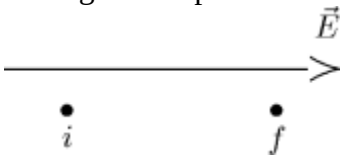
Name: _____ Date: _____

1. An electron moves from point *i* to point *f*, in the direction of a uniform electric field. During this displacement:



A) the work done by the field is positive and the potential energy of the electron-field system increases
B) the work done by the field is negative and the potential energy of the electron-field system increases
C) the work done by the field is positive and the potential energy of the electron-field system decreases
D) the work done by the field is negative and the potential energy of the electron-field system decreases
E) the work done by the field is positive and the potential energy of the electron-field system does not change

2. The potential difference between the ends of a 2-meter stick that is parallel to a uniform electric field is 400 V. The magnitude of the electric field is:

A) zero
B) 100 V/m
C) 200 V/m
D) 400 V/m
E) 800 V/m

3. In separate experiments, four different particles each start from far away with the same speed and impinge directly on a gold nucleus. The masses and charges of the particles are
particle 1: mass m_0, charge q_0
particle 2: mass $2m_0$, charge $2q_0$
particle 3: mass $2m_0$, charge $q_0/2$
particle 4: mass $m_0/2$, charge $2q_0$
Rank the particles according to the distance of closest approach to the gold nucleus, from smallest to largest.

A) 1, 2, 3, 4
B) 4, 3, 2, 1
C) 3, 1 and 2 tie, then 4
D) 4, 1 and 2 tie, then 1
E) 1 and 2 tie, then 3, 4

4. The electric field in a region around the origin is given by $\vec{E} = C(x\,\hat{\mathrm{i}} + y\,\hat{\mathrm{j}})$, where C is a constant. The equipotential surfaces in that region are:

A) concentric cylinders with axes along the z axis
B) concentric cylinders with axes along the x axis
C) concentric spheres centered at the origin
D) planes parallel to the xy plane
E) planes parallel to the yz plane

5. If 500 J of work are required to carry a charged particle between two points with a potential difference of 20 V, the magnitude of the charge on the particle is:

A) 0.040 C
B) 12.5 C
C) 20 C
D) cannot be computed unless the path is given
E) none of these

6. In a certain region of space the electric potential increases uniformly from east to west and does not vary in any other direction. The electric field:

A) points east and varies with position
B) points east and does not vary with position
C) points west and varies with position
D) points west and does not vary with position
E) points north and does not vary with position

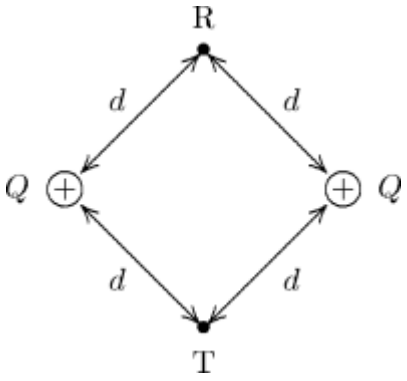
7. Choose the correct statement:

A) A proton tends to go from a region of low potential to a region of high potential
B) The potential of a negatively charged conductor must be negative
C) If $\vec{E}=0$ at a point P then V must be zero at P
D) If $V = 0$ at a point P then $\vec{E}$ must be zero at P
E) None of the above are correct

8. A 5-cm radius isolated conducting sphere is charged so its potential is + 100 V, relative to the potential far away. The charge density on its surface is:

A) $+ 2.2 \times 10^{-7}$ C/m^2
B) -2.2×10^{-7} C/m^2
C) $+ 3.5 \times 10^{-7}$ C/m^2
D) -3.5×10^{-7} C/m^2
E) $+ 1.8 \times 10^{-8}$ C/m^2

9. Points R and T are each a distance d from each of two particles with equal positive charges as shown. If $k = 1/4\pi\epsilon_0$, the work required to move a test charge q from R to T is:



A) 0
B) kQq/d^2
C) kQq/d
D) $kQq/(\sqrt{2}d)$
E) $kQq/(2d)$

10. Two conducting spheres are far apart. The smaller sphere carries a total charge Q. The larger sphere has a radius that is twice that of the smaller and is neutral. After the two spheres are connected by a conducting wire, the charges on the smaller and larger spheres, respectively, are:

A) $Q/2$ and $Q/2$
B) $Q/3$ and $2Q/3$
C) $2Q/3$ and $Q/3$
D) zero and Q
E) $2Q$ and $-Q$

11. A total charge of 7×10^{-8} C is uniformly distributed throughout a non-conducting sphere with a radius of 5 cm. The electric potential at the surface, relative to the potential far away, is about:

A) -1.3×10^4 V
B) 1.3×10^4 V
C) 7.0×10^5 V
D) -6.3×10^4 V
E) 0

12. During a lightning discharge, 30 C of charge move through a potential difference of 1.0×10^8 V in 2.0×10^{-2} s. The energy released by this lightning bolt is:

A) 1.5×10^{11} J
B) 3.0×10^9 J
C) 6.0×10^7 J
D) 3.3×10^6 J
E) 1500 J

13. The potential difference between two points is 100 V. If 2 C is transported from one of these points to the other, the magnitude of the work done is:

