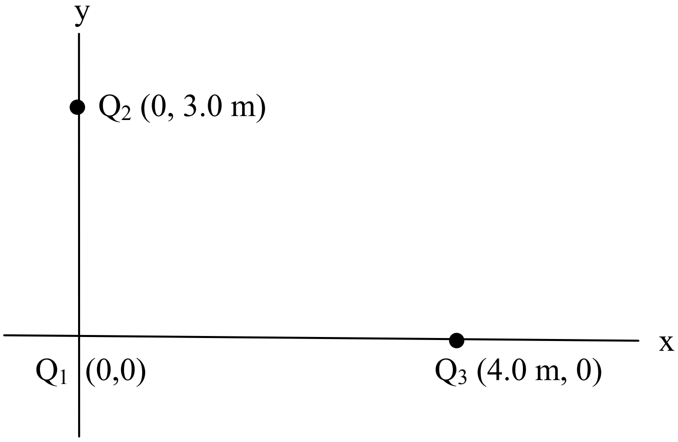
Q1.
Three point charges Q_1, Q_2 = 20 μC and Q_3 = 50 μC are located as shown in the figure. If the net force on Q_3 is in the direction of the negative y-axis, find the charge of Q_1.

Fig#



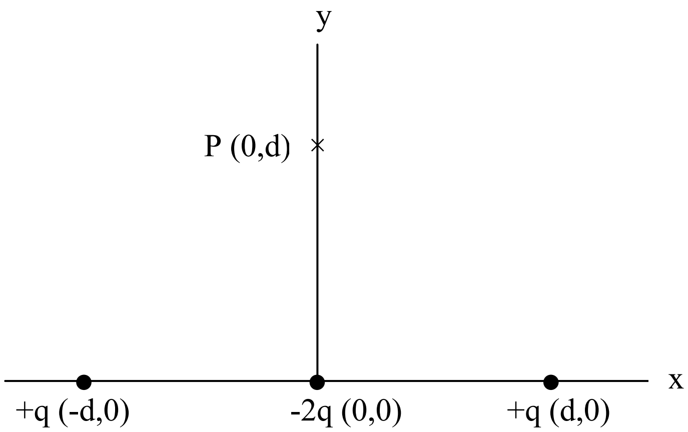
A) −10 μC
B) +10 μC
C) 0
D) −7.7 μC
E) +7.7 μC

Q2.
The distance between two identical conductor spheres is 0.50 m. Initially, one sphere has a charge of -8.0 μC and the other sphere has a charge of +2.0 μC. If the spheres are connected with a very thin conducting wire, what will be the electrostatic force on each sphere?

A) 0.32 N, repulsive.
B) 0.32 N, attractive.
C) 0.
D) 0.58 N, repulsive.
E) 0.58 N, attractive.

Q3.
For the arrangement of charges shown in the figure, what is the electric field at the point P? q = 1.0 μC and d = 50 cm.

Fig#



A) − 47 kV/m ĵ.
B) + 4.7 kV/m ĵ.
C) Zero.
D) − 72 kV/m ĵ.
E) + 72 kV/m ĵ.

Q4.
An electron is released from rest in a region of uniform electric field. The electron travels 4.0 cm in 20×10^{-9} s. What is the magnitude of the electric field?

A) 1.1 kV/m.
B) 2.1 kV/m.
C) 8.0 kV/m.
D) 2.0 kV/m.
E) 0.80 kV/m.

Q5.
A point charged particle is placed at the center of a spherical Gaussian surface. The electric flux through the Gaussian surface can be changed if

A) the point charge is moved to just outside the sphere.
B) the sphere is replaced by a cube of half the volume.
C) the point charge is moved off the center but still inside the original sphere.
D) the sphere is replaced by a cube of the same volume.
E) a second point charge is placed just outside the sphere.

Q6.
A spherical conducting shell has a net charge of 10 μC. If a point charge of +3 μC is placed at the center of the shell, the net charge on the outer surface of the shell will be

A) +13 μC.
B) −3 μC.

C) 0 μC.
D) −7 μC.
E) +10 μC.

Q7.
A hemisphere (half sphere) of radius 3.5 cm contains a total charge of 6.6×10^{-7} C. The flux through the rounded portion of the surface is 9.8×10^{4} Nm^2 /C. The flux through the flat base is

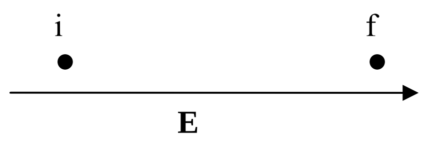
A) -2.3×10^{4} N m^2 /C.
B) $+2.3 \times 10^{4}$ N m^2 /C.
C) 0
D) -9.8×10^{4} N m^2 /C.
E) $+9.8 \times 10^{4}$ N m^2 /C.

