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MATRIC NUMBER: 19/MHS01/376

DEPARTMENT: MBBS

COURSE CODE: PHY 102

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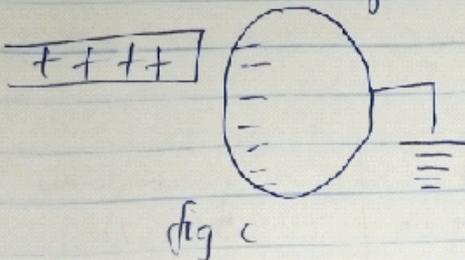
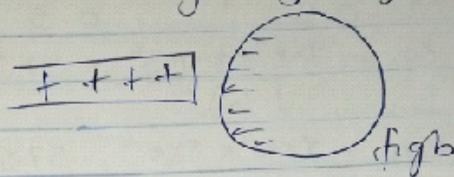
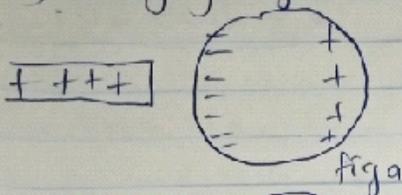
DEPARTMENT: MEDICINE AND SURGERY (MBBS)

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COVID-19 Holiday Assignment

(a) Charging by induction to produce a negatively charged sphere



Electric charges can be obtained on an object without touching it, by a process called electrostatic induction.

(b) $F = 1.0\text{N}$, $r/d = 2.0\text{m}$, $q_1 = ?$, $q_2 = ?$, $q_1 + q_2 = 5.0 \times 10^{-5}\text{C}$

$k = 9 \times 10^9$ Calculating the charge on each sphere.

$$F = k \frac{q_1 q_2}{r^2}$$

$$1 = \frac{(9 \times 10^9) \times (q_1 q_2 - 5 \times 10^{-5})}{2^2}$$

$$4 = 9 \times 10^9 \times (5 \times 10^{-5} q_1) + 9 \times 10^9 q_2$$

$$4 = 4.5 \times 10^5 q_1^2 + 9 \times 10^9 q_2$$

quadratic equation

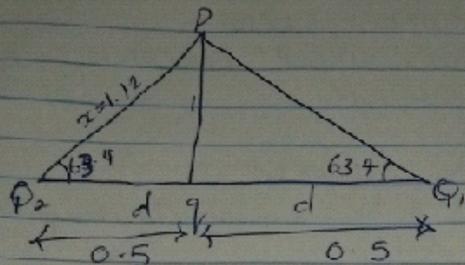
$$9 \times 10^9 q_2 - 4.5 \times 10^5 q_1 + 4 = 0$$

$$q_1 = 0.000011\text{C} \approx 1.1 \times 10^{-5}\text{C}$$

$$q_2 = 0.000038\text{C} \approx 3.8 \times 10^{-5}\text{C}$$

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1c)



$$\begin{aligned} \tan \theta &= 1/0.5 = 2 \\ \theta &= \tan^{-1}(2) \\ \theta &= 63.4 \\ x^2 &= 1^2 + 0.5^2 \\ \sqrt{x^2} &= \sqrt{1.25} \\ x &= \sqrt{1.25} = 1.12 \end{aligned}$$

$$E_1 = \frac{kq_1}{r^2} = \frac{9 \times 10^9 \times 8 \times 10^{-6}}{(1.12)^2} = 5739.795$$

$$E_2 = \frac{kq_2}{r^2} = \frac{9 \times 10^9 \times 8 \times 10^{-6}}{(1.12)^2} = 5739.795$$

$$E_q = \frac{kq}{r^2} = \frac{9 \times 10^9 \times q}{1} = 9 \times 10^9 q$$

vector	angle	x-component	y-component
$E_1 = 5739.795$	63.4°	$E_1 \cos \theta = -2570.05$	5132.26
$E_2 = 5739.795$	63.4	$E_2 \cos \theta = 2570.05$	5132.26
$E_q = 9 \times 10^9 q$	90°	0	$9 \times 10^9 q$
		$\Sigma x = 0$	$\Sigma y = 10264.52$

$$\text{magnitude} = \sqrt{(\Sigma x)^2 + (\Sigma y)^2}$$

$$\Sigma y = \sqrt{(0)^2 + (10264.52)^2}$$

$$9 \times 10^9 q = 0 + 10264.52$$

make q the subject of the formula.

$$q = \frac{10264.52}{9 \times 10^9} = 1.18 \times 10^{-6} \text{ C}$$

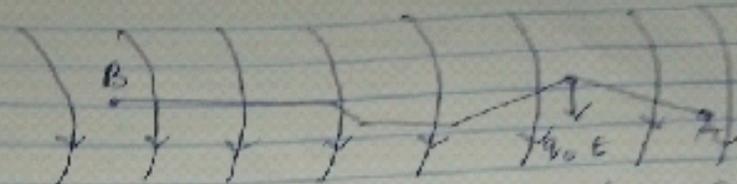
3ai) Volume Charge density = $\rho = \frac{dQ}{dV} \rightarrow dQ = \rho dV$

ii) Surface charge density = $\sigma = \frac{dQ}{dA} \rightarrow dQ = \sigma dA$

iii) Linear charge density = $\lambda = \frac{dQ}{dL} \rightarrow dQ = \lambda dL$

b) Explaining electric potential difference

The electric potential difference between two points in an electric field can be defined as the work done per unit charge against electric forces when a charge is transported from one point to the other. It is measured in volt (V) or joules per coulomb (J/C).



