Q1. Two identical positively charged ions are separated from each other by a distance of 6.8×10^{-9} m. If the electrostatic force between them is 4.5×10^{-9} N, how many electrons are missing from each ion?

A) 30
B) 45
C) 48
D) 37
E) 25

Q2. A charge q is placed at the center of the line joining two equal charges Q . All charges will be in equilibrium if q is equal to:

A) $-Q/4$
B) $-Q/2$
C) $Q/4$
D) $Q/2$
E) $Q/3$

Q3. Three electric charges $Q_A = Q_B = q$, and $Q_C = -2q$ are located at the points A ($x = +a$, $y = 0$), B ($x = -a$, $y = 0$), and C ($x = 0$, $y = +2a$), respectively. What is the electric field at the origin?

A) $k\dfrac{q}{2a^2}$ toward Q_C
B) $k\dfrac{q}{2a^2}$ away from Q_C
C) $k\dfrac{q}{a}$ toward Q_C
D) $k\dfrac{q}{a}$ away from Q_C
E) zero

Q4. A proton with a speed of 3.0×10^{5} m/s moves in uniform electric field of 1.9×10^{3} N/C. The field is acting to decelerate the proton. How far does the proton travel before it is brought to rest?

A) 0.25 m
B) 0.45 m
C) 0.53 m
D) 0.29 m
E) 0.61 m

Q5. In a uniform electric field, which statement is CORRECT?

A) All electric field lines are parallel.
B) All charged particles experience the same force.
C) All charged particles move with the same velocity.

D) All electric field lines are directed away from the negative charges.
E) All electric field lines are directed towards the positive charges.

Q6. When a piece of paper is held with its face perpendicular to a uniform electric field the flux through it is 25.0 N·m^2/C. When the paper is turned 25.0^o with respect to the field the flux through it is:

A) 22.7 N·m^2/C
B) 17.6 N·m^2/C
C) 21.3 N·m^2/C
D) 25.6 N·m^2/C
E) zero

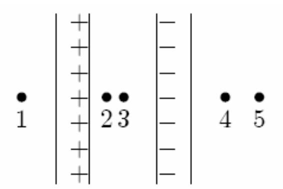
Q7. Charge Q is distributed uniformly throughout a spherical insulating shell. The net electric flux in N·m^2/C through the inner surface of the shell is:

A) 0
B) Q/ε_o
C) $2Q/\varepsilon_o$
D) $Q/4\pi\varepsilon_o$
E) $Q/2\pi\varepsilon_o$

Q8. A long wire, of linear charge density λ_l, runs along the cylindrical axis, of a cylindrical conducting shell, which carries a net linear charge density of λ_c. The charge per unit length on the inner and outer surfaces of the shell, respectively are:
[Note: linear charge density ≡ charge per unit length]

A) $-\lambda_l$ and $\lambda_c + \lambda_l$
B) λ_l and λ_c
C) $-\lambda_l$ and $\lambda_c - \lambda_l$
D) $\lambda_l + \lambda_c$ and $\lambda_c - \lambda_l$
E) $\lambda_l - \lambda_c$ and $\lambda_c + \lambda_l$

Q9. Two large insulating parallel plates carry uniformly-distributed surface charge densities of equal magnitude, one positive and the other negative. Rank the points 1 through 5 according to the magnitude of the electric field at the points, least to greatest.

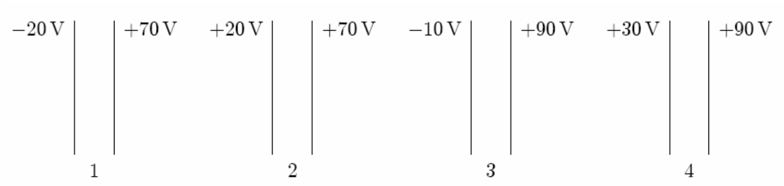


A) 1, 4, and 5 tie, then 2 and 3 tie
B) 1, 2, 3, 4, 5
C) 2, then 1, 3, and 4 tied, then 5
D) 2 and 3 tie, then 1 and 4 tie, then 5
E) 2 and 3 tie, then 1, 4, and 5 tie

Q10. A 5-cm radius conducting sphere has a surface charge density of 2×10^{-6} C/m^2 on its surface. The electric potential, at $r = 2.5$ cm from the center of the sphere is: [Assume V = 0 at infinity.]

A) 1.1×10^4 V
B) 2.2×10^4 V
C) 0.5×10^4 V
D) 3.6×10^5 V
E) 7.2×10^6 V

Q11. The diagram shows four pairs of, identical, large parallel conducting plates. The value of the electric potential is given for each plate. Rank the pairs according to the magnitude of the electric field between the plates, least to greatest.



