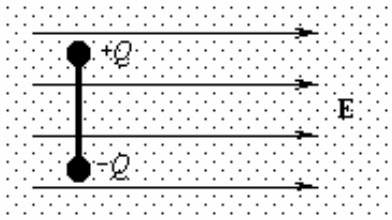
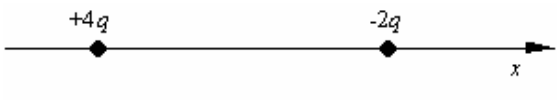
66. A electric dipole is released from rest in a uniform electric field with the orientation shown. Which entry in the table bel ow correctly describes the rotation and the net force on the dipole?



	rotation	*net force*
a.	clockwise	non-zero
b.	zero	zero
c.	counterclockwise	non-zero
d.	counterclockwise	zero
e.	clockwise	zero

67. At which point (or points) is the electric field zero N/C for the two point charges shown on the *x* axis?



a. The electric field is zero somewhere on the *x* axis to the right of the –2*q* charge.
b. The electric field is zero somewhere on the *x* axis between the two charges, but this point is nearer to the –2*q* charge.
c. The electric field is never zero in the vicinity of these charges.
d. The electric field is zero at two points along the *x* axis; one such point is to the right of the –2*q* charge and the other is to the left of the +4*q* charge.
e. The electric field is zero somewhere on the *x* axis to the left of the +4*q* charge.

68. Two point charges, *q*1 and *q*2, are placed a distance *r* apart. The electric field is zero at a point P between the charges on the line segment connecting them. We conclude that:
a. *q*1 and *q*2 must have the same magnitude and sign
b. P must be midway between *q*1 and *q*2
c. *q*1 and *q*2 must have the same sign but may have different magnitudes
d. *q*1 and *q*2 must have equal magnitudes and opposite signs
e. *q*1 and *q*2 must have opposite signs and may have different magnitudes

POTENTIAL PROBLEMS 1

1. A uniform electric field with a magnitude of 500 N/C is directed parallel to the positive *x*-axis. If the potential at *x* = 5 m is 2500 V, what is the potential at *x* = 2 m? Solutions, detailed in my notes.

   a. 1000 V c. 4000 V

   b. 2000 V d. 4500 V

2. A small, positively charged object near a positively charged sphere is moved closer to the sphere. The electric potential energy of the small object

   a. increases. b. decreases. c. stays the same.

3. When an electron is brought near a negatively charged sphere, its potential energy increases. The reason this happens is that

   a. negative charges repel each other.
   b. work was done to bring the charges together.
   c. two like charges go from a position far apart to a position close together.
   d. none of the above

4. Electric potential is defined as

   a. gravitational potential.
   b. electric potential energy.
   c. electric potential energy of a charge divided by the quantity of the charge.
   d. electric potential energy of a charge multiplied by the quantity of the charge.
   e. voltage.

5. If you use 10 J of work to push a 1-C charge into an electric field, its voltage with respect to its starting position is

   a. less than 10 V. b. 10 V. c. more then 10 V.

6. A 2-C charge is located near a positively charged sphere so that it has 40 J of electric potential energy. Its electric potential is

   a. 80 V. b. 40 V. c. 20 V. d. 10 V. e. 2 V.

7. When a positive charge moves because of a force, what happens to the electrical potential energy associated with the charge's position in the system?

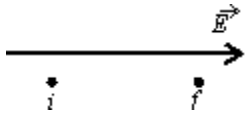
   a. It increases.
   b. It decreases.
   c. It remains the same.
   d. It sharply increases, and then decreases.

8. Charge build up between the plates of a capacitor stops when
   a. there is no net charge on the plates.
   b. unequal amounts of charge accumulate on the plate.
   c. the potential difference between the plates is equal to the potential difference between the terminals of the battery.
   d. the charge on both plates is the same.

9. When comparing the net charge of a charged capacitor with the net charge of the same capacitor when it is uncharged, the net charge is

   a. greater in the charged capacitor.
   b. less in the charged capacitor.
   c. equal in both capacitors.
   d. greater or less in the charged capacitor, but never equal.

