Q1.

Two point charges $q_1 = +2.0\times10^{-6}$ C and $q_2 = -8.0\times10^{-6}$ C are located at (0.0, 0.0) cm and (10.0, 0.0) cm, respectively. Another positive point charge q_3 is to be located somewhere, on x-axis, such that the net electrostatic force on it due to q_1 and q_2 is zero. Its location will be:

A) (-10.0, 0.0) cm
B) (0.0, 0.0) cm
C) (-5.0, 0.0) cm
D) (5.0, 0.0) cm
E) (20.0, 0.0) cm

Q2.

Three point charges q_1, q_2, and q_3 are fixed at the three corners of a right-angle triangle as shown in figure (1). Given that $q_1 = q_2 = +3.2\times10^{-19}$ C while $q_3 = -1.6\times10^{-19}$ C, and b = 5.0 cm. The magnitude of the net electric field at point P due to all the three point charges is:

A) 1.15×10^{-6} N/C
B) 0.00 N/C
C) 5.00×10^{-6} N/C
D) 7.07×10^{-6} N/C
E) 4.80×10^{-6} N/C

Q3.

Figure (2) shows a charged ball of mass m = 1.0 g is suspended by a light string in the presence of a uniform electric field, $\vec{E} = -3.0\times10^{5}\ \hat{i}\ \frac{N}{C}$. In this field, the ball is in equilibrium at $\theta = 37^{0}$. The charge "q" on the ball is**:**

A) -2.46×10^{-8} C
B) 0.00 C
C) 2.46×10^{-8} C
D) -7.07×10^{-8} C
E) 4.80×10^{-6} C

Q4.

The electric field between two long and parallel charged plates is uniform, and is equal to $\vec{E} = 240\ \hat{j}\ \frac{N}{C}$. An electron with velocity components $v_x = 3.0\times10^{5}$ m/s and $v_y = 2.0\times10^{3}$ m/s enters the region between these plates. The acceleration of the electron when its x-coordinate has changed by 2 cm is:

A) $-4.2\times10^{13}\ \hat{j}$ (m/s^2)
B) $-9.8\ \hat{j}$ (m/s^2)
C) $+1.8\times10^{11}\ \hat{i}$ (m/s^2)
D) $-3.0\times10^{8}\ \hat{i}$ (m/s^2)

E) $+5.4\times10^{9}\ \hat{j}$ (m/s^2)

Q5.
A uniform electric field $\vec{E} = a\,\hat{i} + b\,\hat{j}$ intersects a surface of area A. The flux through the area is:

A) Zero if the surface lies in the xy plane.
B) Zero if the surface lies in the xz plane.
C) Zero if the surface lies in the yz plane.
D) aA if the surface lies in xz plane
E) bA if the surface lies yz plane

Q6.
A point charge of 12 μC is placed at the center of a spherical shell of radius 12 cm. Find the ratio of the total electric flux through the entire surface of the shell to that of a concentric spherical surface of radius 6.0 cm.

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

Q7.
An insulating sphere of radius R = 10 mm has a uniform charge density $\rho = 6.00 \times 10^{-3}$ C/m^3. Calculate the electric flux through a concentric spherical surface with radius 5.00 mm.

A) 355 $N.m^2/C$
B) 300 $N.m^2/C$
C) 250 $N.m^2/C$
D) 100 $N.m^2/C$
E) 150 $N.m^2/C$

Q8.
Calculate the ratio of the speed of a proton to that of an electron, both accelerated through the same potential difference.

A) 0.023
B) 0.240
C) 0.353
D) 0.560
E) 1.00

Q9.

The electric field, at a distance of 40 cm, from a very long uniform wire of charge is 840 N/C. How much charge is contained in a 2.0 cm long of the wire?

A) 0.37 nC
B) 0.68 nC
C) 10 nC
D) 5.0 nC
E) 3.5 nC

Q10.
Two charged spherical conductors having radii 4.0 cm and 6.0 cm are connected by a long conducting wire. A total charge of 20 μC is placed on this combination of two spheres. Find the charges on each sphere (smaller first).

A) 8.0 μC & 12 μC
B) 4.0 μC & 16 μC
C) 14 μC & 6.0 μC
D) 7.0 μC & 13 μC
E) 5.0 μC & 15 μC

Q11.
Figure (3) shows three charges located at the corners of a triangle. How much energy would be needed to remove the 4 μC charge to infinity? [Assume V = 0 at infinity.]

