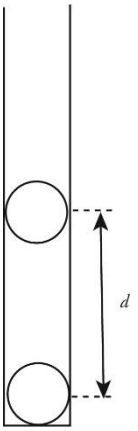
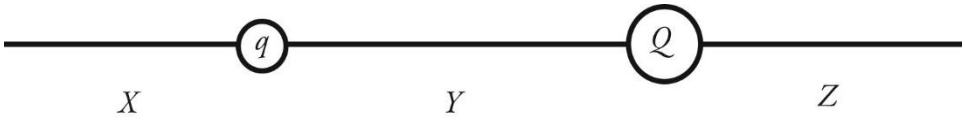
**PHYS 1200 Spring 2024** **Exam 1 Practice Questions**

**A1)** One very small uniformly charged plastic ball is located directly above another such charge in a test tube as shown in the figure at right. The balls are in equilibrium a distance *d* apart. If the charge on each ball is doubled, the distance between the balls in the test tube would become




A) $\sqrt{2}d$.
B) 2*d*.
C) 4*d*.
D) 8*d*.

**A2)** The figure below shows two unequal point charges, *q* and *Q*, of opposite sign. Charge *Q* has greater magnitude than charge *q*. In which of the regions *X*, *Y*, *Z* will there be a point at which the net electric field due to these two charges is zero?



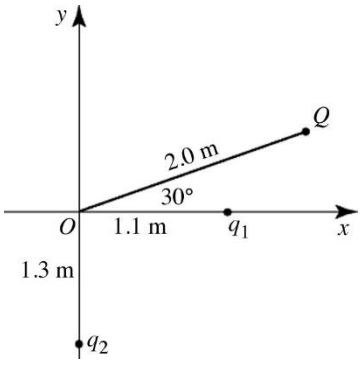

A) Only region *X*. B) Only region *Y*. C) Only region *Z*.
D) Only regions X and Z. E) All three regions.

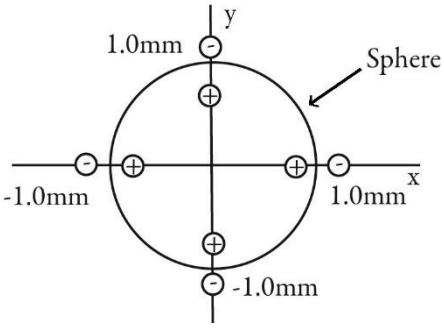
**A3)** Four equal negative point charges are located at the corners of a square, their positions in the *xy*-plane being (1, 1), (-1, 1), (-1, -1), (1, -1). The electric field on the *x*-axis at (1, 0) points in the same direction as

A) $\hat{\boldsymbol{j}}$ . B) $\hat{\boldsymbol{\imath}}$. C) $-\hat{\boldsymbol{\imath}}$. D) $-\hat{\boldsymbol{k}}$. E) $-\hat{\boldsymbol{j}}$. F) $\hat{\boldsymbol{k}}$.

**A4)** A point charge *Q* = -500 nC and two unknown point charges, $q_1$ and $q_2$, are placed as shown in the figure at right. The electric field at the origin *O*, due to charges *Q*, $q_1$ and $q_2$, is equal to zero. The charge $q_1$ is closest to

A) -130 nC. B) 76 nC. C) 150 nC.
D) -76 nC. E) 130 nC.

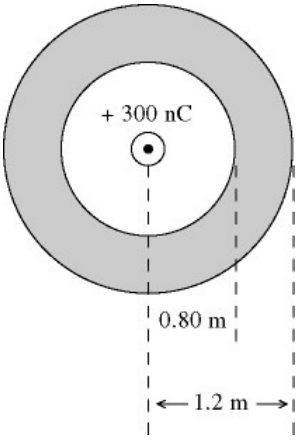





**A5)** Four dipoles, each consisting of a +10-μC charge and a -10-μC charge, are located in the *xy*-plane with their centers 1.0 mm from the origin, as shown at left. A sphere passes through the dipoles, as shown in the figure. What is the electric flux through the sphere due to these dipoles?

