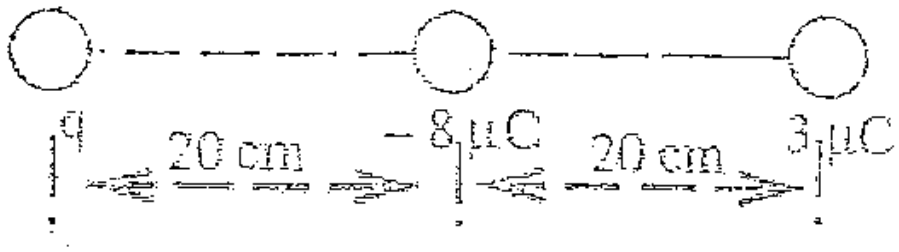
Sheets

SHEET (1)

1. **In the figure shown, what is the magnitude of the charge q that makes the net force on charge 3 μC be zero?**



2. **A -3μC charge is placed 100 mm from a + 3μC charge calculate the force between two charges?**

3. **Two charges q_1 = -8 μC and q_2 = +12 μC are placed 120 mm apart in the air. What is the resultant force on a third charge q_3 = -4 μC placed midway between the other two charges?**

4. **Two small plastic spheres are given positive electrical charges. When they are 40.0 cm apart, the repulsive force between them has magnitude 0.250 N. What is the charge on each sphere (a) if the two charges are equal; (b) if one sphere has twice the charge of the other?**

5. **Three point charges of 2 μC, 7 μC and - 4 μC at the corners of an equilateral triangle as in figure. Calculate the force on the charge 7 μC ?**

SHEET (2)

1. **If $q_1 = 5.0\ \mu C = q_2 = q_3 = q_4$ are located on the corners of a square of length 20.0 cm, find the resultant force on q_3.**

   (Ans.10.8N, out ward along diagonal line between q_1 and q_3)

2. **A point charge $q_1 = 2\ \mu C$ is located at (2m, 1m) and a charge $q_2 = -5\ \mu C$ is at (-2m,4m). Find the force exerted on q_2 by q_1 .**

3. **Two point charges, Q and -2Q, are located at the positions (0, 2m), and (-3m, 0) respectively, (a) what is the force on a charge q at the origin? (b) where would you place a point charge +2.5Q such that the net force on q is zero?**

4. **Three point charges, q_1 ,q_2 , and q_3, lie at the corners of an equilateral triangle of side 10 cm. The forces between them are $F_{12} = 5.4$ N (attractive), $F_{13} = 15$ N (repulsive), and $F_{23} = 9$ N (attractive). Given that q_1 is negative, what are q_2 and q_3 ?**

PROBLEMS

1. **The force between two point charges is 3.5×10^{-2} N. What is the force if the distance separating the charges is doubled?**

2. **Two identical metal spheres attract each other with a force of 5.00×10^{-6} N when they are 5.00 cm apart. The spheres are than touched together and then removed to the original separation where how a force of repulsion of 1.00×10^{-6} N is observed - what is the charge on each sphere after touching and before touching?**

3. **Three charges $q_1 = 2.00\ \mu$ c, $q_2 = 5.00\ \mu$ C, and $q_3 = 8.00\ \mu$ C are placed along the x- axis at 0.00cm, 45.0cm and 72.4 cm, respectively. Find the force on the charge q_1.**

SHEET (2)

1. **A uniform electric field of 2,1 kN/C passes through- a rectangular area 22 cm by 28 cm . The field makes an angle of 30° with the normal to the area, Determine the electric flux through the rectangle?**

2. **A disk with radius 0.10 m is oriented with its normal at an angle of 3cm to a uniform electric field E with magnitude 2.0 x10^3 N/C.**

    a. **What is the total electric flux through the disk?**

    b. **What is the total flux through the disk if it is turned so that its plane is parallel to E?**

    c. **What is the total flux through the disk if its normal is parallel to E?**

3. **A closed surface encloses a net charge of 5.2 μC, What is the net electric flux through me surface?**

4. **Two charges of 8 μC and -5 μC are inside a cube of sides 0,45 m. What is the total electric flux through the cube? Repeat, if the same two charges are inside a spherical shell of radius 0.5 m?**

5. **The charge per unit length on a long straight filament is λ = - 90 μC/m. Find the electric field at the following distances from the filament, 10 cm, 20 cm and 100 cm?**

6. **A conducting sphere of radius 5 cm has a uniform charge density throughout its surface. If the magnitude of the electric field at a**

distance 10 cm from the center is $9*10^4$ N/C, What is the magnitude of the electric field at the center and at a distance 3 cm, 5 cm and 20 cm from the center?