A) 8.2 J
B) 3.4 J
C) zero
D) 1.4 J
E) 5.6 J

Q12.
Three concentric spherical shells A, B and C, of radii a, b and c (a<b<c), have charges q, -q and q respectively. The potential of C is:

A) $V_C = k\frac{q}{c}$

B) $V_C = k\left(\frac{q}{a} + \frac{q}{b} - \frac{q}{c}\right)$

C) $V_C = k\left(\frac{q}{a} + \frac{q}{b} + \frac{q}{c}\right)$

D) $V_C = k\left(-\frac{q}{a} + \frac{q}{b} + \frac{q}{c}\right)$

E) $V_C = k\left(\frac{q}{a} - \frac{q}{b} + \frac{q}{c}\right)$

Q13.

A particle having a charge of $q = 8.0\times10^{-8}$ C is fixed at point D. Another particle of mass 10 g and charge of 5.0×10^{-9} C starts from rest at point A and moves in a straight line to the right, as shown in figure (4). The speed of the particle when it reaches point B is: [Assume V = 0 at infinity.]

A) 0.08 m/s
B) 0.02 m/s
C) 0.2 m/s
D) 1.2 m/s
E) 0.04 m/s

Q14.
How much energy is stored in the combination of capacitors shown figure (5)?

A) 0.03 J
B) 0.04 J
C) 0.02 J
D) 0.01 J
E) 0.06 J

Q15.
Consider three identical capacitors. Their equivalent capacitance when connected in parallel is C_p, and their equivalent capacitance when connected in series is C_s. Which of the following statements is **CORRECT**?

A) $C_p = 9\ C_s$
B) $C_p = 3\ C_s$
C) $C_p = C_s/9$
D) $C_p = C_s/3$
E) $C_p = C_s/2$

Q16.
Two parallel-plate capacitors are connected in series to a battery as shown in figure (6). A dielectric is inserted in capacitor C_1.

A) The charge on C_2 increases.
B) The charge on C_2 increases or decreases depending on the value of the voltage of the battery.
C) The charge on C_2 remains the same.
D) The charge on C_2 increases or decreases depending on the value of the dielectric constant of the dielectric.
E) The charge on C_2 decreases.

Q17.

Figure (7) shows three capacitors connected to a battery of voltage V = 6 Volts. The charges on the capacitors are known to be Q_1 = 24 μC for C_1 and Q_2 = 96 μC for C_2. What are the values of the capacitances C_1 and C_2?

A) C_1 = 8 μF, C_2 = 16 μF
B) C_1 = 8 μF, C_2 = 24 μF
C) C_1 = 10 μF, C_2 = 30 μF
D) C_1 = 21 μF, C_2 = 3 μF
E) C_1 = 4 μF, C_2 = 16 μF

Q18.

If a wire is stretched uniformly to **n**-times its original length, it's resistance changes by a factor of:

A) $\mathbf{n}^2$
B) **n**
C) 1/ **n**
D) 2 **n**
E) no change

Q19.

The potential difference across the ends of a wire is doubled in magnitude. If Ohm's law is obeyed, which one of the following statements concerning the resistance of the wire is true?

A) The resistance is not changed.
B) The resistance is one half of its original value.
C) The resistance is twice its original value.
D) The resistance increases by a factor of four.
E) The resistance decreases by a factor of four.

Q20.

A 40-W and a 60-W light bulbs are designed for use with the same voltage. What is the ratio of the resistance of the 60-W bulb to the resistance of the 40-W bulb?

A) 0.67
B) 2.3
C) 3.0
D) 1.5
E) 0.44

Figure (1)

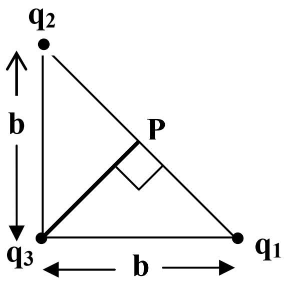


Figure (2)

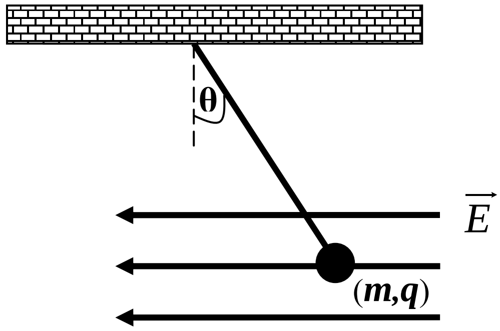


Figure (3)

