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

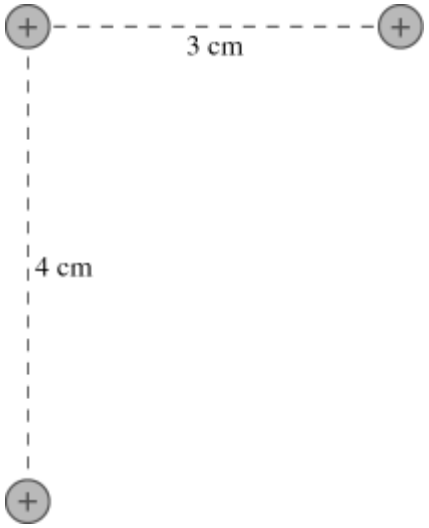
1) A non–conducting disk with a 1.0–mm thickness is lying flat. It has a 6.0 C/m^2 surface charge on the upper surface and a –6.0 C/m^2 surface charge on the lower surface. In terms of ε_o, what is the approximate field strength 1.0 mm above the upper surface? 1) _____
A) 0.0 N/C B) $1.0/\varepsilon_o$ N/C C) $9/\varepsilon_o$ N/C D) $15/\varepsilon_o$ N/C

2) A small particle with a mass of 1.0 kg carrying a charge of 3.0 nC is at the surface of a charged spherical conductor of radius 3.0 mm. If the surface charge density is 10.0 C/m^2, find the acceleration of the particle. (The constant ε_o is 8.85×10^{-12} $C^2/N \cdot m^2$. The value of k is 9.0×10^9 $N \cdot m^2/C^2$.) 2) _____
A) $10\ \hat{\mathbf{r}}$ m/s^2 B) $3400\ \hat{\mathbf{r}}$ m/s^2 C) $30{,}000\ \hat{\mathbf{r}}$ m/s^2 D) $0.0033\ \hat{\mathbf{r}}$ m/s^2

3) A cubical surface with sides of length 2.001 m is centered on the origin. There are eight positive charges located as follows: 3) _____
1 μC at $x = 1.0$ m, $y = 1.0$ m, $z = 1.0$ m
2 μC at $x = 1.0$ m, $y = 1.0$ m, $z = -1.0$ m
3 μC at $x = 1.0$ m, $y = -1.0$ m, $z = 1.0$ m
4 μC at $x = 1.0$ m, $y = -1.0$ m, $z = -1.0$ m
5 μC at $x = -1.0$ m, $y = 1.0$ m, $z = 1.0$ m
6 μC at $x = -1.0$ m, $y = 1.0$ m, $z = -1.0$ m
7 μC at $x = -1.0$ m, $y = -1.0$ m, $z = 1.0$ m
8 μC at $x = -1.0$ m, $y = -1.0$ m, $z = -1.0$ m.
Find the flux through the surface of the cube.
A) 6×10^{-7} $N \cdot m^2/C$ B) 4×10^3 $N \cdot m^2/C$
C) 2×10^3 $N \cdot m^2/C$ D) 4×10^6 $N \cdot m^2/C$

4) The electron mean free time between collisions of 5.0×10^{-14} s in a metal where its drift speed is 5.5×10^{-4} m/s. What is the electric field? 4) _____
A) 17 N/C B) 0.063 N/C C) 220 N/C D) 1.2 N/C

5) Consider the group of charges in this figure. All three charges have $Q = 9.6$ nC. What is their electric potential energy? 5) _____

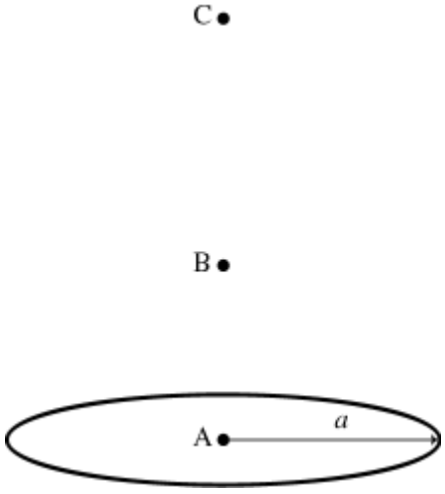


A) 7.0×10^{-5} J B) 6.8×10^{-5} J C) 7.4×10^{-5} J D) 6.5×10^{-5} J

6) How much work does it take to move an electron 20.0 m at an angle of 30.0° to $\hat{\mathbf{r}}$, in the presence of a uniform electric field $E = 5.0\ \hat{\mathbf{r}}$ N/C? 6) _____