7. **A point charge of 12 μC is placed at the center of a spherical shell of radius 22 cm. What is the total electric , flux through :**

   (a) the entire surface of the shell and

   (b) any hemispherical surface of the shell?

   (c) Do the results depend on the radius? Explain.

8. **A uniformly charged, straight filament 7 m in length has a total positive charge of 2 μC. An uncharged cardboard cylinder 2 cm in length and 10 cm in radius surrounds the filament at its center, with the filament as the axis of the cylinder. Using any reasonable approximations, find :**

   (a) the electric field at the surface of the cylinder and

   (b) the total electric flux through the cylinder.

9. **A long, straight metal rod has a radius of 5 cm and a charge per unit length of 30 μC/m. Find the electric field at the following distances from the axis of the rod:**

   (a) 3 cm,

   (b) 10 cm,

   (c) 100 cm.

10. Solid sphere of radius 40 cm has a total positive charge of 26)iC uniformly distributed 'throughout its volume. Calculate the field intensity at the center of the-sphere and at the following distances from the center of the sphere, 10 cm, 40 cm and 60 cm ?

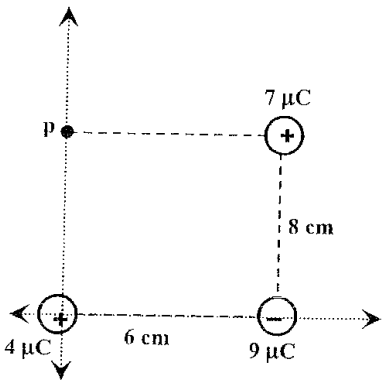
11. A cube of edge length L = 2.5 cm is positioned as shown in Figure 30.46. There is a uniform magnetic field throughout the region given by the expression B = (5i + 4j + 3k) T.

(a) Calculate the flux through the shaded face of the cube,

(b) What is the total flux through the six faces of the cube?

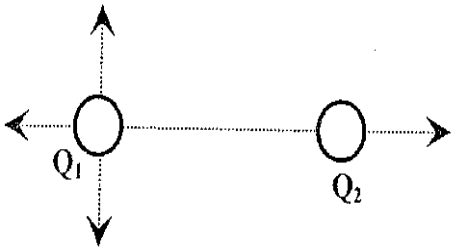
SHEET (4)

1. **In the figure shown, what is the net electric field at point p? Then find the electric force on charge 5 μC placed at point p?**



($k = 9 * 10^9\ N.m^2/C^2$)

2. **In the figure shown, A charge Q_1 = -9 μC placed at (0. 0) and charge Q_2 = -6 μC placed at (1 . 0), At what coordinates does a third charge Q_3 place to make the net force be zero on it?**



Then, without doing any calculations, what is the coordinates if Q_1 = -6 μC and charge Q_2 = -9 μC ?

3. **A proton has an initial velocity of $3*10^5$ m/s is projected in the horizontal direction. It enters a uniform electric field of $5*10^3$ N/C directed vertically, ignore any gravitational effects,**

   a) Find the time does the proton take to travel 9 cm horizontally,

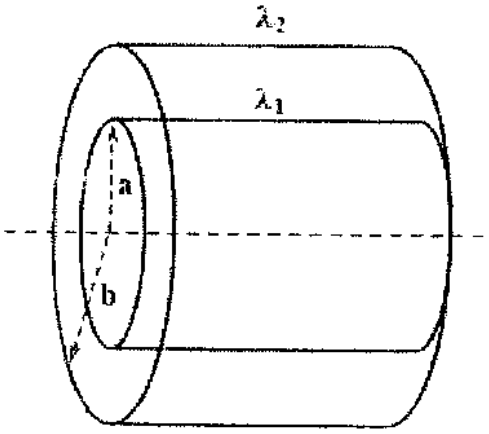
   b) The acceleration,

   c) The horizontal and vertical components of the velocity at this conditions. (e= $1.6*10^{-19}$ C, m = $1.6*10^{-27}$ kg).