Considering the diagram above, suppose a test charge q_0 is moved from point A to point B along an arbitrary path inside an electric field E . The electric field E exerts a force $F = q_0 E$ on the charge as shown in the figure above. To move the test charge from A to B at constant velocity, an external force of $F = -q_0 E$ must act on the charge. Therefore, the elemental work done dW is given as:

$$dW = F_{ext} dL \quad \text{--- (1)} \quad \text{Recall, } F = -q_0 E \quad \text{--- (2)}$$

Substituting (2) in (1) yields

$$dW = -q_0 E dL \quad \text{--- (3)}$$

Total work done in moving the test charge from A to B is:

$$W(A \rightarrow B)_{Ag} = -q_0 \int_A^B E dL \quad \text{--- (4)}$$

From the definition of electric potential difference. It follows that:

$$V_B - V_A = \frac{W(A \rightarrow B)_{Ag}}{q_0} \quad \text{--- (5)}$$

Putting equation (4) in (5) yields:

$$V_B - V_A = - \int_A^B E dL \quad \text{--- (6)}$$

PROPERTIES

The properties of the developed surface depend on the material used which can be controlled by the use of the following factors:

(a) The rate of drying

$$\frac{dW}{dt} = \frac{A \cdot P \cdot V}{V_s}$$

where dW/dt is the

rate of drying

$$\frac{dW}{dt} = \frac{A \cdot P \cdot V}{V_s}$$

where A is the area of the surface

$$\frac{dW}{dt} = \frac{A \cdot P \cdot V}{V_s}$$

(b) The nature of the material

The drying rate is dependent on the nature of the material which is called a physical property. The rate of drying is also dependent on the nature of the material.

$$\frac{dW}{dt} = \frac{A \cdot P \cdot V}{V_s}$$

The rate of drying is dependent on the nature of the material which is called a physical property. The rate of drying is also dependent on the nature of the material.

(c) The rate of drying is dependent on the nature of the material which is called a physical property. The rate of drying is also dependent on the nature of the material.

Double Integrals over
 irregular regions
 and/or

3D surface integrals over a surface (curved surface)

Applying the method of
 the surface integral of the
 part of

the $\iint_R f(x,y,z) \, dS$ (where dS is a vector of a single element surface)

$\iint_R f(x,y,z) \, dS = \iint_D f(x,y,z) \sqrt{1 + z_x^2 + z_y^2} \, dx \, dy$

For surfaces $z = z(x,y)$ (pathogenic domain)

$\iint_R f(x,y,z) \, dS = \iint_D f(x,y,z(x,y)) \sqrt{1 + z_x^2 + z_y^2} \, dx \, dy$

that is $z = z(x,y) = \frac{z}{\sqrt{1 + z_x^2 + z_y^2}}$

or directly (as usual) use the

$\iint_R f(x,y,z) \, dS = \iint_D f(x,y,z) \sqrt{1 + z_x^2 + z_y^2} \, dx \, dy$

$\iint_R f(x,y,z) \, dS = \iint_D f(x,y,z) \sqrt{1 + z_x^2 + z_y^2} \, dx \, dy$

since $dx = dy$

$\iint_R f(x,y,z) \, dS = \iint_D f(x,y,z) \sqrt{1 + z_x^2 + z_y^2} \, dx \, dy$

$\iint_R f(x,y,z) \, dS = \iint_D f(x,y,z) \sqrt{1 + z_x^2 + z_y^2} \, dx \, dy$

using special integrals

$\iint_R f(x,y,z) \, dS = \iint_D f(x,y,z) \sqrt{1 + z_x^2 + z_y^2} \, dx \, dy$

or general domain in general

$\iint_R f(x,y,z) \, dS = \iint_D f(x,y,z) \sqrt{1 + z_x^2 + z_y^2} \, dx \, dy$

$$\frac{d^2x}{dt^2} = -\frac{d}{dt} \left(\frac{dx}{dt} \right) = -\frac{d}{dt} \left(\frac{dx}{dt} \right)$$

Let us assume that the displacement x is a function of time t . Then the velocity v is the first derivative of x with respect to t . The acceleration a is the second derivative of x with respect to t .

$$v = \frac{dx}{dt} \quad (1)$$

$$a = \frac{dv}{dt} = \frac{d^2x}{dt^2} \quad (2)$$

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