Q1.
As shown in Fig. 1, a point charge $q_1 = +\mathbf{Q}$ is placed at the center of a square, and a second point charge $q_2 = -\mathbf{Q}$ is placed at the upper-left corner. It is observed that an electrostatic force of 2.0 N acts on the positive charge at the center. What is the magnitude of the force that acts on the center charge if a third charge $q_3 = -\mathbf{Q}$ is placed at the lower-left corner as shown?

A) 2.8 N
B) 2.0 N
C) 4.0 N
D) 5.3 N
E) 0.0 N

Sec# Electric fields - Coulomb's Law
Grade# 50

Q2.
A point charge Q = – 500 nC and two unknown point charges , q_1 and q_2 , are placed as shown in Fig. 2. The net electric field at the origin O , due to charges Q, q_1 and q_2, is equal to zero. The charges q_1 and q_2, respectively, are:

A) + 131 nC, −106 nC
B) + 210 nC, −206 nC
C) −210 nC, + 106 nC
D) + 270 nC, −301 nC
E) − 100 nC , + 100nC

Sec# Electric fields - The Electric Field
Grade# 50

Q3.
A particle (m = 20 mg, q = −5.0 μC) moves in a uniform electric field
E= (60 N/C) **i** . At t= 0, the particle has a velocity **v** = (30 m/s) **i**. Determine the velocity of the particle at t = 4.0 s.

A) (-30 m/s)**i**
B) (-50 m/s)**i**
C) (5.0 m/s)**i**
D) (15 m/s)**i**
E) (-15 m/s)**i**

Sec# Electric fields - Motion of charge in unform electric field
Grade# 50

Q4.
An electric dipole of dipole moment **p** = (5×10^{-10} C.m) **i** is placed in an electric field **E** = (2×10^6 N/C) **i** + (2×10^6 N/C) **j.** What is magnitude of the maximum torque experienced by the dipole?

A) 1.00×10^{-3} N.m
B) 1.40×10^{-3} N.m
C) 2.80×10^{-3} N.m
D) 2.00×10^{-3} N.m
E) 3.00×10^{-3} N.m

Sec# Electric fields - Motion of charge in unform electric field
Grade# 50

Q5.
The flux of an electric field **E** = (24N/C) **i** + (30N/C) **j** + (16N/C) **k** through a 2.0 m^2 portion of the yz plane is:

A) 48 $N.m^2$ /C
B) 34 $N.m^2$ /C
C) 42 $N.m^2$ /C
D) 32 $N.m^2$ /C
E) 60 $N.m^2$ /C

Sec# Gauss's law - Electric Flux and Gauss' Law
Grade# 50

Q6.
Consider two large oppositely charged parallel metal plates, placed close to each other. The plates are square with sides L and carry charges Q and -Q. The magnitude of the electric field in the region between the plates is:

A) $E= \dfrac{Q}{\varepsilon_O L^2}$
B) $E= \dfrac{2Q}{\varepsilon_O L^2}$
C) $E= \dfrac{4Q}{\varepsilon_O L^2}$
D) $E= \dfrac{Q}{2\varepsilon_O L^2}$
E) E= 0

Sec# Gauss's law - Application to Charged Insulators
Grade# 50

Q7.
A non-conducting sphere of radius R = 10 cm carries a charge density $\rho = 10^{-9}$ C/m^3 distributed uniformly throughout its volume. At what distance within the sphere, measured from the center of the sphere, the magnitude of the electric field is E = 1.32 N/m?

A) 3.50 cm
B) 7.11 cm
C) 5.53 cm
D) 6.57 cm
E) 8.99 cm

Sec# Gauss's law - Application to Charged Insulators
Grade# 50

Q8.
An infinitely long non-conducting cylinder of radius R = 2.00 cm carries a uniform charge density ρ = 18.0 μC/ m^3. Calculate the electric field at distance r = 1.00 cm from the axis of the cylinder?

A) 1.02×10^4 N/C
B) 5.10×10^3 N/C
C) 2.01×10^4 N/C
D) 2.51×10^3 N/C
E) 3.04×10^3 N/C

Sec# Gauss's law - Application to Charged Insulators
Grade# 50

Q9.
A proton with a speed of 2.00 x 10^5 m/s enters a region of space in which source charges have created an electric potential. What is the proton's speed after it has moved through a potential difference of + 100 V?