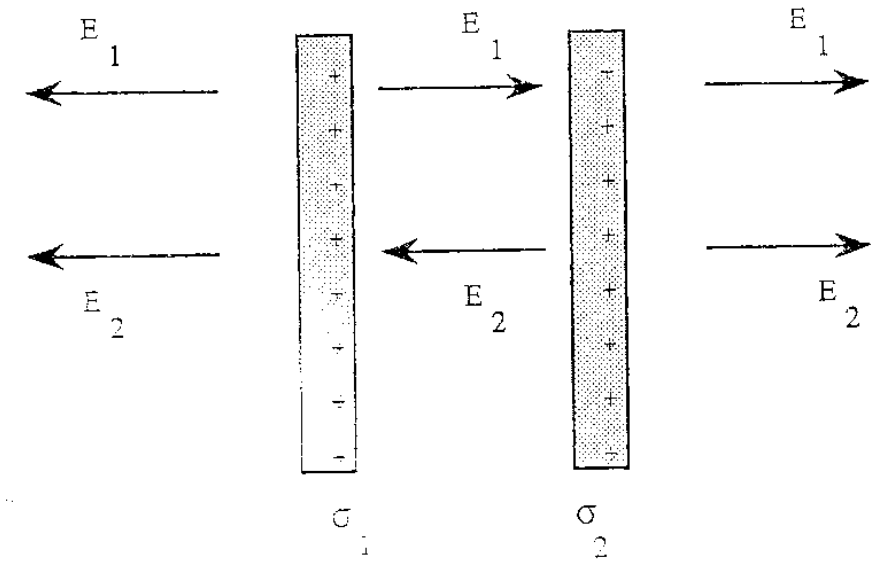
4. **A solid conducting cylinder of radius a = 5 cm with a linear charge density λ_1 = -50 μC/m has the same axis of a conducting cylindrical shell with a linear charge density λ_2 = 70 μC/m of radius b = 10 cm. Find the electric field at the following:**

   a) the axis,

   b) distances 2 cm, 5 cm, 8 cm, 10 cm and 20 cm from the axis of the cylinder ?



5. **In the figure , when both sheets have positive uniform charge densities of value σ .**

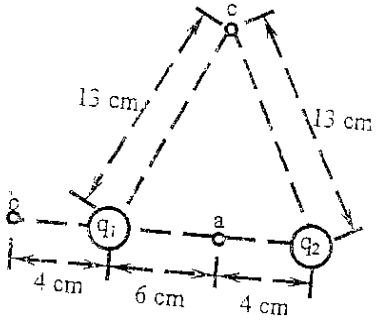


SHEET (5)

1. **What potential difference is needed to stop an electron with an initial speed of $4.2 * 10^5$ m/s?**

2. **A conducting sphere of radius 10 cm has a uniform surface charge density 0.1 nC/m^2. Find the electric field and electric potential at 0.0 cm, 2 cm, 10 cm and 20 cm from the center of the sphere?**

3. **An electric dipole consists of two charges, q_1=12 nC and q_2=-12 nC, placed 10 cm apart as shown in the figure. Compute the potentials at points a, b and c ?**



4. **A solid conducting sphere of radius 10 cm has an electric potential 500 V at the surface. Calculate the electric field at and the electric potential at the center and at 5 cm from the center of the sphere?**

5. **A conducting sphere of radius 10 cm has a charge 8 nC. Find the electric field and electric potential at 0.0 cm, 2 cm, 10 cm and 20 cm from the center of the sphere?**

6. **A solid conducting sphere of radius 10cm has a total charge $5 * 10^{-7}$C Find the electric field at 6 cm, 10 cm and 20 cm from the center of the sphere? Find the electric potential at 5 cm and 50 cm from the center of the sphere, and at the center of the sphere?**

7. **The applied voltage across the plates of a 4-joF capacitor varies in time according to the expression**

$$V_{app}=(8V)(\ 1 - e^{-t/4}\ )$$

where t is in s. Calculate :

(a) the displacement current as a function of time and

(b) the value of the current at t = 4 s.

