No. 1.

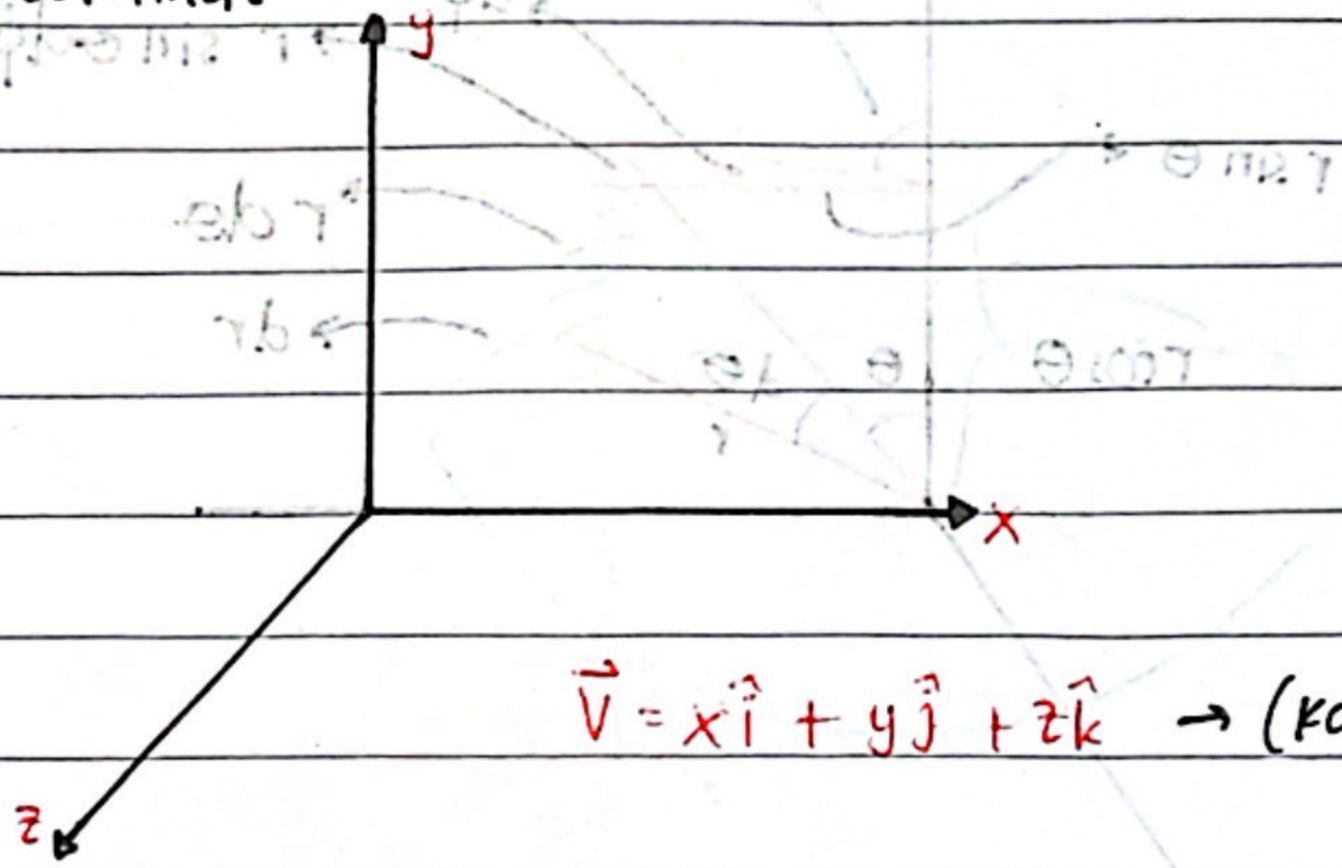
Date : 29 Agustus 2025
Jum'at

Pert. 1

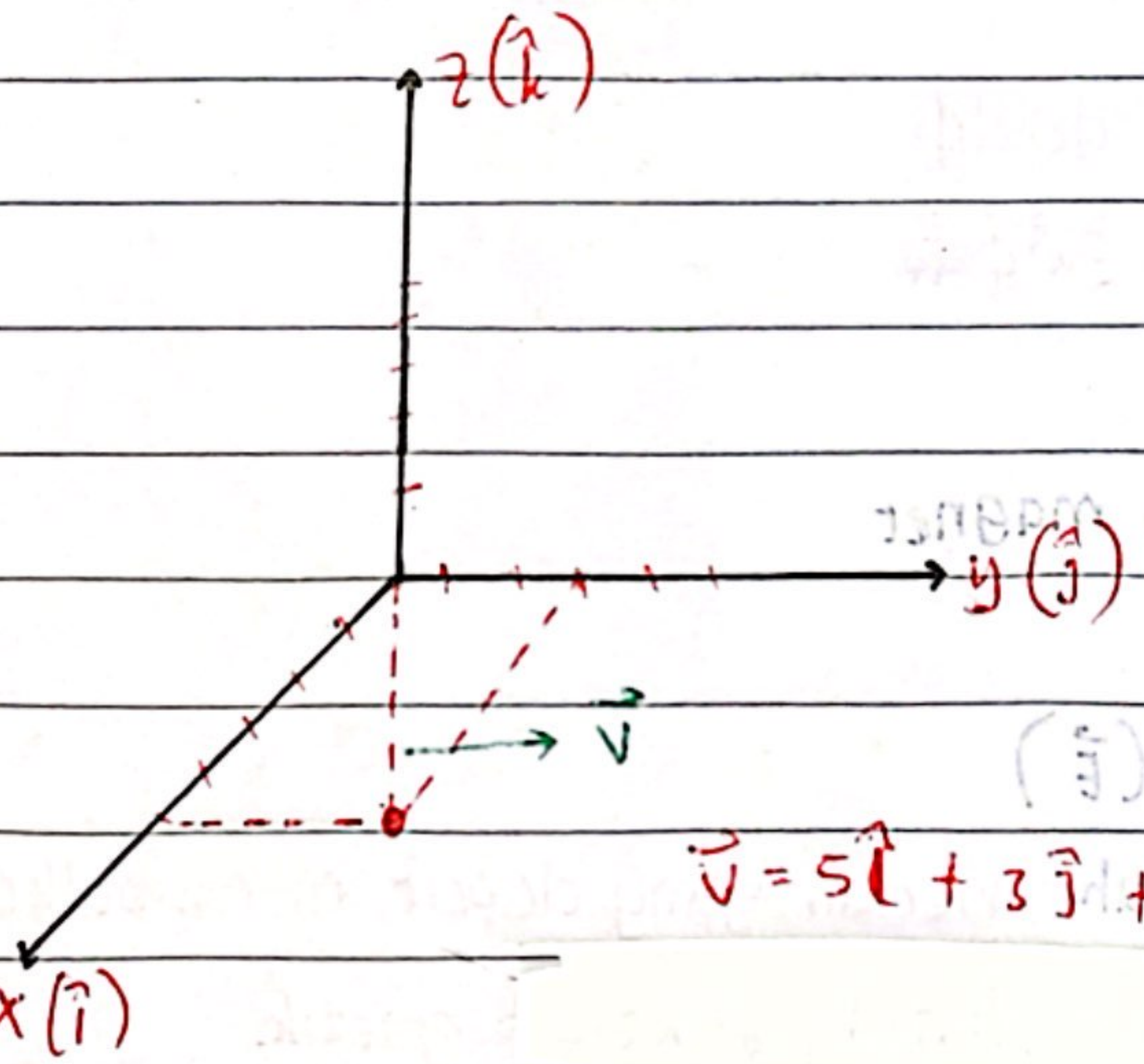
MEDAN ELEKTROMAGNETIK

1. Sistem Koordinat

* Sistem Koordinat



