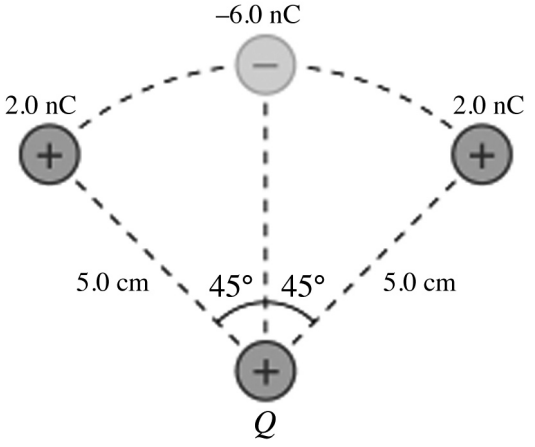
Exam

Name_____

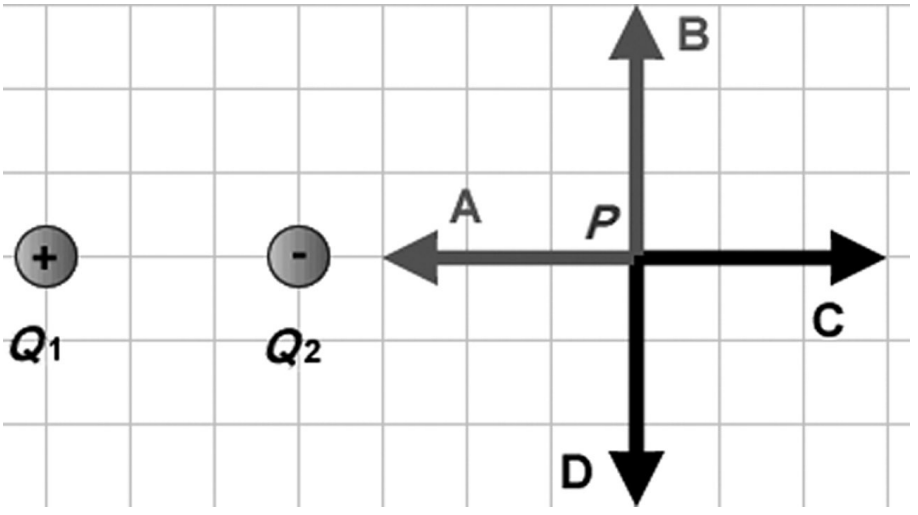
MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

1) The point charge at the bottom of the figure is Q = +17 nC, and the curve is a circular arc. What is the magnitude of the force on the charge Q due to the other point charges shown? ($k = 1/4\pi\varepsilon_0 = 8.99 \times 10^9$ N • m^2/C^2) 1) _____



A) 2.3×10^{-4} N B) 1.2×10^{-4} N C) 1.6×10^{-4} N D) 1.9×10^{-4} N

2) Two point charges Q_1 and Q_2 of equal magnitudes and opposite signs are positioned as shown in the figure. Which of the arrows best represents the net electric field at point *P* due to these two charges? 2) _____

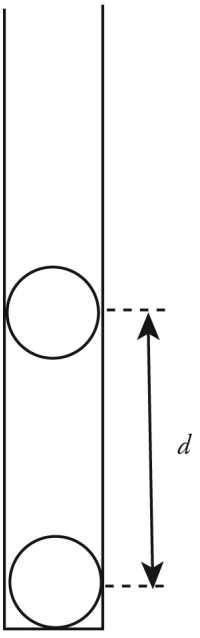


A) A
B) B
C) C
D) D
E) The field is equal to zero at point *P*.

3) Two very large parallel sheets a distance *d* apart have their centers directly opposite each other. The sheets carry equal but opposite uniform surface charge densities. A point charge that is placed near the middle of the sheets a distance *d*/2 from each of them feels an electrical force *F* due to the sheets. If this charge is now moved closer to one of the sheets so that it is a distance *d*/4 from that sheet, what force will feel? 3) _____

A) *F* B) *F*/4 C) *2F* D) *F*/2 E) 4*F*

4) One very small uniformly charged plastic ball is located directly above another such charge in a 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 distance between the balls in the test tube would become 4) _____



