Q1.
Particle 1 with charge q_1, and particle 2 with charge q_2 are on the x axis, with particle 1 at x = 4.0 cm and particle 2 at x = −2.0 cm. Find the relationship between q_1 and q_2 so that the net force on a third particle of charge q located at the origin, be zero,

A) $q_2 = q_1 / 4$
B) $q_2 = 4\, q_1$
C) $q_2 = -2\, q_1$
D) $q_2 = -4\, q_1$
E) $q_2 = -q_1 / 4$

Q2.
A particle with charge 2.0 μC is placed at the origin, an identical particle, with the same charge, is placed 2.0 cm from the origin on the positive x axis, and a third identical particle, with the same charge, is placed 2.0 cm from the origin on the positive y axis. The magnitude of the force on the particle at the origin is:

A) 1.3×10^2 N
B) zero N
C) 6.4×10^3 N
D) 1.8×10^2 N
E) 3.6×10^2 N

Q3.
Two identical charges each of charge Q are positioned at points A (5.0 m, 0.0 m) and B(-5.0 m, 0.0 m) to produce a net electric field of $\vec{E} = \left(-10\hat{j}\right)$ N/C at point C (0.0 m, 5.0 m). Find the value of Q.

A) -39 nC
B) +39 nC
C) +70 nC
D) -70 nC
E) -80 nC

Q4.
The dipole moment of a dipole in a 300-N/C electric field is initially perpendicular to the field, but it rotates so that it becomes in the same direction as the field. If the electric dipole moment has a magnitude of 2.0×10^{-9} C.m, the work done by the field is:

A) $+6.0 \times 10^{-7}$ J
B) -6.0×10^{-7} J
C) 0
D) -12×10^{-7} J
E) $+12 \times 10^{-7}$ J

Q5.
A spherical conducting shell has charge Q. A particle with charge q is placed at the center of the spherical shell. The charge on the inner surface of the shell and the charge on the outer surface of the shell, respectively, are:

A) −q, (Q + q)
B) 0, Q
C) q, (Q − q)
D) Q, 0
E) −q, 0

Q6.
Fig. 1 shows a Gaussian surface in the shape of a cube with edge 2.0 m**.** This cube lies in a region where the electric field vector is given by $\vec{E} = \left(-4.0\hat{i} + 8.0\hat{j}\right)$ N/C **.** Find the net charge contained in the cube.

Fig#

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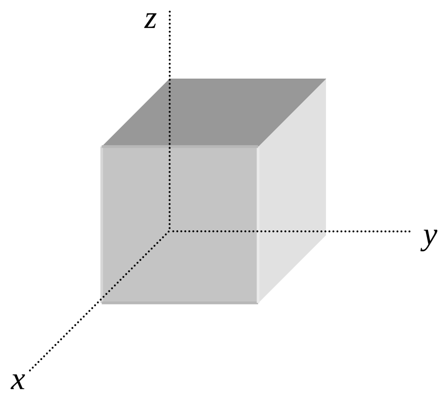

A) 0 C
B) 4.2 C
C) 12 C
D) 5.0 C
E) 9.8 C

Q7.
If the constant electric field in Fig 2 has a magnitude E = 25 N/C, calculate the electric flux through the curved surface of the hemisphere (half a sphere of radius R = 5.0 cm). (Knowing that the electric field is perpendicular to the flat surface and that the hemisphere encloses no electric charges.)

Fig#

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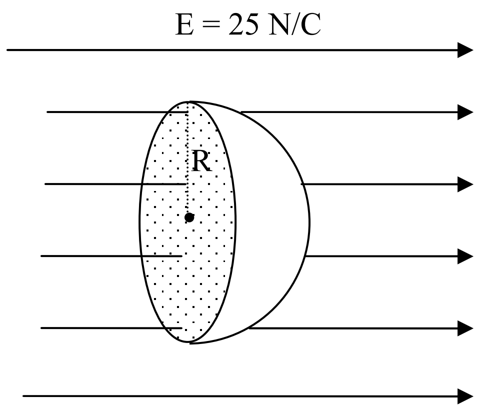

A) 0.20 N·m^2/C
B) 9.0 N·m^2/C
C) 6.4 N·m^2/C
D) 1.3 N·m^2/C
E) 3.6 N·m^2/C

Q8.
A charge is distributed uniformly along a long straight wire. If the electric field 4.0 cm from the wire is 40 N/C, then the electric field 8.0 cm from the wire is:

A) 20 N/C
B) 40 N/C
C) 80 N/C
D) 120 N/C
E) 10 N/C

Q9.
Fig. 3 shows a 3.0x10^5 N/C uniform electric field pointing perpendicularly to the left face of a large neutral vertical conducting plate. The surface charge density of the left (σ_L) and right (σ_R) faces of the plate, respectively, are:

