Name_____

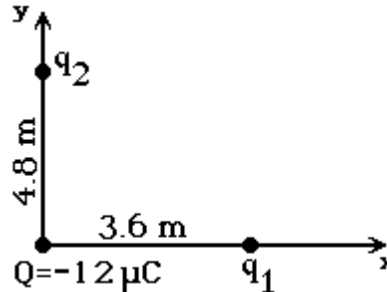**MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.**
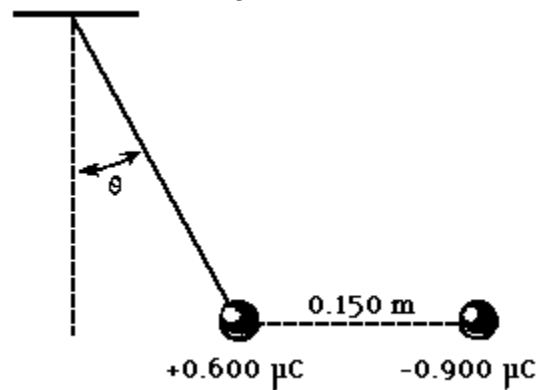
Figure 22.3

A point charge $Q = -12$ μC, and two other charges, q_1 and q_2, are placed as shown. The electric force components on charge Q are $F_x = +0.005$ N and $F_y = -0.003$ N.

1) In Figure 22.3, charge q_1, in nC, is closest to:

A) −200   B) +200   C) +600   D) +400   E) −400

2) In Figure 22.3, charge q_2, in nC, is closest to:

A) −640   B) +320   C) +640   D) +480   E) −480

Figure 22.8

3) In Figure 22.8, a small spherical insulator of mass 12×10^{-2} kg and charge +0.600 μC is hung by a thin wire of negligible mass. A charge of −0.900 μC is held 0.150 m away from the sphere and directly to the right of it, so the wire makes an angle q with the vertical (see drawing). What is the angle q?
A) $15.6°$ B) $11.7°$ C) $18.0°$ D) $21.2°$ E) $10.4°$

1

Figure 23.1

$E_1 = 6000$ N/C   0.20 m $E_2 = 4000$ N/C
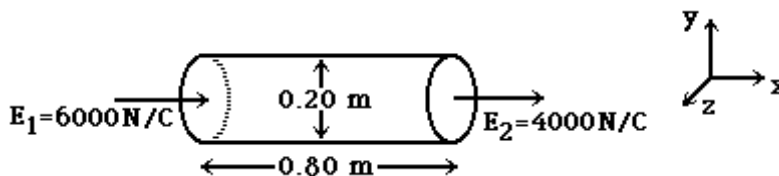
—0.80 m—

A nonuniform electric field is directed along the x–axis at all points in space. This magnitude of the field varies with x, but not with respect to y or z. The axis of a cylindrical surface, 0.80 m long and 0.20 m in diameter, is aligned parallel to the x–axis. The electric fields E_1 and E_2, at the ends of the cylindrical surface, have magnitudes of 6000 N/C and 4000 N/C repsectively, and are directed as shown.

4) In Figure 23.1, the charge enclosed by the cylindrical surface is closest to:
   A) +0.6 nC   B) –2.8 nC   C) +1.4 nC   D) –0.6 nC   E) +2.8 nC

5) When there is a net static charge present on a perfect conductor, and no other charges are present
   A) every point throughout the entire conductor will be at a constant potential, but not necessarily at zero potential.
   B) the electric field inside the conductor need not be zero if the conductor is hollow.
   C) the surface charge density will be greatest where the conductor is flat and smallest where there are sharp protuberances or points.
   D) every point throughout the entire conductor will be at zero potential.
   E) the charge will be uniformly distributed over the outside of the conductor (i.e., the surface charge density will be constant).

Situation 24.1

Two conducting spherical shells are concentric, with radii of 0.80 m and 2.00 m. The electric potential of the inner shell, with the respect to the outer shell, is +1080 V.