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

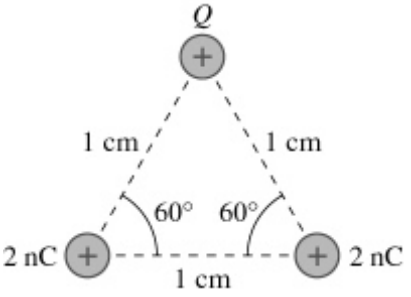
5) An electric dipole is made of two charges of equal magnitudes and opposite signs. The positive charge, q = 1.0 μC, is located at the point (x, y, z) = (0.00 cm, 1.0 cm, 0.00 cm), while the negative charge is located at the point (x, y, z) = (0.00 cm, -1.0 cm, 0.00 cm). How much work will be done by an electric field $\vec{\boldsymbol{E}} = (3.0 \times 10^6 \text{ N/C})\,\hat{\boldsymbol{i}}$ to bring the dipole to its stable equilibrium position? 5) _____

A) 0.020 J B) 0.12 J C) 0.060 J D) 0.00 J E) 0.030 J

6) A +7.00 μC point charge and -9.00 μC point charge are placed along the x-axis at x = 0.000 cm and x = 40.0 cm, respectively. Where must a third charge, q, be placed along the x-axis so that it does not experience any net electric force due to the other two charges? 6) _____

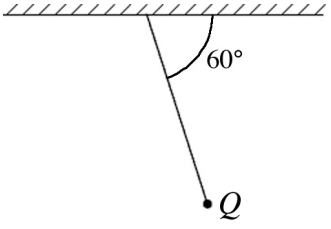
A) 2.99 m B) -0.200 m C) -2.99 m D) 0.187 m E) -0.187 m

7) In the figure Q = 5.8 nC and all other quantities are accurate to 2 significant figures. What is the magnitude of the force on the charge Q? ($k = 1/4\pi\varepsilon_0 = 8.99 \times 10^9$ N • m^2/C^2) 7) _____



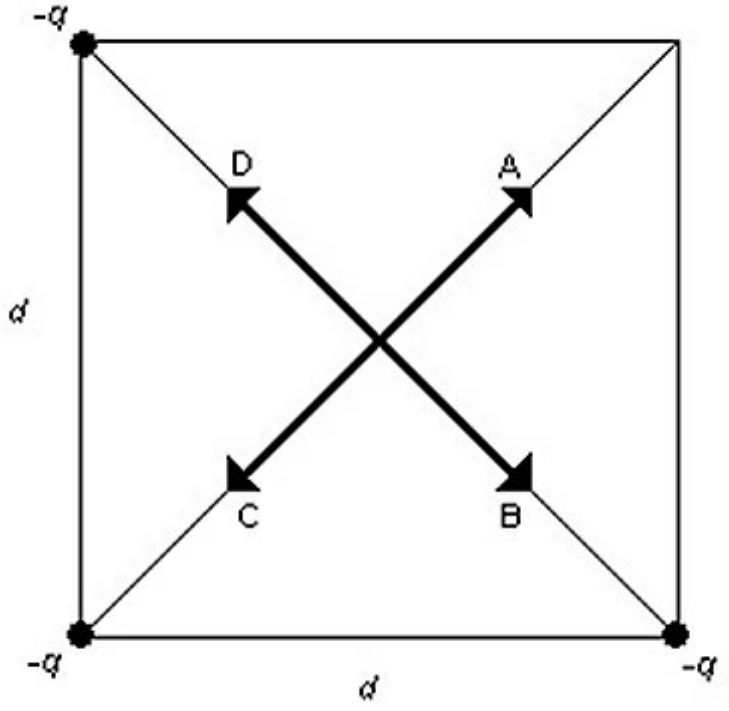
A) 1.2×10^{-3} N B) 1.8×10^{-3} N C) 1.0×10^{-3} N D) 9.0×10^{-4} N

8) A point charge Q of mass 8.50 g hangs from the horizontal ceiling by a light 25.0-cm thread. When a horizontal electric field of magnitude 1750 N/C is turned on, the charge hangs away from the vertical as shown in the figure. The magnitude of Q is closest to 8) _____



A) 27.5 µC. B) 55.0 µC. C) 3.5 µC. D) 47.6 µC. E) 3.0 µC.

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



A) A
B) B
C) C
D) D
E) The field is equal to zero at point *P*.

