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Computer engineering
19/Eng02/1029 CHM 102

4 what is magnetic flux

Magnetic flux is a measurement of the total magnetic field which passes through a given area. It is a useful tool for helping describe the effects of the magnetic force on something occupying a given area. The measurement of magnetic flux is tied to the particular area ~~[illegible]~~ choosen.

It is written mathematically as, $\phi = BA\cos\theta$
where A is the ~~test~~ Area
B = magnetic field vector (magnitude B)
The S.I unit of magnetic flux is the weber and the unit is Wb.

b Solution

$m = 9.11 \times 10^{-31}$ Kg
$r = 1.4 \times 10^{-7}$ m
$B = 3.5 \times 10^{-4}$
$\omega = ?$

$$\omega = \frac{qB}{m} = \frac{1.60 \times 10^{-19} \times 3.5 \times 10^{-1}}{9.11 \times 10^{-31}} = 6.1491 \times 10^{10} \text{ rad/s}$$

c It is because the charge particle circulats at this angular frequency or angular speed in the type of accelerato.

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5 Biot Savart law states that the magnetic intensity dH at a Point P due to current flowing through a small element dl is

i Directly Proportional to the current (i)

ii Directly Proportional to the length of element (dl)

iii Directly Proportional to the sine of the angle between the direction of current and the line Joining the ~~Extracel~~ element dl from Point A

iv Inversity Proportional to the square of distance (x) of Point A from element dL.

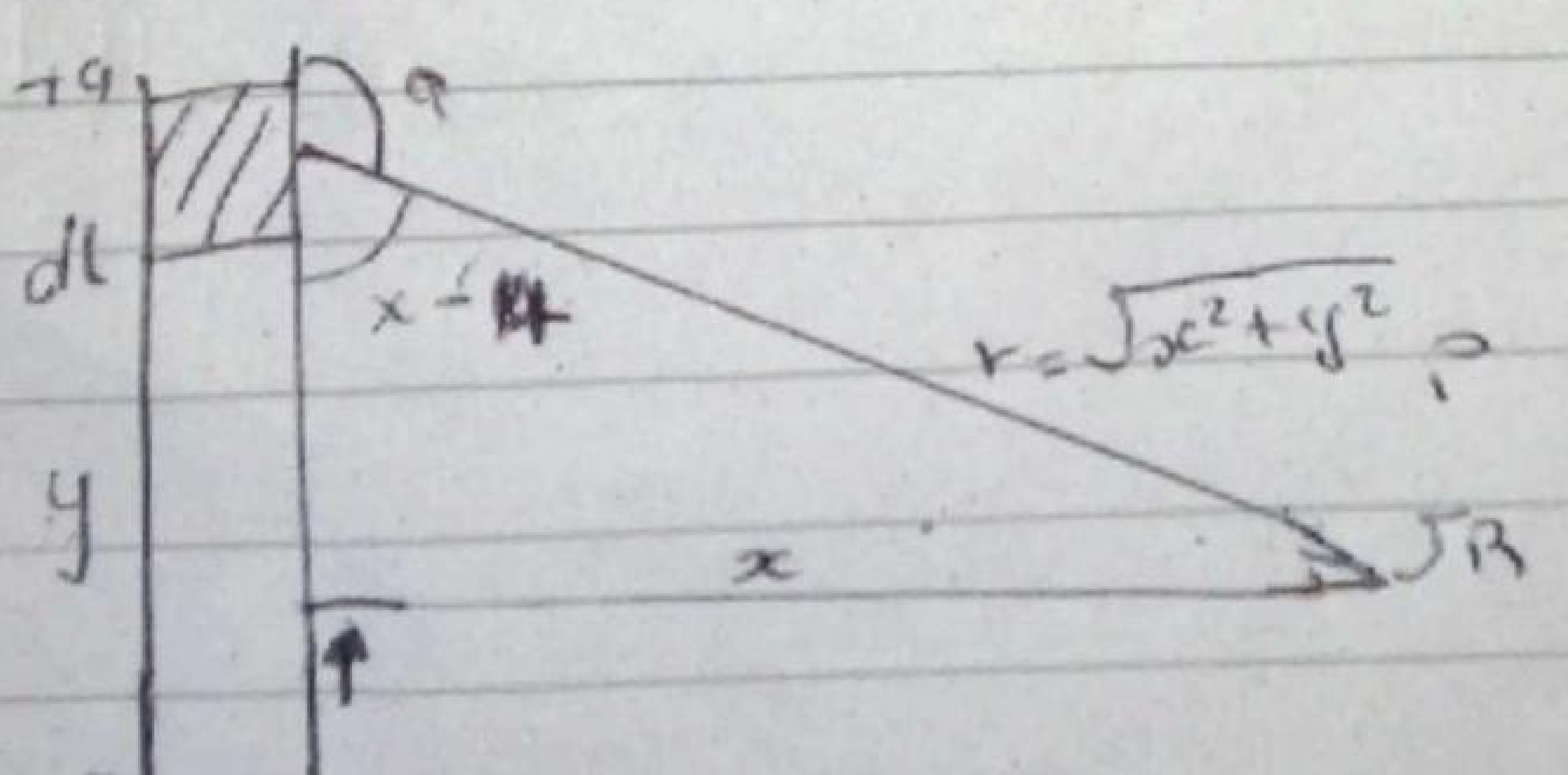
$$dH = \frac{U_0 U_r}{4\pi} \times \frac{I dl \sin\theta}{x^2} \qquad dH = \frac{K \times I\, dl \sin\theta}{x^2} \qquad dH = \frac{I dl \sin\theta}{x^2}$$