6) In Situation 24.1, the maximum electric field magnitude between the shells is closest to:
   A) 2200 V/m   B) 2800 V/m   C) 2600 V/m   D) 2000 V/m   E) 2400 V/m

7) In Situation 24.1, an electron is transported by an external force from the inner shell to the outer shell. The work done by the external force is closest to:
   A) +2.4 x 10^{-16} J
   B) +2.4 x 10^{-16} J
   C) +2.4 x 10^{-16} J
   D) +2.4 x 10^{-16} J
   E) +2.4 x 10^{-16} J
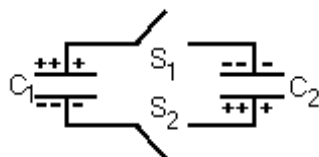
Figure 25.2

8) In Figure 25.2, two capacitors are separately charged by a 100 volt battery and then connected, with opposite polarity, by closing switches S1 and S2. What will be the potential difference across C1 after the switches are closed?
   $C_1 = 2\mu f$, $C_2 = 5\mu f$
   A) 95.2 V   B) 28.6 V   C) 42.9 V   D) 71.4 V   E) 100 V

9) Which of the following explanations best explains how a dielectric affects the capacitance of a capacitor?
   A) The dielectric sets up an electric field which reinforces the field due to the free charge on the plates, thereby increasing the potential difference and the capacitance.
   B) The dielectric effectively reduces the spacing of the capacitor plates, thus increasing the capacitance.
   C) Charge is able to flow from the dielectric onto the capacitor plates, thus increasing the charge on the capacitor for a given potential difference and thereby increasing the capacitance.
   D) The dielectric sets up an electric field which partially cancels the field due to the free charge on the plates. This means that for a given free charge on the plates, the field and hence the potential difference is decreased, resulting in increased capacitance.
   E) The electric field acting on the dielectric sets up mechanical stresses which result in greater stored energy for a given potential difference between the plates. Since the stored energy is $1/2CV^2$, this means that the capacitance is increased.

Situation 26.3

The heater element of a 120 V toaster is a 5.5 m length of nichrome wire, whose diameter is 0.72 mm. The resistivity of nichrome at the operating temperature of the toaster is 1.3×10^{-6} $\Omega \cdot$ m.

10) In Situation 26.3, the nichrome wire is replaced by a 5.5 m length of tungsten wire. The power of the toaster, when operated at a voltage of 120 V, remains unchanged when the wire replacement is made. The resistivity of tungsten, at the operating temperature of the toaster, is 2.4×10^{-7} $\Omega \cdot$ m. The diameter of the tungsten wire is closest to:
   A) 0.19 mm   B) 0.13 mm   C) 0.31 mm   D) 0.25 mm   E) 0.37 mm

11) In a certain electroplating process gold is deposited by using a current of 10 A for 15 minutes. An Au^+ ion has a mass of approximately 3.3×10^{22} g. How many grams of gold are deposited in this process?
   A) 12.3   B) 9.20   C) 14.3   D) 46.5   E) 18.6

Figure 27.4

A multiloop circuit is given. It is not necessary to solve the entire circuit.
12) In Figure 27.4, the current I_1 is closest to:
   A) +4 A   B) –2 A   C) +2 A   D) zero   E) –4 A

13) In Figure 27.4, the current I_2 is closest to:
   A) –4 A   B) zero   C) –10 A   D) +4 A   E) +10 A

14) In Figure 27.4, the emf ε is closest to:
   A) +35 V   B) –55 V   C) –15 V   D) +55 V   E) +15 V

15) If you were to cut a small permanent bar magnet in half,
   A) neither piece would be magnetic.
   B) each piece would in itself be a smaller bar magnet with both north and south poles.
   C) one piece would be a magnetic north pole and the other piece would be a south pole.
   D) each piece would contain both north and south poles, but on a given piece the intensity of the north and south poles would not necessarily be equal.
   E) None of these statements is true.

Figure 28.3
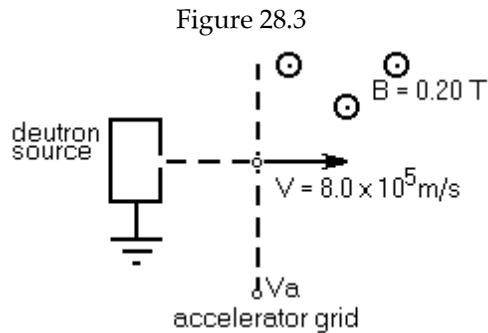
A mass spectrograph is operated with deuterons, which have a charge of +e and a mass of 3.34 x 10^{-27} kg. Deuterons emerge from the source, which is grounded with negligible velocity. The velocity of the deuterons as they pass through the accelerator grid is 8.0 x 105 m/s. A uniform magnetic field of magnitude B = 0.20 T, directed out of the plane, is present at the right of the grid.

