AP Physics Study Guide Chapter 17 Electric Potential and Energy Name_____

Circle the vector quantities below and underline the scalar quantities below

electric potential electric field electric potential energy

work by electric forces potential difference

Write the equation that defines each quantity, **INCLUDE UNITS FOR ALL QUANTITIES**

Electric potential Capacitance Electric energy stored in capacitor

electric potential energy as a function of charge and distance r

Work-charge-potential difference Electric field-potential difference-distance

electric potential as a function of distance r from charge q

For there to be electric potential energy there must be an electric _____ located in an electric _____.

Is electric potential dependent on the potential energy and the amount of charge in the field or is it a property of the electric field itself?

Write the formula that defines electric potential below and explain why it is INDEPENDENT of the charge or the potential energy that are in the formula.

Write the units that the unit Volt is based on:

Electric field lines always are directed from points of _____ electric potential to points of _____ electric potential.

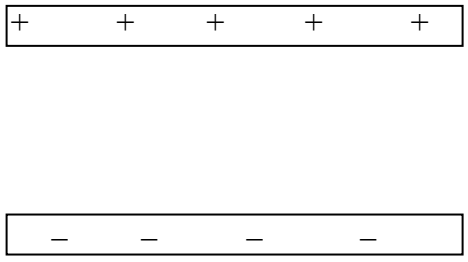
A positive charge will move from a point in an electric field that has _____ electric potential to a point of _____ electric potential.

The electron-Volt is a unit for _____. How many joule is equivalent to 1 eV?

Electric potential near a positive charge is _____ and the electric potential near a negative charge is _____.

The word used to express electric potential difference ΔV is _____.

For the oppositely charged parallel plates below draw and label the electric field vector E and put an H at a point of High potential and an L at a point of Low electric potential



Write the definition of an equipotential line

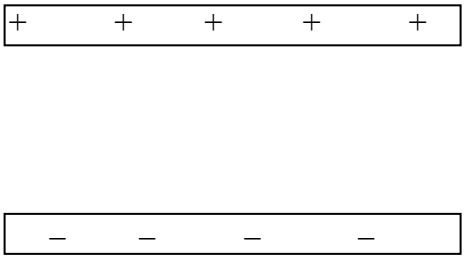
How much work is required to move a charge q along an equipotential line?

What is the angle between electric field lines and equipotential lines?

Explain how excess charge that is placed on a conductor distributes itself across the surface.

Draw the pattern of equipotential lines in the region near the two charges below.

Draw the pattern of equipotential lines in the region between the two charged plates below



Explain what a capacitor is and what its function is.

Write the definition of capacitance C in terms of charge Q on the plates and voltage V between plates. Include the units for capacitance.

Like electric field, which does not depend on the force or test charge, capacitance does not depend on charge Q or voltage V. Explain why.

What does capacitance depend on?

When two charged conductors are touched together explain how the charge distributes across their surfaces.

No process is required for these multiple choice questions. Put answers on lines provided.

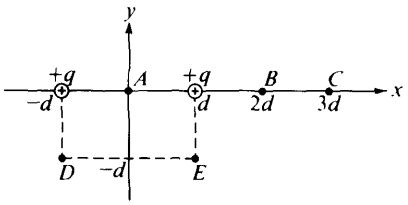
1) The electron volt is a measure of 1)_____
(A) charge (B) energy (C) impulse (D) momentum (E) velocity

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

2)_____

3. 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 remain fixed. (B) Both increase. (C) Both decrease. 3)_____
(D) The charge increases and the voltage decreases. (E) The charge remains fixed and the voltage increases.

4) A point P is 0.50 meter from a point charge of 5.0×10^{-8} coulomb. 4)_____
The electric potential at point P is most nearly
(A) 2.5×10^{-8} V (B) 2.5×10^{1} V (C) 9.0×10^{2} V (D) 1.8×10^{3} V (E) 7.5×10^{3} V



5) Two positive charges of magnitude q are each a distance d from the origin A of a coordinate system as shown above. At which of the following points is the electric potential greatest in magnitude?
(A) A (B) B (C) C (D) D (E) E

5)_____

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

6)_____

7). A positive charge of l x 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) The electric field inside the sphere is constant in magnitude, but not zero.
(C) The electric field in the region surrounding the sphere increases with increasing distance from the sphere.
(D) An insulated metal object acquires a net positive charge when brought near to, but not in contact with, the sphere.
(E) 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.

