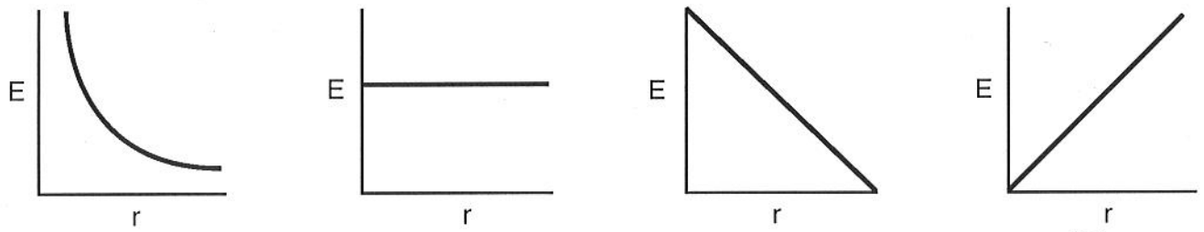
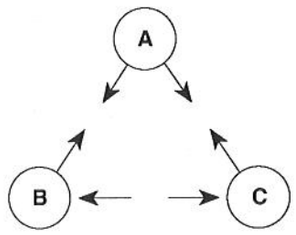
1. Which graph best represents the relationship between the magnitude of the electric field strength, *E*, around a point charge and the distance, *r*, from the point charge?



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

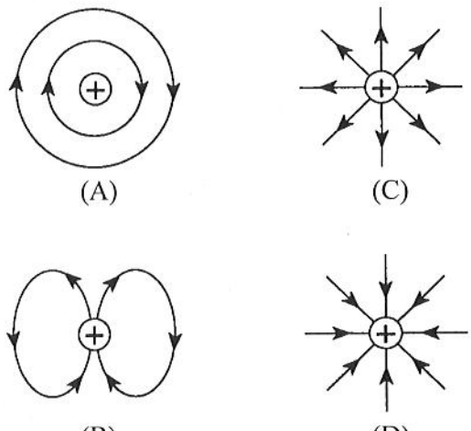
2. The diagram below shows the arrangement of three charged hollow metal spheres, *A*, *B*, and *C*. The arrows indicate the direction of the electric forces acting between the spheres. At least two of the spheres are positively charged.



Which sphere, if any, could be negatively charged?

(A) sphere *A*
(B) sphere *B*
(C) sphere *C*
(D) no sphere

3. Which diagram best represents the electric field near a positively charged conducting sphere?

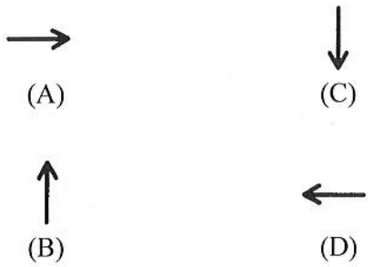


(A) (C)

(B) (D)

4. In the diagram below, *A* is a point near a positively charged sphere.

Which vector best represents the direction of the electric field at point *A*?



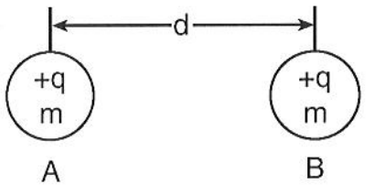
(A) (C)

(B) (D)

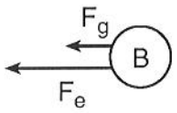
5. Two positively charged masses are separated by a distance, *r*. Which statement best describes the gravitational and electrostatic forces between the two masses?

(A) Both forces are attractive.
(B) The gravitational force is repulsive and the electrostatic force is attractive.
(C) Both forces are repulsive.
(D) The gravitational force is attractive and the electrostatic force is repulsive.

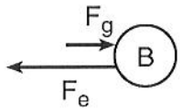
6. The diagram below shows two identical metal spheres, A and B, separated by distance d. Each sphere has mass m and possesses charge q.



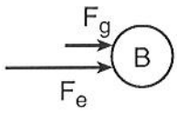
Which diagram best represents the electrostatic force F_e and the gravitational force F_g acting on sphere B due to sphere A?



