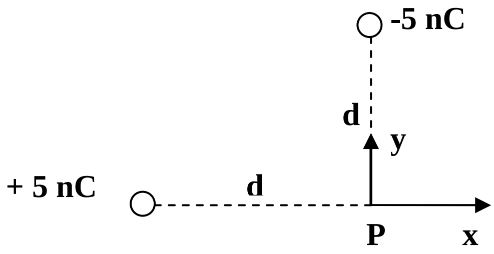
Q1.
Two charges are arranged as shown in the figure below. If d=7.2 cm, what is the resultant electric field at P?

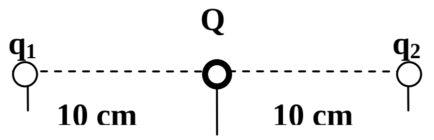
Fig#



A) 1.23 x 10^4 N/C making an angle of 45^o with + x-axis.
B) 1.23 x 10^4 N/C making an angle of 135^o with + x-axis.
C) 1.23 x 10^4 N/C making an angle of 225^o with + x-axis.
D) 1.23 x 10^4 N/C making an angle of 315^o with + x-axis.
E) 1.23 x 10^4 N/C making an angle of 0^o with + x-axis.

Q2.
In the figure below, charge Q = - 3.7 nC. For what value of charge q_1 will charge q_2 be in static equilibrium?

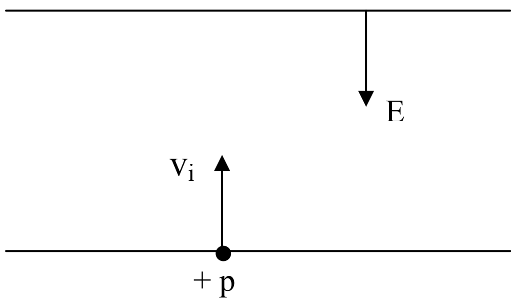
Fig#



A) 15 nC
B) 7.4 nC
C) 10.7 nC
D) 30 nC
E) 20 nC

Q3.
In the figure below, a uniform electric field E = -18 j N/C exists between two plates that are 4 cm apart. A proton is fired from the lower plate with a velocity 8×10^3 j m/s. Find the distance from that plate at which the instantaneous velocity of the proton is zero.(ignore gravity)

Fig#



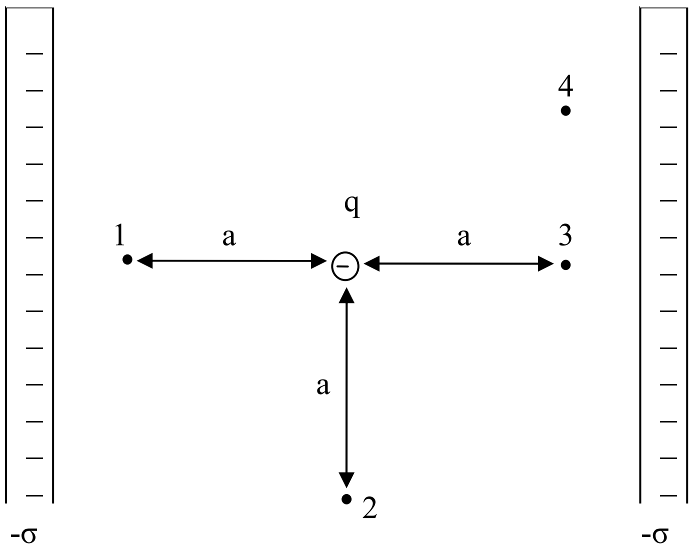
A) 1.9 cm
B) 2.0 cm
C) 3.3 cm
D) 2.5 cm
E) 4.0 cm

Q4.
A conducting spherical shell, of inner radius a = 2.0 cm and outer radius b = 4.0 cm, is neutral. A small charge Q = 4.0 nC is located at the center of the shell. What is the magnitude of the electric field E at r = 1.0 cm and r = 3.0 cm from the center of the spherical shell, respectively?

A) 36×10^4 N/C and zero
B) Zero and zero
C) 16×10^4 N/C and zero
D) Zero and 16×10^4 N/C
E) 36×10^6 N/C and 4×10^4 N/C

Q5.
The figure below shows two large, parallel, non-conducting sheets with identical negative uniform charge density of magnitude σ. A negative point charge q is placed between the two sheets.. Rank the four numbered points according to the magnitude of the net electric field there, greatest first.