7)_____

8. 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. 2,400 N/C d. 5,000 N/C e. 20,000 N/C

8)_____

9) . A 4 μF capacitor is charged to a potential difference of 100 V. The electrical energy stored in the capacitor is
a. 2 x 10^{-10} J b. 2 x 10^{-8} J c. 2 x 10^{-6} J d. 2x 10^{-4} J e. 2 x 10^{-2} J

9)_____

10) The capacitance of a parallel-plate capacitor can be increased by increasing which of the following?
(A) The distance between the plates (B) The charge on each plate (C) The area of the plates
(D) The potential difference across the plates (E) None of the above

10)_____

11. The unit $\frac{N}{C}$ is equivalent to which of the following units 11)_____

(A) J (B) V•m (C) F (D) $\frac{V}{m}$ (E) $\frac{J}{s}$

An isolated, hollow aluminum sphere is positively charged. A cross section through the center of the sphere is shown above.

5. The magnitude of the electric field is greatest at point

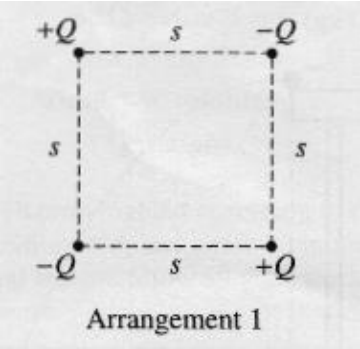
(A) *A*
(B) *B*
(C) *C*
(D) *D*
(E) *E*

6. The direction of the electric field is correctly indicated in which of the following?

I. To the left at point *A*
II. To the right at point *D*
III. To the right at point *E*

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

5)_____ 6)_____



Arrangement 1

1) Four charged particles are held fixed at the corners of a square of side *s*. All the charges have the same magnitude *Q*, but two are positive and two are negative. In Arrangement 1, shown above, charges of the same sign are at opposite corners. Express your answers to parts (a) and (b) in terms of the given quantities and fundamental constants.

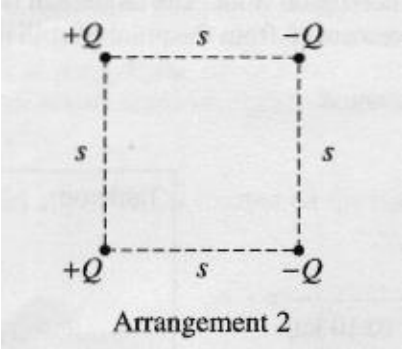
(a) For Arrangement 1, determine the following.

i. The electrostatic potential at the center of the square

i)_____

ii. The magnitude of the electric field at the center of the square

ii)_____



Arrangement 2

The bottom two charged particles are now switched to form Arrangement 2, shown above, in which the positively charged particles are on the left and the negatively charged particles are on the right.

(b) For Arrangement 2, determine the following.

i. The electrostatic potential at the center of the square

i)_____

ii. The magnitude of the electric field at the center of the square

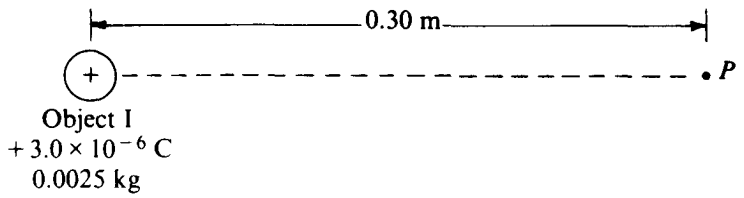
ii)_____

(c) In which of the two arrangements would more work be required to remove the particle at the upper right corner from its present position to a distance a long way away from the arrangement?

____Arrangement 1 ____Arrangement 2

Justify your answer.