$\vec{V} = x\hat{i} + y\hat{j} + z\hat{k}$ → (kartesian)



$\vec{V} = 5\hat{i} + 3\hat{j} + 1\hat{k}$

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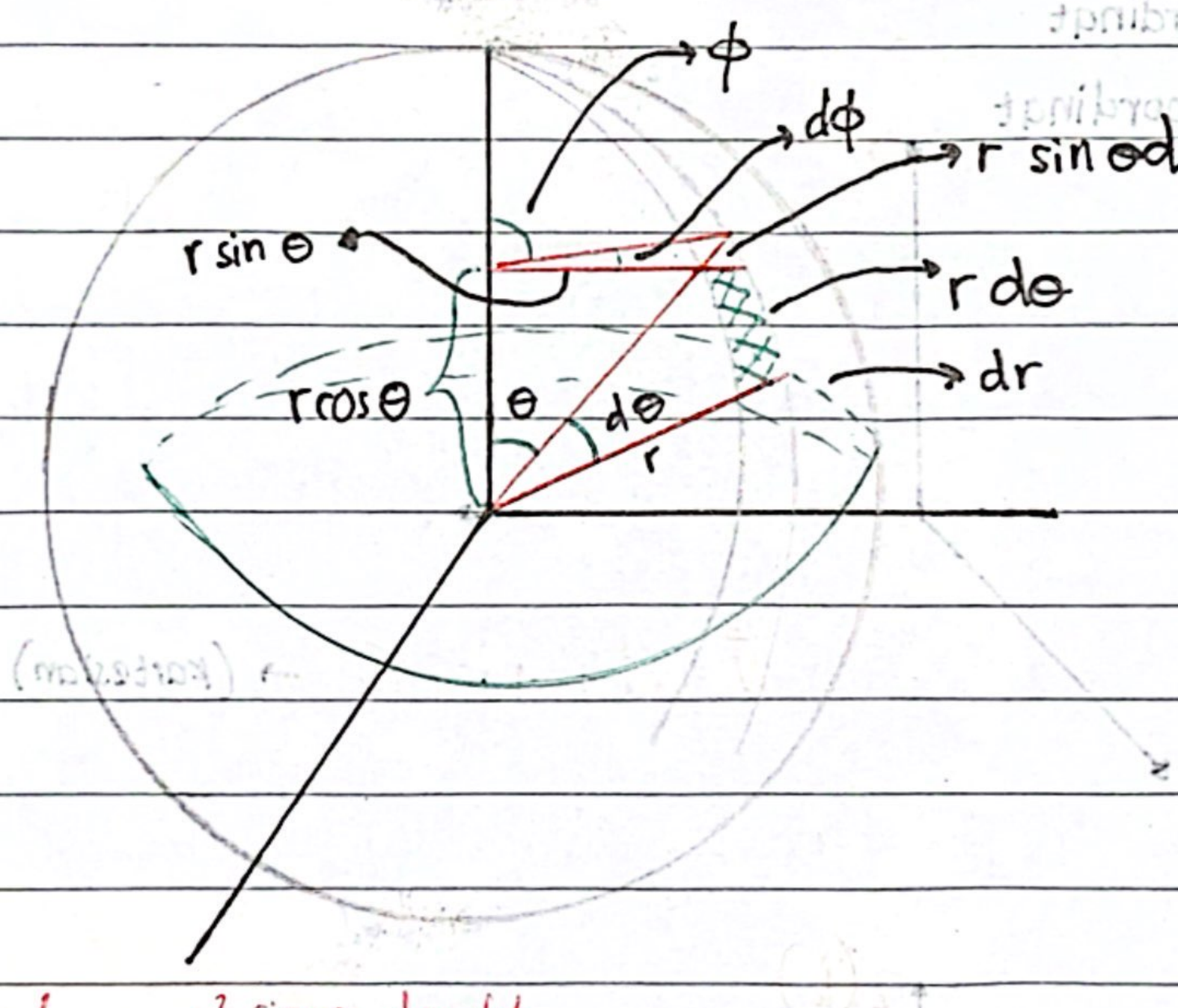
✱ Sistem Koordinat Bola