The effect of a dielectric on a capacitor

Is to increase its capacitance by a factor K (the dielectric constant) over its empty capacitance. The reason for this is that induced surface charges on the dielectric reduces the electric field inside the material from E to E/k.

EQUATION & CONCEPTS

The capacitance of a capacitor is defined as the ratio of the charge on either conductor (or plate) to the magnitude of the potential difference between the conductors.

$$C = \frac{Q}{V} \qquad (1)$$

The capacitance of an air-filled parallel plate capacitor is proportional to the area of the plates and inversely proportional to the separation of the plates.

$$C = \varepsilon_0 \frac{A}{d} \qquad (2)$$

When the region between the plates is completely filled by a material of dielectric constant K, the capacitance increases by the factor K.

$$C = K\varepsilon_0 \frac{A}{d} \qquad (3)$$

The equivalent capacitance of a parallel combination of capacitors is larger than any individual capacitor in the group.

$$C_{eq} = C_1 + C_2 + C_3 + \ldots\ldots \qquad (4)$$

The equivalent capacitance of a series combination of capacitors is smaller than the smallest capacitor in the group.

$$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + \ldots\ldots \qquad (5)$$

In the special case of only two capacitors in series, the equivalent capacitance is equal to the ratio of the product to the sum of their capacitance.

$$C_{eq} = \frac{C_1 C_2}{C_1 + C_2}$$

The electrostatic energy stored in the electrostatic field of a charged capacitor equals the work done (by a battery or other source) in charging the capacitor from q = 0 to q = Q.

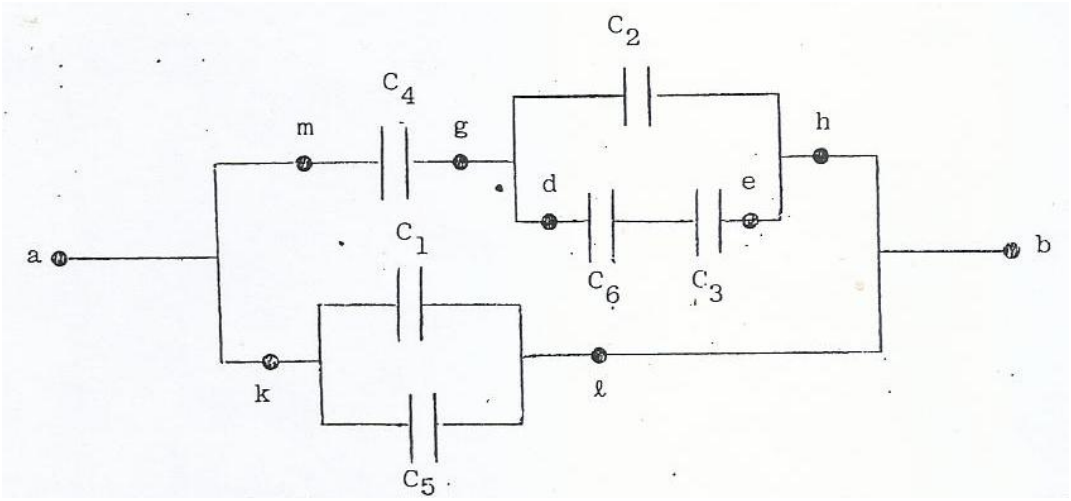
$$U = \frac{Q_2}{2C} = \frac{1}{2} QV = \frac{1}{2} CV^2 \qquad (6)$$

The energy density at any point in the electrostatic field of a charged capacitor is proportional to the square of the electric field intensity at that point.

$$u = \frac{1}{2} \varepsilon_0 E^2 \qquad (7)$$

SHEET (6)

1. **(a) Find the equivalent capacitance between the points a and b for the group of capacitors shown in the figure below. C_1 = 1 μF, C_2 = 2 μF, C_3 = 3 μF, C_4 = 4 μF, C_5 = 5 μF, and C6 = 6 μF.**



(b) Determine the potential difference across each capacitor and the charge accumulated on each capacitor if the total charge on the group of six capacitors is 384 μC.