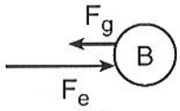
(A)



(C)

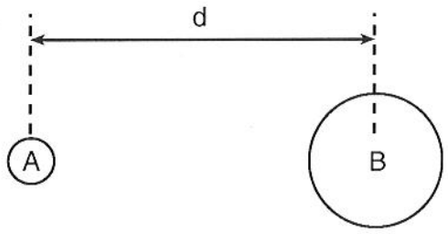


(B)



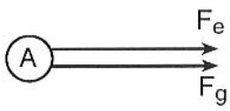
(D)

7. In the diagram below, two positively charged spheres, A and B, of masses m_A and m_B are located a distance d apart.

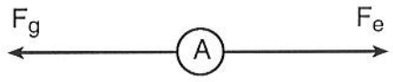


Which diagram best represents the directions of the gravitational force, F_g, and the electrostatic force, F_e, acting on sphere A due to the mass and charge of sphere B? [Vectors are not drawn to scale.]

(A)

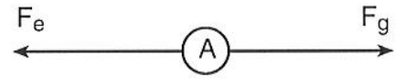


(B)

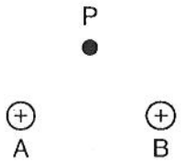


(C)

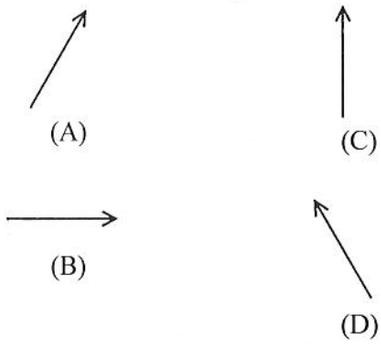
(D)



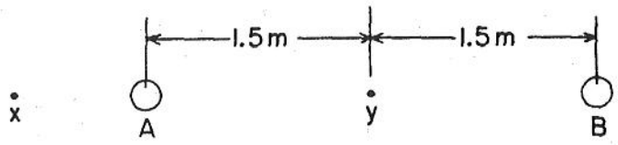
8. In the diagram below, two identical spheres, *A* and *B*, have equal net positive charges.



Which arrow best represents the direction of their resultant electric field at point *P*?



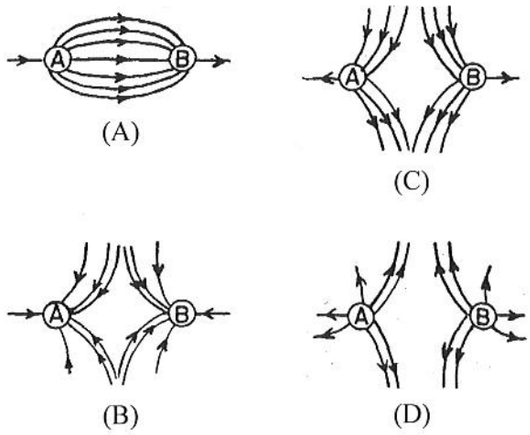
Base your answers to questions **9** through **11** on the diagram below which represents two small charged spheres, *A* and *B*, 3 meters apart. Each sphere has a charge of $+2.0 \times 10^{-6} C$.



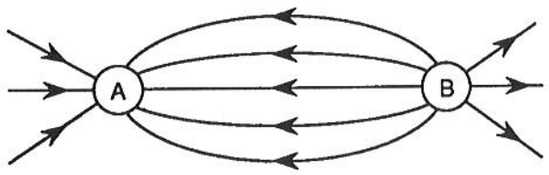
9. If sphere *A* is moved toward sphere *B*, the electric field intensity at point *x* will
   (A) decrease (C) remain the same
   (B) increase

10. If a positive charge is placed at point *x*, the direction of the net force on the charge will be
   (A) out of the page (C) into the page
   (B) toward the left (D) toward the right

11. Which diagram best illustrates the electric field between charges *A* and *B*?

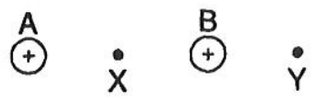


12. The diagram below represents the electric field lines in the vicinity of two isolated electrical charges, *A* and *B*.



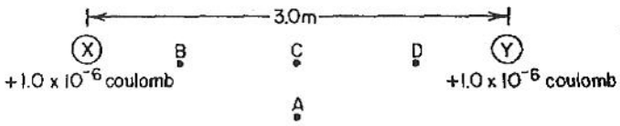
Which statement identifies the charges of *A* and B?
(A) *A* is negative and *B* is positive.
(B) *A* and *B* are both negative.
(C) *A* is positive and *B* is negative.
(D) *A* and *B* are both positive.