$L = P \times l = r^2 \sin\theta \, d\theta \, d\phi$

$V = P \times l \times t = r^2 \sin\theta \, d\phi \, dr$

2. Medan listrik dan magnet

✱ Medan listrik ($\vec{E}$)

Medan listrik adalah medan yang dapat menimbulkan gelombang listrik / elektromagnetik.

✱ Elektromagnetik

Elektromagnetik adalah gelombang yang ditimbulkan oleh arus listrik dan muatan.

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* Muatan → Sifat dari sebuah benda.

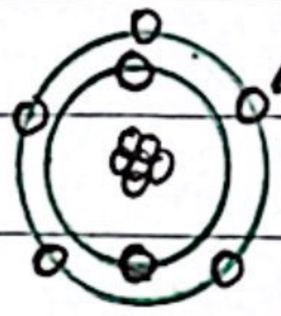
• Medan gravitasi:

$$\vec{g} = G \frac{M}{r^2} \hat{r}_0$$

• Elektromagnetik:

$$\vec{E} = k \frac{q}{r^2} \hat{r}_0$$

Muatan



→ Muatan o → (bertambah) cinderamata muatan negatif.

$q = 2\,C \rightarrow$ Coulomb

Note:

$$\vec{E} = k \frac{q}{r^2} \hat{r}_0$$

$$\vec{E} = k \left[\frac{q_1}{r_1^2} \hat{r}_0 + \frac{q_2}{r_2^2} \hat{r}_0 + \dots \right]$$

• Medan Magnet

Ditimbulkan oleh arus listrik.

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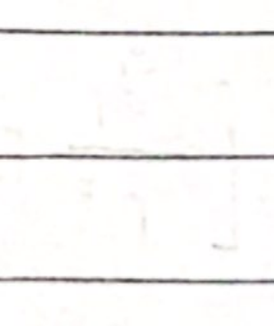
arus yang dilalui

$$\vec{B} = id\vec{l}\frac{x}{r^2} \longrightarrow \vec{B} = \frac{qv \times \hat{B}}{r^2}$$

$F = Bil \sin\theta \Rightarrow$ sudut 90° $F = qv \times B$

$F = Bi\frac{l}{r^1}\sin\theta \quad * 90°$



No. 1
Date 11-09-2017

R Part 8

MEDAN ELEKTROMAGNETIK

Medan dan Muatan Diskrit

q (muatan) = 1 Mc
= 2e⁻.

Proton q, elektron q = Stabil

Note: arah ke atas, maka simbolnya $\hat{r}$

$$\vec{E} = \frac{1}{4\pi\varepsilon_0} = \frac{1q}{r^2}\hat{r}$$

Muatan terperangkap di sistem koordinat

Note: Muatan adalah kata sifat dari atom

Medan ($\vec{E}$) terdistribusi dalam bahan

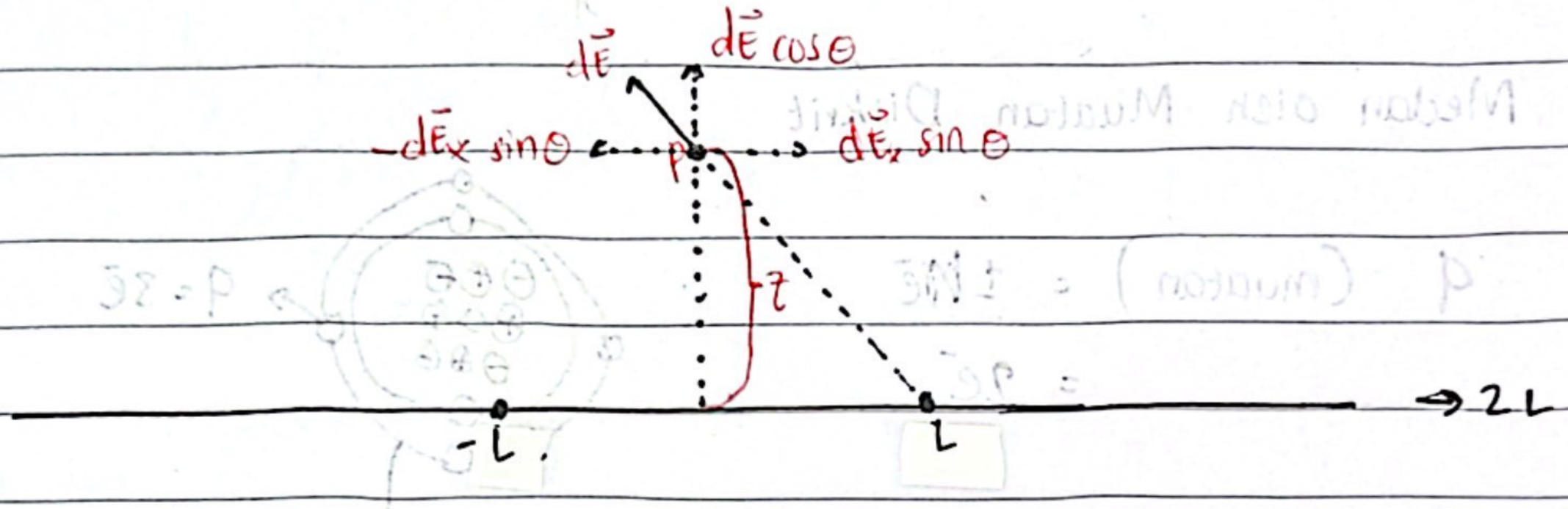
$$\vec{E} = \frac{q}{4\pi\varepsilon_0 r^2}\hat{r}_0 \longrightarrow \text{diskrit}$$

$$\vec{E} = \frac{1}{4\pi\varepsilon_0 r^2}\int \frac{q}{r^2}\,dl \longrightarrow \text{terbentuk garis}$$

