Name: Key

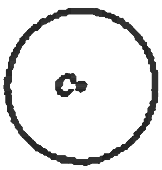
AP Physics

Date ______________________

Test #8 Review

Electrostatics

1) The hollow metal sphere shown below is positively charged.



Point C is the center of the sphere. Which of the following is true of the electric potential and the electric field at this point?

A) Electric Potential: not zero
Electric Field: not zero

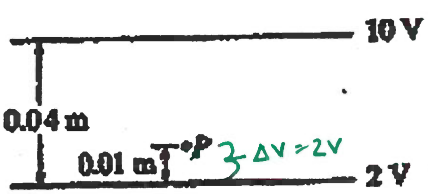
B) Electric Potential: zero
Electric Field: zero

C) Electric Potential: zero
Electric Field: not zero

D) Whether or not these quantities are zero cannot be determined without knowing the value of the charge on the sphere.

E) Electric Potential: not zero
Electric Field: zero

Questions 2 and 3 refer to the following:



Two large, flat, parallel, conducting plates are 0.04 m apart, as shown above. The lower plate is at a potential of 2 V with respect to ground. The upper plate is at a potential of 10 V with respect to ground. Point P is located 0.01 m above the lower plate.

2) The electric potential at point P is

A) 2 V
B) 8 V
C) 10 V
D) 6 V
E) 4 V

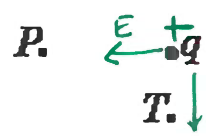
3) The magnitude of the electric field at point P is

A) 800 V/m
B) 200 V/m
C) 600 V/m
D) 400 V/m
E) 100 V/m

4) A particle of charge Q and mass m is accelerated from rest through a potential difference V, attaining a kinetic energy K. What is the kinetic energy of a particle of chare $2Q$ and mass $m/2$ that is accelerated from rest through the same potential difference?

A) $2K$
B) $K/2$
C) $K/4$
D) K
E) $4K$

5) An isolated positive charge q is in the plane of the page, as shown below.



The directions of the electric field vectors at points P and T, which are also in the plane of the page, are given by which of the following?

A) Point P: left
Point T: toward the top of the page

B) Point P: left
Point T: right

C) Point P: right
Point T: left

D) Point P: right
Point T: toward the top of the page

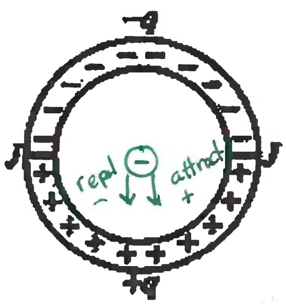
E) Point P: left
Point T: toward the bottom of the page

6) From the electric field vector at a point, one can determine which of the following?

I. The direction of the electrostatic force on a test charge of known sign at that point
II. The magnitude of the electrostatic force exerted per unit charge on a test charge at that point
III. The electrostatic charge at that point

A) I only
B) II and III only
C) I, II, and III
D) II only
E) I and II only

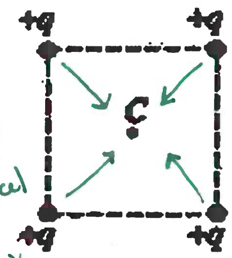
7) A circular ring made of an insulating material is cut in half. One half is given a charge $-q$ uniformly distributed along its arc. The other half is given a charge $+q$ also uniformly distributed along its arc. The two halves are then rejoined with insulation at the junctions J, as shown below.



If there is no change in the charge distributions, what is the direction of the net electrostatic force on an electron located at the center of the circle?

A) Toward the top of the page
B) Toward the bottom of the page
C) To the right
D) To the left
E) Into the page

8) Four positive charges of magnitude q are arranged at the corners of a square, as shown below.