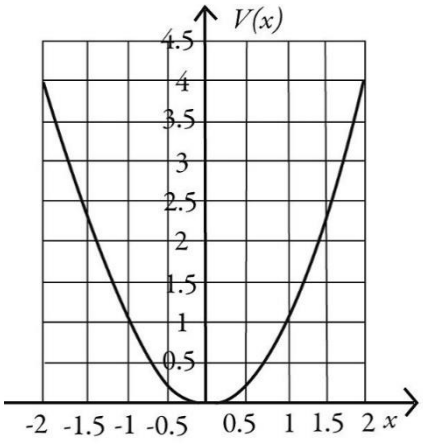
A) $4.5 \times 10^6$ N • $m^2$/C. B) 0.00 N • $m^2$/C.
C) $9.0 \times 10^6$ N • $m^2$/C D) $11 \times 10^5$ N • $m^2$/C

**A6)** Two long straight parallel lines, #1 and #2, carry uniform positive linear charge densities. The charge density on line #2 is twice as great as the charge density on line #1. The locus of points where the electric field due to these lines is zero is
A) along a line between the lines closer to line #2 than line #1.
B) at a point midway between the lines.
C) along a line perpendicular to lines #1 and #2.
D) along a line between the lines closer to line #1 than line #2.




**A7)** A hollow conducting spherical shell has radii of 0.80 m and 1.20 m, as shown in the figure at right. The sphere carries a net excess charge of -500 nC. A point charge of +300 nC is present at the center. The radial component of the electric field at a point that is 1.50 m from the center is closest to
A) +1200 N/C. B) +2000 N/C. C) -800 N/C. D) -1600 N/C. E) -2000 N/C.

**A8)** Under electrostatic conditions, the electric field just outside the surface of any charged conductor
A) is always parallel to the surface.
B) is always zero because the electric field is zero inside conductors.
C) is always perpendicular to the surface of the conductor.
D) is perpendicular to the surface of the conductor only if it is a sphere, a cylinder, or a flat sheet.
E) can have nonzero components perpendicular to and parallel to the surface of the conductor.



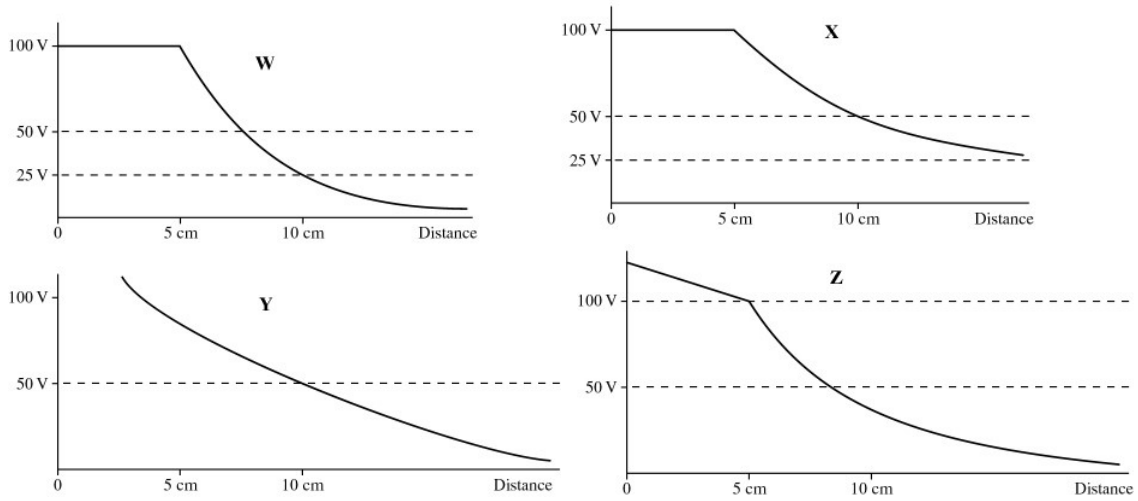

**A9)** The graph in the figure at left shows the variation of the electric potential $V(x)$ (in arbitrary units) as a function of the position $x$ (also in arbitrary units). Which of the choices below correctly describes the orientation of the $x$-component of the electric field along the $x$-axis?
A) $E_X$ is positive from $x$ = -2 to $x$ = 2.
B) $E_X$ is positive from $x$ = -2 to $x$ = 0, and negative from $x$ = 0 to $x$ = 2.
C) $E_X$ is negative from $x$ = -2 to $x$ = 0, and positive from $x$ = 0 to $x$ = 2.
D) $E_X$ is negative from $x$ = -2 to $x$ = 2.
E) None of these.