where K is constant and depends on the magnetic properties of the medium

$K = \frac{U_0 U_r}{4\pi}$ U_0 = absolute Permeability of air or Vacuum is 4×10^{-7} Wb/Am

U_r = relative Permeability of the medium

5 magnetic filed of a Straight current carrying conductor



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

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

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

$$\sin(x - \cancel{\phi}) = \frac{x}{\sqrt{x^2 + y^2}} = \frac{x}{(x^2+y^2)^{1/2}} \quad --- \text{(II)}$$

Substituting (II) into (I), we have

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

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

recall $dl = dy$

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

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

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 (III) becomes

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

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

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

$(x^2+a^2)^{1/2} \simeq$ as $a \to \infty$

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

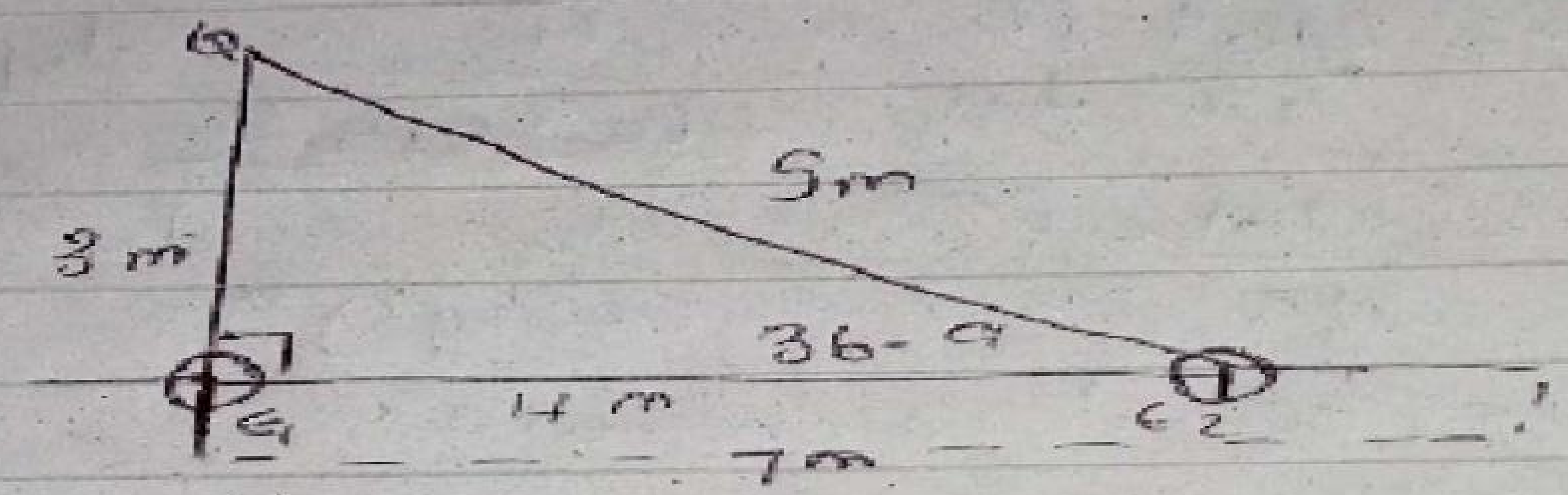
2 Electric field is a region of space in ...
electric charge will experience an electric force.