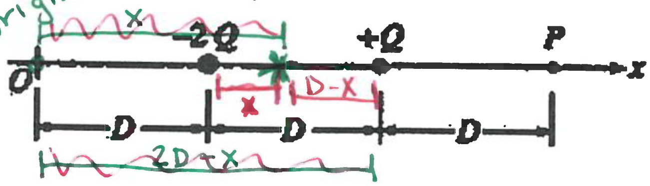
At the center C of the square, the potential due to one charge alone is V_0, and the electric field due to one charge alone has magnitude E_0. Which of the following correctly gives the electric potential and the magnitude of the electric field at the center of the square due to all four charges?

A) Electric potential: Zero
Electric field: $2E_0$
B) Electric potential: $2V_0$
Electric field: $4E_0$
C) Electric potential: $4V_0$
Electric field: Zero
D) Electric potential: Zero
Electric field: Zero
E) Electric potential: $4V_0$
Electric field: $2E_0$

9) A conducting sphere of radius R carries a charge Q. Another conducting sphere has a radius $R/2$, but carries the same charge. The spheres are far apart. The ratio of the electric field near the surface of the smaller sphere to the field near the surface of the larger sphere is most nearly

A) 2
B) 4
C) 1
D) 1/2
E) 1/4

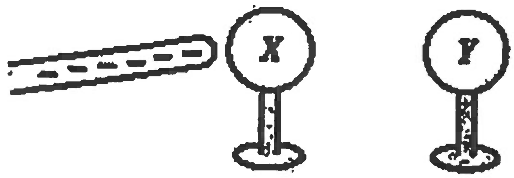
10) Two charges, $-2Q$ and $+Q$, are located on the x-axis, as shown below.



Point P, at a distance of $3D$ from the origin O, is one of two points on the positive x-axis at which the electric potential is zero. How far from the origin O is the other point?

A) $2/3\ D$
B) D
C) $3/2\ D$
D) $5/3\ D$
E) $2\ D$

11) Two metal spheres that are initially uncharged are mounted on insulating stands, as shown below.



A negatively charged rubber rod is brought close to, but does not make contact with, sphere *X*. Sphere *Y* is then brought close to *X* on the side opposite to the rubber rod. *Y* is allowed to touch *X* and then is removed some distance away. The rubber rod is then moved far away from *X* and *Y*. What are the final charges on the spheres?

A) Sphere *X*: positive
Sphere *Y*: positive

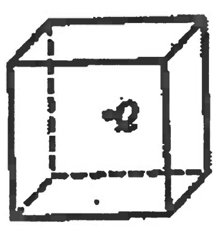
B) Sphere *X*: negative
Sphere *Y*: negative

C) Sphere *X*: negative
Sphere *Y*: positive

D) Sphere *X*: zero
Sphere *Y*: zero

E) Sphere *X*: positive
Sphere *Y*: negative

12) The point charge *Q* shown below is at the center of a metal box that is isolated, ungrounded, and uncharged.



Which of the following is true?

A) The net charge on the outside surface of the box is *Q*.

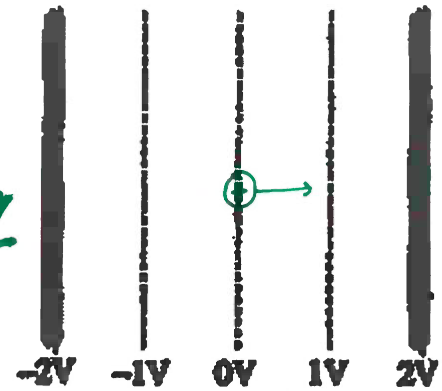
B) The electric field outside the box is the same as if only the point charge (and not the box) were there.

C) The electric field outside the box is zero everywhere.

D) The electric field inside the box is constant.

E) The potential inside the box is zero.

13)



A battery or batteries connected to two parallel plates produce the equipotential lines between the plates shown above.

The force on an electron located on the 0-volt potential line is

A) 1 N, directed to the left

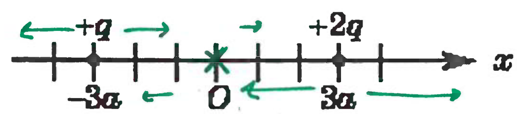
B) 0 N

C) directed to the right, but its magnitude cannot be determined without knowing the distance between the lines

D) directed to the left, but its magnitude cannot be determined without knowing the distance between the lines

E) 1 N, directed to the right

14) Two charges are located on the *x*-axis of a coordinate system as shown below.