16) In Figure 28.3, the deuterons are in circular orbit in the magnetic field. The radius of the orbit and the initial sense of deflection are closest to:
   A) 70 mm, upward
   B) 80 mm, downward
   C) 70 mm, downward
   D) 60 mm, upward
   E) 60 mm, downward
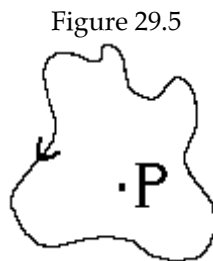
Figure 29.5

17) In Figure 29.5, an irregular loop of wire carrying a current lies in the plane of the paper here. Suppose that now the loop is distorted into some other shape while remaining in the same plane. Point P is still within the loop. Which of the following is a true statement concerning this situation?
   A) The magnetic field at P will not change in direction when the loop is distorted.
   B) It is possible that the magnetic field at point P is zero.
   C) The magnetic field at point P will not change in magnitude when the loop is distorted.
   D) The magnetic field at point P will always lie in the plane of the paper.
   E) None of these is true.

Figure 30.3
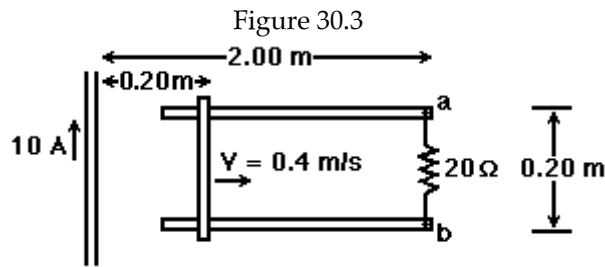
A long vertical wire carries a steady 10 A current. A pair of rails are horizontal and are 0.20 m apart. A 20 ohm resistor connects points a and b, at the end of the rails. A bar is in contact with the rails, and is moved by an external force with a constant velocity of 0.40 m/s, as shown. The bar and the rails have negligible resistance. At a given instant t_1, the bar is 0.20 m from the wire, as shown.

18) In Figure 30.3, at time t_1, the induced current and its direction through the resistor are closest to:

A) 0.02 μA, from a to b
B) 0.04 μA, from a to b
C) 0.12 μA, from b to a
D) 0.02 μA, from b to a
E) 0.04 μA, from b to a
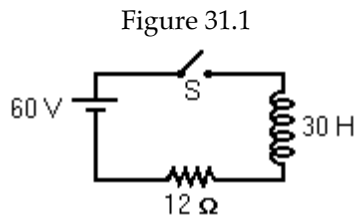
Figure 31.1

An R–L circuit has a 60 V battery, a 30 H inductor, a 12 ohm resistor, and a switch S, in series, as shown. Initially, the switch is open, and there is no magnetic flux in the inductor. At time t = 0 s, the switch is closed.

19) In Figure 31.1, when the magnetic energy of the inductor is equal to one half of its terminal value, the time t is closest to:

A) 3.7 s   B) 3.9 s   C) 3.1 s   D) 3.3 s   E) 3.5 s
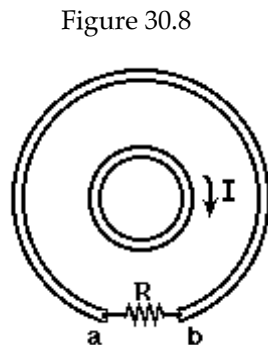
Figure 30.8

20) In Figure 30.8, the inner loop carries a current I that is increasing. The resistor R is in the outer loop. The induced current through the resistor R is:

A) from b to a   B) from a to b   C) zero

5

1) C
2) A
3) E
4) D
5) A
6) A
7) D
8) C
9) D
10) C
11) E
12) B
13) D
14) C
15) B
16) B
17) A
18) B
19) C
20) B