99
198

The Danielle
Dentistry
College of Medicine and Health Sciences
100 Level
19/MHS09/009.

Physics 102 assignment.

Section B

~~(2) Electric field~~

(4) Magnetic flux.

The magnetic flux is defined as the strength of magnetic field represented by lines of force. It is usually represented by the symbol ϕ

(b)

(5) The Biot - Savart law

$\vec{dB}$ at a point P associated with a length element $\hat{dl}$ of a wire carrying a steady current I

(b)

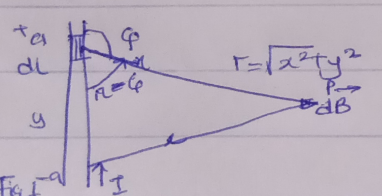


Fig 1: A section of a straight current carrying conductor.

Applying the biot - savart law, we find magnitude of the field d B

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

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

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

$\therefore$ from the diagram, $r^2 = x^2 + y^2$

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

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

substituting (xx) into (x)

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

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

recall $dl = dy$

$$B = \frac{\mu_0 I}{4\pi} \int_{-a}^{a} \frac{1}{(x^2+y^2)^{3/2}} dy \quad \text{———} (xxx)$$

using special integrals

$$\int \frac{dy}{(x^2+y^2)^{3/2}} = \frac{1}{x^2} \frac{y}{(x^2+y^2)^{1/2}}$$

Equation (xxx) becomes

$$B = \frac{\mu_0 I x}{4\pi} \left[\frac{y}{x^2+(x^2+y^2)^{1/2}} \right]_{-a}^{a}$$

$$B = \frac{\mu_0 I x}{4\pi} \left(\frac{2a}{x^2 (x^2+a^2)^{1/2}} \right)$$

when $B = \frac{\mu_0 I}{4\pi x} \left[\frac{2a}{(x^2+a^2)^{1/2}} \right]$

when the length $2a$ of the conductor is very great in comparison to its distance x from point P, we consider it infinitely long. That is when a is much larger than x

$(x^2+a^2)^{1/2} = a$, as $a \rightarrow \infty$

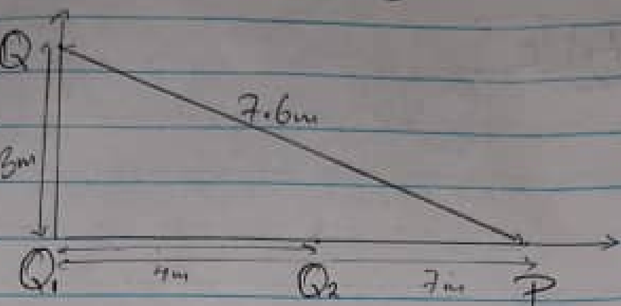
$$\therefore B = \frac{\mu_0 I}{2\pi x}$$

In physical situation, we have axial symetry about the y-axis. Thus at all points in a circle of radius r, around the conductor, the magnitude of B is

$$B = \frac{\mu_0 I}{2\pi r}$$

2 Electric field is a ~~ge~~ region around a charge in which it exerts electrostatics force on another charges while Electric field intensity is the strength of electric field at any point in space.

b



Where $Q_1 = 8nC$

$Q_2 = 12nC$

Recall $E = kq_1/r^2$

$$\therefore E_1 = \frac{[9\times10^9 Nm^2/C]\cdot[8\times10^{-9}C]}{[7.0m]^2}$$

$E_1 = 1.47 N/C$

$$E_2 = \frac{[9\times10^9 Nm^2/C]\cdot[12\times10^{-9}C]}{[3.0m]^2}$$

$E_2 = 12 N/C$

Vector	Angle	X Component	Y Component
$E_1 = 1.47 N/C$	0°	$E_{1x} = 1.47 \cos 0^\circ$ $E_{1x} = 1.47 N/C$	$E_{1y} = 1.47 \sin 0^\circ$ $E_y = 0$
$E_2 = 12 N/C$	0°	$E_{2x} = 12 \cos 0^\circ$ $= 12 N/C$ $\Sigma E_x = 13.47 N/C$	$E_{2y} = 12 \sin 0$ $E_{2y} = 0$ $\Sigma E_y = 0$

3| Volume charge density, $\rho = q/v$

Where $\rho = \dfrac{dQ}{dv}$ — Where ρ = volume charge density, q = electric charge, v = Volume

$dQ = \rho dv$

ii Surface charge density, $\sigma = q/A$

Where $\sigma = \dfrac{dQ}{dA}$ — Where σ = surface charge, q = electric charge, A = Area

$dQ = \sigma dA$

iii Linear charge density, $\lambda = q/L$

Where $\lambda = \dfrac{dQ}{dL}$ — Where λ = linear charge, q = electric charge, L = Length

$dQ = \lambda dL$

b– Electric Potential Difference.

this can be defined as the difference in electric potential (v) between the final and the initial position when work is done upon a charge to change its potential energy. In equation

$$\Delta V = V_B - V_A = \frac{Work}{Charge} = \frac{\Delta PE}{Charge}$$

Where $1V = 1 J/C$

Unit of Potential difference are Joules per Coulomb. given the name volt (v) after Alessandro Volta.

$$E_{net} = \sqrt{[E_x]^2 + [E_y]^2}$$

$$= \sqrt{[13.47]^2 + [0]^2}$$

$$= \sqrt{181.4409}$$

$$E_{net} = \underline{13.47 N/C}$$

4