**A10)** An electron is released from rest at a distance of 9.00 cm from a proton. If the proton is held in place, how fast will the electron be moving when it is 3.00 cm from the proton? ($m_{el} = 9.11 \times 10^{-31}$ kg, $e = 1.60 \times 10^{-19}$ C, $k = 1/4\pi\varepsilon_0 = 8.99 \times 10^9$ N • m$^2$/C$^2$)

A) 75.0 m/s. B) 106 m/s. C) 130 m/s. D) $1.06 \times 10^3$ m/s. E) $4.64 \times 10^5$ m/s.

**A11)** A metallic sphere of radius 5 cm is charged such that the potential of its surface is 100 V (relative to infinity). Which of the following plots correctly shows the potential as a function of distance from the center of the sphere?

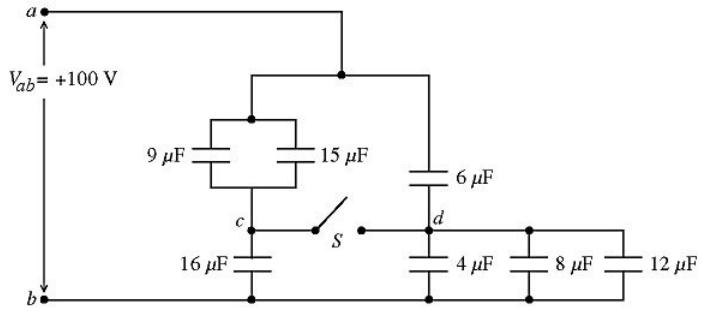
A) plot W
B) plot X
C) plot Y
D) plot Z
E) None.




**A12)** The charge on the square plates of a parallel-plate capacitor is $Q$. The potential across the plates is maintained with constant voltage by a battery as they are pulled apart to twice their original separation, which is small compared to the dimensions of the plates. The amount of charge on the plates is now equal to

A) $4Q$. B) $2Q$. C) $Q$. D) $Q/2$. E) $Q/4$.

**A13)** The capacitive network shown in the figure is assembled with initially uncharged capacitors. A potential difference, $V_{ab}$ = +100V, is applied across the network. The switch $S$ in the network is kept open. Assume that all the capacitances shown are accurate to two significant figures. What is the potential difference $V_{cd}$ across the open switch $S$?



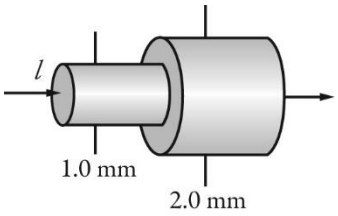

A) 0 V B) 40 V C) 50 V D) 60 V E) 70 V

**A14)** A 6.00-μF parallel-plate capacitor has charges of ±40.0 μC on its plates. How much potential energy is stored in this capacitor?

A) 103 $\mu$J B) 113 $\mu$J C) 123 $\mu$J D) 133 $\mu$J E) 143 $\mu$J

**A15)** The resistivity of gold is $2.44 \times 10^{-8}\ \Omega \cdot \text{m}$ at room temperature. A gold wire that is 0.9 mm in diameter and 14 cm long carries a current of 940 mA. What is the electric field in the wire?

A) 0.036 V/m B) 0.0090 V/m C) 0.028 V/m D) 0.046 V/m E) 0.090 V/m

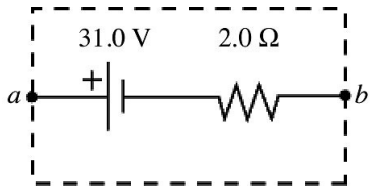


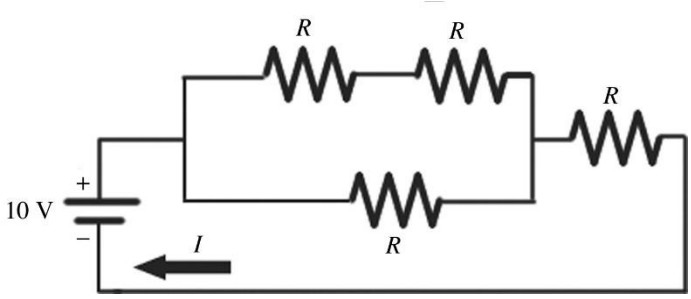

**A16)** The figure shows two connected wires that are made of the same material. The current entering the wire on the left is 2.0 A and in that wire the electron drift speed is $v_d$. What is the electron drift speed in the wire on the right side?