10) A small sphere with a mass of 441 g is moving upward along the vertical +*y*-axis when it encounters an electric field of 5.00 N/C $\hat{\boldsymbol{i}}$. If, due to this field, the sphere suddenly acquires a horizontal acceleration of 13.0 m/s^2 $\hat{\boldsymbol{i}}$, what is the charge that it carries? 10) _____

A) 1.15 C B) 1150 C C) -1.15 C D) -1150 C

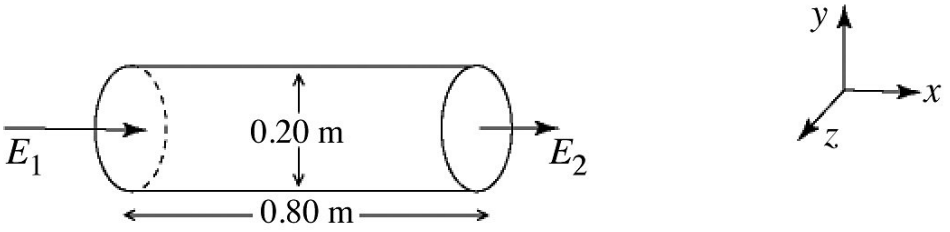
11) A charge q = 2.00 μC is placed at the origin in a region where there is already a uniform electric field $\vec{\boldsymbol{E}}$ = (100 N/C) $\hat{\boldsymbol{i}}$. Calculate the flux of the net electric field through a Gaussian sphere of radius R = 10.0 cm centered at the origin. ($\varepsilon_0 = 8.85 \times 10^{-12}$ C^2/N • m^2) 11) _____

A) zero
B) 2.26×10^5 N • m^2/C
C) 1.13×10^5 N • m^2/C
D) 5.52×10^5 N • m^2/C

12) A very large sheet of a conductor carries a uniform charge density of $4.00\ \text{pC/mm}^2$ on its surfaces. What is the electric field strength 3.00 mm outside the surface of the conductor? ($\varepsilon_0 = 8.85 \times 10^{-12}\ \text{C}^2/\text{N} \cdot \text{m}^2$) 12) _____

A) 0.452 N/C
B) 9.04×10^5 N/C
C) 0.226 N/C
D) 4.52×10^5 N/C
E) 2.26×10^5 N/C

13) A nonuniform electric field is directed along the *x*-axis at all points in space. This magnitude of the field varies with *x*, but not with respect to *y* or *z*. The axis of a cylindrical surface, 0.80 m long and 0.20 m in diameter, is aligned parallel to the *x*-axis, as shown in the figure. The electric fields E_1 and E_2, at the ends of the cylindrical surface, have magnitudes of 6000 N/C and 1000 N/C respectively, and are directed as shown. What is the net electric flux passing through the cylindrical surface? 13) _____

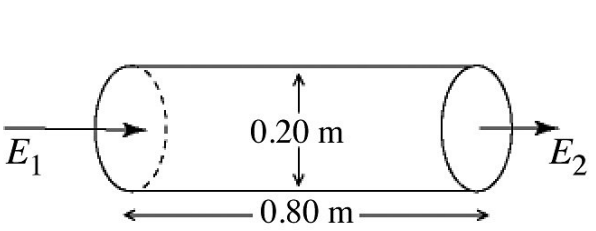


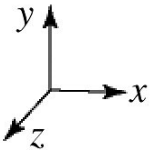
A) 0.00 N • m^2/C
B) -350 N • m^2/C
C) +160 N • m^2/C
D) -160 N • m^2/C
E) +350 N • m^2/C

14) A huge (essentially infinite) horizontal nonconducting sheet 10.0 cm thick has charge uniformly spread over both faces. The upper face carries $+95.0\ \text{nC/m}^2$ while the lower face carries $-25.0\ \text{nC/ m}^2$. What is the magnitude of the electric field at a point within the sheet 2.00 cm below the upper face? ($\varepsilon_0 = 8.85 \times 10^{-12}\ \text{C}^2/\text{N} \cdot \text{m}^2$) 14) _____

A) 6.78×10^3 N/C
B) 1.36×10^4 N/C
C) 3.95×10^3 N/C
D) 0.00 N/C
E) 7.91×10^3 N/C

15) A nonuniform electric field is directed along the *x*-axis at all points in space. This magnitude of the field varies with *x*, but not with respect to *y* or *z*. The axis of a cylindrical surface, 0.80 m long and 0.20 m in diameter, is aligned parallel to the *x*-axis, as shown in the figure. The electric fields E_1 and E_2, at the ends of the cylindrical surface, have magnitudes of 9000 N/C and 5000 N/C respectively, and are directed as shown. ($\varepsilon_0 = 8.85 \times 10^{-12}$ C^2/N • m^2) The charge enclosed by the cylindrical surface is closest to 15) _____





A) 4.8 nC. B) -1.1 nC. C) 1.1 nC. D) -2.4 nC. E) -4.8 nC.

