at point P is

A) $\vec{1}$ B) $\vec{2}$ C) $\vec{3}$ D) $\vec{4}$ E) $\vec{5}$

Ans: B

Section: 21–5 Topic: Electric Field Lines Type: Conceptual

62.



The point P is on the axis of a ring of charge, and all vectors shown lie in the *yz* plane. The negatively charged ring lies in the *xz* plane. The vector that correctly represents the direction of the electric field at this point is

A) $\vec{1}$ B) $\vec{2}$ C) $\vec{3}$ D) $\vec{4}$ E) $\vec{5}$

Ans: A

Section: 21–5 Topic: Electric Field Lines Type: Conceptual

63. Which of the following statements about electric field lines is not true?
    A) The number of lines leaving a positive charge or entering a negative charge is proportional to the charge.
    B) The lines begin on positive charges and end on negative charges.
    C) The density of the lines (the number per unit area perpendicular to the lines) is proportional to the magnitude of the field at that point.
    D) Electric field lines cross midway between charges that have equal magnitude and sign.
    E) The direction of each line indicates the direction that a positively charged particle would move if placed at that point in the electric field.

    Ans: D

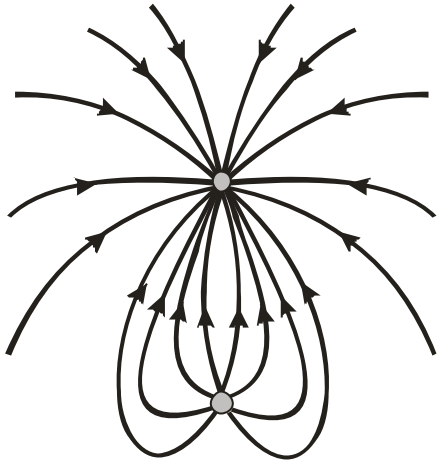
Section: 21–5 Topic: Electric Field Lines Type: Conceptual

64. Which of the following statements about electric field lines are true?
    A) The lines are drawn symmetrically entering or leaving an isolated charge.
    B) At large distances from a system of charges, the field lines are equally spaced and radial, as if they came from a single point charge equal to the net charge of the system.
    C) Electric field lines begin on positive charges (or at infinity) and end on negative charges (or at infinity).
    D) The number of lines leaving a positive charge or entering a negative charge is proportional to the charge.
    E) All of these statements are true.

    Ans: E

Section: 21–5 Topic: Electric Field Lines Type: Conceptual

65.



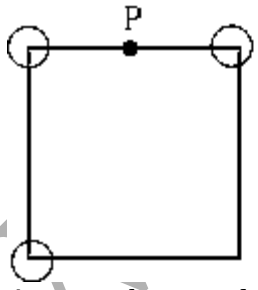
The figure shows the field lines for two charges. What is the ratio of the top charge to the bottom charge?

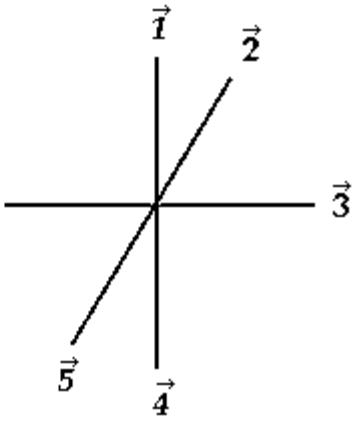
A) 1:2
B) –1:2
C) 2:1
D) –2:1
E) 2:–1

Ans: D

Section: 21–5 Topic: Electric Field Lines Type: Conceptual

66.