13. Two equal positive point charges, *A* and *B* are positioned as shown below.



At which location is the electric field intensity due to these two charges equal to zero?
(A) *A* (C) *X*
(B) *B* (D) *Y*

Base your answers to questions **14** and **15** on the diagram below which represents two charged spheres, *X* and *Y*.



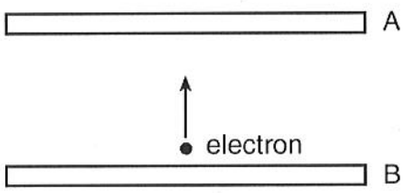
14. Compared to the force of the electric field of sphere *X* on sphere *Y* the force of the electric field of sphere *Y* on sphere *X* is

    (A) less
    (B) greater
    (C) the same

15. Which arrow best represents the direction of the electric field at point *A*?

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

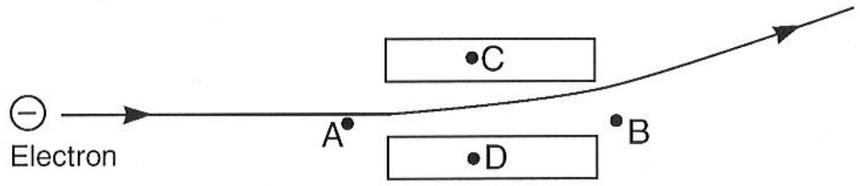
16. An electron placed between oppositely charged parallel plates *A* and *B* moves toward plate *A*, as represented in the diagram below



What is the direction of the electric field between the plates?

(A) toward plate *A*
(B) toward plate *B*
(C) into the page
(D) out of the page

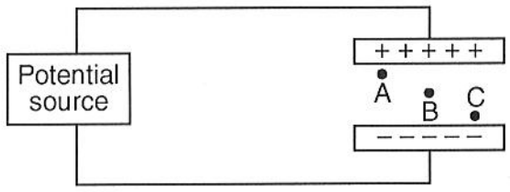
17. A moving electron is deflected by two oppositely charged parallel plates, as shown in the diagram below.



The electric field between the plates is directed from

(A) *A* to *B* (B) *B* to *A* (C) *C* to *D* (D) *D* to *C*

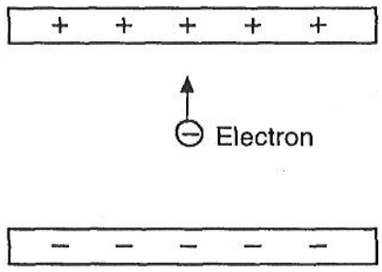
18. The diagram below represents a source of potential difference connected to two large, parallel metal plates separated by a distance of 4.0×10^{-3} meter.



Which statement best describes the electric field strength between the plates?

(A) It is a maximum at point *B*.
(B) It is the same at points *A*, *B*, and *C*.
(C) It is a maximum at point *C*.
(D) It is zero at point *B*.

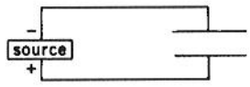
19. An electron is placed between two oppositely charged parallel plates as shown in the diagram below.



As the electron mover toward the positive plate, the magnitude of the electric force acting on the electron

(A) decreases (C) remains the same
(B) increases

20. Two parallel aluminum plates are connected to a source of potential as shown in the diagram.



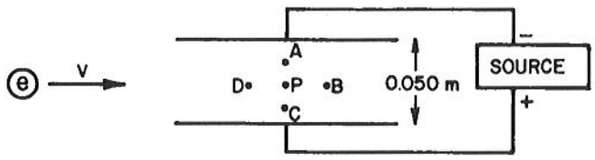
The electric field strength between the two plates is

(A) maximum near the positively charged plate
(B) zero midway between the plates
(C) constant between the plates except near the edges
(D) maximum midway between the plates

21. An electrostatic force of 20. Newtons is exerted on a charge of 8.0×10^{-2} coulomb at point *P* in an electric field. The magnitude of the electric field intensity at *P* is

(A) 4.0×10^{-3} N/C (C) 1.6 N/C
(B) 2.5×10^{2} N/C (D) 20. N/C

22. Base your answer to the following question on the diagram below which represents two large parallel conducting plates charged to a potential of 10. volts. The plates are separated by a distance of 0.050 meter.

