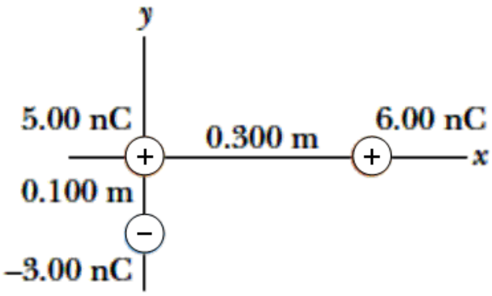
Q1. Three point charges are arranged as shown in **FIGURE 1**. Find the magnitude of the net electrostatic force on the point charge at the origin.

Fig#



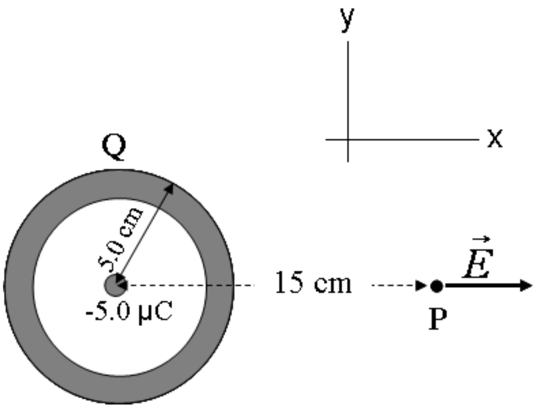
A) 1.38×10^{-5} N
B) 3.00×10^{-6} N
C) 8.15×10^{-5} N
D) 2.11×10^{-6} N
E) 7.50×10^{-5} N

Q2. Two small identical neutral metal spheres A and B of radii 2.0 cm have their centers separated by a fixed distance of 8.0 cm. Electrons are then transferred from sphere A to sphere B until the force of attraction between them becomes 36×10^{-5} N. How many electrons have been transferred from sphere A to sphere B?

A) 1.0×10^{11}
B) 1.6×10^{8}
C) 1.6×10^{3}
D) 1.0×10^{13}
E) 1.6×10^{7}

Q3. A spherical conducting shell of outer radius 5.0 cm has a net positive charge Q, then a point charge of -5.0 μC is placed at its center as shown in **FIGURE 2**. If the net electric field at point P, 15 cm away from the center of the spherical shell is $\vec{E} = 2\times10^{6}\,\hat{i}$ N/C, find the charge on the ***outer surface*** of the spherical shell

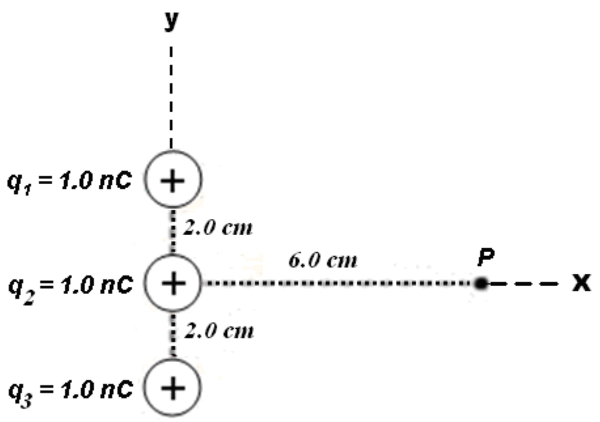
Fig#



A) +5.0 μC
B) +10 μC
C) +15 μC
D) −5.0 μC
E) −10 μC

Q4. Three identical point charges each of 1.0 nC are placed along a vertical line as shown in the **FIGURE 3**. Find the magnitude of the resultant electric field at a point P, 6.0 cm in front of middle charge.