The electric field intensity E, can be defined as the force per unit charge mathematically the magnitude of the field is given by

$$E = \frac{f(N)}{q_0(C)}$$

It is measured in newoton per coulomb (N/C)

b



$Hyp^2 = adj^2 + opp^2$

$Hyp = 3^2 + 4^2$

$= 9 + 16$

$= 25$

$= \sqrt{25} = 5m$

$\theta = \cos^{-1}[3/5]$

$= 36.9°$

$E_1 = \frac{kQ_1}{r^2} = \frac{9\times10^9 \times 5\times10^{-9}}{(7)^2} = 1.4673\ N/C$

$E_2 = \frac{kQ_1}{r^2} = \frac{9\times10^9 \times 12\times10^{-9}}{(3)^2} = 12\ N/C$

$E_1 + E_2 = 13.469\ N/C \simeq 13.5\ N/C$

θ	E	$E_x = E\cos\theta$	$E_y = E\sin\theta$
$90°$	8	$= 8\cos 90° = 0$	$8\sin 90° = 8$
$36.9°$	4.32	$4.32\cos 36.9 = -3.455$ $= -3.455$	$4.32\sin 36.9 = 2.594$ $10.5738 = 10.594$

$$E = \frac{9\times10^9 \times 3\times10^{-9}}{3^2} = 8\,N/C$$

$$E_2 = \frac{9\times10^9 \times 12\times10^{-9}}{5^2} = 4.32\,N/c$$

$$= \sqrt{E_x^2 + E_y^2}$$

$$= \sqrt{(-3.455)^2 + (10.594)^2}$$

$$= 11.1\,N/C$$

$$\theta = \tan^{-1}\left[\frac{y}{x}\right] = \frac{10.594}{3.455}$$

$$= 71.9^\circ \simeq 72^\circ$$

3a Volume charge Density. ρ. $\frac{dQ}{dv} \rightarrow dQ \cdot \rho dv$

Surface charge Density. $\sigma = \frac{dQ}{dA} \rightarrow dQ \cdot \sigma dA$

Linear charge density λ. $\frac{dQ}{dl} \rightarrow dQ \cdot \lambda dl$

b Electric potential difference two points in an electric field can be defined as the work done per unit charge against electrical forces when a charge is transferred from one person to the other, It is measured in volt (V) or Joules per coul (J/C)

$$dW = F \cdot dl$$

$$F = -q_0 E$$

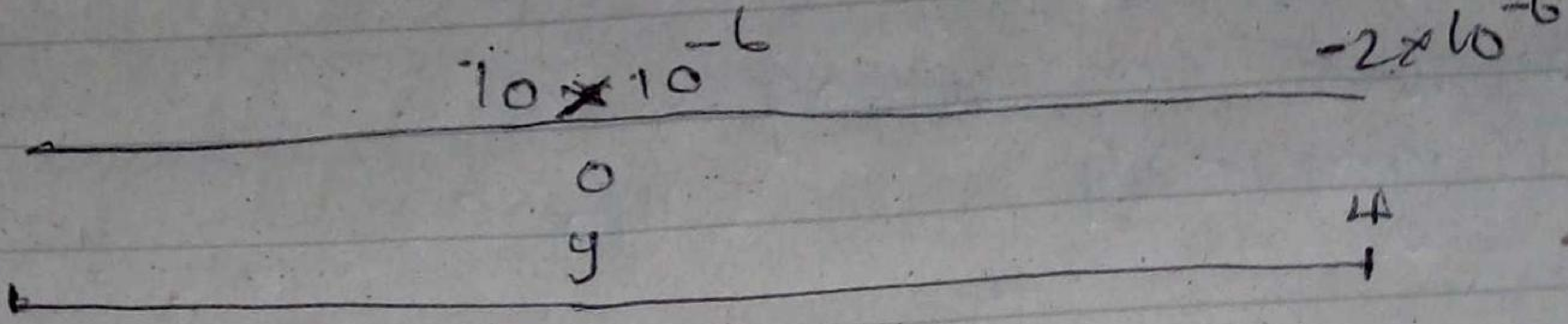
$$dw = -q_0 E\,dl$$

$$W(A \rightarrow B) = -q_0 \int_A^B E\,dl$$

$$V_B - V_A = \frac{W(A \rightarrow B)}{q_0}$$

$$V_B - V_A = \int_A^B E\,dl$$

3c



$y = x + 4$

$U_1 = x$ $\quad U_2 = x + 4$

Potential is $\frac{Kq}{r}$

$$V_B - V_A = \left[\frac{Q_1}{r_1} + \frac{Q_2}{r_2}\right]$$

$$K\left[\frac{10}{x} + \left[\frac{-2}{x+4}\right]\right]$$

At $V = 0$

$$x\left[\frac{10(x+4)}{x(x+4)} - 2x\right] = 0$$

$$x[10(x+4) - 2x] = 0$$

$$10(x+4) - 2x = 0$$

$$10x + 40 - 2x = 0$$

$$\frac{8x}{8} = \frac{40}{8} \qquad x = \underline{5m}$$