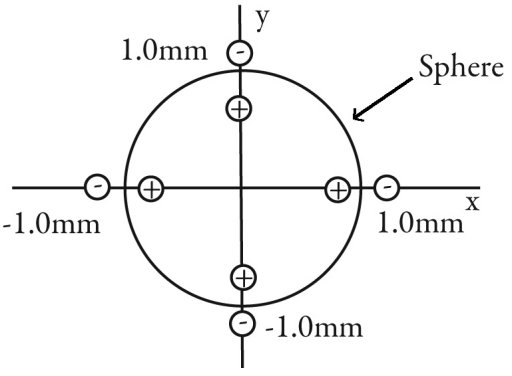
16) A solid nonconducting sphere of radius *R* carries a charge *Q* distributed uniformly throughout its volume. At a certain distance r_1 ($r_1 < R$) from the center of the sphere, the electric field has magnitude *E*. If the same charge *Q* were distributed uniformly throughout a sphere of radius 2*R*, the magnitude of the electric field at the same distance r_1 from the center would be equal to 16) _____

A) 8*E*. B) *E*. C) *E*/8. D) 2*E*. E) *E*/2.

17) Electric charge is uniformly distributed inside a nonconducting sphere of radius 0.30 m. The electric field at a point *P*, which is 0.50 m from the center of the sphere, is 15,000 N/C and is directed radially outward. At what distance from the center of the sphere does the electric field have the same magnitude as it has at *P*? 17) _____

A) 0.17 m
B) 0.13 m
C) 0.15 m
D) 0.11 m
E) at no other point

18) Four dipoles, each consisting of a +10-μC charge and a -10-μC charge, are located in the *xy*-plane with their centers 1.0 mm from the origin, as shown. A sphere passes through the dipoles, as shown in the figure. What is the electric flux through the sphere due to these dipoles? ($\varepsilon_0 = 8.85 \times 10^{-12}$ C^2/N • m^2) 18) _____



A) 11×10^5 N • m^2/C
B) 4.5×10^6 N • m^2/C
C) 9.0×10^6 N • m^2/C
D) 0.00 N • m^2/C

