Physics 2426
Engineering Physics II
Review Problems Exam 1

22. Three charges are located at 100-m intervals along a horizontal line: a charge of –3.0 C on the left, +2.0 C in the middle, and +1.0 C on the right. What is the resultant force on the 1.0 C charge due to the other two?

A) 1.1×10^6 N to the right
B) 1.1×10^6 N to the left
C) 2.5×10^6 N to the right
D) 2.5×10^6 N to the left
E) 4.5×10^7 N to the right

Ans: A

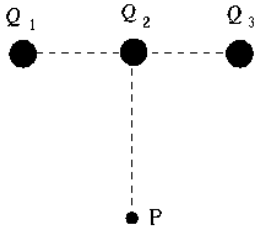
18.

Three charges $+q$, $+Q$, and $-Q$ are placed at the corners of an equilateral triangle as shown. The net force on charge $+q$ due to the other two charges is

A) vertically up.
B) vertically down.
C) zero.
D) horizontal to the left.
E) horizontal to the right.

Ans: E

38.

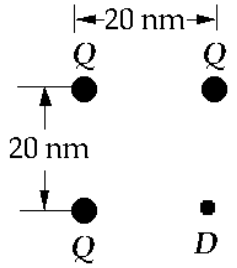


Three charges Q_1, Q_2, and Q_3, each equal to 6.4×10^{-19} C, are in a straight line. The distance between neighboring charges is 60 nm. The magnitude of the electric field at P, which is 80 nm from Q_2 on a line at right angles to the line between Q_1 and Q_3, is

A) 1.2×10^{-8} N/C
B) 16 N/C
C) 2.0 N/C
D) 1.9×10^{10} N/C
E) 1.2×10^{8} N/C

Ans: D

41.

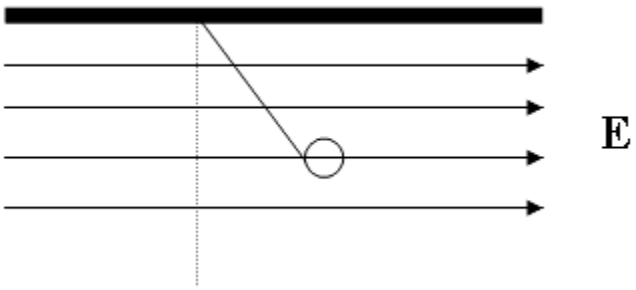


Three charges, each of $Q = 3.2 \times 10^{-19}$ C, are arranged at three of the corners of a 20-nm square as shown. The magnitude of the electric field at D, the fourth corner of the square, is approximately

A) 1.4×10^{7} N/C
B) 1.0×10^{11} N/C
C) 3.6×10^{10} N/C
D) 30 N/C
E) 1.8×10^{7} N/C

Ans: A

52.

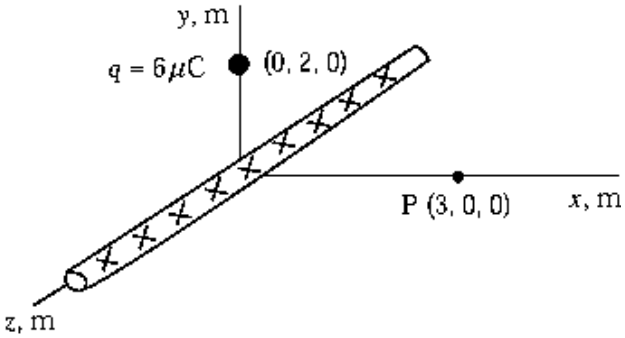


A bob of mass m (m = 0.500 g), and charge magnitude Q (Q = 50.0 μC) is held by a massless string in a uniform electric field E. If the bob makes an angle of 10.0 degrees with the vertical, then calculate the magnitude of the electric field E and the sign of the bob charge Q.

A) 1.73×10^{1} N/C and Q is positive.
B) 9.81×10^{1} N/C and Q is negative.
C) 9.81×10^{1} N/C and Q is positive.
D) 1.73×10^{1} N/C and Q is negative.
E) 1.80×10^{-1} N/C and Q is positive.