Fig#

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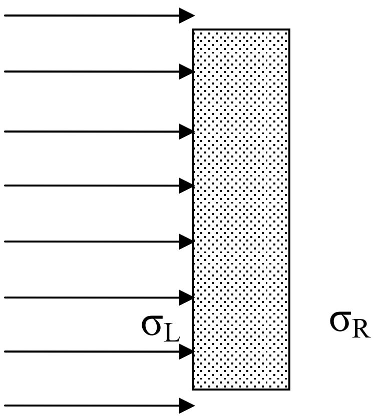
$E = 3.0 \times 10^5$ N/C



A) -2.7×10^{-6} C/m^2 ; $+2.7 \times 10^{-6}$ C/m^2
B) $+2.7 \times 10^{-6}$ C/m^2 ; -2.7×10^{-6} C/m^2
C) -5.3×10^{-6} C/m^2 ; $+5.3 \times 10^{-6}$ C/m^2
D) $+5.3 \times 10^{-6}$ C/m^2 ; -5.3×10^{-6} C/m^2
E) 0 C/m^2 ; 0 C/m^2

Q10.
Points A (2.0 m, 3.0 m) and B (5.0 m, 7.0 m) are located in a region where the electric field is uniform and is given by $\vec{E} = \left(4.0\hat{i} + 3.0\hat{j}\right)$ N/C . What is potential difference (V_A-V_B)?

A) 24 V
B) 27 V
C) 30 V
D) 33 V
E) 11 V

Q11.
Eight isolated identical spherical raindrops are each at a potential of 100 V at the surface, relative to the potential at infinity. They are combined together to make one spherical raindrop whose potential at the surface is:

A) 400 V
B) 200 V
C) 600 V
D) 800 V
E) 100 V

Q12.

Point charges q and Q are placed as shown in Fig. 4. If q = +2.0 nC and Q = -2.0 nC, *a* = 3.0 m, and *b* = 4.0 m, what is the electric potential difference (V_A-V_B)?

Fig#

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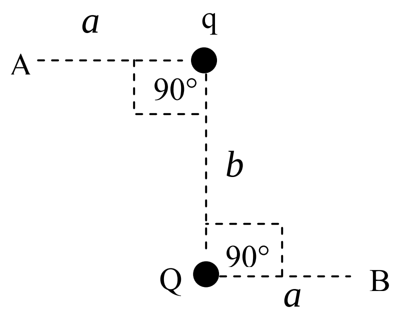

A) 4.8 V
B) 6.0 V
C) -7.2 V
D) 8.4 V
E) 0 V

Q13.
Two identical and isolated 8.0 μC point charges are positioned on the x-axis, one is at x = +1.0 m and the other is at x = -1.0 m. They are released from rest simultaneously. What is the kinetic energy of either of the charges after it has moved 2.0 m along the x axis?

A) 96 mJ
B) 54 mJ
C) 84 mJ
D) 63 mJ
E) 48 mJ

Q14.
A conducting sphere 1 with radius R has a positive charge Q. Another conducting sphere 2 with radius 2 R is far from sphere 1 and initially uncharged. After the separated spheres are connected with a thin conducting wire the two spheres end up with charges q_1 and q_2. Which of the following statements is correct?

A) both spheres are at same potential.
B) the amount of charge on each sphere is Q/2.
C) the electric field at the surfaces of the two spheres is equal.
D) the potential of the spheres are in the ratio $V_2/V_1=q_2/q_1$
E) the potential of the spheres are in the ratio $V_2/V_1= 2$

Q15.
You are to connect capacitors C_1= C and C_2 = 2C to the same battery, first individually, then in series and then in parallel. In which of the following cases, the charge stored is the smallest?

A) C1 and C2 in series
B) C1 and C2 in parallel
C) C1 individually
D) C2 individually
E) In all cases the same amount of charge is stored

Q16.
Given a 9.4 pF air-filled capacitor, you are asked to convert it to a capacitor that can store 9.4 µJ, with a potential of 877 V. What is the dielectric constant of the material that you must insert between the plates of the capacitor?

A) 2.6
B) 0.39
C) 4.7
D) 0.21
E) 310

Q17.
A capacitor C1 = 1.00 µF and another capacitor C2 = 2.00 µF are connected in series across a 900 V supply line. The charged capacitors are disconnected from the supply line then reconnected to each other with terminals of like sign together. Find the final charges on C1 and C2, respectively.

A) 400 µC, 800 µC
B) 200 µC, 400 µC
C) 100 µC, 200 µC
D) 800 µC, 400 µC
E) 400 µC, 200 µC

Q18.
Two capacitors each of capacitance 250 µF are connected in parallel across a battery of 120V. How much energy is produced after both capacitors are completely discharged?