A) 1.44 x 10^5 m/s
B) 1.78 x 10^5 m/s
C) 2.78 x 10^5 m/s
D) 2.21 x 10^5 m/s
E) 1.08 x 10^5 m/s

Sec# Electric Potential - Electric Potential and Potential Difference
Grade# 50

Q10.
The electric potential at points in xy plane is given by $V= 2x^2y+32$. What is the electric field at (2.0 m, 3.0 m)

A) -24 **i**-8.0 **j**
B) 24 **i**-8.0 **j**
C) 3.0 **i**
D) 5 **i**+4.0 **j**
E) 8**i**+24 **j**

Sec# Electric Potential - Electric Potential and Potential Energy
Grade# 50

Q11.
Four equal positive charges, each 3.2 μC, are held at the four corners of a square of edge 0.50 m. How much work is required to move one of those charges far away from other three?

A) − 0.50 J
B) − 0.89 J
C) 0.50 J
D) +0.89 J
E) 1.0 J

Sec# Electric Potential - Potential of a Charged Conductor
Grade# 50

Q12.
An electric field of 100 V/m strength is often observed near the surface of earth. What would be the electric potential at a point on the earth surface? (Radius of Earth= 6.37 x 10^6 m)

A) 6.37 x 10^8 V
B) 1.23 x 10^9 V
C) 8.18 x 10^8 V
D) 8.18 x 10^9 V
E) 100 V

Sec# Electric Potential - Electric Potential and Potential Energy
Grade# 50

Q13.
Each of the two 25-μF capacitors, as shown in Fig. 3, is initially uncharged. How many Coulombs of charge pass through ammeter A after the switch S is closed for long time?

A) 0.20 C
B) 0.10 C
C) 0.40 C
D) 0.80 C
E) Zero C

Sec# Capacitance and Dielectrics - Combinations of Capacitors
Grade# 50

Q14.
Each of the two 25-μF capacitors, as shown in Fig. 4 , is initially uncharged. How much energy is stored in the two capacitors after the switch S is closed for long time?

A) 100 J
B) 200 J
C) 50 J
D) 300 J
E) 80 J

Sec# Capacitance and Dielectrics - Energy Stored in a Charged Capacitor

Grade# 50

Q15.
The plates of a parallel plate capacitor are connected to a battery. If the distance between the plates is halved, the energy stored in the capacitor:

A) Increases two-fold
B) Increases four-fold
C) Remains constant
D) Reduces to one-half
E) Reduces to one-fourth

Sec# Capacitance and Dielectrics - Calculation of Capacitance
Grade# 50

Q16.
A parallel-plate capacitor has a capacitance of 10 μF and is charged with a 20 V power supply. The power supply is then removed and a dielectric of dielectric constant 4 is filled in the space between the plates. The voltage across the capacitor with dielectric is:

A) 5 V
B) 20 V
C) 10 V
D) 80 V
E) 50 V

Sec# Capacitance and Dielectrics - Capacitors with Dielectrics
Grade# 50

Q17.
A 10-ohm resistor has a constant current. If 1200 C of charge flow through it in 4 minutes what is the value of the current?

A) 5.0 A
B) 3.0 A
C) 11 A
D) 15 A
E) 20 A

Sec# Current and Resistance - Electric Current
Grade# 50

Q18.
Two cylindrical resistors R_1 and R_2 are made from the same material and have the same length. When connected across the same battery, R_1 dissipates twice as much power as R_2. The ratio of diameter of resistor R_1 to that of R_2 is:

A) $\sqrt{2}$
B) 2

C) $3/\sqrt{2}$
D) ½
E) $2(\sqrt{2})$

Sec# Current and Resistance - Electrical Energy and Power
Grade# 50

Q19.
A carbon resistor has a resistance of 18 Ω at a temperature of 20°C. What is its resistance at a temperature of 120°C?
(The temperature coefficient of resistivity for carbon is **$- 5.0 \times 10^{-4}$ /C°**.)

A) 17 Ω
B) 22 Ω
C) 11 Ω
D) 32 Ω
E) 10 Ω

Sec# Current and Resistance - Resistance and Temperature
Grade# 50

Q20.
Electric charges flow through a wire shaped as shown in Fig. 5. The cross-sectional areas are $A_1 = 4\ mm^2$ and $A_2 = 1\ mm^2$ respectively. What is the drift speed of the electrons in the narrow section of the wire if their speed is 0.08 m/s in the wider region?