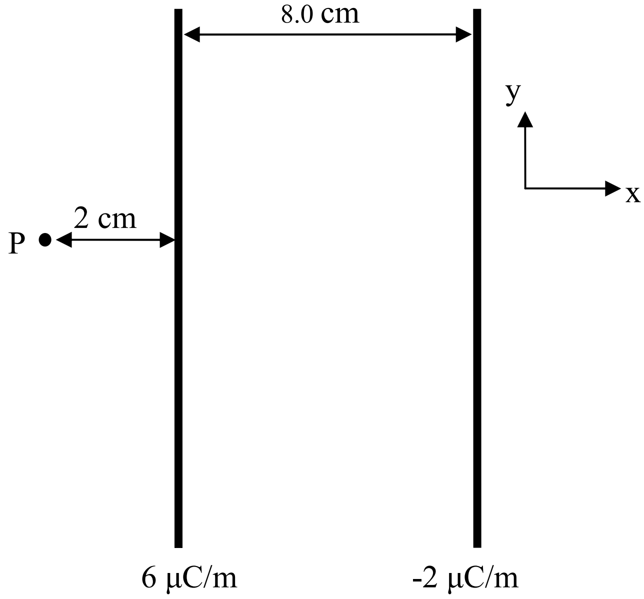
Fig#



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

Q6.
The figure shows short sections of two very long parallel wires carrying uniform linear charge densities + 6.0 μC/m and – 2.0 μC/m. Find the magnitude and direction of the net electric field at point P.

Fig#



A) 5.04×10^{6} (-i) N/C
B) 5.04×10^{6} (i) N/C

C) 9.0×10^{6} (-i) N/C
D) 9.0×10^{6} (i) N/C
E) Zero

Q7.
For the electric field: E = (10 i + 20y j) N/C, what is the electric flux through a 2.0 m^2 portion of the xy-plane?

A) Zero.
B) 40 Nm^2/C.
C) 20 Nm^2/C.
D) 50 Nm^2/C.
E) 70 Nm^2/C.

Sec# Gauss's law - Flux of an Electric Field
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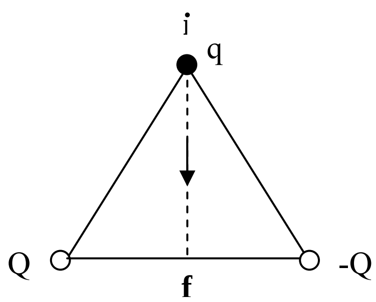
Q8.
A solid nonconducting sphere, of radius 4.0 m, has a uniform charge density. What is the ratio of the magnitude of the electric field at a distance 2.0 m from the center to the magnitude of the electric field at the surface of the sphere?

A) 0.5
B) 1.0
C) 2.0
D) 0.25
E) 3.0

Q9.
In the figure below, two particles with charges Q and −Q are fixed at the vertices of an equilateral triangle with sides of length a. The work required to move a particle with charge q from point **i** to point **f** is:

Fig#



A) 0
B) kQq/a

C) 4kQq/a
D) 2kQq/a
E) √2kQq/a

Q10.
Over a certain region of space, the electric potential is give by: $V(x,y) = x^2+y^2+2xy$ where V is in volts and x and y are in meters. Find the magnitude of the electric field at the point P (1.0 , 2.0).

A) 8.5 N/C
B) 12 N/C
C) 0
D) 6 N/C
E) 3 N/C

Q11.
.In the figure below, two conducting spheres, one having twice the diameter of the other, are separated by a distance large compared to their diameters. Initially, the smaller sphere (1) has charge q and the larger sphere (2) is uncharged. If the spheres are then connected by a long thin conducting wire:

Fig#

A) 1 and 2 have the same potential
B) 2 has twice the potential of 1
C) 2 has half the potential of 1
D) 1 and 2 have the same charge
E) 1 has twice the charge of 2

Q12.
A charge q_1 = -5.0 μC and a charge q_2 = 6.0μC are located at (8.0 cm, 0.0) and (0.0 cm, 6.0 cm) respectively in the xy plane. How much work was done, by an external agent, to bring these charges to their final positions starting from infinite separation.[Consider V = 0 at infinity]

A) – 2.7 J
B) 2.7 J
C) – 3.4 J
D) – 4.5 J
E) 3.4 J

Q13.

A particle, with mass = 9.0×10^{-9} kg and charge = +8 nC , has a kinetic energy of 36 μJ at point A and moves to point B where the potential is 3.0×10^{3} V greater than that at point A. What is the particle's kinetic energy at point B?

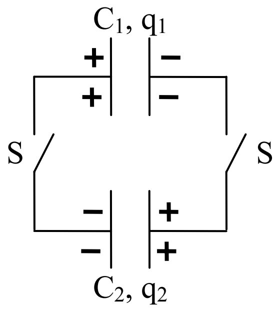
A) 12 μJ
B) 60 μJ
C) 24 μJ
D) 36 μJ
E) -24 μJ

Q14.
The magnitude of the charge on each plate of a parallel plate capacitor is 2.5 μC. If the capacitor has a plate area of 0.25 m^2 and a plate separation of 0.1 mm, what is the electric field between its plates?