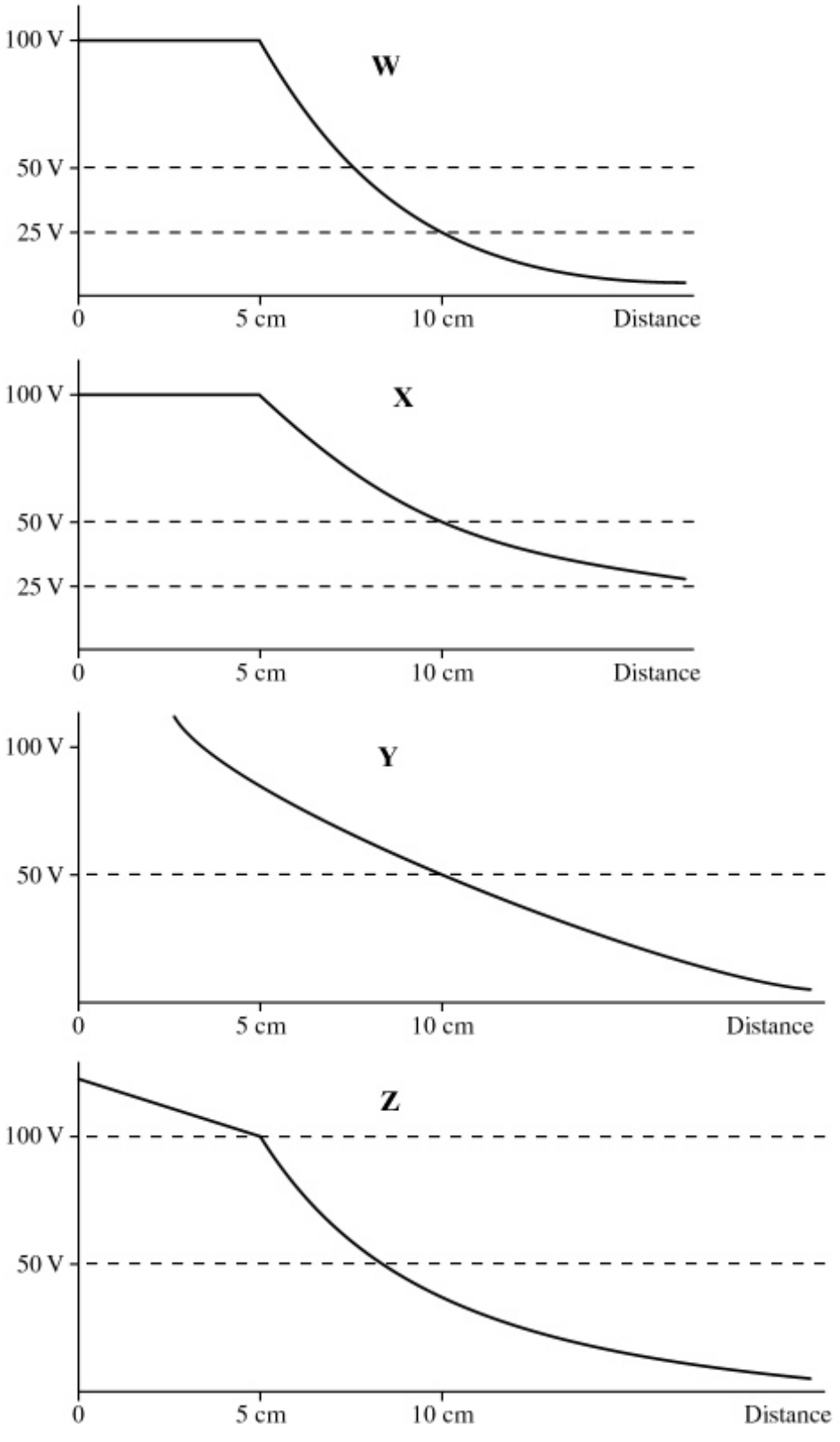
19) An uncharged conductor has a hollow cavity inside of it. Within this cavity there is a charge of +10 μC that does not touch the conductor. There are no other charges in the vicinity. Which statement about this conductor is true? (There may be more than one correct choice.) 19) _____

A) Both surfaces of the conductor carry no excess charge because the conductor is uncharged.
B) The net electric field within the material of the conductor points away from the +10 μC charge.
C) The inner surface of the conductor carries a charge of -10 μC and its outer surface carries no excess charge.
D) The outer surface of the conductor contains +10 μC of charge and the inner surface contains -10 μC.
E) The inner and outer surfaces of the conductor each contain charges of -5 μC.

20) A spherical, non-conducting shell of inner radius $r_1 = 10$ cm and outer radius $r_2 = 15$ cm carries a total charge Q = 15 μC distributed uniformly throughout the volume of the shell. What is the magnitude of the electric field at a distance $r = 12$ cm from the center of the shell? ($k = 1/4\pi\varepsilon_0 = 8.99 \times 10^9$ N • m^2/C^2) 20) _____

A) 5.75×10^3 N/C
B) zero
C) 5.75×10^6 N/C
D) 2.87×10^3 N/C
E) 2.87×10^6 N/C

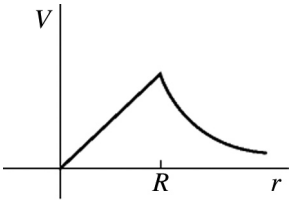
21) A metallic sphere of radius 5 cm is charged such that the potential of its surface is 100 V (relative to infinity). Which of the following plots correctly shows the potential as a function of distance from the center of the sphere? 21) _____



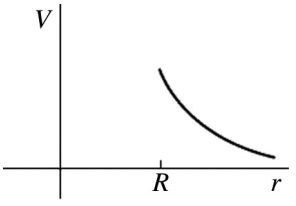
A) plot W B) plot X C) plot Y D) plot Z

22) A conducting sphere of radius *R* carries an excess positive charge and is very far from any other charges. Which one of the following graphs best illustrates the potential (relative to infinity) produced by this sphere as a function of the distance *r* from the center of the sphere? 22) _____

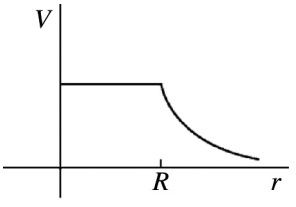
A)