A) 200 J
B) 100 J
C) 50 J
D) 100 J
E) 2 J

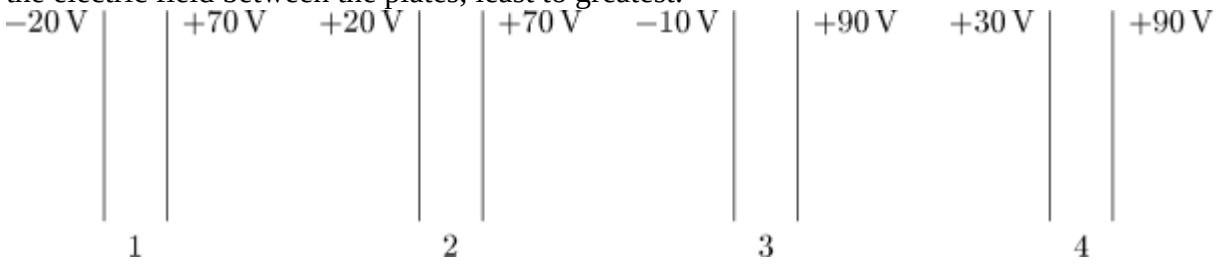
14. A 5.5×10^{-8}-C charge is fixed at the origin. A -2.3×10^{-8}-C charge is moved from x = 3.5 cm on the x axis to y = 3.5 cm on the y axis. The change in the potential energy of the two-charge system is:

A) 3.2×10^{-4} J
B) -3.2×10^{-4} J
C) 9.3×10^{-3} J
D) -9.3×10^{-3} J
E) 0

15. The work in joules required to carry a 6.0-C charge from a 5.0-V equipotential surface to a 6.0-V equipotential surface and back again to the 5.0-V surface is:

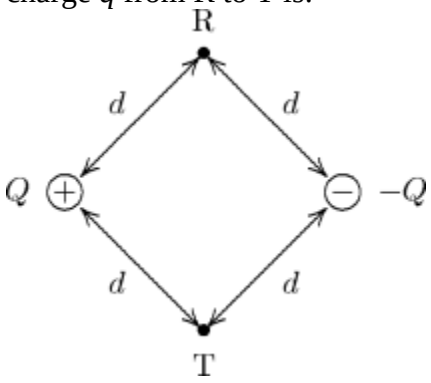
A) 0
B) 1.2×10^{-5}
C) 3.0×10^{-5}
D) 6.0×10^{-5}
E) 6.0×10^{-6}

16. The diagram shows four pairs of large parallel conducting plates. The value of the electric potential is given for each plate. Rank the pairs according to the magnitude of the electric field between the plates, least to greatest.



A) 1, 2, 3, 4
B) 4, 3, 2, 1
C) 2, 3, 1, 4
D) 2, 4, 1, 3
E) 3, 2, 4, 1

17. Points R and T are each a distance *d* from each of two particles with equal and opposite charges as shown. If $k = 1/4\pi\epsilon_0$, the work required to move a particle with negative charge *q* from R to T is:



A) 0
B) kqQ/d^2
C) kqQ/d
D) $kqQ/(\sqrt{2}d)$
E) $kQq/(2d)$

18. Equipotential surfaces associated with an electric dipole are:

A) spheres centered on the dipole
B) cylinders with axes along the dipole moment
C) planes perpendicular to the dipole moment
D) planes parallel to the dipole moment
E) none of the above

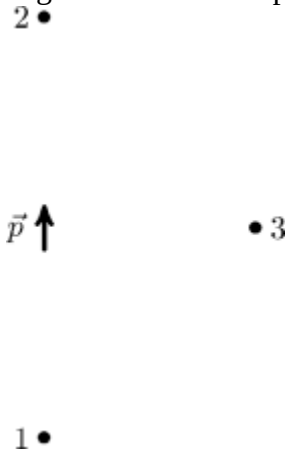
19. Positive charge is distributed uniformly throughout a non-conducting sphere. The highest electric potential occurs:

A) at the center
B) at the surface
C) halfway between the center and surface
D) just outside the surface
E) far from the sphere

20. An electron is accelerated from rest through a potential difference *V*. Its final speed is proportional to:

A) V
B) V^2
C) $\sqrt{V}$
D) $1/V$
E) $1/\sqrt{V}$

21. In the diagram, the points 1, 2, and 3 are all the same very large distance from a dipole. Rank the points according to the values of the electric potential at them, from the most negative to the most positive.



A) 1, 2, 3
B) 3, 2, 1
C) 2, 3, 1
D) 1, 3, 2
E) 1 and 2 tie, then 3

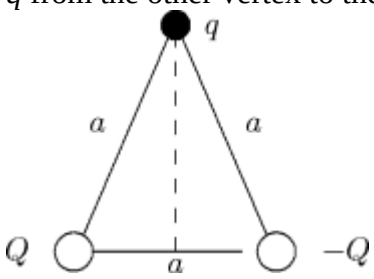
22. A conducting sphere with radius *R* is charged until the magnitude of the electric field just outside its surface is *E*. The electric potential of the sphere, relative to the potential far away, is:

A) zero
B) E/R
C) E/R^2
D) ER
E) ER^2

23. Eight identical spherical raindrops are each at a potential *V*, relative to the potential far away. They coalesce to make one spherical raindrop whose potential is:

A) *V*/8
B) *V*/2
C) 2*V*
D) 4*V*
E) 8*V*

24. Two particles with charges *Q* and –*Q* are fixed at the vertices of an equilateral triangle with sides of length *a*. If $k = 1/4\pi\epsilon_0$, the work required to move a particle with charge *q* from the other vertex to the center of the line joining the fixed charges is:



A) 0
B) *kQq*/*a*
C) kQq/a^2
D) 2*kQq*/*a*
E) $\sqrt{2}kQq/a$

25. Two identical charges *q* are placed on the *x* axis, one at the origin and the other at *x* = 5 cm. A third charge –*q* is placed on the *x* axis so the potential energy of the three-charge system is the same as the potential energy at infinite separation. Its *x* coordinate is:

A) 13 cm
B) 2.5 cm
C) 7.5 cm
D) 10 cm
E) –5 cm

Answer Key

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