Ans: A

Use the following to answer questions 1-3:

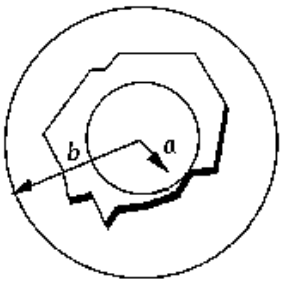


1. An infinite line charge of linear density λ = 0.30 μC/m lies along the z axis and a point charge q = 6.0 μC lies on the y axis at y = 2.0 m. The x component of the electric field at the point P on the x axis at x = 3.0 m is approximately

A) 1.8 kN/C B) 4.2 kN/C C) 0.96 kN/C D) 5.2 kN/c E) 0.64 mN/C

Ans: D

30.

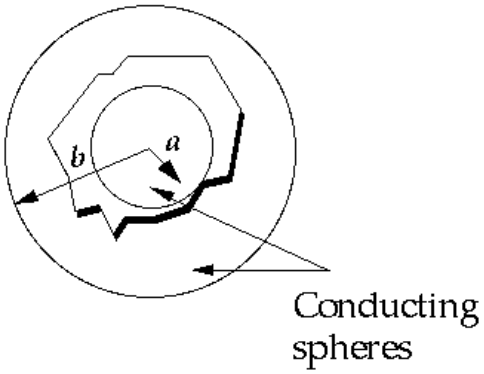


A solid sphere of radius a is concentric with a hollow sphere of radius b, where $b > a$. If the solid sphere has a uniform charge distribution totalling $+Q$ and the hollow sphere a charge of $-Q$, the electric field at radius r, where $r < a$, is which of the following, in terms of $k = (4\pi\in_0)^{-1}$?

A) kQ/r^2 B) kQr/a^3 C) kQ/a^2 D) kQ/b^2 E) zero

Ans: B

Use the following to answer questions 31-33:

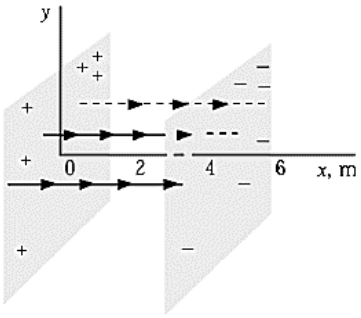


31. A solid sphere of radius a is concentric with a hollow sphere of radius b, where $b > a$. If the solid sphere has a charge $+Q$ and the hollow sphere a charge of $-Q$, the electric field at radius r, where $a < r < b$, is which of the following, in terms of $k = (4\pi\in_0)^{-1}$?
A) kQ/r^2 B) $2kQ/r^2$ C) kQ/a^2 D) kQ/b^2 E) $kQ/(b-a)^2$
Ans: A

32. A solid sphere of radius a is concentric with a hollow sphere of radius b, where $b > a$. If the solid sphere has a charge $+Q$ and the hollow sphere a charge of $-Q$, the electric field at radius r, where $r > b$, is which of the following, in terms of $k = (4\pi\in_0)^{-1}$?
A) kQ/r^2 B) $2kQ/r^2$ C) kQ/a^2 D) kQ/b^2 E) zero
Ans: E

33. A solid sphere of radius a is concentric with a hollow sphere of radius b, where $b > a$. If the solid sphere has a charge $+Q$ and the hollow sphere a charge of $-Q$, the electric field at radius r, where $r < a$, is which of the following, in terms of $k = (4\pi\in_0)^{-1}$?
A) kQ/r^2 B) kQr/a^3 C) kQ/a^2 D) kQ/b^2 E) zero
Ans: E

51.

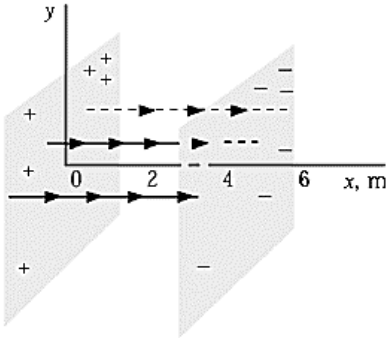


An infinite plane of surface charge density $\sigma = +8.00$ nC/m^2 lies in the *yz* plane at the origin, and a second infinite plane of surface charge density $\sigma = -8.00$ nC/m^2 lies in a plane parallel to the *yz* plane at $x = 4.00$ m. The electric field at $x = 3.50$ m is approximately

A) 226 N/C B) 339 N/C C) 904 N/C D) 452 N/C E) zero

Ans: C

52.