No. 2

Date :

Contoh:



Penyelesaian:

$$d\vec{E} = dE_y + dE_x \quad (dE_x = 0)$$

$$= dE_y$$

$$d\vec{E} = dE\cos\theta$$

$$\vec{E} = \frac{1}{4\pi\varepsilon_0}\int_{-L}^{L}\frac{d\vec{q}}{r^2}$$

$$= \frac{1}{4\pi\varepsilon_0}\int_{-L}^{L}\frac{\lambda\, dr}{r^2}\cos\theta$$

$$= \frac{1}{4\pi\varepsilon_0}\int_{0}^{2L}\frac{\lambda\, dl}{r^2}\cos\theta \quad \frac{1}{0}\int_{0}^{2L}\frac{\lambda dl}{r^2}\cos\theta$$

$$= \frac{1}{4\pi\varepsilon_0}\int_{0}^{2L}\frac{\lambda z}{r^2}dl$$

$$= \frac{1}{4\pi\varepsilon_0}\int_{0}^{2L}\frac{\lambda z\, dl}{(z^2+l^2)^{3/2}}$$

$$= \frac{z\lambda}{4\pi\varepsilon_0}\int\frac{dl}{(z^2+l^2)^{3/2}}$$

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$$= \frac{z\lambda}{4\pi\varepsilon_0} \left[\frac{l}{z^2 (z^2 + l^2)^{1/2}} \right]_0^{2l}$$

diganti dengan $2l$ (l)

$$\vec{E} = \frac{z\lambda}{4\pi\varepsilon_0} \left[\frac{2l}{z^2 (z^2 + 2l)^2} \right]$$

Note: $r^2 (z^2 + l^2)^{1/2}$

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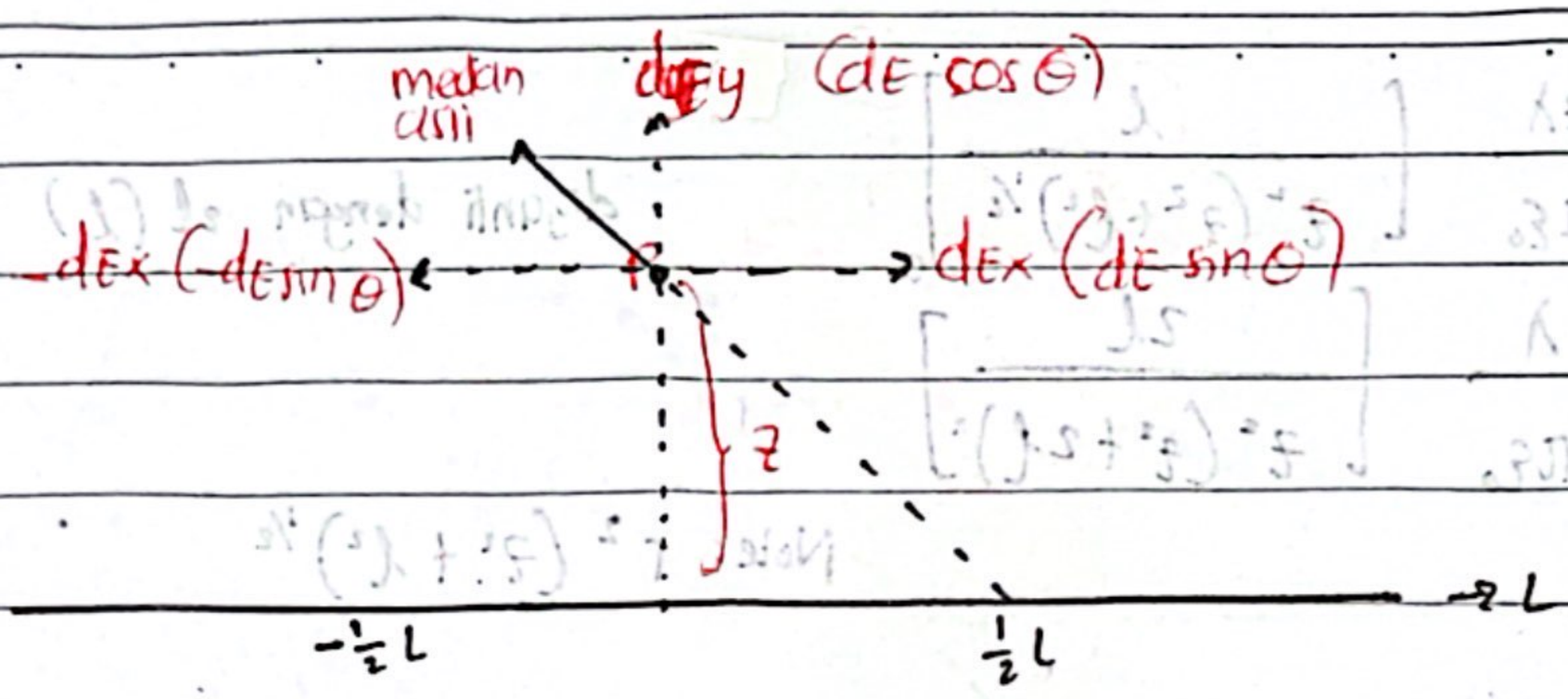
Date : 12-09-2025