A) 3.6 J
B) 5.8 J
C) 8.6 J
D) 12 J
E) 36 J

Q19.
A current of 0.300 A is passed through a lamp (light bulb) for 2.00 minutes using a 6.00 V power supply. The energy dissipated by this lamp during the 2.00 minutes is:

A) 216 J
B) 12.0 J
C) 20.5 J
D) 36.0 J
E) 1.85 J

Q20.
A certain wire has resistance R. Another wire, of the same material, has half the length and half the diameter of the first wire. The resistance of the second wire is:

A) 2R
B) R / 2
C) R
D) R/4
E) 4 R

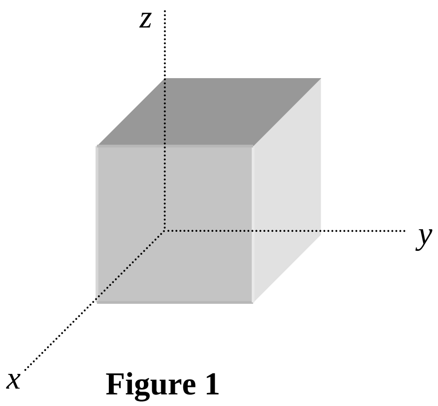

Figure 1

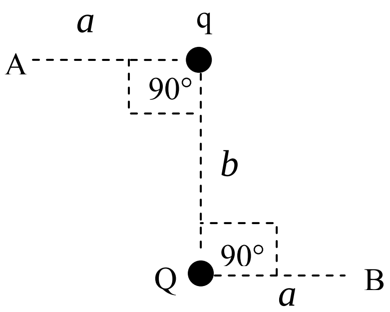

Figure 4

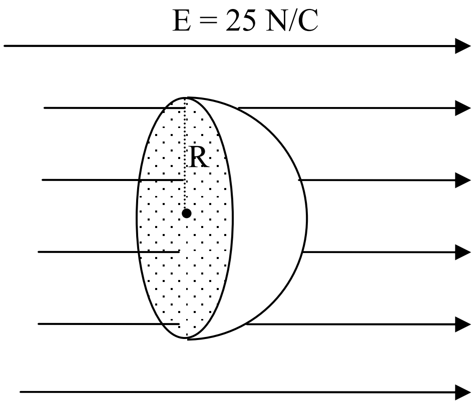

Figure 2

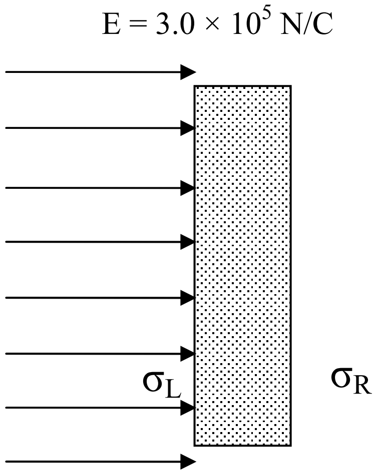

Figure 3

Physics 102
Formula sheet for Second Major

$F = \frac{kq_1q_2}{r^2}$, $F = q_0 E$

$\Phi = \int_{Surface} \vec{E} \cdot d\vec{A}$, $E = \frac{kq}{r^2}$

$E = \frac{kQ}{R^3} r$, $E = \frac{2k\lambda}{r}$

$\varphi_c = \oint \vec{E} . d\vec{A} = \frac{q_{in}}{\varepsilon_0}$; $E = \frac{\sigma}{2\varepsilon_o}$; $E = \frac{\sigma}{\varepsilon_o}$

$E = \frac{\sigma}{2\varepsilon_o}$, $E = \frac{\sigma}{\varepsilon_o}$

$V = \frac{kQ}{r}$, $W = -\Delta U$

$\Delta V = V_B - V_A = -\int_A^B \vec{E} . d\vec{s} = \frac{\Delta U}{q_0}$

$E_x = -\frac{\partial V}{\partial x}$, $E_y = -\frac{\partial V}{\partial y}$, $E_z = -\frac{\partial V}{\partial z}$

$U = \frac{kq_1q_2}{r_{12}}$

$C = \frac{Q}{V}$, $C_o = \frac{\varepsilon_0 A}{d}$, $C = 4\pi\varepsilon_o \frac{ab}{b-a}$,

$U = \frac{1}{2} CV^2$, $u = \frac{1}{2}\varepsilon_o E^2$, $C = \kappa C_0$,

$I = \frac{dQ}{dt}$, $I = J A$,

$R = \frac{V}{I} = \rho \frac{L}{A}$

$\rho = \rho_0 [1 + \alpha(T - T_0)]$, $P = IV$

$v = v_o + at$

$x - x_o = v_o t + \frac{1}{2} at^2$

$v^2 = v_o^2 + 2a(x - x_o)$

$\varepsilon_0 = 8.85 \times 10^{-12}$ $C^2/N.m^2$
$k = 9.0 \times 10^9$ $N.m^2/C^2$
$q_e = -1.6 \times 10^{-19}$ C
$m_e = 9.11 \times 10^{-31}$ kg
$m_p = 1.67 \times 10^{-27}$ kg
1 eV = 1.6×10^{-19} J
micro (μ) = 10^{-6}, nano (n) = 10^{-9},
pico (p) = 10^{-12}
g = 9.8 m/s^2