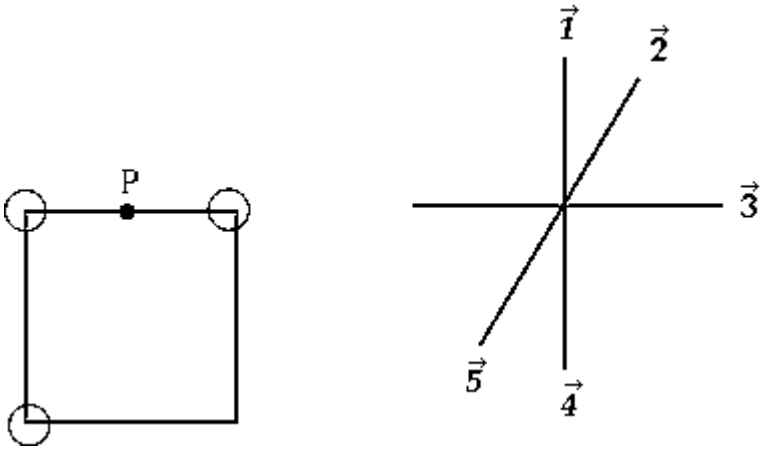
A square has equal positive charges at three of its corners, as shown. The direction of the electric field at point P is

A) $\vec{1}$ B) $\vec{2}$ C) $\vec{3}$ D) $\vec{4}$ E) $\vec{5}$

Ans: B

Section: 21–5 Topic: Electric Field Lines Type: Conceptual

67.



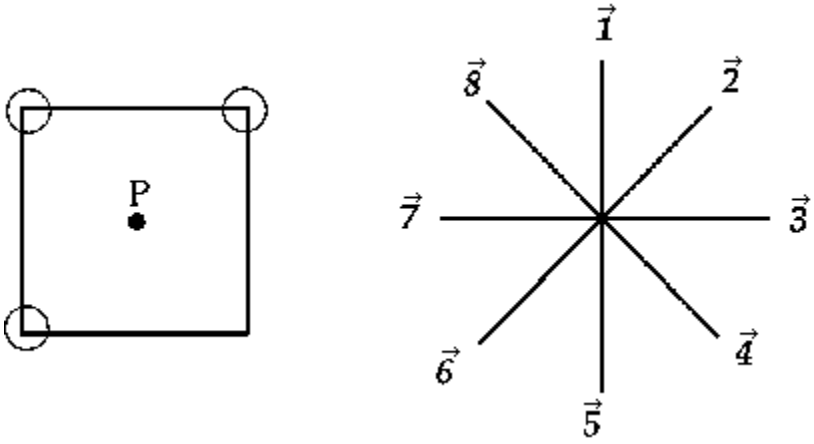
A square has equal positive charges at three of its corners and a negative charge at the third. The direction of the electric field at point P is

A) $\vec{1}$ B) $\vec{2}$ C) $\vec{3}$ D) $\vec{4}$ E) $\vec{5}$

Ans: B

Section: 21–5 Topic: Electric Field Lines Type: Conceptual

68.



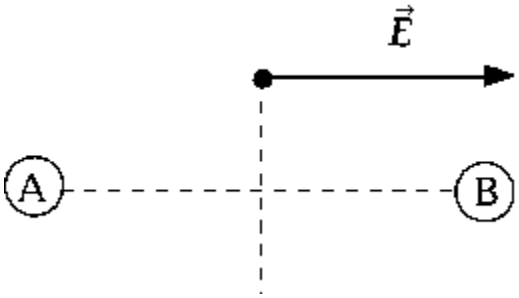
A square has equal positive charges at three of its corners, as shown. The direction of the electric field at point P is

A) $\vec{1}$ B) $\vec{2}$ C) $\vec{3}$ D) $\vec{4}$ E) $\vec{5}$

Ans: D

Section: 21–5 Topic: Electric Field Lines Type: Conceptual

69.



In the figure, the direction of the electric field at a point equidistant from two equally charged bodies A and B is indicated by a vector. The direction of the vector indicates that

A) both A and B are positive.
B) both A and B are negative.
C) A is positive and B is negative.
D) B is positive and A is negative.
E) B is negative and A is neutral.

Ans: C

Section: 21–6 Topic: Action of the Electric Field on Charges Type: Conceptual

70. In a uniform electric field a proton has
A) a constant velocity in the direction of the field.
B) a constant velocity in a direction opposite to that of the field.
C) an approximately constant acceleration the direction of the field.
D) an approximately constant acceleration in a direction opposite to that of the field.
E) an approximately constant acceleration in a direction at right angles to the field.