A) 100 eV B) 87 eV C) –87 eV D) 50 eV

7) A uniformly charged ring of radius a is situated horizontally, as shown below. The net charge is positive. The location A is in the center of the ring. The location B is a distance a directly above the center. Location C is very far above the center of the ring. The voltage is zero at infinity. At which location is the voltage the highest? 7) _____



A) Location A B) Location B C) Location C

8) A copper wire of length L and radius b is attached to another copper wire of length L and radius $2b$, forming one long wire of length $2L$. This long wire is attached to a battery, and a current is flowing through it. Relative to the electric field within the wire of radius b, the magnitude of the electric field within the wire of radius $2b$ is 8) _____
A) two times stronger.
B) two times weaker.
C) four times weaker.
D) four times stronger.
E) equal.

9) A long rod has a charge density $\lambda = 4.0\ \mu C/m$. Find the electric field strength 3 m from the center of the rod measured perpendicular to the axis. Assume the radius of the rod is less than 3 m. 9) _____
A) 0.15 MN/C
B) 5.6×10^{-18} N/C
C) 1.3 μN/C
D) 0.024 MN/C

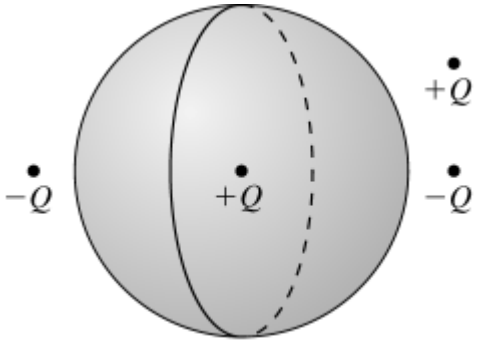
10) A spherical object with a 2.0 m radius has a charge spread throughout it with a uniform charge density, ρ. If the electric field strength 4.1 m from the center of the sphere is 2.0×10^{12} N/C, what is the charge density of the sphere? 10) _____
A) 110 C/m^3 B) 4.1 C/m^3 C) 6.4 C/m^3 D) 2.0 C/m^3

11) A wire has a current of 4.0 mA in it. How many electrons pass a given point in a minute? 11) _____
A) 4.2×10^{14} B) 1.5×10^{18} C) 240 D) 3.6×10^{-15}

12) A current flowing through a copper wire (which is connected to a battery) is due to 12) _____
A) positively charged particles being attracted to the negative terminal of a battery.
B) electrons being accelerated by an electric field.
C) electrons being bumped by positively charged particles.
D) positively charged particles being pushed off the battery terminal.

13) A silver wire with resistivity $1.59 \times 10^{-8}\ \Omega \cdot m$ has a $1.0\ A/mm^2$ current density. What is the magnitude of the electric field inside the wire? 13) _____
A) 0.0099 V/m B) 0.63 V/m C) 0.025 V/m D) 0.016 V/m

14) A particle with a charge +*Q* is inside a spherical Gaussian surface, and three other charges (one with a charge +*Q* and two with a charge –*Q*) are outside the Gaussian surface, as shown below. 14) _____



The net electric flux through the surface is
A) less than zero (flowing into the sphere).
B) equal to zero.
C) greater than zero (flowing out of the sphere).