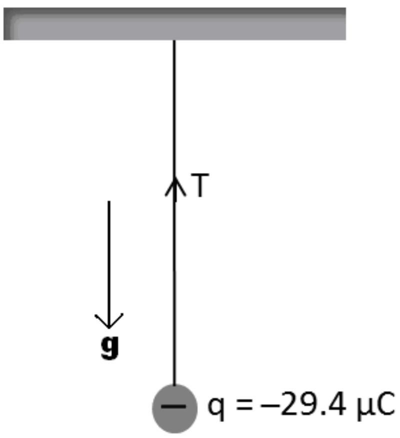
Fig#



A) 6.8×10^3 N/C
B) 8.0×10^3 N/C
C) 3.9×10^3 N/C
D) 2.7×10^3 N/C
E) 1.7×10^4 N/C

Q5. In **FIGURE 4**, a 0.300 g metallic ball carrying a charge of q = −29.4 μC, hangs from a light insulating string in a vertical electric field. If the ball is in static equilibrium and the tension in the string is zero find the magnitude and direction the electric field.

Fig#



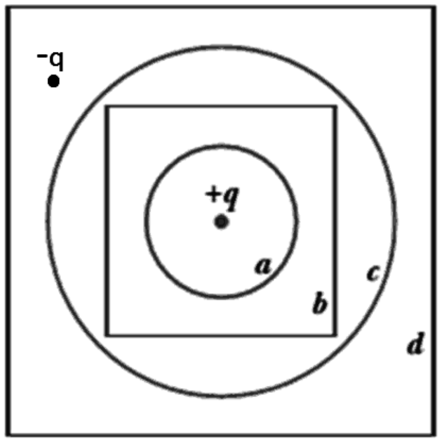
A) 100 N/C downward
B) 2.94 N/C upward
C) 200 N/C downward
D) 100 N/C upward
E) 150 N/C upward

Q6. How much work is required to turn an electric dipole 180° in a uniform electric field of magnitude E = 35.6 N/C if the dipole moment has a magnitude of p = 3.02×10^{-25} C. m and the initial angle between $\vec{P}$ and $\vec{E}$ is 64°?

A) $+9.43 \times 10^{-24}$ J
B) -1.19×10^{-24} J
C) -9.43×10^{-24} J
D) $+1.19 \times 10^{-24}$ J
E) $+19.3 \times 10^{-24}$ J

Q7. **FIGURE 5** shows, in cross section, two Gaussian spheres and two Gaussian cubes. A positive charge +q is placed at the center of inner sphere 'a' and a charge of –q is placed between the sphere 'c' and the cube 'd'. Rank the net flux Φ through the four Gaussian surfaces, **GREATEST FIRST**.

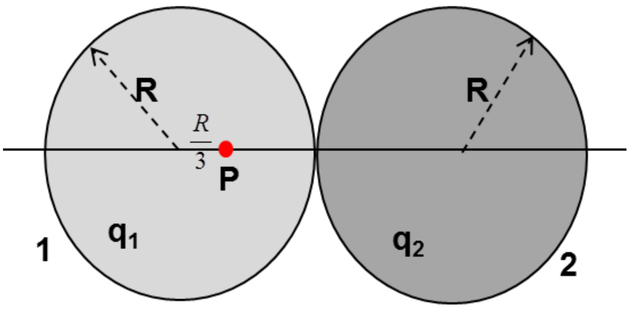
Fig#



A) Φ_a, Φ_b, and Φ_c tie, Φ_d
B) Φ_d, Φ_a, Φ_b, Φ_c
C) Φ_d than Φ_a, Φ_b, and Φ_c tie
D) Φ_d, Φ_b, Φ_c, Φ_a
E) Φ_d and Φ_b tie, Φ_a and Φ_c tie

Q8. **FIGURE 6** shows, in cross-section, two solid insulating spheres 1 and 2, each of radius R. Positive charges q_1 and q_2 are uniformly distributed throughout the volume of sphere 1 and 2, respectively. Point P lies on a line connecting the centers of the spheres, at radial distance R/3 from the center of sphere 1. If the net electric field at point P is zero, what is the ratio q_2/q_1?