A) $4v_d$ B) $2v_d$ C) $v_d$ D) $v_d/2$ E) $v_d/4$

**A17)** The emf and the internal resistance of a battery are as shown in the figure. When the terminal voltage $V_{ab}$ is equal to 17.4 V, what is the current through the battery, including its direction?

A) 8.7 A, from *b* to *a* B) 6.8 A, from *a* to *b* C) 8.7 A, from *a* to *b*
D) 16 A, from *b* to *a* E) 6.8 A, from *b* to *a*



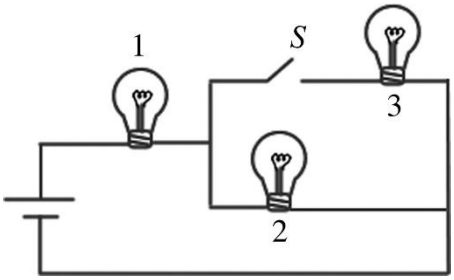



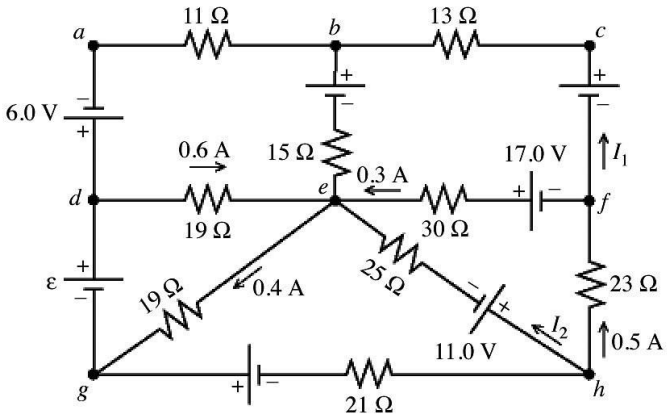

**A18)** When four identical resistors are connected to an ideal battery of voltage $V = 10$ V as shown in the figure, the current $I$ is equal to 0.20 A. What is the value of the resistance $R$ of the resistors?

A) 20 Ω B) 40 Ω C) 30 Ω
D) 50 Ω E) 10 Ω

**A19)** The figure shows three identical lightbulbs connected to a battery having a constant voltage across its terminals. What happens to the brightness of lightbulb 1 when the switch *S* is closed?

A) The brightness will increase momentarily then return to its previous level.
B) The brightness increases permanently.
C) The brightness will decrease momentarily then return to its previous level.
D) The brightness remains the same as before the switch is closed.
E) The brightness decreases permanently.

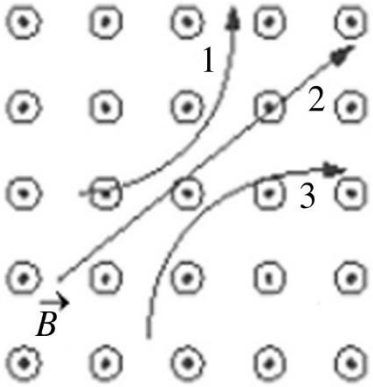





**A20)** A multiloop circuit is shown in the figure. Some circuit quantities are not labeled. It is not necessary to solve the entire circuit. The emf $\varepsilon$ is closest to

A) +3 V.
B) +19 V.
C) -3 V.
D) -10 V.
E) -1 V.

**A21)** Three particles travel through a region of space where the magnetic field is out of the page, as shown in the figure. The electric charge of each of the three particles is, respectively,

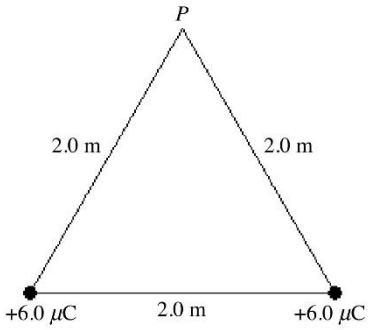



A) 1 is neutral, 2 is negative, and 3 is positive.
B) 1 is neutral, 2 is positive, and 3 is negative.
C) 1 is positive, 2 is neutral, and 3 is negative.
D) 1 is positive, 2 is negative, and 3 is neutral.
E) 1 is negative, 2 is neutral, and 3 is positive.

