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

1) Which of the following is not a vector?
a. electric force b. electric field **c. electric charge** d. electric lines of force e. acceleration

2) If a conductor is in electrostatic equilibrium near an electric charge
a. the total charge on the conductor must be zero
b. any charge on the conductor must be uniformly distributed
c. the force between the conductor and the charge must be zero
d. the total electric field of the conductor must be zero
e. the electric field of the conductor is perpendicular to the surface

3) For an electron moving in a direction opposite to the electric field
a. its potential energy increases and its electric potential increases
b. its potential energy decreases and its electric potential increases
c. its potential energy increases and its electric potential decreases
d. its potential energy decreases and its electric potential decreases
e. both the potential energy and the electric potential remain constant

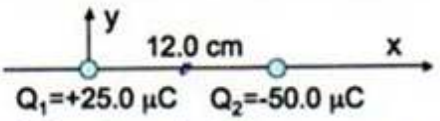
4) (T) F Good conductors are materials that have a lot of free charges.
(T) F Insulators are materials that lack free charges.
T (F) The electric force on an electrically neutral object is always zero.
T (F) The smallest magnitude of charge an object can acquire is 2e.

5) T (F) Electric field lines point towards positive charges and away from negative charges.
(T) F The electric field inside a current-carrying conductor is non-zero.
T (F) The electric potential is higher where electric field lines are closer together.
(T) F A region of uniform electric field has parallel electric field lines.

6) A tiny styrofoam ball is suspended on a thread. Some tests show it gets attracted to a positively charge nd repelled by a negatively charged rod. What can you can conclude about the tiny styrofoam ball?

(a.) It has a negative net charge b. It has zero net charge.
c. It has positive net charge. d. Its net charge changes when then rods are placed near it.

7) Two charges, $Q_1 = +25.0\ \mu C$ and $Q_2 = -50.0\ \mu C$ are separated by 12.0 cm on the x-axis as shown. The charges produce an electric field in the surrounding region. Consider only the electric field along the x-axis.



a) (T) F At any point between the charges, their net electric field points to the right.

b) T (F) To the right of Q_2, there is a point at finite x where the electric field is zero.

c) Determine the magnitude of the net electric field at the point midway between the charges.

use $r = 6.0\,cm$

Use superposition of electric fields from both charges. $\rightarrow E_1$, $\rightarrow E_2$

Both $\vec{E}_1$ and $\vec{E}_2$ point to the right, away from + charge; towards the − charge.

$$E_1 = \left|\frac{kQ_1}{r^2}\right| = \frac{\left(8.988\times10^9 \frac{Nm^2}{C^2}\right)(25\times10^{-6}C)}{(0.06\,m)^2} = 6.24\times10^7\ N/C$$

$$E_2 = \left|\frac{kQ_2}{r^2}\right| = \frac{\left(8.988\times10^9 \frac{Nm^2}{C^2}\right)(50\times10^{-6}C)}{(0.06m)^2} = 12.48\times10^7\ N/C$$

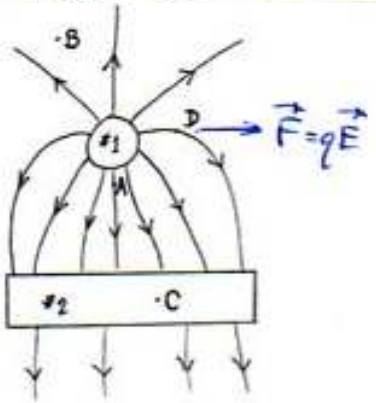
Net is $E = E_1 + E_2 = 18.7\times10^7\ N/C = 187\ MN/C$

8) (T) F All points of a conductor with static charges are at the same electric potential.

T (F) Electric field lines point towards regions of higher electric potential.

T (F) An electron-volt is the same as 1.602×10^{-19} volts. $1\,eV = 1.602\times10^{-19}\,J$.

9. The diagram shows the electric field lines surrounding two conductors.



a) The net charge of conductor #1 is

a. negative b. zero (c) positive d. unknown, no way to tell.

b) The net charge of conductor #2 is

(a) negative b. zero c. positive d. unknown, no way to tell.

c) At which of these points is the electric field strength greatest?

(a) A b. B c. C d. D e. unknown, no way to tell.

d) A proton placed at point D will experience an electric force whose direction is most nearly

a. ↑ b. ↓ c. ← (d) →

e) A proton moves from D towards C. This causes the system's electric potential energy to

(a.) decrease. b. remain the same. c. increase. d. unknown, no way to tell.

10. Questions about electric potential.

a) (T) F The closer to a positively charged object, the higher the electric potential.

b) T (F) On an equipotential surface, the electric field is a constant.

c) (T) F Electric field lines point towards lower electric potential.

d) (T) F An electron volt is the same as 1.602×10^{-19} joules.

e) (T) F When equal and opposite charges move farther apart, their electric potential energy increases.

11) When an initially uncharged capacitor is charged up by connecting its terminals to a battery, its two electrodes acquire

(a.) equal charges of opposite signs. b. unequal charges of opposite signs.
c. equal charges of the same sign. d. unequal charges of the same sign.

12) The electric field inside a parallel plate capacitor points

(a.) from the positively charged plate towards the negatively charged plate.
b. from the negatively charged plate towards the positively charged plate.
c. parallel to the surfaces of the plates.

13) A spherical metallic shell carries a charge 2q. A point charge q is placed at the center of the shell. When electrostatic equilibrium is reached, what is the charge carried by the outer surface of the shell?

A) 0 B) q C) 4q D) 2q → (E) 3q

14) A spherical metallic shell carries a charge 2q. A point charge q is placed at the center of the shell. When electrostatic equilibrium is reached, what is the charge carried by the inner surface of the shell?