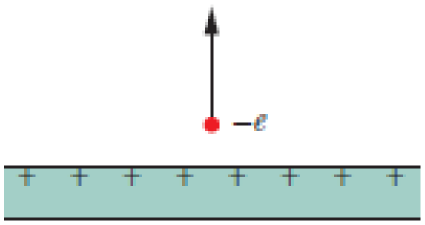
Fig#



A) 25/27
B) 9/8
C) 2/3
D) 1
E) 400/3

Q9. An electron is shot directly upward away from a uniformly positively charged plastic sheet as shown in **FIGURE 7**. The sheet is non-conducting, flat, and very large. If the magnitude of the electron's acceleration is 2.50×10^{16} m/s^2, what is the sheet's surface charge density? (ignore the effect of gravity)

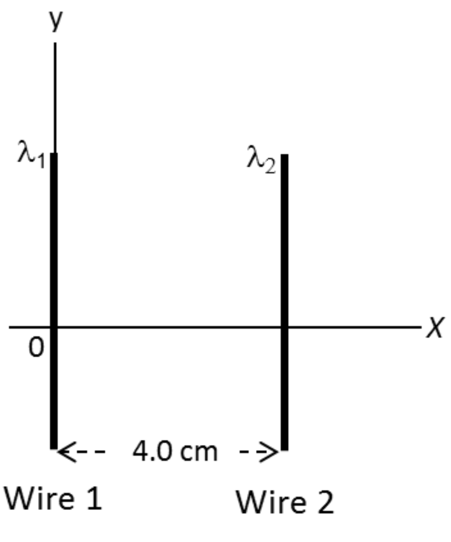
Fig#



A) 2.52×10^{-6} C/m^2
B) 1.26×10^{-6} C/m^2
C) 1.42×10^{5} C/m^2
D) 1.38×10^{-7} C/m^2
E) 7.52×10^{-7} C/m^2

Q10. In **FIGURE 8,** short sections of two very long parallel lines of charges are shown, fixed in place, separated by 4.00 cm. The uniform linear charge densities are λ_1 = +8.00 µC/m and λ_2 = +4.00 µC/m. where along the x-axis from wire 1 the net electric field will be zero.

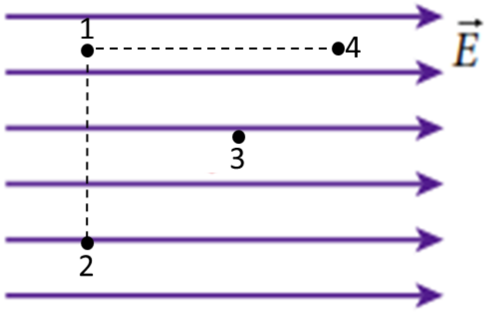
Fig#



A) +2.67 cm
B) +5.00 cm
C) +1.33 cm
D) −2.00 cm
E) −1.20 cm

Q11. Four points 1, 2, 3, and 4 are in a uniform horizontal electric field $\vec{E}$, shown in the **FIGURE 9**. Points 2 and 1 are along same vertical line and points 4 and 1 are along same horizontal line. Rank the points according to their electric potentials, GREATEST FIRST (assume potential is zero at infinity)

Fig#



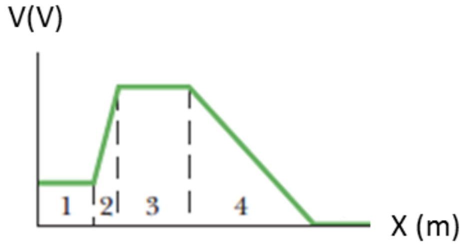
A) 1, 2 tie, 3, 4
B) 4, 3, then 1 and 2 tie
C) 1 and 4 tie, 3, 2
D) 1, 2, 3, 4
E) 4, 3, 2, 1

Q12. A charge of 1.50 × 10^{-6} C is put on an isolated metal sphere of radius 16.0 cm. With V = 0 at infinity, what is the electric potential at the center of the sphere.

A) 8.44×10^4 V
B) 5.27×10^5 V
C) 0
D) 16.0 V
E) 32.0 V

Q13. **FIGURE 10** gives the electric potential V as a function of distance x. Rank the four regions according to the ***magnitude*** of the x-component of the electric field within them, **GREATEST FIRST**.