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



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

11. If 500 J of work are required to carry a 40-C charge from one point to another, the potential difference between these two points is:

A) 12.5 V
B) 20,000 V
C) 0.08 V
D) depends on the path
E) none of these

12. 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:

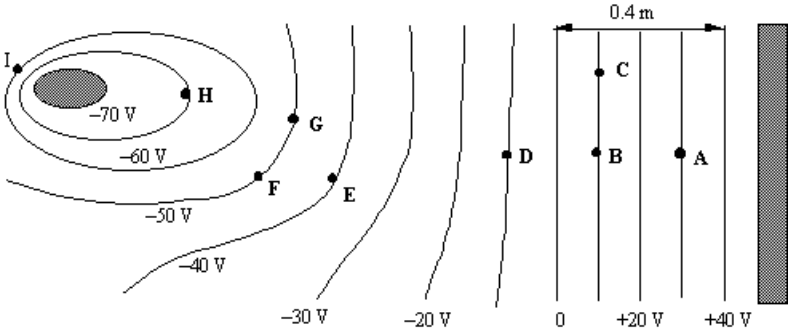
A) 200 J
B) 100 J
C) 50 J
D) 100 V
E) 2 J

13. 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

Use the following to answer questions 14-22:

The sketch below shows cross sections of equipotential surfaces between two charged conductors that are shown in solid black. Various points on the equipotential surfaces near the conductors are labeled **A**, **B**, **C**, ..., **I**.



14. At which of the labeled points will the electric field have the greatest magnitude?
A) **D** B)**H** C)**G** D)**A** E)**I**

15. What is the magnitude of the electric field at point **A**?
A) 100 V/m
B) 10 V/m
C) 75 V/m
D) 25 V/m
E) 30 V/m

16. At which of the labeled points will an electron have the greatest potential energy?
A) **H** B)**D** C)**G** D)**I** E)**A**

17. What is the direction of the electric field at **B**?
A) toward **D**
B) up and out of the page
C) into the page
D) toward **A**
E) toward **C**

18. A positive point charge is placed at **F.** Complete the following statement: When it is released,
A) a force will cause it to move toward **E**.
B) it would subsequently lose kinetic energy.
C) a force will cause it to move away from **E**.
D) no force will be exerted on it.
E) a force will cause it to move toward **G**.

19. How much work is required to move a $-1\ \mu C$ charge from **A** to **E**?
A) -4.0×10^{-5} J
B) -7.0×10^{-5} J
C) $+7.0 \times 10^{-5}$ J
D) zero joules
E) $+3.0 \times 10^{-5}$ J

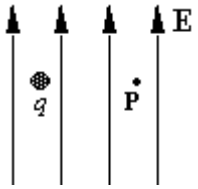
20. A point charge gains 50 μJ of electric potential energy when it is moved from point **D** to point **G**. Determine the magnitude of the charge.
A) 50 μC
B) 1.3 μC
C) 130 μC
D) 25 μC
E) 1.0 μC

21. What is the potential difference between points **B** and **E**?
A) 50 V
B) 30 V
C) 60 V
D) 40 V
E) 10 V

22. How much work is required to move a -1 μC charge from **B** to **D** to **C**?
A) -4.0×10^{-5} J
B) $+2.0 \times 10^{-5}$ J
C) $+4.0 \times 10^{-5}$ J
D) zero joules
E) -2.0×10^{-5} J

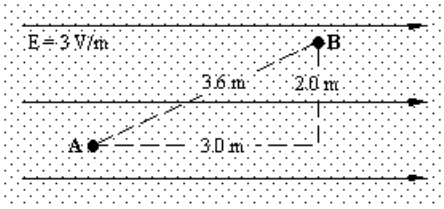
23. A charge q = -4.0 μC is moved 0.25 m horizontally to point **P** in a region where an electric field is 150 V/m and directed vertically as shown. What is the change in the electric potential energy of the charge?

A) $+2.4 \times 10^{-3}$ J
B) -1.5×10^{-4} J
C) -2.4×10^{-3} J
D) zero joules
E) $+1.5 \times 10^{-4}$ J



24. The electric potential at a certain point is space is 12 V. What is the electric potential energy of a -3.0 μC charge placed at that point?
A) +4 μJ
B) -4 μJ
C) -36 μJ
D) zero μJ
E) +36 μJ

25. A +1.0 μC point charge is moved from point **A** to **B** in the uniform electric field as shown. Which one of the following statements is necessarily true concerning the potential energy of the point charge?



A) It decreases by 6.0×10^{-6} J.
B) It increases by 6.0×10^{-6}J.
C) It decreases by 10.8×10^{-6} J.
D) It decreases by 9.0×10^{-6} J.
E) It increases by 10.8×10^{-6} J.