Soal



Jawab:

$$d\vec{E} = dEy + dEx \quad (dEx = 0)$$

$$= d\vec{E}y$$

$$d\vec{E} = dE\cos\theta$$

Note: $r = (z^2 + l^2)^{1/2}$

$$\vec{E} = \frac{1}{4\pi\varepsilon_0}\int_{-1/2L}^{1/2L}\frac{dq}{r}\cos\theta$$

$$= \frac{1}{4\pi\varepsilon_0}\int_{-1/2L}^{1/2L}\frac{\lambda dl}{r^2}\cos\theta$$

$$= \frac{1}{4\pi\varepsilon_0}\int_{0}^{L}\frac{\lambda dl}{r^2}\cos\theta = \frac{1}{4\pi\varepsilon_0}\int_{0}^{L}\frac{\lambda dl}{r^2}\cos\theta$$

$$= \frac{1}{4\pi\varepsilon_0}\int_{0}^{L}\frac{dz}{r^3}dl$$

$$\vec{E} = \frac{1}{4\pi\varepsilon_0}\int_{0}^{L}\frac{z\,dl}{(z^2+l^2)^{3/2}}$$

$$= \frac{z\lambda}{4\pi\varepsilon_0}\int_{0}^{L}\frac{dl}{(z^2+l^2)^{3/2}}$$

$$= \frac{z\lambda}{4\pi\varepsilon_0}\left[\frac{\lambda}{z^2(z^2+l^2)^{1/2}}\right]_0^L$$

$$E = \frac{z\lambda}{4\pi\varepsilon_0}\left[\frac{L}{z^2\left(z^2+(L)^2\right)}\right]$$

$$E = \frac{1}{4\pi\varepsilon_0}\left[\frac{\lambda L}{z^2\left(z^2+(L)^2\right.}\right]$$

No. 1

Date : 26-09-2025
Jum'at

Pert. 5

MEDAN ELEKTROMAGNETIK

A. Medan Listrik ($\vec{E}$)

1. $\vec{E}$ (medan diskrit)

$$\vec{E} = \frac{1}{4\pi\varepsilon_0} \frac{q_1 q_0}{r^2} \hat{r}_0$$

medan terpisah-pisah

2. $\vec{E}$ (medan kontinu)

$$\vec{E} = \frac{1}{4\pi\varepsilon_0} \frac{\lambda dr}{r^2} \xrightarrow{\to q} \text{garis}$$

$$\vec{E} = \frac{1}{4\pi\varepsilon_0} \frac{\sigma dl}{r^2} \xrightarrow{\to q} \text{luas}$$

$$\vec{E} = \frac{1}{4\pi\varepsilon_0} \frac{\rho d\tau}{r^2} \xrightarrow{\to q} \text{volume}$$

→ Hukum Coulomb

→ Hukum Gauss
Dimensi tinggi

B. Medan Magnet ($\vec{B}$)

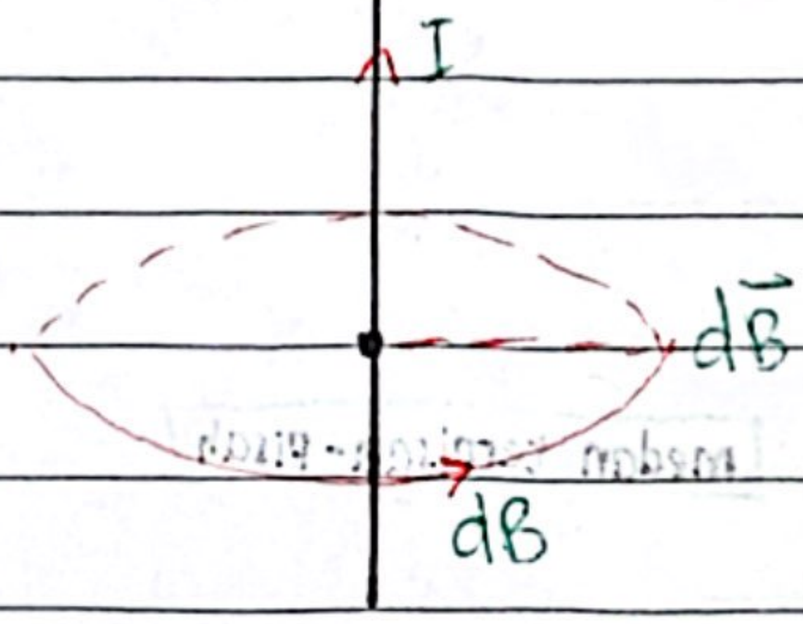
$$\vec{F} = q\,\vec{v} \cdot \vec{B}$$

$$\vec{B} = \frac{\mu_0}{4\pi} \frac{q\vec{v}}{r^2} \hat{r}$$

$$= \frac{\mu_0}{4\pi} \frac{q\vec{v}}{r^2}$$

No. 2

Date :