Fig#



A) 2, 4, then 1and 3 tie
B) 4, 2, then 1 and 3 tie
C) 4, 2, 3, 1
D) 4, 3, 1, 2
E) 2, 1, 3, 4

Q14. Two electrons are fixed 2.00 cm apart. Another electron is shot from infinity and stops midway between the two. What was the initial speed of the electron? [Assume potential is zero at infinity]

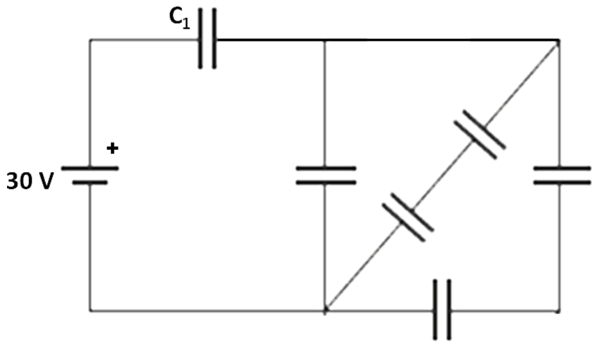
A) 318 m/s
B) 355 m/s
C) 251 m/s
D) 125 m/s
E) 875 m/s

Q15. If the voltage across a parallel-plate capacitor is doubled, which of the following statements is correct?

A) Its capacitance will remain the same
B) Its capacitance doubles
C) Its capacitance reduces to half
D) Charge stored on the capacitor reduces to half
E) Charge stored on the capacitor remains the same

Q16. In **FIGURE 11**, the battery has a potential difference of 30 V and the six capacitors each have a capacitance of 4.0 μF. Find the charge on capacitor C_1.

Fig#



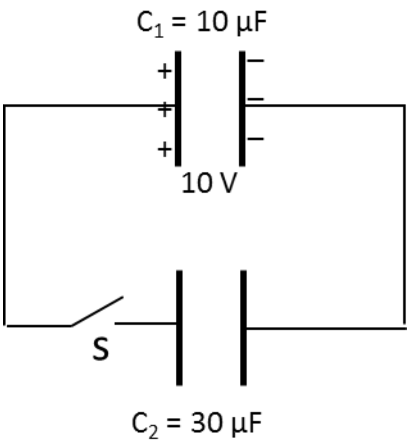
A) 80.0 μC
B) 40.0 μC
C) 100 μC
D) 60.0 μC
E) 20.0 μC

Q17. For a 7.40 pF air-filled parallel plate capacitor, it is desired to store 7.40 μJ energy with a potential difference of 652 V using a dielectric material between the plates. What is dielectric constant of the material to be filled between the plates?

A) 4.70
B) 7.21
C) 5.43
D) 3.16
E) 1.12

Q18. A parallel plate capacitors C_1 = 10 μF is charged to a potential difference of 10 V. If you then close the switch 'S' to connect the charged capacitor C_1 to another uncharged capacitor C_2 = 30 μF as shown in the **FIGURE 12**, find the new voltage V across the capacitors.

Fig#



A) 2.5 V
B) 5.0 V
C) 10 V
D) 3.3 V
E) 6.6 V

Q19. The current density in a wire is uniform and has magnitude 2.00×10^6 A/m^2, the wire's length is 0.100 m, and the density of conduction electrons is 8.49×10^{28} m^{-3}. How long does an electron take (on the average) to travel the length of the wire?

A) 6.79×10^2 s
B) 1.50×10^2 s
C) 4.10×10^2 s
D) 9.90×10^2 s
E) 8.40×10^2 s

Q20. An unknown resistor is connected between the terminals of a 3.0 V battery. Energy is dissipated in the resistor at the rate of 0.36 W. The same resistor is then connected between the terminals of a 1.5 V battery. At what rate is energy now dissipated?

A) 0.09 W
B) 0.18 W
C) 0.06 W
D) 0.72 W
E) 0.50 W