**26. A completely ionized beryllium atom (net charge = +4*e*) is accelerated through a potential difference of 6.0 V. What is the increase in kinetic energy of the atom?
A) 24 eV
B) 0.67 eV
C) 4 eV
D) 6 eV
E) zero eV

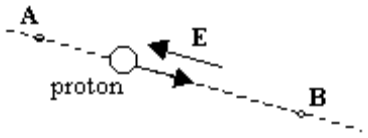
27. A uniform electric field of 8 V/m exists between the plates of a parallel plate capacitor. How much work is required to move a +20 μC point charge from the negative plate to the positive plate if the plate separation is 0.050 m?

A) 8×10^{-4} J
B) 8×10^{-6} J
C) 8×10^{-5} J
D) 1.6 J
E) 0.4 J

28. If the work required to move a +0.35 C charge from point **A** to point **B** is +125 J, what is the potential difference between the two points?

A) 180 V
B) 88 V
C) zero volts
D) 360 V
E) 44 V

29. A proton moves in a constant electric field **E** from point A to point B. The magnitude of the electric field is 4.2×10^4 N/C; and it is directed as shown in the drawing, the direction opposite to that of the proton. If the distance from point A to point B is 0.18 m, what is the change in the proton's electric potential energy, $U_A - U_B$?



A) $+1.2 \times 10^{-15}$ J
B) -2.4×10^{-15} J
C) -1.8×10^{-15} J
D) $+2.4 \times 10^{-15}$ J
E) -1.2×10^{-15} J

POTENTIAL PROBLEMS 2

1. An electron traveling north enters a region where the electric field is uniform and points west. The electron:
a. speeds up b. slows down c. veers east d. veers west
e. continues with the same speed in the same direction

2. Electric potential energy is the energy a charged object has because of its
a. location. b. size. c. motion. d. momentum. e. electric charge.

5. After you rub a balloon on your hair, the balloon will likely be charged
a. to several thousand volts.
b. to several hundred volts.
c. to less than 10 volts.
d. not at all.

8. Which of the following is NOT a characteristic of electrical potential energy?
a. It is a form of mechanical energy.
b. It results from a single charge.
c. It results from the interaction between charges.
d. It is associated with a charge in an electric field.

12. A capacitor consists of two metal plates; ____ is stored on one plate and ____ is stored on the other.
a. negative charge; positive charge
b. potential energy; kinetic energy
c. potential difference; internal resistance
d. residual charge; induced charge

15. A proton of mass m and charge e is accelerated from rest through a potential difference V. The final speed of the proton is

A. $\sqrt{\frac{2Ve}{m}}$. B. $\frac{2Ve}{m}$. C. $\sqrt{\frac{Ve}{m}}$. D. $\frac{Ve}{m}$.

16. Which of the following correctly describes the nature of electric potential and electric field strength?

	Potential	Electric field
A.	Scalar	Scalar
B.	Scalar	Vector
C.	Vector	Scalar
D.	Vector	Vector

17. The electric field required to suspend a proton against the force of gravity is:
A 102 nanovolts/m directed upward
B 102 nanovolts/m directed downward
C 557 picovolts/m directed upward
D 557 picovolts/m directed downward

18. An alpha particle (nucleus of helium with 2 protons and 2 neutrons) and an electron are each accelerated from rest through a potential difference of 2500 volts. Their resultant kinetic energies, in electron volts will be, respectively:

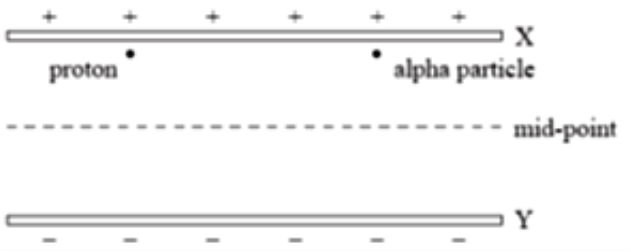
A. none of these
B. 2500, 1.36
C. 10000, 2500
D. 2500, 1250
E. 5000, 2500

19. Two large, parallel, conducting plates are 1.2 mm apart and have equal and opposite charges on their facing surfaces. An el ectrostatic force of 6×10^{-13} N acts on an electron placed anywhere between the two plates. What is the potential difference in vo lts between the plates?

A. 4500
B. 720
C. 3.76×10^{6}
D. 2250

20. A proton and an alpha particle (nucleus of helium atom = 2 neutrons +

2 protons) are accelerated from rest from the positively charged plate X to the negatively charged plate Y.



At the mid-point between the plates, the proton has a kinetic energy E_K. At this point, the alpha particle has a kinetic energy

A. E_K /2. B. E_K . C. 2 E_K. D. 4 E_K.