An infinite plane of surface charge density $\sigma = +8.00$ nC/m^2 lies in the *yz* plane at the origin, and a second infinite plane of surface charge density $\sigma = -8.00$ nC/m^2 lies in a plane parallel to the *yz* plane at $x = 4.00$ m. The electric field at $x = 5.00$ m is approximately

A) 226 N/C B) 339 N/C C) 904 N/C D) 452 N/C E) zero

Ans: E

33. You attach a 30-pF capacitor across a 1.5-V battery. How much energy is stored in the capacitor?

A) 3.4×10^{-11} J
B) 4.5×10^{-11} J
C) 6.7×10^{-11} J
D) 3.4×10^{-8} J
E) 4.5×10^{-8} J

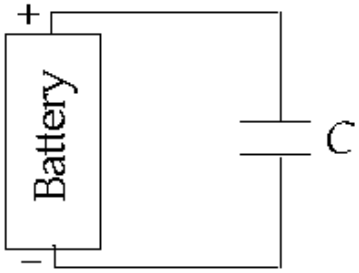
Ans: A

63. When you insert a piece of paper ($\kappa = 3.7$) into the air between the plates of a capacitor, the capacitance

A) increases.
B) decreases.
C) does not change.
D) could increase, decrease, or not change depending on the dielectric constant of the paper.
E) does none of these.

Ans: A

65.



A capacitor is connected to a battery as shown. When a dielectric is inserted between the plates of the capacitor,

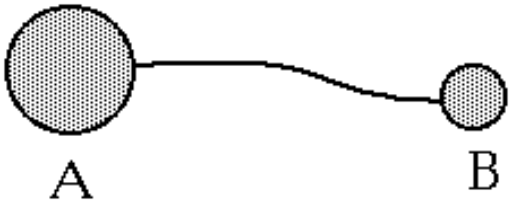
A) only the capacitance changes.
B) only the voltage across the capacitor changes.
C) only the charge on the capacitor changes.
D) both the capacitance and the voltage change.
E) both the capacitance and the charge change.

Ans: E

66. The capacitance of a parallel-plate capacitor is 24 μF when the plates are separated by a material of dielectric constant 2.0. If this material is removed, leaving air between the plates, and the separation between the plates is tripled, the capacitance is
A) unchanged B) 16 μF C) 36 μF D) 0.14 mF E) 4.0 μF
Ans: E

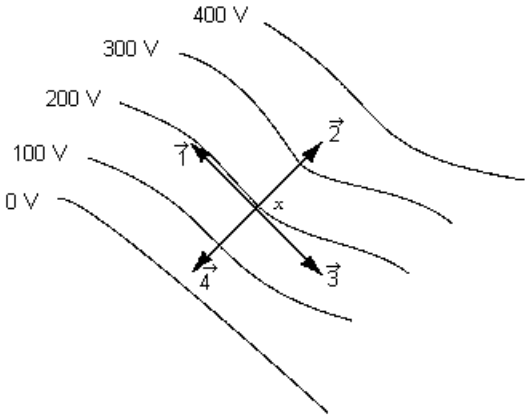
71. A parallel plate capacitor of area $A = 30\ \text{cm}^2$ and separation $d = 5$ mm is charged by a battery of 60-V. If the air between the plates is replaced by a dielectric of $\kappa = 4$ with the battery still connected, then what is the ratio of the initial charge on the plates divided by the final charge on the plates?
A) 4.3 B) 1 C) 16 D) 0.25 E) 4.0
Ans: D

67.



Two charged metal spheres are connected by a wire. Sphere A is larger than sphere B, as shown. The magnitude of the electric potential of sphere A
A) is greater than that at the surface of sphere B.
B) is less than that at the surface of sphere B.
C) is the same as that at the surface of sphere B.
D) could be greater than or less than that at the surface of sphere B, depending on the radii of the spheres.
E) could be greater than or less than that at the surface of sphere B, depending on the charges on the spheres.
Ans: C

63.



The vector that best represents the direction of the electric field intensity at point *x* on the 200-V equipotential line is

A) $\vec{1}$ B) $\vec{2}$ C) $\vec{3}$ D) $\vec{4}$ E) None of these is correct.

Ans: D

57. A charge of 100 nC resides on the surface of a spherical shell of radius 20 cm. The electric potential at a distance of 15 cm from the center of the spherical shell is

A) 18 V B) 180 V C) 1800 V D) 18,000 V E) None of these is correct.

Ans: E