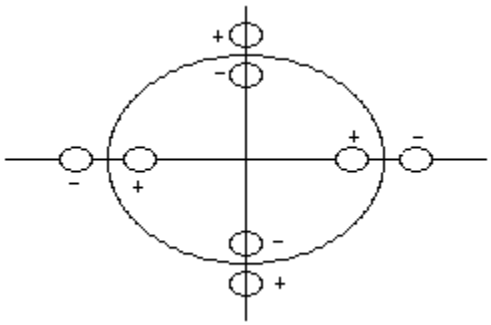
15) An extensive sheet of a conductor carries a charge density of 4.0 μC/mm^2. What is the electric field strength 6.0 mm from the conductor? 15) _____
A) 7.5 x 10^{10} N/C B) 4.5 x 10^5 N/C C) 4.5 x 10^{11} N/C D) 4.1 x 10^6 N/C

16) An electron was accelerated from rest through a potential difference of 1800 V. What is its speed? 16) _____
A) 2.5 x 10^7 m/s B) 1.2 x 10^7 m/s C) 1.7 x 10^7 m/s D) 2.1 x 10^7 m/s

17) A charge of 8.0 × 10^{-6} μC is located inside a sphere. What is the flux through the sphere? 17) _____
A) 0.23π N•m^2/C
B) It cannot be determined if the radius is unknown.
C) 0.90 N•m^2/C
D) 71 N•m^2/C

18) Consider two spheres, each containing the same net charge +*Q*. Sphere #1 has a larger radius than Sphere #2. The spheres are very far apart from each other. If the voltage is zero at infinity, 18) _____
A) the voltage on the surface of sphere #1 is lower than that of sphere #2.
B) the voltage on the surface of sphere #1 is equal to that of sphere #2.
C) the voltage on the surface of sphere #1 is higher than that of sphere #2.

19) Four protons and four electrons are arranged as shown. A 3–dimensional surface encloses them. What is the value of flux Φ through the surface? 19) _____



A) 0.38 N•m^2/C B) 0 N•m^2/C
C) 0.72 N•m^2/C D) 6.4 x 10^{-19} N•m^2/C

20) A parallel plate capacitor contains a positively charged plate on the left, and a negatively charged plate on the right. An electron in between the plates is moving to the right. Which statement is true? 20) _____

A) The potential energy of the electron is decreasing and it is moving to a region having a higher potential.
B) The potential energy of the electron is decreasing and it is moving to a region having a lower potential.
C) The potential energy of the electron is increasing and it is moving to a region having a lower potential.
D) The potential energy of the electron is increasing and it is moving to a region having a higher potential.

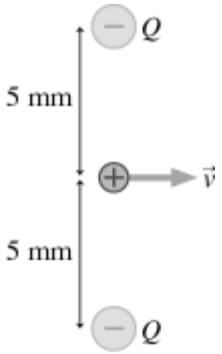
21) A point–charge particle with a charge *Q* is inside a Gaussian cube (but not necessarily in the center). The net electric flux through the Gaussian surface of the cube is 21) _____

A) zero.
B) Q/e_o
C) impossible to determine without doing a complicated surface integral.

22) A flat 1.0 m^2 surface is vertical at x = 2.0 m and parallel to the yz–plane. What is the flux through the surface if it is located in a uniform electric field given by 22) _____
$\vec{E} = 29.0\,\hat{i} + 42.0\,\hat{j} + 62.0\,\hat{k}$ N/C?

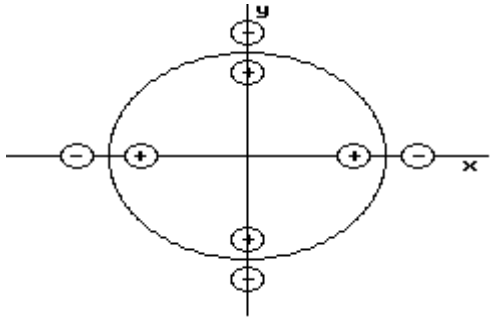
A) 29 N•m^2/C B) 100 N•m^2/C C) 62 N•m^2/C D) 42 N•m^2/C

23) The figure shows an arrangement of two $Q = -1.5$ nC charges each separated by 5.0 mm from a proton ($m_p = 1.67 \times 10^{-27}$ kg, $e = 1.60 \times 10^{-19}$ C). If the two $Q = -1.5$ nC charges are held fixed at their locations and the proton is set into motion, what is the escape speed of the proton? 23) _____



A) 7.8 x 10^6 m/s B) 2.0 x 10^6 m/s C) 3.9 x 10^6 m/s D) 1.0 x 10^6 m/s

24) Four dipoles, each consisting of two charges ±5.0 μC, are located in the xy–plane 3.0 mm from the origin, as shown. What is the flux through the sphere? 24) _____