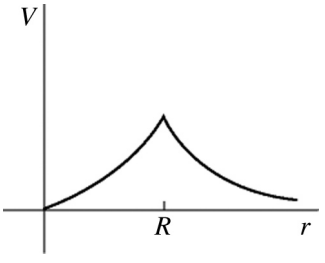
B)



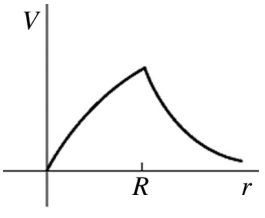
C)



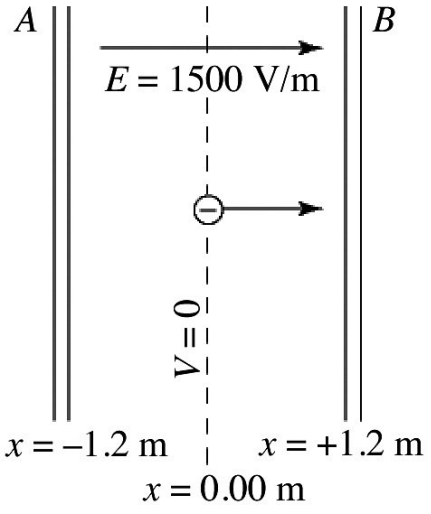
D)



E)



23) Two large conducting parallel plates *A* and *B* are separated by 2.4 m. A uniform field of 1500 V/m, in the positive *x*-direction, is produced by charges on the plates. The center plane at $x = 0.00$ m is an equipotential surface on which $V = 0$. An electron is projected from $x = 0.00$ m, with an initial velocity of 1.0×10^7 m/s perpendicular to the plates in the positive *x*-direction, as shown in the figure. What is the kinetic energy of the electron as it reaches plate *A*? ($e = 1.60 \times 10^{-19}$ C, $m_{el} = 9.11 \times 10^{-31}$ kg) 23) _____



A) -2.4×10^{-16} J
B) -3.3×10^{-16} J
C) $+3.3 \times 10^{-16}$ J
D) -2.9×10^{-16} J
E) $+2.4 \times 10^{-16}$ J

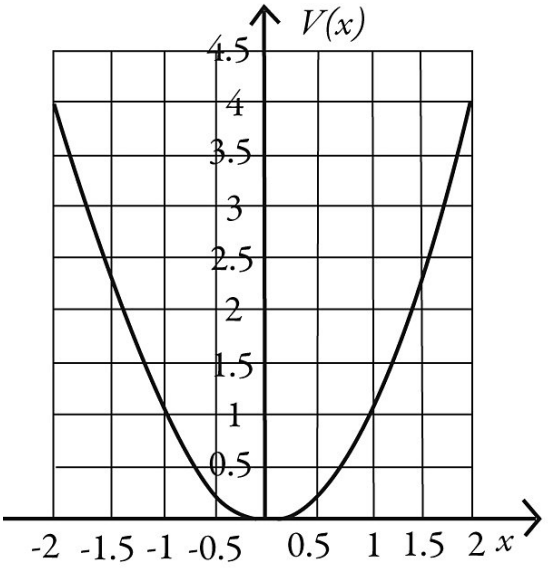
24) Two point charges of +1.0 μC and -2.0 μC are located 0.50 m apart. What is the minimum amount of work needed to move the charges apart to double the distance between them? ($k = 1/4\pi\varepsilon_0 = 8.99 \times 10^9$ N • m^2/C^2) 24) _____

A) +36 mJ B) -18 mJ C) +18 mJ D) 0 mJ E) -36 mJ

25) A tiny object carrying a charge of +3.00 μC and a second tiny charged object are initially very far apart. If it takes 29.0 J of work to bring them to a final configuration in which the +3.00 μC object i is at $x = 1.00$ mm, $y = 1.00$ mm, and the other charged object is at $x = 1.00$ mm, $y = 3.00$ mm, find the magnitude of the charge on the second object. ($k = 1/4\pi\varepsilon_0 = 8.99 \times 10^9$ N • m^2/C^2) 25) _____

A) 4.30 nC B) 10.74 μC C) 4.30 μC D) 2.15 μC

26) The graph in the figure shows the variation of the electric potential $V(x)$ (in arbitrary units) as a function of the position x (also in arbitrary units). Which of the choices below correctly describes the orientation of the x-component of the electric field along the x-axis? 26) _____