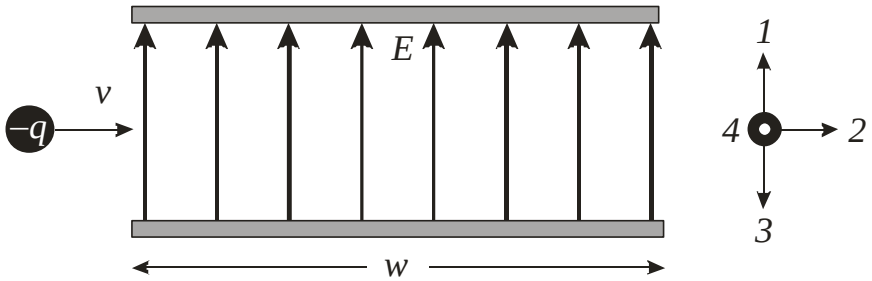
Ans: C

Section: 21–6 Topic: Action of the Electric Field on Charges Type: Conceptual

71. If nonelectric forces are negligible, a positively charged particle released from rest in a nonuniform electric field
A) moves perpendicular to the field with constant velocity.
B) moves with constant velocity parallel to the field.
C) accelerates in the direction of the field.
D) accelerates perpendicularly to the field.
E) moves only along equipotential lines.

Ans: C

Use the picture for the next two problems.



A negatively charged particle moving with speed *v* enters a region of uniform electric field *E*.

Section: 21–6 Topic: Action of the Electric Field on Charges Type: Conceptual

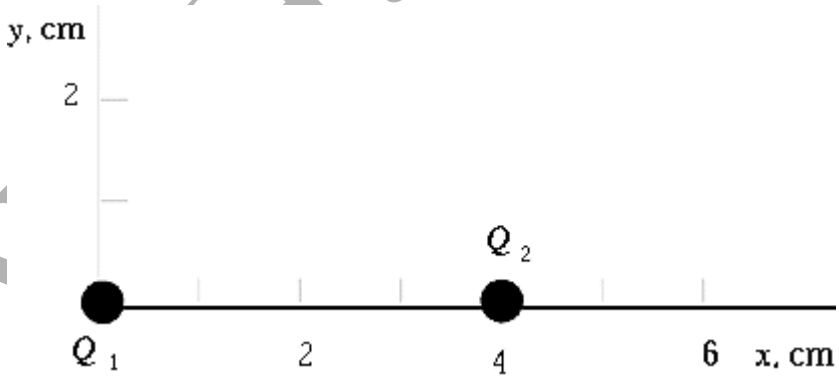
72. Using the direction compass on the right, the direction of the force on the charge is
A) 1 B) 2 C) 3 D) 4 E) There is no force on the charge.
Ans: C

Section: 21–6 Topic: Action of the Electric Field on Charges Type: Numerical

73. If the charge q = 1 nC, mass m = 1×10^{-14} kg, speed $v = 10^5$ m/s, the electric field strength $E = 2 \times 10^5$ V/m, and width, *w*, of the electric field is 0.2 m, what is the speed of the particle when it emerges from the other side?
A) 1.0×10^5 m/s
B) 4.0×10^4 m/s
C) 1.08×10^5 m/s
D) 1.4×10^5 m/s
E) 1.8×10^5 m/s
Ans: C

