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18/ENG01/001
CHEMICAL ENGINEERING
PHYSICS

2a. Electric field is a region around a charge in which it exerts electrostatic force in another charge while electric field is the strength of electric field.

2b. $Q_1 = 8nc$, $Q_2 = 12nc$
Find electric field at point P on the same axis at $x = 7$

$E = E_1 + E_2$

$E = \frac{Kq_1}{r^2} + \frac{Kq_2}{r^2}$

$E = \frac{9\times10^9 \times (8\times10^{-9})}{7^2} + \frac{9\times10^9 \times 12\times10^{-9}}{5^2}$

$= 1.47 + 12 = 13.47 \simeq 13.5N/C$

$E_2 = \frac{Kq_1}{r^2} + \frac{Kq_2}{r^2}$

$E_2 = \frac{9\times10^9 \times 12\times10^{-9}}{5^2} + \frac{9\times10^9 \times 8\times10^{-9}}{3^2}$

$= 4.32N/C$ $\quad 8.0N/C$

Resultant field at Q_m + the x-direction

$E_x = E_2 \sin \theta$

$\sin \theta = 0.8$

$= 4.32 \times 0.8 = 3.46N/C$

$E_y = E_1 + E_2 \cos \theta$

$\cos \theta = 0.6$

$[8 + (4.32 \times 0.6)] = 8 + 2.592 = 10.6N/C$

3a. Volume charge density (ρ) This is the quantity of charge per unit volume measured in the SI system (C/m^3) at any point in a volume

Surface charge density (σ) This is the quantity of charge per unit area b)

applying the Biot Savart law, we find the magnitude of the field $d\vec{B}$

$$B = \frac{\mu_0 I}{4\pi} \int_{-a}^{a} \frac{dl \sin\theta}{r^2}$$

$$\sin(\pi - \phi) = \sin\theta$$

$$\therefore B = \frac{\mu_0 I}{4\pi} \int_{-a}^{a} \frac{dl \sin(\pi - \phi)}{r^2}$$

$$B = \frac{\mu_0 I}{4\pi} \int_{-a}^{a} \frac{dl \sin(\pi - \phi)}{x^2 + y^2}$$

But $\sin(\pi - \phi) = \frac{x}{\sqrt{x^2+y^2}} = \frac{x}{(x^2+y^2)^{1/2}}$

$$B = \frac{\mu_0 I}{4\pi} \int_{-a}^{a} dl \frac{x}{(x^2+y^2)^{1/2}(x^2+y^2)}$$

Recall $dl = dy$

$$B = \frac{\mu_0 I}{4\pi} \int_{-a}^{a} \frac{x}{(x^2+y^2)^{3/2}} dy$$

measured in coulombs per square meter (c/m²) at any point on a surface distribution on a two dimensional surface.

Linear charge density (λ) This is the quantity of charge per unit length measured in coulombs per meter (c/m) at any point on linear distribution.

6. Electric Potential: This is the electric potential energy per unit charge

$V = \frac{PE}{q}$

q = ms PE is proportional to q, the dependence ovy

$\Delta V = V_B - V_A = \Delta PE/q$

6. $Q_1 = -10$ $Q_2 = -2$

Q_1 = left Q_2 = right and in between to the left $(x<0)$

$V = K \times 10 \; 2x = 10(4+x)$

$= -40/K = -5$

∴ in between

$V = K10/x - 2K \div (4-x)$

∴ to the right

$10x - 40 = 2x$

$10x - 2x = 40$

$8x = 40$

∴ $x = -5$

4. Magnetic flux is defined as the strength of magnetic field represented by lorenz force.

6. $m = 9.11 \times 10^{-31}$ kg $r = 1.4 \times 10^{-7}$ m $B = 3.5 \times 10^{-1}$ $q = 1.6 \times 10^{-19}$

$f = \frac{1.6 \times 10^{-19} \times 3.5 \times 10^{-1}}{9.11 \times 10^{-31}}$

$= \frac{5.6 \times 10^{-20}}{9.11 \times 10^{-31}} = 6.147 \times 10^{10}$ rad/s

5a. Biot - Savart law states that following observation for the magnetic field dB at a point P associated with a length dl of a wire carrying a steady current I