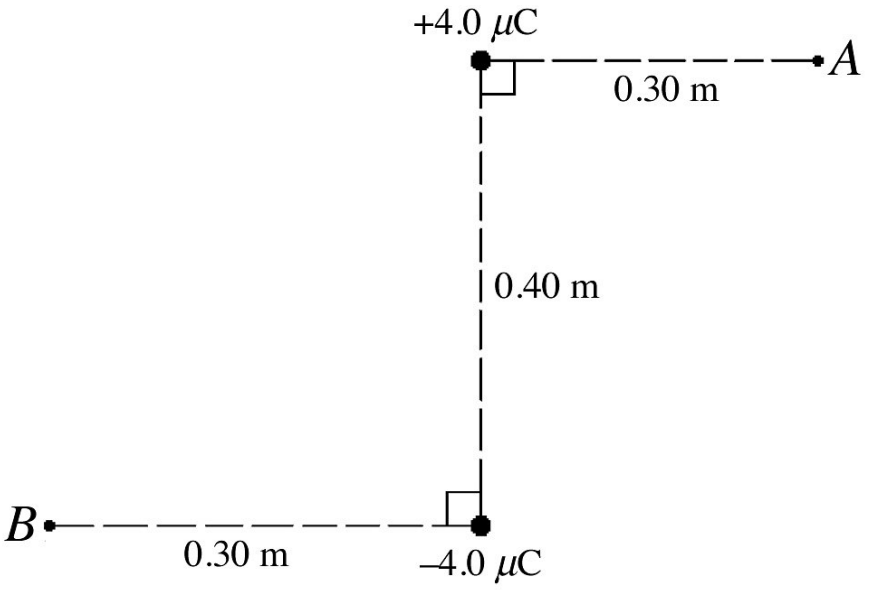


A) E_X is negative from x = -2 to x = 0, and positive from x = 0 to x = 2.
B) E_X is positive from x = -2 to x = 2.
C) E_X is negative from x = -2 to x = 2.
D) E_X is positive from x = -2 to x = 0, and negative from x = 0 to x = 2.

27) A nonconducting sphere contains positive charge distributed uniformly throughout its volume. Which statements about the potential due to this sphere are true? All potentials are measured relative to infinity. (There may be more than one correct choice.) 27) _____

A) The potential at the center of the sphere is the same as the potential at the surface.
B) The potential at the surface is higher than the potential at the center.
C) The potential at the center is the same as the potential at infinity.
D) The potential is highest at the center of the sphere.
E) The potential at the center of the sphere is zero.

28) A +4.0 μC-point charge and a -4.0-μC point charge are placed as shown in the figure. What is the potential difference, $V_A - V_B$, between points *A* and *B*? ($k = 1/4\pi\varepsilon_0 = 8.99 \times 10^9$ N • m^2/C^2) 28) _____



A) 96 V B) 48 V C) 48 kV D) 0.00 V E) 96 kV

29) If the potential in a region is given by $V(x,y,z) = xy - 3z^{-2}$, then the *y* component of the electric field in that region is 29) _____

A) $-y$. B) $x + y - 6z^{-3}$. C) $-x$. D) $x + y$.

30) Two long conducting cylindrical shells are coaxial and have radii of 20 mm and 80 mm. The electric potential of the inner conductor, with respect to the outer conductor, is +600 V. An electron is released from rest at the surface of the outer conductor. What is the speed of the electron as it reaches the inner conductor? ($e = 1.60 \times 10^{-19}$ C, $m_{el} = 9.11 \times 10^{-31}$ kg, $k = 1/4\pi\varepsilon_0 = 8.99 \times 10^9$ N • m^2/C^2) 30) _____

A) 1.1×10^7 m/s
B) 1.7×10^7 m/s
C) 1.5×10^7 m/s
D) 1.3×10^7 m/s
E) 1.9×10^7 m/s

Answer Key
Testname: PRACTICE EXAM 1

1) D
2) A
3) A
4) B
5) C
6) C
7) B
8) A
9) C
10) A
11) B
12) D
13) D
14) A
15) B
16) C
17) D
18) B
19) D
20) E
21) B
22) C
23) C
24) C
25) D
26) D
27) D
28) E
29) C
30) C