Section: 21–6 Topic: Action of the Electric Field on Charges Type: Numerical

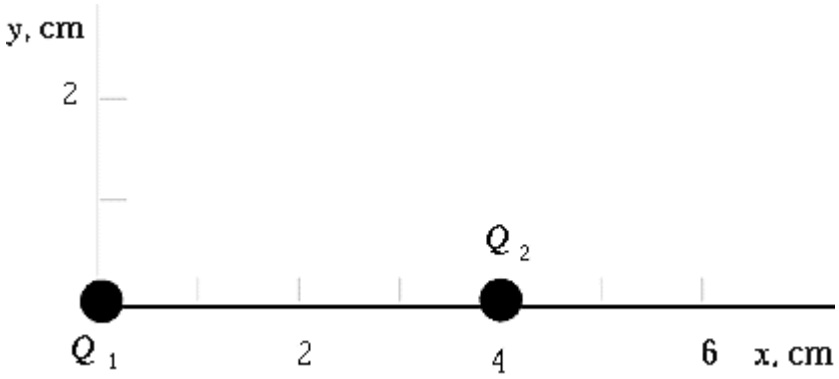
74.



In the diagram, Q_1 = 6.0 μC and Q_2 = –6.0 μC. If Q_2 has a mass of 2.0 g, a uniform electric field of 1.5 kN/C imposed in the positive *y* direction would give this particle an acceleration in the *y* direction of approximately
A) zero B) 9.0 mm/s^2 C) 22 cm/s^2 D) 4.5 m/s^2 E) 7.5×10^5 m/s^2
Ans: D

Section: 21–6 Topic: Action of the Electric Field on Charges Type: Conceptual

75.



In the diagram, Q_1 = 9.0 μC and Q_2 = –9.0 μC. If Q_2 has a mass of 3.0 g, a uniform electric field of 1.8 kN/C imposed in the positive *y* direction would give this particle an acceleration in the *y* direction of approximately

A) zero B) 5.4 m/s^2 C) 6.8 cm/s^2 D) 4.5 m/s^2 E) 7.5 cm/s^2

Ans: B

Section: 21–6 Topic: Action of the Electric Field on Charges Type: Numerical

76. An electron is released from rest in a uniform electric field. If the electric field is 1.25 kN/C, at the end of 20 ns the electron's velocity will be approximately

A) 2.5×10^{-5} m/s
B) 3.9×10^{3} m/s
C) 3.0×10^{8} m/s
D) 2.5×10^{3} m/s
E) 4.4×10^{6} m/s

Ans: E

Section: 21–6 Topic: Action of the Electric Field on Charges Type: Numerical

77. An electron is released from rest in a uniform electric field. If the electric field is 3.65 kN/C, at the end of 15 ns the electron's velocity will be approximately

A) 9.6×10^{6} m/s
B) 3.9×10^{3} m/s
C) 3.1×10^{8} m/s
D) 5.5×10^{3} m/s
E) 7.4×10^{6} m/s

Ans: A

Section: 21–6 Topic: Action of the Electric Field on Charges Type: Numerical

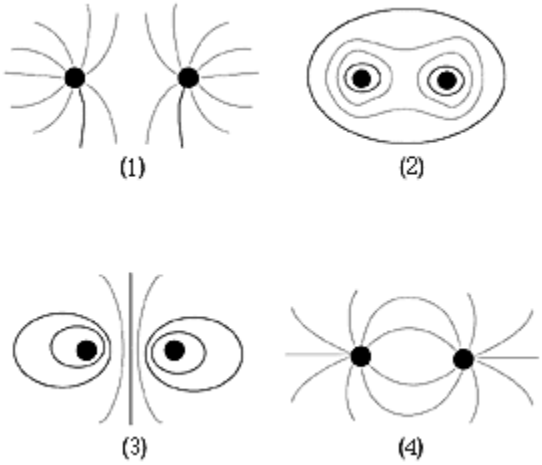
78. An oil droplet of mass 1.00×10^{-14} kg loses an electron while it is in an electric field of 1.00×10^{6} N/C. The resulting change in the acceleration of the oil droplet is approximately

A) 1.76×10^{17} m/s^2
B) 16.0 m/s^2
C) 1.60 m/s^2
D) 1.76×10^{18} m/s^2
E) 176 m/s^2

Ans: B

Section: 21–6 Topic: Action of the Electric Field on Charges Type: Factual

79.