The charge $+2q$ is located at $x = +3a$ and the charge $+q$ is located at $x = -3a$. Where on the *x*-axis should an additional charge $+4q$ be located to produce an electric field equal to zero at the origin *O*?

A) $x = +6a$

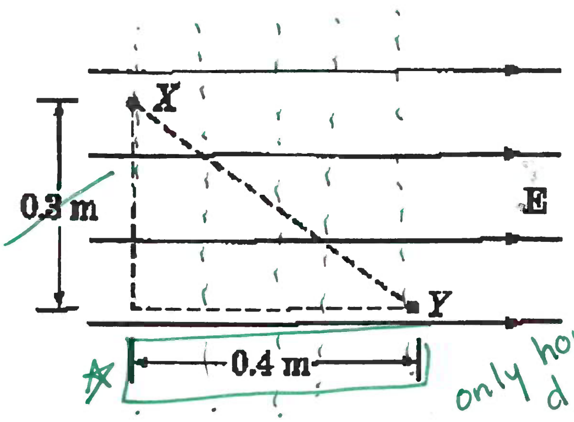
B) $x = -2a$

C) $x = +2a$

D) $x = -6a$

E) $x = +a$

15) A uniform electric field E of magnitude 6,000 V/m exists in a region of space as shown below.



What is the electric potential difference, $V_X - V_Y$, between points X and Y?

A) -12,000 V
B) 0 V
C) 2,400 V
D) 3,000 V
E) 1,800 V

16) A solid conducting sphere is given a positive charge Q. How is the charge Q distributed in or on the sphere?

A) Its density increases radially outward from the center.
B) It is concentrated at the center of the sphere.
C) Its density decreases radially outward from the center.
D) It is uniformly distributed throughout the sphere.
E) It is uniformly distributed on the surface of the sphere only.

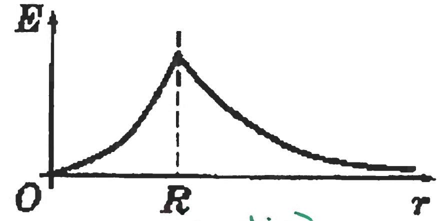
17) A parallel-plate capacitor is charged by connection to a battery. If the battery is disconnected and the separation between the plates is increased, what will happen to the charge on the capacitor and the voltage across it?

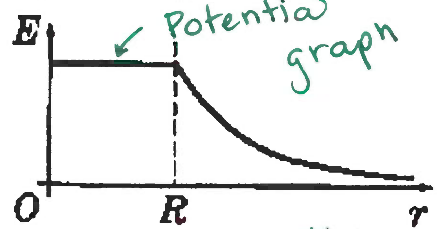
A) Both decrease.
B) The charge increases and the voltage decreases.
C) The charge remains fixed and the voltage increases.
D) Both remain fixed.
E) Both increase.

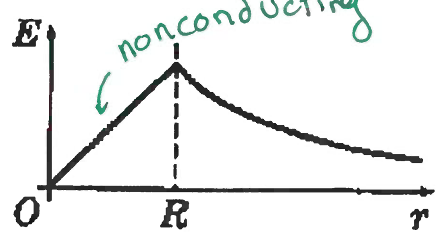
18) A parallel-plate capacitor has a capacitance C_0. A second parallel-plate capacitor has plates with twice the area and twice the separation. The capacitance of the second capacitor is most nearly

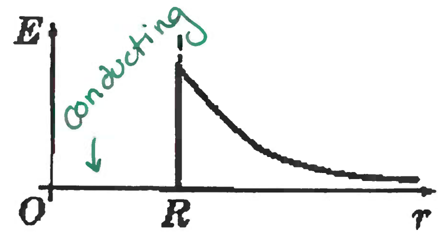
A) $4C_0$
B) $2C_0$
C) $\frac{1}{2}C_0$
D) $\frac{1}{4}C_0$
E) C_0