A) 1.1×10^{6} V/m
B) 1.0×10^{5} V/m
C) 1.0×10^{-5} V/m
D) 1.1×10^{2} V/m
E) 1.1×10^{-11} V/m

Q15.
The figure shows two capacitors C_1=30 μF carrying a charge q_1=200 μC and C_2=20 μF carrying a charge q_2=900 μC. If the switches S are closed, the voltage across C_1 will be

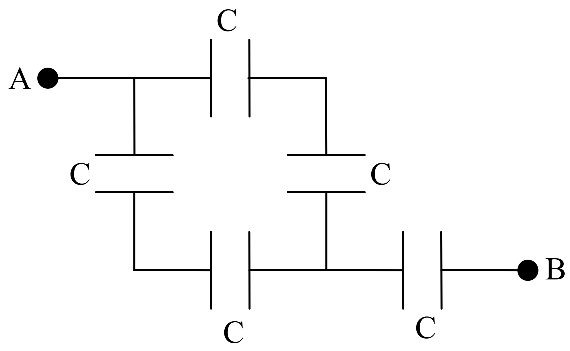
Fig#



A) 14 V
B) 20 V
C) 23 V
D) 33 V
E) 0 V

Q16.
If C = 12 μF and the potential between points A and B is 10 V, what is the total energy stored by the group of capacitors shown in the figure?

Fig#



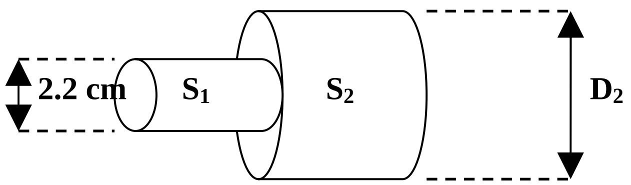
A) 300 μJ
B) 2500 μJ
C) 1200 μJ
D) 600 μJ
E) 150 μJ

Q17.
An air-filled parallel-plate capacitor is connected across a 24 V battery. When the battery is disconnected and then a dielectric slab is inserted into and fills the region between the plates, the voltage across the capacitor drops to 8 V. What is the dielectric constant of the slab?

A) 3.0
B) 1.5
C) 0.33
D) 0.66
E) 1.0

Q18.
Two wires, as shown in the figure below, are made of same material. If the current density through segment S_1 is J_1= 6400 A/m^2 and the current density through segment S_2 is J_2= 1239 A/m^2, then the diameter D_2 of segment S_2 is:

Fig#



A) 5.0 cm
B) 4.0 cm
C) 5.5 cm
D) 6.5 cm

E) 3.5 cm

Q19.
Wires A and B are made from same material. Wire A has twice the diameter and half the length of wire B. If the resistance of wire A is 20 Ω, the resistance of wire B is:

A) 160 Ω
B) 100 Ω
C) 60 Ω
D) 260 Ω
E) 300 Ω

Q20.
A 10 V battery is applied across a 15 W device. How much charge goes through the device in 4.0 hours?

A) 2.2×10^4 C
B) 1.0×10^4 C
C) 1.5×10^5 C
D) 4.0×10^3 C
E) 1.7×10^6 C

Physics 102
Formula sheet for Second Major

$F = \frac{kq_1q_2}{r^2}$, $F = q_0 E$	$I = \frac{dQ}{dt}$, $I = J A$,
$\varphi = \int_{\text{Surface}} \vec{E} . d\vec{A}$, $E = \frac{kq}{r^2}$	$R = \frac{V}{I} = \rho \frac{L}{A}$
$E = \frac{kQ}{R^3} r$, $E = \frac{2k\lambda}{r}$	$\rho = \rho_0 [1 + \alpha(T - T_0)]$, $P = IV$
$\varphi_c = \oint \vec{E}.d\vec{A} = \frac{q_{in}}{\varepsilon_0}$	$v = v_o + at$
$E = \frac{\sigma}{2\varepsilon_o}$, $E = \frac{\sigma}{\varepsilon_o}$	$x - x_o = v_o t + \frac{1}{2} at^2$
$V = \frac{kQ}{r}$, $W = - \Delta U$	$v^2 = v_o^2 + 2a(x - x_o)$
$\Delta V = V_B - V_A = -\int_A^B \vec{E}.d\vec{S} = \frac{\Delta U}{q_0}$	$\varepsilon_0 = 8.85 \times 10^{-12}\ C^2/N.m^2$
$E_x = -\frac{\partial V}{\partial x}$, $E_y = -\frac{\partial V}{\partial y}$, $E_z = -\frac{\partial V}{\partial z}$	$k = 9.0 \times 10^9\ N.m^2/C^2$
$U = \frac{kq_1q_2}{r_{12}}$	$q_e = -1.6 \times 10^{-19}\ C$
$C = \frac{Q}{V}$, $C_o = \frac{\varepsilon_0 A}{d}$, $C = 4\pi\varepsilon_o \frac{ab}{b-a}$,	$m_e = 9.11 \times 10^{-31}$ kg
$U = \frac{1}{2} CV^2$, $u = \frac{1}{2}\varepsilon_o E^2$, $C = \kappa C_0$,	$m_p = 1.67 \times 10^{-27}$ kg
	1 eV = 1.6×10^{-19} J
	micro (μ) = 10^{-6}, nano (n) = 10^{-9},
	pico (p) = 10^{-12}
	$g = 9.8\ m/s^2$