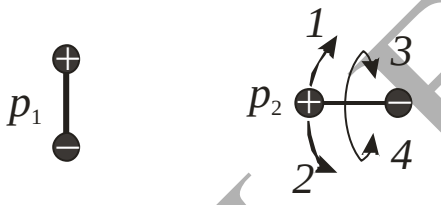
An electric dipole consists of a positive charge separated from a negative charge of the same magnitude by a small distance. Which, if any, of the diagrams best represents the electric field lines around an electric dipole?

A) 1 B) 2 C) 3 D) 4 E) None of these is correct.

Ans: D

Section: 21–6 Topic: Action of the Electric Field on Charges Type: Conceptual

80.



Two electric dipoles, p_1 and p_2, are arranged as shown. The first dipole is not free to rotate but the second dipole can rotate in any direction. Which way will p_2 rotate? The directions represent the following: 1 – clockwise, 2 – counter-clockwise, 3 – rotate about axis of the dipole rolling up, and 4 – rotate about axis of the dipole rolling down.

A) 1 B) 2 C) 3 D) 4 E) None of these is correct.

Ans: 2

Section: 21–6 Topic: Action of the Electric Field on Charges Type: Numerical

81. A point charge of +35 nC is above a point charge of –35 nC on a vertical line. The distance between the charges is 4.0 mm. What are the magnitude and direction of the dipole moment $\vec{p}$?

A) zero
B) 1.4 pC · m up
C) 1.4 pC · m down
D) 2.8 pC · m up
E) 2.8 pC · m down

Ans: B

Section: 21–6 Topic: Action of the Electric Field on Charges Type: Numerical

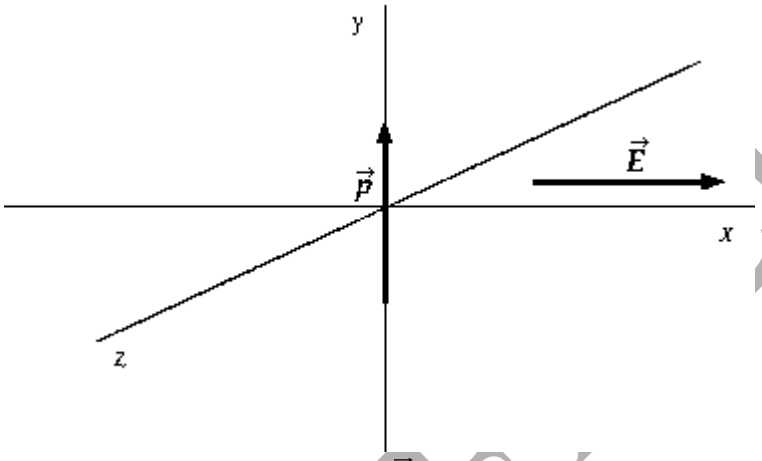
82. An electric dipole $\vec{p}$ of magnitude 25 p C · m makes an angle of 65° with a uniform electric field $\vec{E}$ of magnitude 3.0×10^{-6} N/C. What is the magnitude of the torque on the dipole?

A) 3.2×10^{-16} N · m
B) 6.2×10^{-16} N · m
C) 1.4×10^{-15} N · m
D) 6.8×10^{-16} N · m
E) 7.5×10^{-16} N · m

Ans: D

Section: 21–6 Topic: Action of the Electric Field on Charges Type: Conceptual

83.



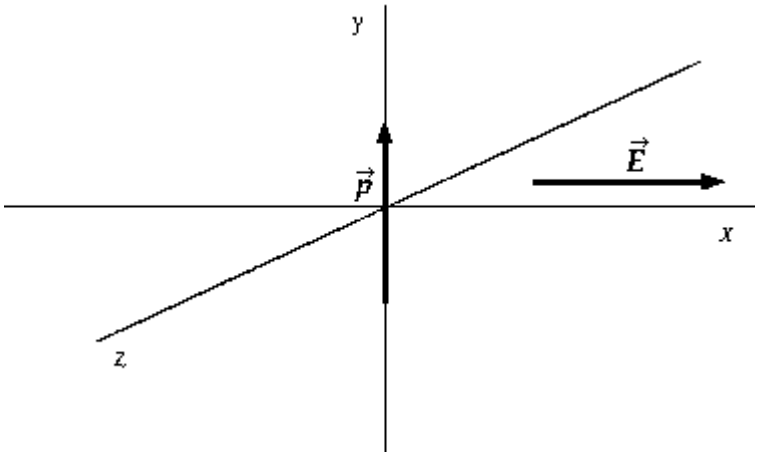
An electric dipole of moment $\vec{p}$ is placed in a uniform external electric field. The dipole moment vector $\vec{p}$ is in the positive *y* direction. The external electric field vector $\vec{E}$ is in the positive *x* direction. When the dipole is aligned as shown in the diagram, the net torque is in the