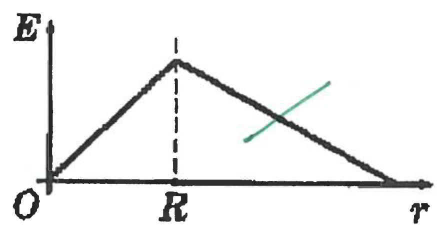
19) Charge is distributed uniformly throughout a long nonconducting cylinder of radius R. Which of the following graphs best represents the magnitude of the resulting electric field E as a function of r, the distance from the axis of the cylinder?

A)


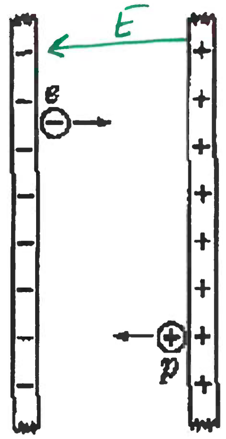
B)


C)


D)


E)


20) A proton *p* and an electron *e* are released simultaneously on opposite sides of an evacuated area between large, charged parallel plates, as shown below.



Each particle is accelerated toward the oppositely charged plate. The particles are far enough apart so that they do not affect each other. Which particle has the greater kinetic energy upon reaching the oppositely charged plate?

A) It cannot be determined without knowing the amount of charge on the plates.
B) It cannot be determined without knowing the value of the potential difference between the plates.
C) The electron
D) Neither particle; both kinetic energies are the same.
E) The proton

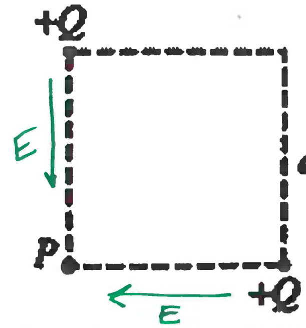
21) Which of the following is true about the net force on an uncharged conducting sphere in a uniform electric field?

A) It produces a torque on the sphere about the direction of the field.
B) It is in the direction opposite to the field.
C) It is zero.
D) It is in the direction of the field.
E) It causes the sphere to oscillate about an equilibrium position.

22) Two parallel conducting plates are connected to a constant voltage source. The magnitude of the electric field between the plates is 2,000 N/C. If the voltage is doubled and the distance between the plates is reduced to 1/5 the original distance, the magnitude of the new electric field is

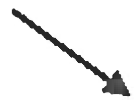
A) 800 N/C
B) 1,600 N/C
C) 5,000 N/C
D) 2,400 N/C
E) 20,000 N/C

Questions 23 and 24 refer to the following:



The figure above shows two particles, each with a charge of +Q, that are located at the opposite corners of a square of side *d*.

23) What is the direction of the net electric field at point P?

A) 

B) 

C) 

D) 

E) 

24) What is the potential energy of a particle of charge +*q* that is held at point P?

A) $\frac{1}{4\pi\varepsilon_0}\frac{qQ}{d}$

B) $\frac{\sqrt{2}}{4\pi\varepsilon_0}\frac{qQ}{d}$

C) $\frac{2}{4\pi\varepsilon_0}\frac{qQ}{d}$

D) $\frac{2\sqrt{2}}{4\pi\varepsilon_0}\frac{qQ}{d}$

E) zero

25) Two parallel conducting plates, separated by a distance d, are connected to a battery of emf ε. Which of the following is correct if the plate separation is doubled while the battery remains connected?

A) The capacitance is unchanged.
B) The potential difference between the plates is halved.
C) The electric charge on the plates is halved.
D) The electric charge on the plates is doubled.
E) The potential difference between the plates is doubled.