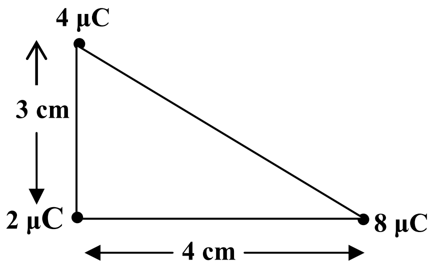


Figure (4)

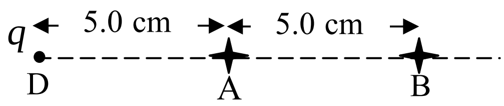


Figure (5)

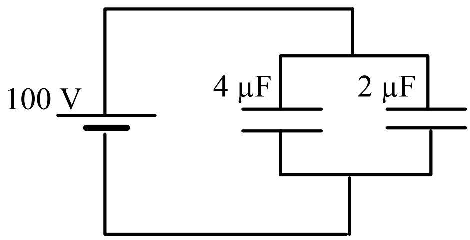


Figure (6)

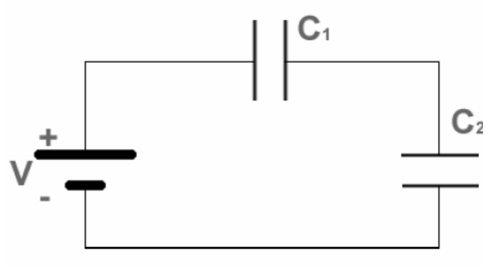
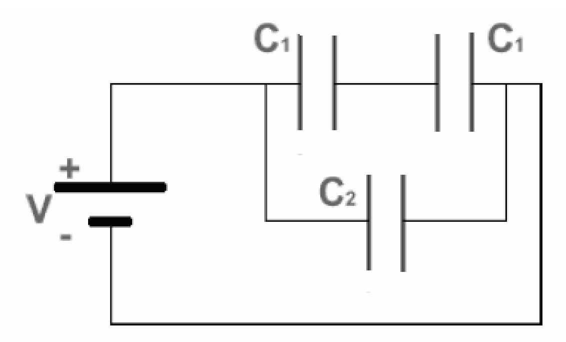


Figure (7)



Physics 102
Formula sheet for Second Major
Spring semester 2006-2007 (Term 062)

$F = \frac{kq_1q_2}{r^2}$, $F = q_0 E$ $\varphi = \int_{Surface} \vec{E}.d\vec{A}$, $E = \frac{kq}{r^2}$ $E = \frac{kQ}{R^3} r$, $E = \frac{2k\lambda}{r}$ $\varphi_c = \oint \vec{E}.d\vec{A} = \frac{q_{in}}{\varepsilon_0}$ $E = \frac{\sigma}{2\varepsilon_o}$, $E = \frac{\sigma}{\varepsilon_o}$ $V = \frac{kQ}{r}$, $W = - \Delta U$ $\Delta V = V_B - V_A = -\int_A^B \vec{E}.d\vec{S} = \frac{\Delta U}{q_0}$ $E_x = -\frac{\partial V}{\partial x}, E_y = -\frac{\partial V}{\partial y}, E_z = -\frac{\partial V}{\partial z}$ $U = \frac{kq_1q_2}{r_{12}}$, $C = \frac{Q}{V}$, $C_o = \frac{\varepsilon_0 A}{d}$ $C = 4\pi\varepsilon_o \frac{ab}{b-a}$, $U = \frac{1}{2}CV^2$ $u = \frac{1}{2}\varepsilon_o E^2$, $C = \kappa C_0$,	$I = \frac{dQ}{dt}$, $I = J A$, $R = \frac{V}{I} = \rho \frac{L}{A}$ $\rho = \rho_0 [1 + \alpha(T - T_0)]$, $P = IV$ $v = v_o + at$ $x - x_o = v_o t + \frac{1}{2} at^2$ $v^2 = v_o^2 + 2a(x - x_o)$ $\varepsilon_0 = 8.85 \times 10^{-12}$ $C^2/N.m^2$ $k = 9.0 \times 10^9$ $N.m^2/C^2$ $q_e = -1.6 \times 10^{-19}$ 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