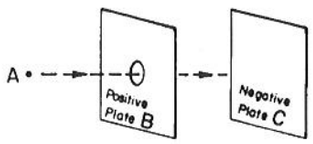


If an electron were projected into the electric field with a velocity *v*, it would experience a deflection

(A) into the page
(B) out of the page
(C) toward the top of the page
(D) toward the bottom of the page

23. A proton and an electron traveling with the same velocity enter a uniform electric field. Compared to the acceleration of the proton, the acceleration of the electron is
(A) less, but in the opposite direction
(B) less, and in the same direction
(C) greater, and in the same direction
(D) greater, but in the opposite direction

24. A beam of electrons is fired from point *A* toward plate *B* as shown in the diagram.



After the beam passes through a hole in positively charged plate *B*, the electrons will
(A) speed up
(B) be pushed up
(C) be pushed toward the right
(D) slow down

25. What is the magnitude of the electric field intensity at a point where a proton experiences an electrostatic force of magnitude 2.30×10^{-25} newton?
(A) 3.68×10^{-44} N/C (C) 1.44×10^{-6} N/C
(B) 3.68×10^{6} N/C (D) 1.44×10^{44} N/C

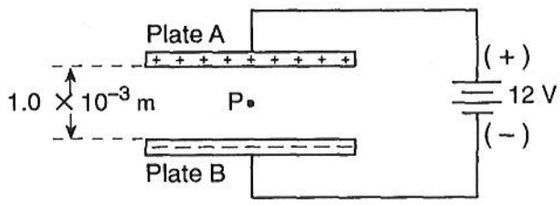
26. An object with a net charge of 4.80×10^{-6} coulomb experiences an electrostatic force having a magnitude of 6.00×10^{-2} Newtons when placed near a negatively charged metal sphere. What is the electric field strength at this location?
(A) 2.88×10^{-8} N/C directed away from the sphere
(B) 2.88×10^{-8} N/C directed toward the sphere
(C) 1.25×10^{4} N/C directed away from the sphere
(D) 1.25×10^{4} N/C directed toward the sphere

27. What is the magnitude of the electrostatic force acting on an electron located in an electric field having a strength of 5.0×10^{3} newtons per coulomb?
(A) 3.1×10^{22} N (C) 3.2×10^{-23} N
(B) 8.0×10^{-16} N (D) 5.0×10^{3} N

28. At point *P* in an electric field, the magnitude of the electrostatic force on a proton is 4.0×10^{-10} newton. What is the magnitude of the electric field intensity at point *P*?
(A) 4.0×10^{-10} N/C (C) 6.4×10^{-29} N/C
(B) 2.5×10^{9} N/C (D) 1.6×10^{-19} N/C

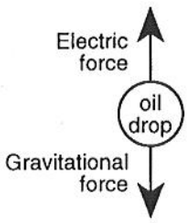
29. Base your answer to the following question on the information and diagram below.

Two parallel plates separated by a distance of 1.0×10^{-3} meter are charged to a potential difference of 12 volts. An alpha particle with a charge of +2 elementary charges is located at point *P* in the region between the plates



What is the magnitude and direction of the electric field intensity between the plates?
(A) 1.2×10^{4} V/m toward plate *A*
(B) 1.2×10^{4} V/m toward plate *B*
(C) 1.2×10^{3} V/m toward plate *A*
(D) 1.2×10^{3} V/m toward plate *B*

30. The diagram below, which illustrates the Millikan oil drop experiment, shows a 3.2×10^{-14} -kilogram oil drop with a charge of-1.6×10^{-18} coulomb. The oil drop was in equilibrium when the upward electric force on the drop was equal in magnitude to the gravitational force on the drop.



$q = -1.6 \times 10^{-18}$ C

$m = 3.2 \times 10^{-14}$ kg

What was the magnitude of the electric field intensity when this oil drop was in equilibrium?

(A) 2.0×10^{-5} N/C (C) 5.0×10^{-5} N/C

(B) 2.0×10^{5} N/C (D) 5.0×10^{5} N/C

31. What is the magnitude of the electrostatic force experienced by one elementary charge at a point in an electric field where the electric field intensity is 3.0×10^{3} Newtons per coulomb?

(A) 1.0×10^{3} N (C) 3.0×10^{3} N

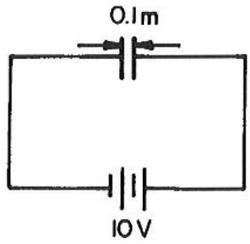
(B) 1.6×10^{-19} N (D) 4.8×10^{-16} N

32. What is the magnitude of the electric force acting on an electron located in an electric field with an intensity of 5.0×10^{3} Newtons per coulomb?