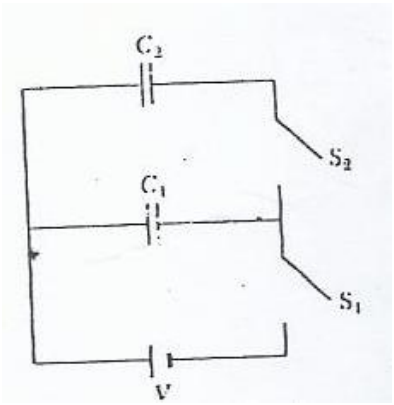
2. **Three capacitors of 8 μF, 10 μF, and 14 μF are connected to the terminals of a 12-volt battery. How much energy does the battery supply if the capacitors are connected (a) in series and (b) in parallel?**

3. **An isolated charged conducting sphere of radius 12 cm creates an electric field of 4.9 x 10^4N/C at a distance of 21 cm from its center, (a) What is its surface charge density? (b) What is us capacitance?**

4. **An air filled capacitor consists of two parallel plates , each with an area 7.6 cm^2 , separated by a distance of 1.8 mm. If a 20-V potential difference is applied to these plates , Calculate (a) the electric field**

between the plates , (b) the surface charge density , (c) the capacitance , and (d) the charge on each plate .

5. **Consider the circuit shown in Figure (5), where C_1 = 6 μF, C_2 = 3 μF, and V = 20 V. C_1 is first charged by the closing of switch S_1. Switch S_1 is then opened, and the charged capacitor is connected to the uncharged capacitor by the closing of S_2. Calculate the initial charge acquired by C_1 and the final charge on each of the Two capacitors.**



6. **Calculate the energy stored in an 18-μF capacitor when it is charge to a potential of 100 V.**

7. **A parallel-plate area of 0.64 cm^2 . When the Plates are in a vacuum, the capacitance of the advice is 4.9 PF.**

   (a) Calculate the value of the capacitance if the space between the plates is filled with nylon,

   (b) What is the maximum potential difference that can be applied to the plates without causing dielectric breakdown, or discharge?

8. **An air-filled spherical capacitor is constructed with inner and outer shell radii of 7 and 14 cm respectively**

   (a) Calculate the capacitance of the device,

   (b) What potential difference between the spheres will result in charge of 4 μC on each conductor?

9. A parallel-plate capacitor has plates of dimensions of 3cm x 4cm. The plates are separated by 1mm thickness of paper,

(a) Calculate the capacitance of this capacitor,

(b) Find the maximum operating voltage that can be applied on it

(c) Calculate the maximum charge that can be placed on the capacitor.

10. A 6.0 μF parallel-plate air capacitor is connected across 100-V battery. After the capacitor is fully charged, the battery is removed and "a slab of dielectric that completely fills the space between the plates is inserted. If the dielectric constant of this material is k = 8.0, calculate the potential across this capacitor after the slab is inserted. Is it required to do work either to insert or to remove the slab? If so, which of these processes requires to be done on the system, and how much?

SHEET (7)

1. **Find the current along straight wire that would produce a magneti field twice the strength of the Earth's (5.0×10^{-5} T) at a distane of 5.0 cm from the wire (where $\mu_0 = 4\pi . 10^{-7} \quad \frac{T.m}{A}$)**

2. **A long straight wire carries a current of 4A to the right of page . Find the magnitude and direction of the β-field at a distance of 5cm above the wire .**

3. **A long straight wire has a current of 1.5 A. Find the magnitude of the magnetic field at a point that is 5.0 cm from the wire .**

4. **A magnetic field is directed parallel to the surface of Earth . It has a magnitude of 3.2 T and is directed at an angle of 30 north of east . A positive charge of 12 μC moves with velocity 8.0 m/s directed west . Find the magnitude and direction of the magnetic force of the charge .**

5. **A singly charged positive ion has a mass of 2.5×10^{-26} Kg. After being accelerated through a potential difference of 250 V, the ion enters a magnetic field of 0.5 T , in a direction perpendicular to the field . Calculate the radius of the path of the ion in the field .**

6. **Find the radius of the circular path of the electron moving with speed , 1.2 x 10^8 m/s in a uniform magnetic field of 0.5 T .**

7. **A 2.0 m length of straight wire carries a current in a uniform magnetic field of 50 mT whose direction is at an angle of 37 from the direction of the current . Find the fore on the wire .**

8. **Two wires in a 2m long cord are 4 mm a part . If the y carry a DC current of , 8A , calculate the force between the wires .**