A) 0.32 m/s
B) 0.02 m/s
C) 0.04 m/s
D) 0.16 m/s
E) 0.08 m/s

Sec# Current and Resistance - Ohm's Law
Grade# 50

Test Expected Average = 50

/

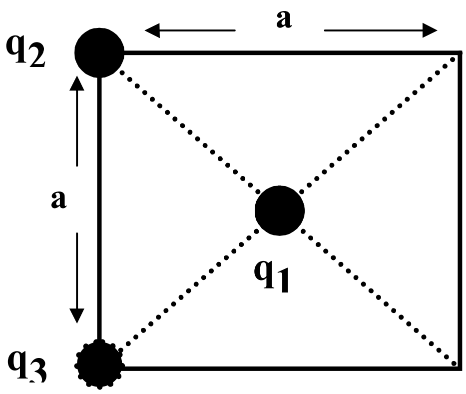

Figure 1

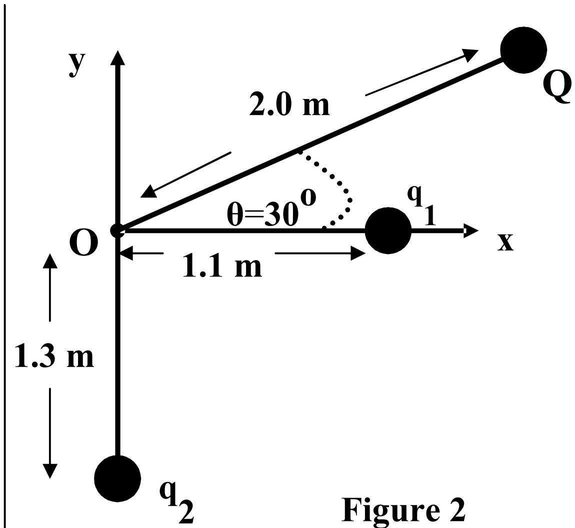

Figure 2

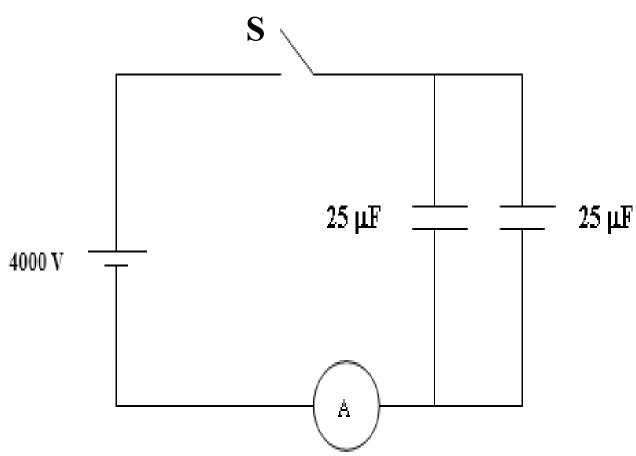

Figure 3

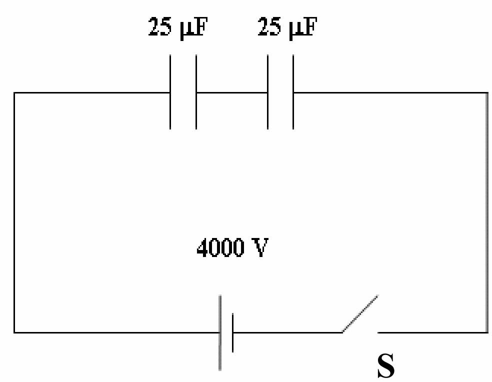

Figure 4

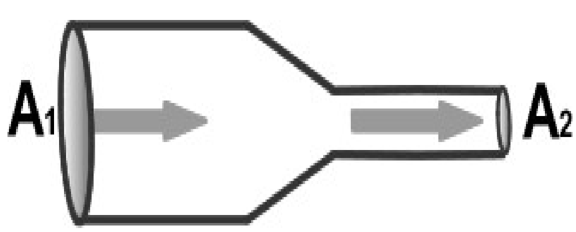

Figure5

Physics 102
Formula sheet for Second Major

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

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

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

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

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

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

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

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

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

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

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

$$I = \frac{dQ}{dt}, \quad I = J A, \quad \vec{J} = (ne)\vec{v}_d$$

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

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

$$v = v_o + at$$

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

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

$\varepsilon_0 = 8.85 \times 10^{-12}$ $C^2/N.m^2$
$k = 9.0 \times 10^9$ $N.m^2/C^2$
$q_e = -1.6 \times 10^{-19}$ 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