(A) 3.2×10^{22} N (C) 8.0×10^{-16} N

(B) 3.2×10^{-23} N (D) 5.0×10^{3} N

33. The diagram shows two parallel metal plates, 0.1 meter apart, with a potential difference between them of 10 volts.



What is the electric field intensity between the plates?

(A) 1 N/C (C) 0.001 N/C

(B) 100 N/C (D) 0 N/C

34. What is the approximate electrostatic force between two protons separated by a distance of 1.0×10^{-6} meter?

(A) 9.0×10^{21} N and attractive

(B) 2.3×10^{-16} N and repulsive

(C) 2.3×10^{-16} N and attractive

(D) 9.0×10^{21} N and repulsive

35. An electrostatic force of magnitude F exists between two metal spheres having identical charge q. The distance between their centers is r. Which combination of changes would produce *no* change in the electrostatic force between the spheres?

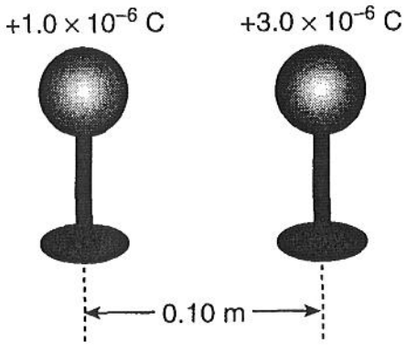
(A) doubling q on one sphere while halving r

(B) doubling q on both spheres while doubling r

(C) doubling q on both spheres while halving r

(D) doubling q on one sphere while doubling r

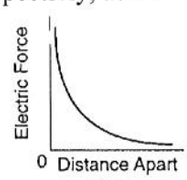
36. The diagram below shows two metal spheres charged to $+1.0 \times 10^{-6}$ coulomb and $+3.0 \times 10^{-6}$ coulomb, respectively, on insulating stands separated by a distance of 0.10 meter.



The spheres are touched together and then returned to their original positions. As a result, the magnitude of the electrostatic force between the spheres changes from 2.7 N to

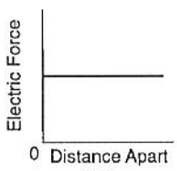
(A) 1.4 N
(C) 3.6 N
(B) 1.8 N
(D) 14 N

37. Which graph best represents the relationship between the magnitude of the electric force between two identical spheres possesing +1.0 coulomb of charge and –1.0 coulombs of charge respectivly, as well as the distance between them?

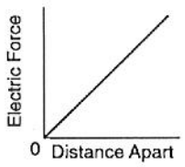


(A)

(C)



(B)

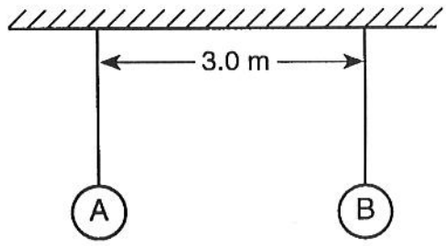


(D)

38. A point charge of $+3.0 \times 10^{-7}$ coulomb is placed 2.0×10^{-2} meter from a second point charge of $+4.0 \times 10^{-7}$ coulomb. The magnitude of the electrostatic force between the charges is

(A) 2.7 N
(C) 3.0×10^{-10} N
(B) 5.4×10^{-2} N
(D) 6.0×10^{-12} N

39. The diagram below shows two metal spheres suspended by strings and separated by a distance of 3.0 meters. The charge on sphere A is $+5.0 \times 10^{-4}$ coulomb and the charge on sphere B is $+3.0 \times 10^{-5}$ coulomb.



Which statement best describes the electrical force between the spheres?

(A) It has a magnitude of 15 N and is attractive.
(B) It has a magnitude of 45 N and is repulsive.
(C) It has a magnitude of 15 N and is repulsive.
(D) It has a magnitude of 45 N and is attractive.