26) A 4 μF capacitor is charged to a potential difference of 100 V. The electrical energy stored in the capacitor is

A) 2×10^{-8} J
B) 2×10^{-2} J
C) 2×10^{-10} J
D) 2×10^{-4} J
E) 2×10^{-6} J

27) 

The diagram above shows an isolated, positive charge Q. Point B is twice as far away from Q as point A. The ratio of the electric field strength at point A to the electric field strength at point B is

A) 1 to 2
B) 4 to 1
C) 8 to 1
D) 1 to 1
E) 2 to 1

28) 

Two conducting spheres of different radii, as shown above, each have charge -Q. Which of the following occurs when the two spheres are connected with a conducting wire?

A) Negative charge flows from the larger sphere to the smaller sphere until the electric potential of each sphere is the same.
B) No charge flows.
C) Negative charge flows from the smaller sphere to the larger sphere until the electric potential of each sphere is the same.
D) Negative charge flows from the smaller sphere to the larger sphere until the electric field at the surface of each sphere is the same.
E) Negative charge flows from the larger sphere to the smaller sphere until the electric field at the surface of each sphere is the same.

29) The capacitance of a parallel-plate capacitor can be increased by increasing which of the following?

A) The charge on each plate
B) The distance between the plates
C) The area of the plates
D) The potential difference across the plates
E) None of these choices

30) An electron-volt is a measure of

A) electric potential due to one electron
B) energy
C) electric field
D) electric charge
E) force per unit electron charge

Questions 31 and 32 refer to the following:

An electron is accelerated from rest for a time of 10^{-9} second by a uniform electric field that exerts a force of 8.0×10^{-15} newton on the electron.

31) What is the magnitude of the electric field?

A) 8.0×10^{-6} N/C
B) 5.0×10^{4} N/C
C) 9.1×10^{-22} N/C
D) 8.0×10^{-24} N/C
E) 2.0×10^{-5} N/C

32) The speed of the electron after it has accelerated for the 10^{-9} second is most nearly

A) 10^{1} m/s
B) 10^{7} m/s
C) 10^{3} m/s
D) 10^{5} m/s
E) 10^{9} m/s

33) A hollow metal sphere of radius R is positively charged. Of the following distances from the center of the sphere, which location will have the greatest electric field strength?

A) 3R/2
B) None of these choices since the field is of constant strength
C) 5R/4
D) 0 (center of the sphere)
E) 2R

34) Two isolated charges, +Q and -2Q, are 2 centimeters apart. If F is the magnitude of the force acting on charge -2Q, what are the magnitude and direction of the force acting on charge +Q?

A) Magnitude: $\frac{1}{2}F$
Direction: Toward charge -2Q

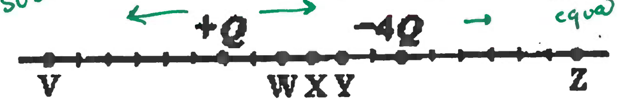
B) Magnitude: $2F$
Direction: Away from charge -2Q

C) Magnitude: F
Direction: Toward charge -2Q

D) Magnitude: F
Direction: Away from charge -2Q

E) Magnitude: $2F$
Direction: Toward charge -2Q

35)



Charges +Q and -4Q are situated as shown above. The net electric field is zero nearest which point?

A) W
B) Z
C) V
D) Y
E) X

36) A positive charge of 10^{-6} coulomb is placed on an insulated solid conducting sphere. Which of the following is true?

A) The charge resides uniformly throughout the sphere.
B) An insulated metal object acquires a net positive electric charge when brought near to, but not in contact with, the sphere.
C) When a second conducting sphere is connected by a conducting wire to the first sphere, charge is transferred until the electric potentials of the two spheres are equal.
D) The electric field inside the sphere is constant in magnitude, but not zero.
E) The electric field in the region surrounding the sphere increases with increasing distance from the sphere.

37) The electron-volt is a measure of

A) momentum
B) charge
C) velocity
D) impulse
E) energy

Questions 38 and 39 refer to the following:

A point P is 0.50 meter from a point charge of 5.0×10^{-8} coulomb.