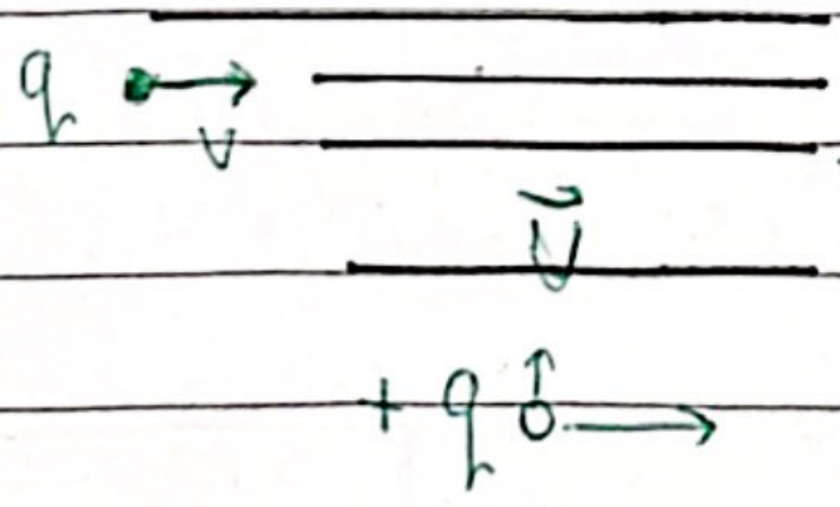


$$d\vec{B} = \frac{\mu_0}{4\pi} \frac{i d\vec{r} \hat{r}_0}{r^2}$$ → muatan

$$\vec{B} = \frac{\mu_0}{4\pi} \int \frac{i d\vec{r} \times \hat{r}_0}{r^2}$$ → arus

$$B = \frac{\mu_0}{4\pi} \iint \frac{i d\vec{a} \times \hat{r}_0}{r^2}$$ → luas

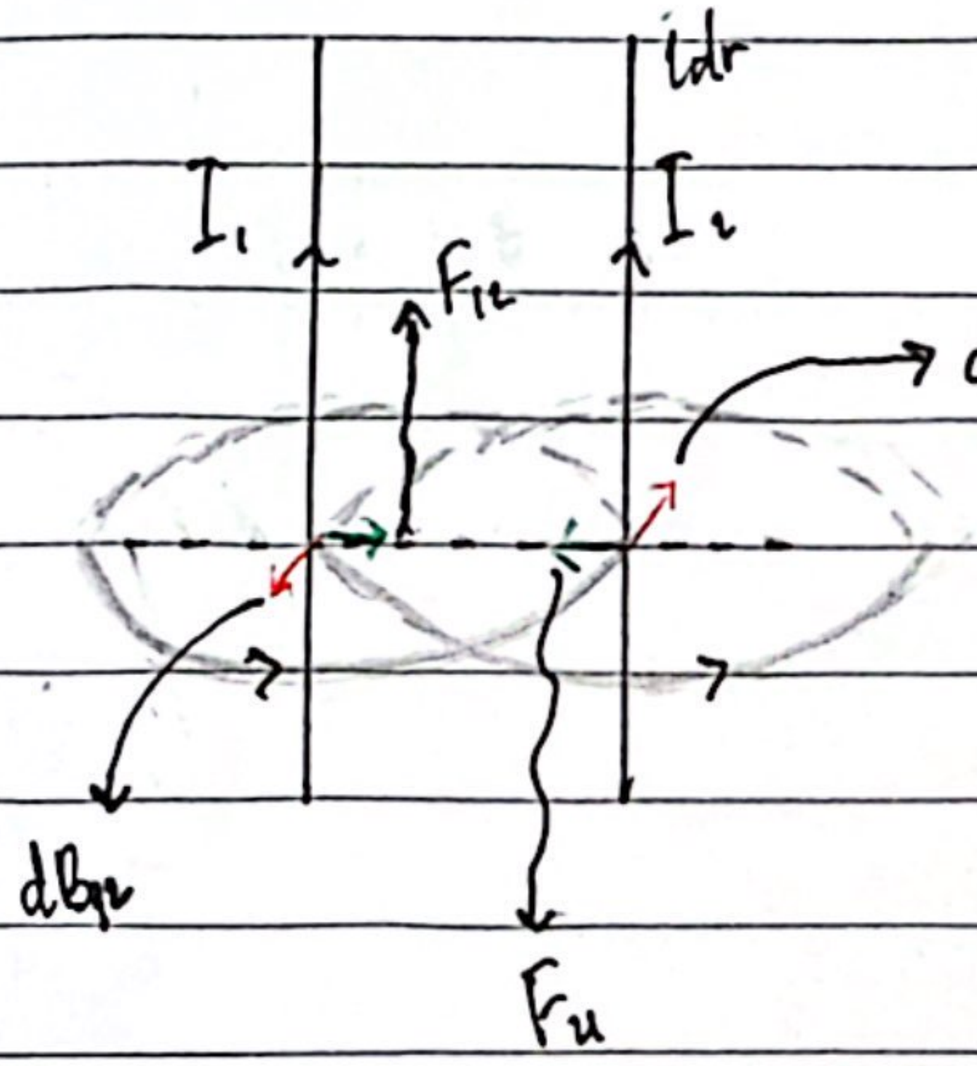
$$B = \frac{\mu_0}{4\pi} \iiint \frac{i d\tau \times \hat{r}_0}{r^2}$$ → volume