**A22)** Ions having equal charges but masses of $M$ and $2M$ are accelerated through the same potential difference and then enter a uniform magnetic field perpendicular to their path. If the heavier ions follow a circular arc of radius $R$, what is the radius of the arc followed by the lighter?

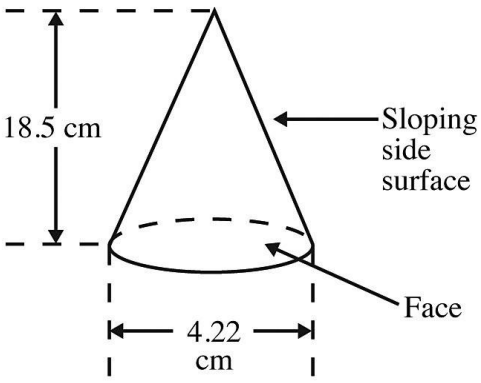
A) $4R$ B) $3R$ C) $\sqrt{2}R$ D) $R/\sqrt{2}$ E) $R/2$

**Part B**




**B1)** Two +6.0-μC point charges are placed at the corners of the base of an equilateral triangle, as shown in the figure. At the vertex, *P*, of the triangle
(a) what is the electric potential (relative to infinity) due to these charges?
(b) what is the magnitude of the electric field due to these charges?

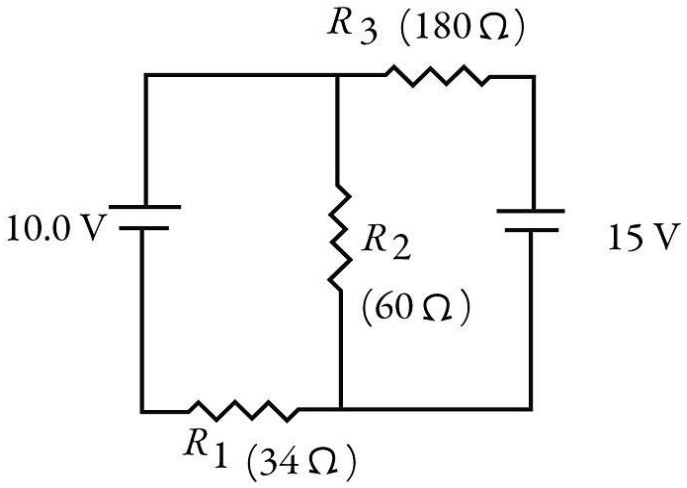
**B2)** An empty cone is resting on a tabletop as shown in the figure with its face horizontal. A uniform electric field of magnitude 4550 N/C points vertically upward. How much electric flux passes through the sloping side surface area of the cone?




**B3)** Three capacitors, of capacitance 5.00 $\mu$F, 10.0 $\mu$F, and 50.0 $\mu$F, are connected in series across a 12.0-V voltage source.
(a) How much charge is stored in the 5.00-$\mu$F capacitor?
(b) What is the potential difference across the 10.0-$\mu$F capacitor?

**B4)** Two unknown resistors are connected together. When they are connected in series their equivalent resistance is 15 Ω. When they are connected in parallel, their equivalent resistance is 3.3 Ω. What are the resistances of these resistors?

**B5)** For the circuit shown in the figure, what is the current through resistor $R_3$?




**B6)** A wire along the *z*-axis carries a current of 6.8 A in the +*z* direction. Find the magnitude and direction of the force exerted on a 6.1-cm long length of the wire by a uniform magnetic field with magnitude 0.36 T in the -*x* direction.

**B7**) A uniform magnetic field of magnitude 0.80 T in the negative *z*-direction is present in a region of space, as shown in the figure. A uniform electric field is also present. An electron that is projected with an initial velocity $9.5 \times 10^4$ m/s in the positive *x*-direction passes through the region without deflection. What is the electric field vector in the region?