A) 2, 4, 1, 3
B) 1, 2, 3, 4
C) 4, 3, 2, 1
D) 2, 3, 1, 4
E) 3, 2, 4, 1

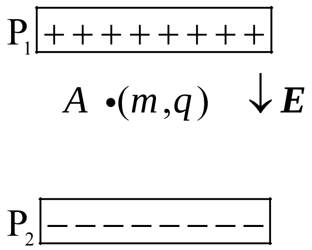
Q12. An electron starts from rest at a point 10 cm from a positively charged conducting plate, with a surface charge density $\sigma = +1 \times 10^{-9}$ C/m^2. The electron is attracted to the plate until it collides with the plate. With what speed will the electron collide with plate?

A) 2.0×10^6 m/s
B) 1.4×10^6 m/s
C) 7.1×10^5 m/s
D) 1.0×10^6 m/s
E) 2.7×10^6 m/s

Q13. A point charge of 5.0×10^{-9} C is transferred, by an external agent, from infinity to the surface of a ball of radius 5.0 cm. If the ball has the charge density 5.0×10^{-4} C/m^2, then the amount of work done, by the external agent, in the process is: [Assume V = 0 at infinity.]

A) 1.4×10^{-2} J
B) 3.0×10^{-3} J
C) 7.1×10^{-5} J
D) 8.4×10^{-3} J
E) 7.0×10^{2} J

Q14. A particle, of mass m and charge q, is placed at rest at point A in a uniform electric field $\mathbf{E}$, as shown in the figure. If the particle is released, then the kinetic energy it attains after moving a distance y is:



A) qEy

B) qE^2y

C) $\frac{1}{2}m(qEy)^2$

D) $\frac{1}{2}mqEy$

E) $\frac{1}{2}qEy$

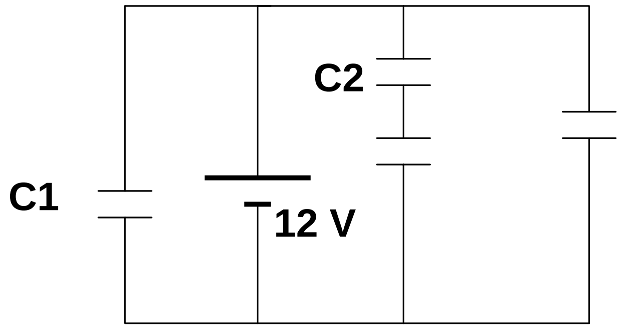
Q15. A parallel plate capacitor has square shaped plates with an area = 4.1×10^{-3} m^2 and 1.6×10^{-3} m separation. What charge will appear on the plates of such capacitor if a potential difference of 80 V is applied?

A) 1.8×10^{-9} C
B) 2.8×10^{-9} C
C) 3.6×10^{-9} C
D) 5.6×10^{-9} C
E) 0.9×10^{-9} C

Q16. An air filled parallel-plate capacitor has a capacitance of 3.0×10^{-12} F. The plate separation is then doubled and a wax dielectric is inserted, completely filling the space between the plates. As a result the, capacitance becomes 7.5×10^{-12} F. The dielectric constant of the wax is:

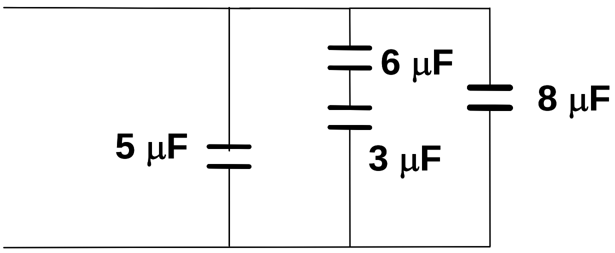
A) 3
B) 2
C) 8
D) 4
E) 6.0×10^{-12}

Q17. A battery having potential difference V = 12 V and four capacitors, each having a capacitance of 12 μF, are connected as shown in the figure. What is the charge on C2?



A) 72 μC
B) 36 μC
C) 12 μC
D) 27 μC
E) 88 μC

Q18. Consider the combination of capacitors as shown in the Figure. The energy stored in the $8.0\ \mu$F capacitor is 0.40 J. The energy stored in the $5.0\ \mu$F capacitor is:



A) 0.25 J
B) 0.51 J
C) 0.84 J
D) 0.42 J
E) 0.13 J

Q19. A 100 W bulb is designed to operate with a line voltage of 120-V. If the line voltage decreases and the bulb consumes only 90 W, find the final voltage in the line. Assuming the resistance of the bulb is constant.

A) 114 V
B) 110 V
C) 100 V
D) 94 V
E) 135 V

Q20. A heater of unknown resistance is plugged into a 120-V line. The charge passing through it in one hour is 4800 C. What is the resistance of the heater?

A) 90 Ω
B) 120 Ω

C) 160 Ω
D) 15 Ω
E) 1.5 Ω