A) 2q → (B) -q C) q D) 3q E) 0

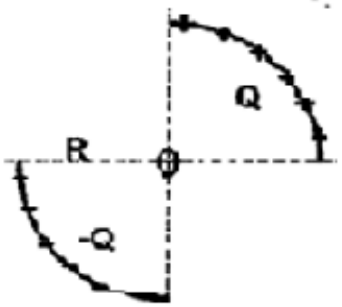
15) If the electric potential is given by $V(x,y,z) = xy - 3z^{-2}$, then the electric field has a y-component

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

16) An electric dipole of dipole moment $\vec{p} = p_0\hat{i} + p_0\hat{j}$ is placed in a uniform electric field $\vec{E} = E_0\hat{i}$. What is the value of the torque applied on the dipole by the electric field?

A) The torque is equal to zero. (B) $\vec{\tau} = -p_0E_0\hat{k}$ C) $\vec{\tau} = p_0E_0\hat{k}$ D) $\vec{\tau} = -p_0E_0\hat{i}$ E) $\vec{\tau} = -p_0E_0\hat{j}$

17) The figure below shows two arcs of a circle on which charges +Q and -Q have been spread uniformly. What is the value of the electric potential at the center of the circle?



(A) 0 B) $\frac{1}{4\pi\varepsilon_0}\frac{2Q}{R}$ C) $\frac{1}{4\pi\varepsilon_0}\frac{Q}{R^2}$ D) $\frac{1}{4\pi\varepsilon_0}\frac{Q}{R}$ E) $\frac{-1}{4\pi\varepsilon_0}\frac{Q}{R}$

18) Four positively charged particles with equal charge, $+Q$ are situated near a very long wire carrying a negative uniform linear charge density, $-\lambda$. A sphere of radius R is centered about point P indicated in the figure below. The electric flux, $\Phi_E = \oint \vec{E} \cdot d\vec{A}$ through the sphere is:

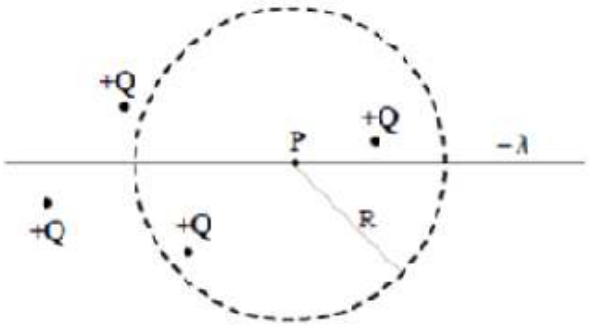
(A) $\Phi_E = 0$.

(B) $\Phi_E = \frac{8Q\pi R^2 - 4\lambda\pi R^2}{\varepsilon_0}$.

(C) $\Phi_E = \frac{2Q - 2\lambda R}{\varepsilon_0}$.

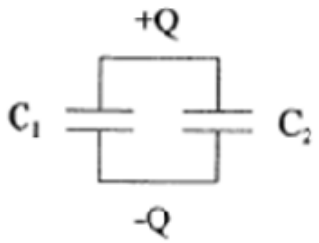
(D) $\Phi_E = \frac{-2\lambda R}{\varepsilon_0}$.

(E) $\Phi_E = \frac{2Q}{\varepsilon_0}$.



19) Consider the arrangement of two capacitors connected by wires depicted below. A charge of $+Q$ is ripped from the bottom wire and added to the top. For the case $C_1 > C_2$, compare the charge on each capacitor's top plate (Q_1 and Q_2) and the voltage difference (V_1 and V_2) across each capacitor. Which of the statement(s) below is (are) true?

I. $Q_1 > Q_2$.
II. $Q_1 = Q_2$.
III. $Q_1 < Q_2$.
IV. $V_1 > V_2$.
V. $V_1 = V_2$.
VI. $V_1 < V_2$.



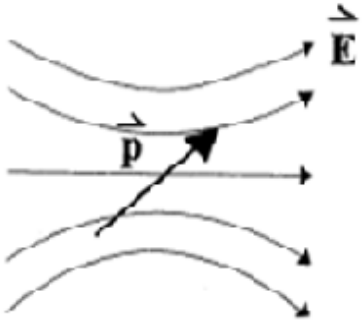
(A) Only I and VI are correct.
(B) Only II and VI are correct.
(C) Only I and IV are correct.
(D) Only III and VI are correct.
(E) Only I and V are correct

$C = \frac{Q}{V}$

$Q_1 = C_1 V$

$Q_2 = C_2 V$ $\quad Q_1 > Q_2$

20) An electric dipole $\vec{p}$ is placed in an external electric field $\vec{E}$ as shown in the figure below. What statement is correct about the subsequent behavior of the electric dipole?



(A) The electric dipole experiences a net force but no net torque.

(B) The electric dipole experiences a net torque but no net force.

(C) The electric dipole experiences both a net torque and a net force

(D) The electric dipole experiences no net torque and no net force

21) Which of the following statements is true?

A. Electric field lines stay inside equipotent surfaces.
B. Equipotent surfaces intersect in straight lines.
C. Equipotent surfaces intersect in curved lines.
D. Electric field lines are perpendicular to equipotent surfaces.
E. Equipotent surfaces are parallel to each other.

22) A parallel plate capacitor has an air dielectric. The capacitor is charged with surface charge density σ_0 and then the voltage source is removed. When an insulator with dielectric constant 5.0 is inserted between the plates, what happens to the electric field strength if the surface charge density does not change?

A. It increases by a factor of 5. B. It increases by a factor of 25. **C. It decreases by a factor of 5.**
D. It decreases by a factor of 25. E. It stays the same