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SOLUSI TUTORIAL FISIKA DASAR IIA

Medan Magnet dan Arus Listrik

1. Bagian vertikal kawat merupakan setengah dari kawat panjang tak hingga pada jarak x dari P sehingga medan yang dihasilkan:

$$B = \frac{1}{2}\left(\frac{\mu_0 I}{2\pi x}\right)$$

Arah medan magnet ke dalam (menjauhi). Pada bagian horizontal medan yang dihasilkan=0. Sehingga medan magnet yang dihasilkan kawat:

$$B = \boxed{\frac{\mu_0 I}{4\pi x} \text{ into the paper}}$$

2. Asumsikan kawat di sebelah kanan adalah kawat 1 dan sebelah kiri kawat 2.Pilih arah positif untuk medan magnet kea rah luar dan negative untuk medan magnet ke arah dalam.

a. Di titik antara dua kawat

$$B_{\text{net}} = -B_1 - B_2 = -\left[\frac{\mu_0 I_1}{2\pi r_1} + \frac{\mu_0 I_2}{2\pi r_2}\right] = -\frac{\mu_0}{2\pi r}(I_1 + I_2)$$

$$= -\frac{\left(4\pi \times 10^{-7}\ \text{T}\cdot\text{m/A}\right)}{2\pi\left(5.00\times 10^{-2}\ \text{m}\right)}(10.0\ \text{A}) = -4.00\times 10^{-5}\ \text{T}$$

atau

$$B_{\text{net}} = \boxed{40.0\ \mu\text{T}\ \text{ into the page}}$$

b. Di titik P1

$$B_{\text{net}} = +B_1 - B_2 = \frac{\mu_0}{2\pi}\left[+\frac{I_1}{r_1} - \frac{I_2}{r_2}\right]$$

$$B_{\text{net}} = \frac{4\pi\times 10^{-7}\ \text{T}\cdot\text{m/A}}{2\pi}\left[\frac{5.00\ \text{A}}{0.100\ \text{m}} - \frac{5.00\ \text{A}}{0.200\ \text{m}}\right]$$

$$= \boxed{5.00\ \mu\text{T out of page}}$$

c. Di titik P2

$$B_{\text{net}} = -B_1 + B_2 = \frac{\mu_0}{2\pi}\left[-\frac{I_1}{r_1} + \frac{I_2}{r_2}\right]$$

$$B_{\text{net}} = \frac{4\pi\times10^{-7}\ \text{T}\cdot\text{m/A}}{2\pi}\left[-\frac{5.00\ \text{A}}{0.300\ \text{m}} + \frac{5.00\ \text{A}}{0.200\ \text{m}}\right]$$

$$= \boxed{1.67\ \mu\text{T out of page}}$$

3. Gunakan hukum Biot-Savart, sehingga medan magnet yang dihasilkan:

$$B = \frac{\mu_0}{4\pi}\frac{I}{r^2}s$$

$$s = r\theta = (0.600\ \text{m})(30.0°)\left(\frac{2\pi}{360°}\right) = 0.314\ \text{m}$$

$$B = \left(10^{-7}\ \text{T}\cdot\text{m/A}\right)\frac{(3.00\ \text{A})}{(0.600\ \text{m})^2}(0.314\ \text{m})$$

$$B = \boxed{262\ \text{nT into the page}}$$

4. $F/\ell = \mu_0 I_1 I_2 / 2\pi d$

$$\frac{F}{\ell} = \frac{\left(4\pi\times10^{-7}\ \text{T}\cdot\text{m/A}\right)(3.00\ \text{A})^2}{2\pi\left(6.00\times10^{-2}\ \text{m}\right)} = \boxed{3.00\times10^{-5}\ \text{N/m}}$$

Gayanya saling tarik menarik

5. Berdasarkan hokum Ampere,

$$\oint Bds = \mu_0 \int JdA$$

- Untuk r_1<R

$$2\pi r_1 B = \mu_0 \int_0^{r_1} br(2\pi r dr) = \mu_0 2\pi b\left[\frac{r_1^3}{3} - 0\right]$$

$$B = \boxed{\frac{1}{3}\left(\mu_0 b r_1^2\right)\ \text{(inside)}}$$

- Untuk r_2>R

$$2\pi r_2 B = \mu_0 \int_0^{R} br(2\pi r dr)$$

$$B = \boxed{\frac{\mu_0 b R^3}{3r_2}\ \text{(outside)}}$$

6. $B = \mu_0 in = \mu_0 i\left(\frac{N}{\ell}\right)$

$B = 0.00571\ \text{T}.$

7. $F_{\perp\ \text{sides}} = \int_a^{a+b} \frac{i_2 \mu_0 i_1}{2\pi y} dy.$

$$F = \frac{\mu_0 i_1 i_2 L}{2\pi}\left(\frac{1}{a} - \frac{1}{a+d}\right) = \frac{\mu_0 i_1 i_2 b}{2\pi a(a+b)}$$

$$= \frac{(4\pi \times 10^{-7}\ \text{T}\cdot\text{m/A})(30.0\text{A})(20.0\text{A})(8.00\text{cm})(300\times 10^{-2}\ \text{m})}{2\pi(1.00\text{cm} + 8.00\text{cm})} = 3.20\times 10^{-3}\ \text{N},$$

8. $|\vec{B}_{\text{net}}| = 2\frac{\mu_0 i}{2\pi r}\sin\theta$

$i = 4.00\ \text{A},\ r =\ r = \sqrt{d_2^2 + d_1^2/4} = 5.00\ \text{m},$

$$\theta = \tan^{-1}\left(\frac{d_2}{d_1/2}\right) = \tan^{-1}\left(\frac{4.00\ \text{m}}{6.00\ \text{m}/2}\right) = \tan^{-1}\left(\frac{4}{3}\right) = 53.1°.$$

$$|\vec{B}_{\text{net}}| = \frac{\mu_0 i}{\pi r}\sin\theta = \frac{(4\pi\times 10^{-7}\ \text{T}\cdot\text{m/A})(4.00\ \text{A})}{\pi(5.00\ \text{m})}\sin 53.1° = 2.56\times 10^{-7}\ \text{T}.$$

9. $B = \frac{\mu_0 i}{4}\left(\frac{1}{R_1} - \frac{1}{R_2}\right) = \frac{(4\pi\times 10^{-7}\ \text{T}\cdot\text{m/A})(0.281\text{A})}{4}\left(\frac{1}{0.0315\text{m}} - \frac{1}{0.0780\text{m}}\right) = 1.67\times 10^{-6}\ \text{T}.$

Arah medan ke dalam bidang gambar