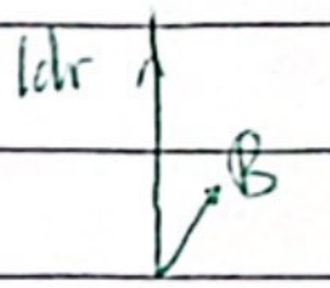
$$\vec{F} = q\vec{v} \times \vec{B}$$

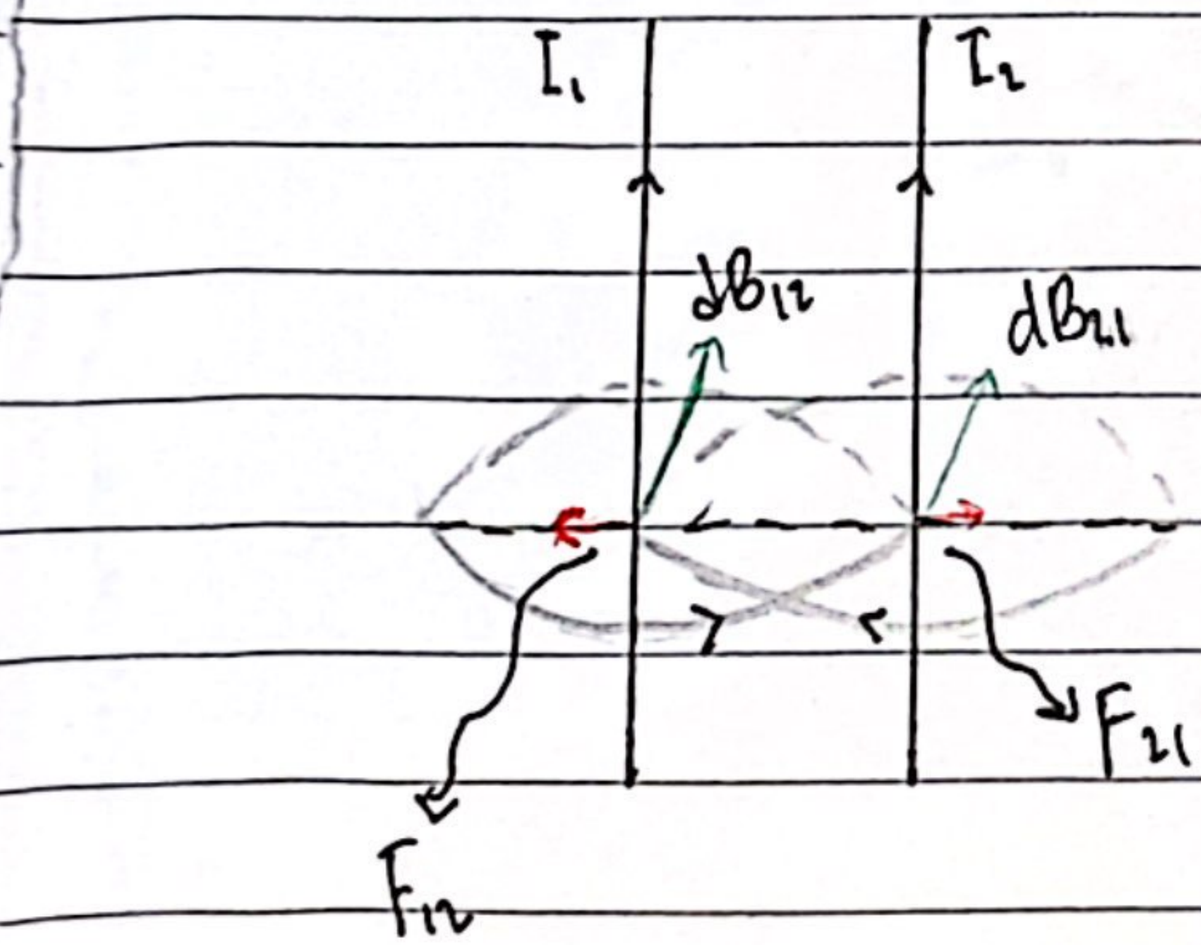
$$|q\vec{v}| \rightarrow B$$

$$\vec{B} = \frac{\mu_0}{4\pi} \frac{q\vec{v} \times \vec{B}}{r^2}$$



$\vec{F} = i\vec{dr} \times \vec{B}$





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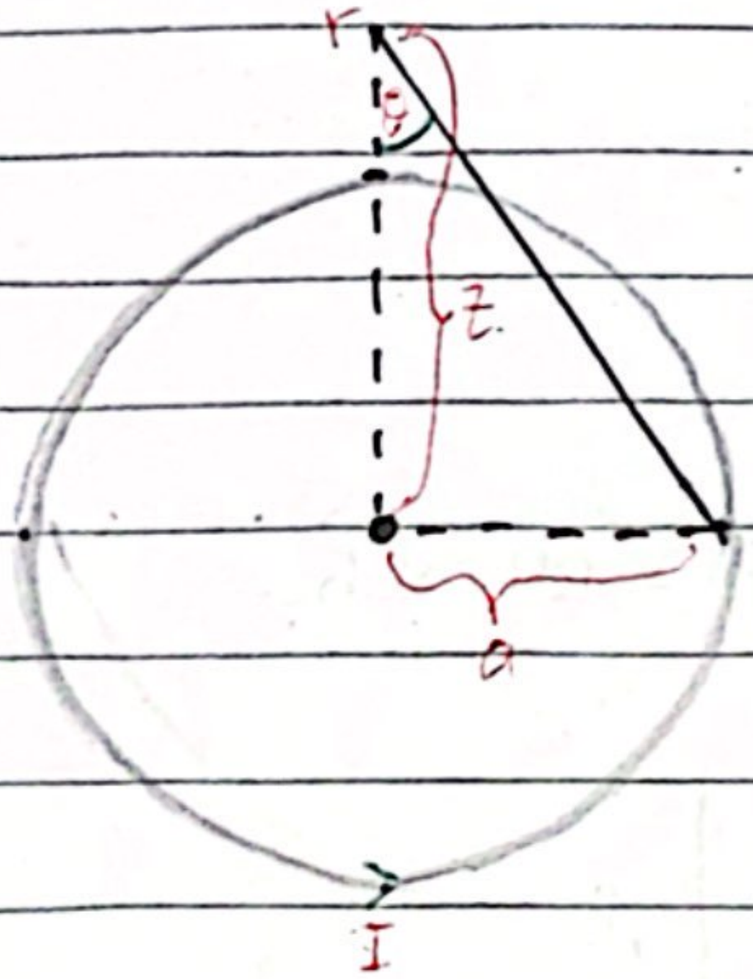
Date :