A) positive *x* direction.
B) positive *y* direction.
C) negative *x* direction.
D) positive *z* direction.
E) negative *z* direction.

Ans: E

Section: 21–6 Topic: Action of the Electric Field on Charges Type: Conceptual

84.



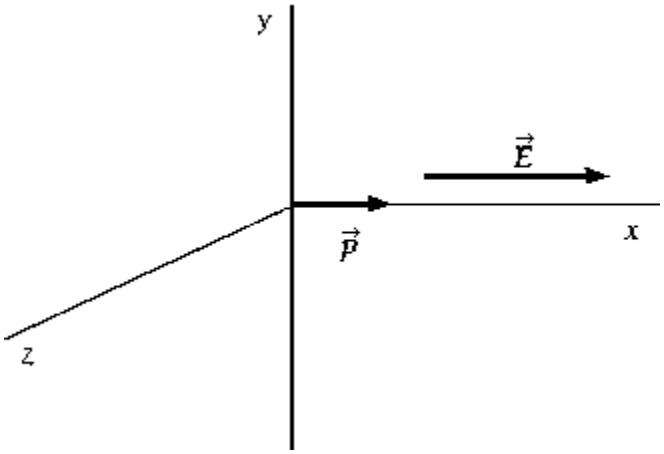
An electric dipole of moment $\vec{p}$ is placed in a uniform external electric field as shown in the diagram. The dipole moment vector $\vec{p}$ is in the positive *y* direction. The external electric field vector $\vec{E}$ is in the positive *x* direction. If the dipole is to have minimum potential energy, $\vec{p}$ should be in the

A) positive *x* direction.
B) negative *x* direction.
C) positive *y* direction.
D) negative *y* direction.
E) positive *z* direction.

Ans: A

Section: 21–6 Topic: Action of the Electric Field on Charges Type: Conceptual

85.



An electric dipole of moment $\vec{p}$ is placed in a uniform external electric field. The dipole moment vector $\vec{p}$ is in the positive *x* direction. The external electric field vector $\vec{E}$ is also in the positive *x* direction. When the dipole is aligned as shown, the net torque experienced by the dipole is

A) in the positive *x* direction.
B) in the positive *y* direction.
C) in the negative *z* direction.
D) zero.
E) described by none of these.

Ans: D

Section: 21–6 Topic: Action of the Electric Field on Charges Type: Numerical

86. An electric dipole *p* makes an angle of 30° with a uniform electric field of magnitude 300 N/C. If the torque on the dipole is 3.00×10^{-12} N · m then calculate the magnitude of the dipole moment *p*.

A) 2.00×10^{-14} C · m
B) 1.00×10^{-14} C · m
C) 4.00×10^{-14} C · m
D) 1.15×10^{-14} C · m
E) 1.73×10^{-14} C · m

Ans: A

Section: 21–6 Topic: Action of the Electric Field on Charges Type: Numerical

87. A molecule of HCl has a dipole moment of 3.39×10^{-30} C · m. If we assume full donation of the hydrogen electron to the chlorine, then calculate the distance between the charge centers.

A) 4.72×10^{10} m
B) 1.06×10^{-11} m
C) 4.24×10^{-11} m
D) 2.12×10^{-11} m
E) 2.44×10^{-11} m

Ans: D