Q8.
Charge is uniformly distributed on a long straight wire. At a distance of 5.0 cm from the wire, the electric field is 600 N/C. What is the charge on a length of 80 cm of the wire?

A) 1.3 nC.
B) 1.7 nC.
C) 0.27 nC.
D) 2.4 nC.
E) 0.67 nC.

Q9.
An electron moves from point i to point f, in the direction of a uniform electric field. During this displacement

Fig#



A) the work done by the field is negative and the electric potential energy of the electron-field system increases.
B) the work done by the field is positive and the electric potential energy of the electron-field system increases.
C) the work done by the field is positive and the electric potential energy of the electron-field system decreases.
D) the work done by the field is negative and the electric potential energy of the electron-field system decreases.
E) the work done by the field is positive and the electric potential energy of the electron-field system does not change.

Q10.

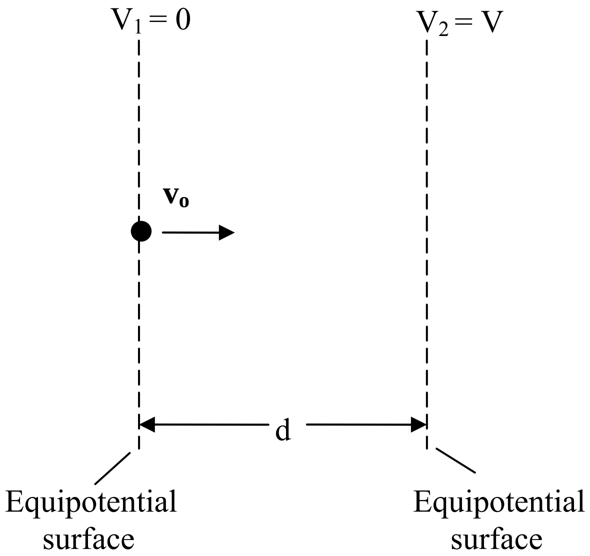
A particle with a charge of 5.5×10^{-8} C is fixed at the origin. A particle with a charge of -2.3×10^{-8} C is moved from x = 3.5 cm on the x-axis to y = 4.3 cm on the y-axis. The change in potential energy of the two-particle system is

A) $+6.0\times10^{-5}$ J.
B) -3.1×10^{-3} J.
C) $+3.1\times10^{-3}$ J.
D) -6.0×10^{-5} J.
E) 0.

Q11.

The figure shows a particle of mass m and charge –q moving between two equipotential surfaces V_1 and V_2 which are separated by a distance d. If the speed of the particle at surface V_1 is v_o, what is the change in the kinetic energy of the particle when it moves from surface V_1 to surface V_2?

Fig#



A) qV.
B) – qV.
C) $(\frac{1}{2})mv_o^2$.
D) $-(\frac{1}{2})mv_o^2$.
E) $qV-(\frac{1}{2})mv_o^2$.

Q12.

An electric potential is described by the function: $V(x) = 3x^2 - 15x + 7$ volt, where x is in meters. At what point on the x-axis is the electric field strength is zero?

A) 2.5 m.
B) 7.5 m.
C) 3.5 m.
D) 4.5 m.
E) 1.5 m.

Q13.
Suppose you have two capacitors C_1 = 1.0 μF and C_2 = 2.0 μF. C_2 is uncharged and C_1 is charged to a voltage of 5.0 V by a battery. The battery is disconnected from C_1 and then C_1 is connected directly to C_2. What will be the potential across each capacitor?

A) 1.7 V.
B) 0 V.
C) 5.0 V
D) 2.5 V.
E) 3.0 V.

Q14.
A 15 μF capacitor is connected to a 50 V battery and becomes fully charged. The battery is removed and a slab of dielectric that completely fills the space between the plates is inserted. If the dielectric has a dielectric constant of 5.0, what is the voltage across the capacitor's plates after the slab is inserted?

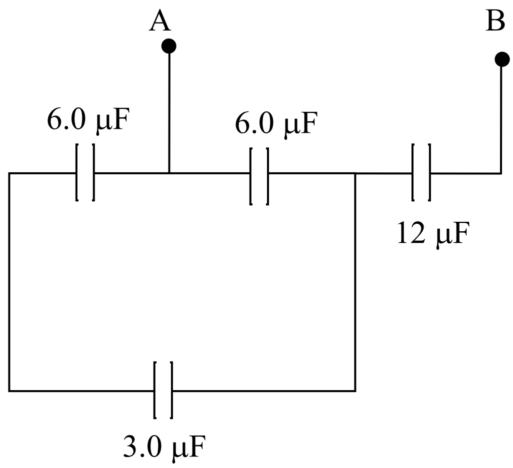
A) 10 V.
B) 250 V.
C) 2.0 V.
D) 75 V.
E) 3.0 V.