38) The intensity of the electric field at point P is most nearly

A) 1.8×10^{3} N/C
B) 9.0×10^{2} N/C
C) 7.5×10^{8} N/C
D) 2.5×10^{1} N/C
E) 2.5×10^{-8} N/C

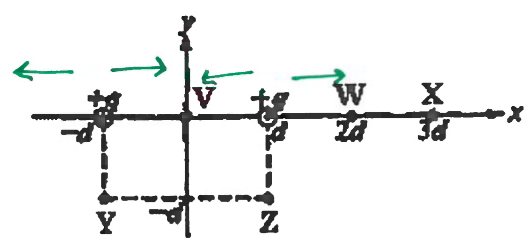
39) The electric potential at point P is most nearly

A) 2.5×10^{-8} V
B) 7.5×10^{3} V
C) 2.5×10^{1} V
D) 1.8×10 V
E) 9.0×10^{2} V

40) One joule of work is needed to move one coulomb of charge from one point to another with no change in velocity. Which of the following is true between the two points?

A) The current is one ampere.
B) The electric field strength is one newton per coulomb.
C) The potential difference is one volt.
D) The resistance is one ohm.
E) The electric field strength is one joule per electron.

Questions 41 and 42 refer to the following:



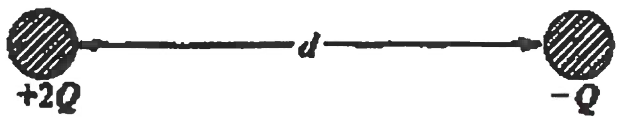
41) At which of the following points is the electric field strength least in magnitude?

A) X
B) Z
C) W
D) V
E) Y

42) At which of the following points is the electric potential greatest in magnitude?

A) W
B) V
C) Z
D) X
E) Y

$① q = \frac{q_{tot}}{\#} = \frac{+2q + -q}{2} = \frac{1}{2}Q$

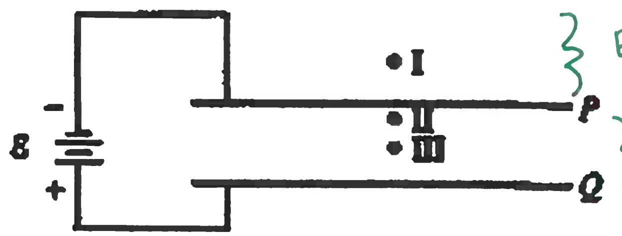
43) 

$② F = \frac{kqq}{r^2} = \frac{(1)(\frac{1}{4})(\frac{1}{2})}{1^2} = \frac{1}{8}$

q_1 is $2q \to \frac{1}{2}q$ that $\frac{1}{4}$ the size; q_2: q to $\frac{1}{2}q$ that's $\frac{1}{2}$ size

Two identical conducting spheres are charged to +2Q and -Q, respectively, and are separated by a distance *d* (much greater than the radii on the spheres) as shown above. The magnitude of the force of attraction on the left sphere is F_1. After the two spheres are made to touch and then are reseparated by a distance *d*, the magnitude of the force on the left sphere is F_2. Which of the following relationships is correct?

A) $F_1 = 4F_2$ B) $F_1 = 2F_2$ C) $2F_1 = F_2$ D) $F_1 = F_2$ E) $F_1 = 8F_2$

44) 

$F_2 = F_3$

Two large parallel conducting plates P and Q are connected to a battery of emf ε, as shown above. A test charge (+q) is placed successively at points I, II, and III. If edge effects are negligible, the force on the charge when it is at point III is

A) much greater in magnitude than the force on the charge when it is at point II, but in the same direction.
B) equal in magnitude to the force on the charge when it is at point I, but in the opposite direction.
C) much less in magnitude than the force on the charge when it is at point II, but in the same direction.
D) of equal magnitude and in the same direction as the force on the charge when it is at point II.
E) of equal magnitude and in the same direction as the force on the charge when it is at point I.

$F_2 = F_3$ b/c uniform E

$F_1 < F_2 = F_3$ b/c E↓ outside

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