A) 4.5 x 10^6 N•m^2/C B) 2.3 x 10^6 N•m^2/C
C) 5.6 x 10^5 N•m^2/C D) 0 N•m^2/C

25) What is the electric field strength if the flux through a 2.0 m by 1.0 m rectangular surface is 800.0 N•m^2/C, if the electric field is uniform, and if the plane of the surface is at an angle of $\pi/3$ radians with respect to the direction of the field? 25) _____

A) 400 N/C B) 460 N/C C) 200 N/C D) 800 N/C

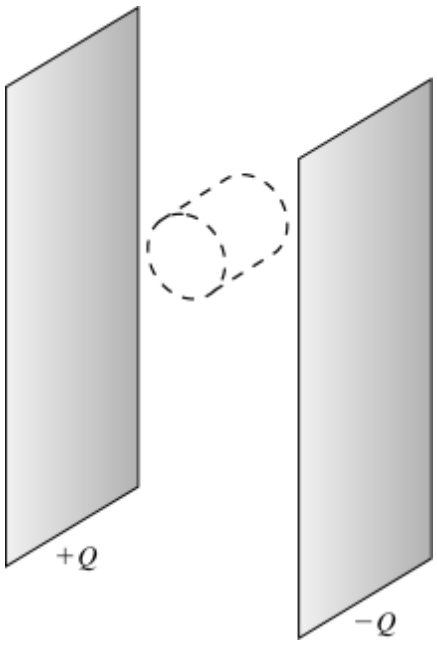
26) The density of conduction electrons in aluminum is 2.1 x 10^{29} m^{-3}. What is the drift velocity in an aluminum conductor that has a 3.0 μm by 4.0 μm rectangular cross section and when a 35.0 mA current flows through the conductor? 26) _____

A) 0.087 m/s B) 0.054 m/s C) 0.22 m/s D) 0.14 m/s

27) Consider two spheres, each containing the same net charge +*Q*. Sphere #1 has a larger radius than Sphere #2. The spheres are very far apart from each other. If the voltage is zero at infinity, how do the voltage evaluated a distance *D* away from the center of sphere #1 compare to the voltage evaluated the same distance *D* away from the center of sphere #2? 27) _____

A) The voltage near sphere #1 is greater.
B) The voltages are equal.
C) The voltage near sphere #2 is greater.

28) A Gaussian pillbox is situated inside a parallel plate capacitor (with one plate positively charged and one plate negatively charged), as shown below. 28) _____



The net electric flux through the pillbox is

A) into the pillbox. B) zero. C) out of the pillbox.

29) A piece of metal has a resistivity of $2.5 \times 10^{-14}\ \Omega \cdot m$. What is the conductivity of the piece of metal? 29) _____

A) $6.4 \times 10^{-6}\ \Omega^{-1} \cdot m^{-1}$ B) $4.0 \times 10^{-33}\ \Omega^{-1} \cdot m^{-1}$
C) $6.4 \times 10^{32}\ \Omega^{-1} \cdot m^{-1}$ D) $4.0 \times 10^{13}\ \Omega^{-1} \cdot m^{-1}$

30) The current density in a 2.6 μm thick × 75 μm wide gold long film is 750,000 A/m^2. The current flows along the length of the film. What is the current in the film? 30) _____

A) 5.1 μA B) 150 μA C) 4.2 mA D) 2.6×10^{16} A

Solve the problem. (The value of k is $9.0 \times 10^9\ N \cdot m^2/C^2$.)

31) A 6.0 μC point charge and a 10.0 μC point charge are initially infinitely far apart. How much work does it take to bring the 6.0 μC point charge to $x = 3.0$ mm, $y = 0.0$ mm and the 10.0 μC point charge to $x = -3.0$ mm, $y = 0.0$ mm? 31) _____

A) 90 J B) 15 J C) 60 J D) 180 J

Answer Key
Testname: PH2200–EX2–F05.TST

1) A
2) B
3) D
4) B
5) D
6) B
7) A
8) C
9) D
10) A
11) B
12) B
13) D
14) C
15) C
16) A
17) C
18) A
19) B
20) C
21) B
22) A
23) D
24) B
25) B
26) A
27) B
28) B
29) D
30) B
31) A