Q15.
A parallel plate capacitor is connected to a battery and becomes fully charged. The capacitor is then disconnected, and the separation between the plates is increased in such a way that no charge leaks off. What happens to the energy stored in this capacitor?

A) increases.
B) decreases.
C) becomes zero.
D) does not change.
E) not enough data to choose the right answer.

Q16.
Find the equivalent capacitance between the points A and B.

Fig#



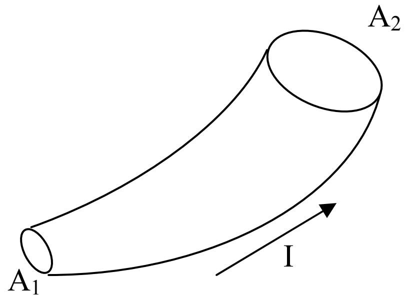
A) 4.8 μF.
B) 4.0 μF.
C) 5.1 μF.
D) 3.0 μF.
E) 6.0 μF.

Q17.
A coffee maker, which draws 12.0 A of current, has been left on for 8.0 min. What is the net number of electrons that have passed through the coffee maker?

A) 3.6×10^{22}.
B) 6.0×10^{22}.
C) 1.0×10^{22}.
D) 5.7×10^{22}.
E) 2.0×10^{22}.

Q18.
The figure represents a section of a circular conductor of non-uniform diameter carrying a current of 10.0 A. The cross-sectional area A_1 has a radius of 0.400 cm. If the cross-sectional area A_2 has a radius twice of that of cross-sectional area A_1, then what is the current density at A_2?

Fig#



A) 4.97 A/cm^2.
B) 5.80 A/cm^2.
C) 2.31 A/cm^2.
D) 7.01 A/cm^2.
E) 1.97 A/cm^2.

Q19.
What would be the uniform cross-sectional area of a wire made out of 1.50 g of a metal having a resistance of 0.600 Ω, and all of the metal was used to make the wire? Take the density of the metal to be 8.92 g/cm^3 and resistivity1.69×10^{-8} Ω-m.

A) 6.88×10^{-8} m^2.
B) 4.73×10^{-8} m^2.
C) 2.22×10^{-8} m^2.
D) 5.92×10^{-8} m^2.
E) 9.93×10^{-8} m^2.

Q20.
A light bulb is rated at 0.40 A and 3.0 V. At 20^{o}C, the bulb filament has a resistance of 2.0 Ω. If the filament is made of tungsten, what is the temperature of the filament when bulb is on? The temperature coefficient of resistivity for tungsten is 4.5×10^{-3} K^{-1}.

A) 630 ^{o}C.
B) 900 ^{o}C.
C) 340 ^{o}C.
D) 500 ^{o}C.
E) 450 ^{o}C.

Physics 102
Formula sheet for Second Major

$F = \frac{kq_1q_2}{r^2}$, $F = q_0 E$	$I = \frac{dQ}{dt}$, $I = J A$,
$\varphi = \int_{Surface} \vec{E}.d\vec{A}$, $E = \frac{kq}{r^2}$	$R = \frac{V}{I} = \rho \frac{L}{A}$
$E = \frac{kQ}{R^3} r$, $E = \frac{2k\lambda}{r}$	$\rho = \rho_0 [1 + \alpha(T - T_0)]$, $P = IV$
$\varphi_c = \oint \vec{E}.d\vec{A} = \frac{q_{in}}{\varepsilon_0}$	$v = v_o + at$
$E = \frac{\sigma}{2\varepsilon_o}$, $E = \frac{\sigma}{\varepsilon_o}$	$x - x_o = v_o t + \frac{1}{2} at^2$
$V = \frac{kQ}{r}$, $W = - \Delta U$	$v^2 = v_o^2 + 2a(x - x_o)$
$\Delta V = V_B - V_A = -\int_A^B \vec{E}.d\vec{S} = \frac{\Delta U}{q_0}$	$\varepsilon_0 = 8.85 \times 10^{-12}$ $C^2/N.m^2$ $k = 8.99 \times 10^9$ $N.m^2/C^2$ $q_e = -1.6 \times 10^{-19}$ 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
$E_x = -\frac{\partial V}{\partial x}$, $E_y = -\frac{\partial V}{\partial y}$, $E_z = -\frac{\partial V}{\partial z}$	
$U = \frac{kq_1q_2}{r_{12}}$,	
$C = \frac{Q}{V}$, $C_o = \frac{\varepsilon_0 A}{d}$, $C = 4\pi\varepsilon_o \frac{ab}{b-a}$,	
$U = \frac{1}{2} CV^2$, $u = \frac{1}{2}\varepsilon_o E^2$, $C = \kappa C_0$,	