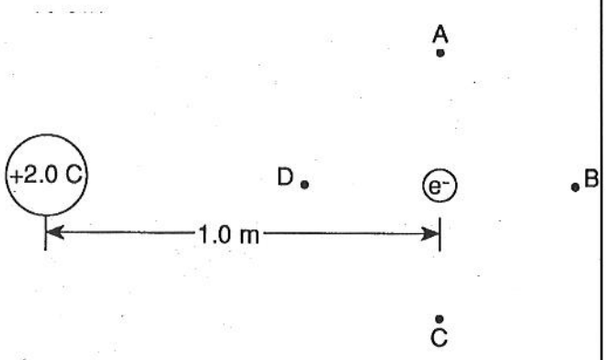
40. The magnitude of the electrostatic force of attraction between two point charges is F. The charge on one of the objects is then quadrupled and the charge on the other object is doubled. The new electrostatic force between the objects has a magnitude of

(A) $6F$
(C) $\frac{1}{2}F$
(B) $2F$
(D) $8F$

41. An electric force F exists between two charged spheres. If the quantity of charge on each sphere is doubled, the electric-force between the two spheres will be equal to

(A) $\frac{F}{2}$
(C) 3F
(B) 2F
(D) 4F

42. An electron is located 1.0 meter from a +2.0-coulomb charge, as shown in the diagram below.

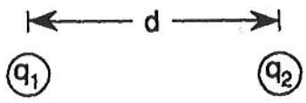


The electrostatic force acting on the electron is directed toward point

(A) *A* (C) *C*

(B) *B* (D) *D*

43. The diagram represents two charges, q_1 and q_2, separated by a distance d.



Which change would produce the greatest increase in the electrical force between the two charges?

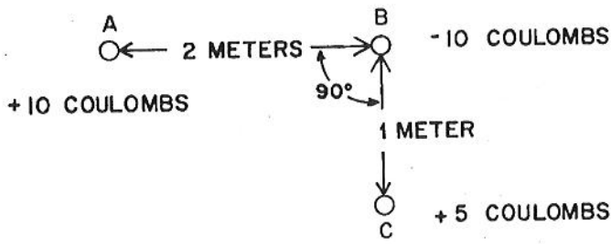
(A) doubling *d* and charge q_1, only

(B) doubling charge q_1, only

(C) doubling *d* and charges q_1 and q_2

(D) doubling *d*, only

44. The diagram shows three small metal spheres with different charges.

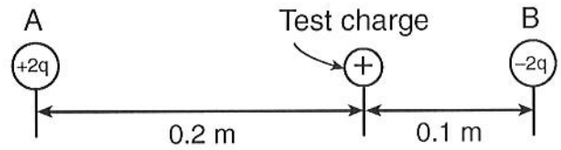


Compared to the force between spheres *A* and *B*, the force between spheres *B* and *C* is

(A) one-quarter as great (C) one-half as great

(B) twice as great (D) four times as great

45. In the diagram below, a positive test charge is located between two charged spheres, *A* and *B*. Sphere *A* has a charge of $+2q$ and is located 0.2 meter from the test charge. Sphere *B* has a charge of $-2q$ and is located 0.1 meter from the test charge.



If the magnitude of the force on the test charge due to sphere *A* is *F*, what is the magnitude of the force on the test charge due to sphere *B*?

(A) $\frac{F}{4}$ (C) $\frac{F}{2}$

(B) 2F (D) 4F

46. The magnitude of the electrostatic force between two point charges is *F*. If the distance between the charges is doubled, the electrostatic force between the charges will become

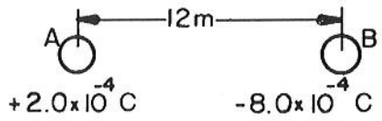
(A) $4F$

(B) $\frac{F}{2}$

(C) $\frac{F}{4}$

(D) $2F$

47. Base your answer to the following question on the diagram below which represents a system consisting of two charged metal spheres with equal radii.



Compared to the force exerted on sphere *B* at a separation of 12 meters, the force exerted on sphere *B* at a separation of 6.0 meters would be

(A) 1/2 as great
(C) 1/4 as great
(B) 2 times as great
(D) 4 times as great

48. If the charge on each of two point sources is doubled, the electrostatic force between them

(A) remains the same
(C) is twice as great
(B) is one-half as great
(D) is four times as great

Answer Key
[New Exam]

1. A
2. A
3. C
4. A
5. D
6. D
7. D
8. C
9. A
10. B
11. D
12. A
13. C
14. C
15. A
16. B
17. C
18. B
19. C
20. C
21. B
22. D
23. D
24. D
25. C
26. D
27. B
28. B
29. B
30. B
31. D
32. C
33. B
34. B
35. B
36. C
37. A
38. A
39. C
40. D
41. D
42. D
43. B
44. B
45. D
46. C
47. D
48. D

Version A