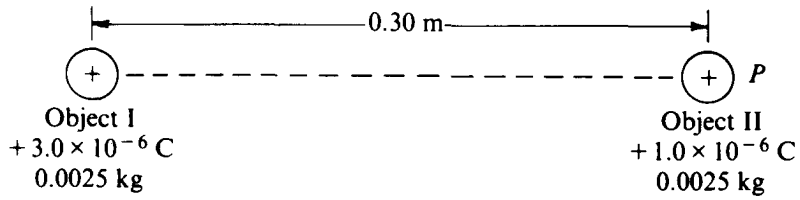
2) Object I, shown below, has a charge of + 3 x 10^{-6} coulomb and a mass of 0.0025 kilogram.



a. What is the electric potential at point P, 0.30 meter from object I ?

a)_____

Object II, of the same mass as object I, but having a charge of + 1 x 10^{-6} coulomb, is brought from infinity to point P, as shown below.



b. How much work must be done to bring the object II from infinity to point P ?

b)_____

c. What is the magnitude of the electric force between the two objects when they are 0.30 meter apart?

c)_____

d. What are the magnitude and direction of the electric field at the point midway between the two objects?

d)_____

The two objects are then released simultaneously and move apart due to the electric force between them. No other forces act on the objects.

e. What is the speed of object I when the objects are very far apart?

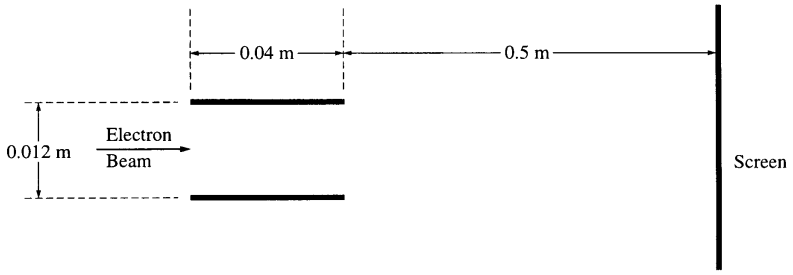
e)_____

3) In a television set, electrons are first accelerated from rest through a potential difference in an electron gun. They then pass through deflecting plates before striking the screen.

a. Determine the potential difference through which the electrons must be accelerated in the electron gun in order to have a speed of 6.0×10^7 m/s when they enter the deflecting plates.

a)_____

The pair of horizontal plates shown below is used to deflect electrons up or down in the television set by placing a potential difference across them. The plates have length 0.04 m and separation 0.012 m, and the right edge of the plates is 0.50 m from the screen. A potential difference of 200 V is applied across the plates, and the electrons are deflected toward the top of the screen. Assume that the electrons enter horizontally midway between the plates with a speed of 6.0×10^7 m/s and that fringing effects at the edges of the plates and gravity are negligible.



Note: Figure not drawn to scale.

b. Which plate in the pair must be at the higher potential for the electrons to be deflected upward? Check the appropriate box below.

☐ Upper plate ☐ Lower plate

Justify your answer.

c. Considering only an electron's motion as it moves through the space between the plates, compute the following.
i. The time required for the electron to move through the plates

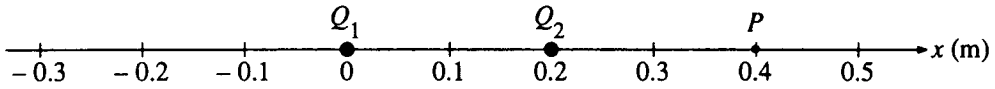
i)_____

ii. The vertical displacement of the electron while it is between the plates

ii)_____

d. Show why it is a reasonable assumption to neglect gravity in part c.

e. Still neglecting gravity, describe the path of the electrons from the time they leave the plates until they strike the screen. State a reason for your answer.



4) Two point charges, Q_1 and Q_2, are located a distance 0.20 meter apart, as shown above. Charge Q_1 = +8.0μC. The net electric field is zero at point P, located 0.40 meter from Q_1 and 0.20 meter from Q_2.

a. Determine the magnitude and sign of charge Q_2.

a)_____

b. Determine the magnitude and direction of the net force on charge Q_1

b)_____

c. Calculate the electrostatic potential energy of the system.

c)_____

d. Determine the coordinate of the point R on the x-axis between the two charges at which the electric potential is zero.

d)_____

e. How much work is needed to bring an electron from infinity to point R. which was determined in the previous part?

e)_____