$$\vec{B} = \frac{M_0}{4\pi} \int \frac{i dr \times \hat{r}_0}{r^2}$$

$$= \frac{M_0}{4\pi} \int_0^{2\pi a} \frac{i \sin dr}{r^2}$$

$$= \frac{M_0}{4\pi} \int_0^{2\pi a} \frac{ia}{r^3} dr$$

$$= \frac{M_0}{4\pi} \int_0^{2\pi a} \frac{ia}{(a^2+z^2)^{3/2}} dr$$

$$= \frac{M_0}{4\pi} \cdot \frac{ia}{(a^2+z^2)^{3/2}} \int_0^{2\pi a} dr$$

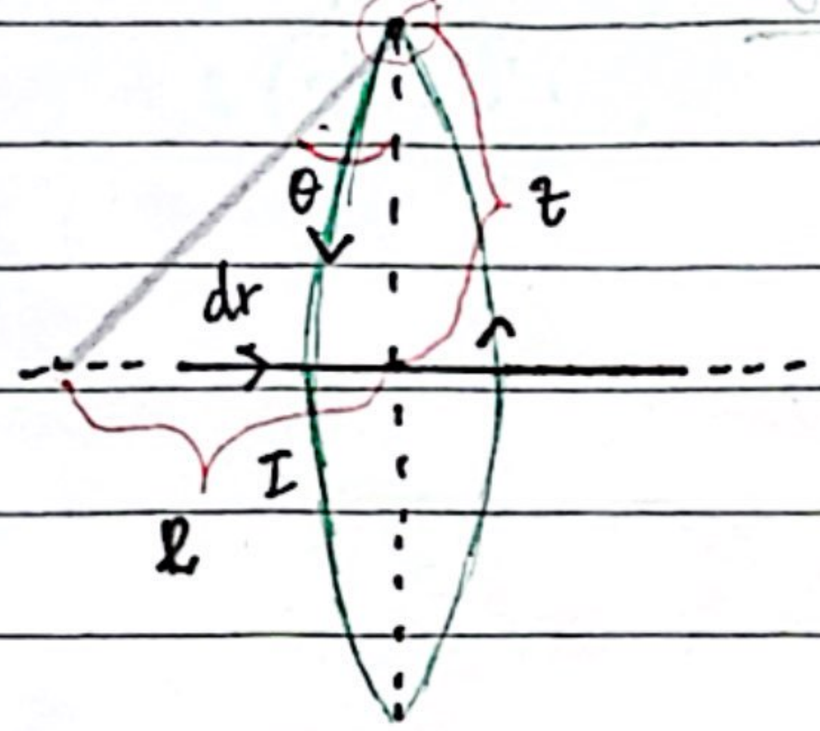
$$= \frac{M_0}{4\pi} \frac{ia}{(a^2+z^2)^{3/2}} (2\pi a)$$

$$= \frac{M_0 \cdot a^2 \cdot}{2(a^2+z^2)^{3/2}}$$

$$B = \frac{M \cdot i}{2a}$$

No. 5

Date :



$$d\vec{B} = \frac{\mu_0}{4\pi} \int \frac{i\,d\vec{r} \times \vec{B}}{r^2}$$

$$= \frac{\mu_0}{4\pi} \int \frac{i \sin\theta\, dr}{r^2}$$

$$\tan\theta = \frac{l}{z} \longrightarrow l = z \tan\theta$$

$$dr = z \sec^2\theta\, d\theta$$

$$\tan = \frac{\sin\theta}{\cos\theta}$$

$$= \frac{\sin^2\theta + \cos^2\theta}{\cos^2\theta}$$

$$= \frac{1}{\cos^2\theta}$$

$$= \sec^2\theta$$

$$\cos\theta = \frac{z}{r}$$

$$r = \frac{z}{\cos\theta}$$

$$= z \sec\theta$$

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$$\vec{B} = \frac{\mu_0}{4\pi} I \int_{-2\pi}^{2\pi} \frac{\sin\theta \; z \; \sec^2\theta \; d\theta}{z^2 \sec^2\theta}$$

$$= \frac{\mu_0 i}{4\pi} I \int_{-2\pi}^{2\pi} \frac{\sin\theta \; d\theta}{z}$$

$$= \frac{\mu_0 i}{4\pi z} \int_{-2\pi}^{2\pi} \sin\theta \; d\theta$$

$$= \frac{\mu_0 i}{2\pi z}$$

$-\cos 2\pi = -(-1)$

$= 1 - (\cos 2\pi)$

$1 + 1 = 2$

$$\vec{B} = \frac{\mu_0}{4\pi} \int \frac{i d\vec{r} \times \hat{r}_0}{r^2}$$

$$= \frac{\mu_0}{4\pi} \int_0^{2\pi a} \frac{i \sin\theta \, dr}{r^2}$$

$$= \frac{\mu_0}{4\pi} \int_0^{2\pi a} \frac{ia}{r^3} dr$$

$$= \frac{\mu_0}{4\pi} \int_0^{2\pi a} \frac{ia}{(a^2+z^2)^{3/2}} dr$$

$$= \frac{\mu_0}{4\pi} \frac{ia}{(a^2+z^2)^{3/2}} \int_0^{2\pi a} dr$$

$$= \frac{\mu_0}{4\pi} \frac{ia}{(a^2+z^2)^{3/2}} (2\pi a)$$

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$$= \frac{\mu_0 i a^2}{2 (a^2 + z^2)^{3/2}}$$