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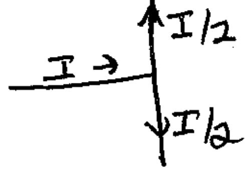
33-12 The B-field is zero.

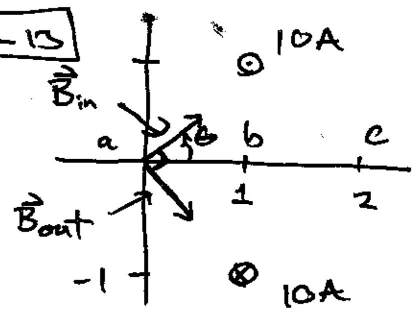
The incoming current, I, runs at 0° w.r.t. the vector $\vec{r}$ connecting any segment of the wire and the point at distance d from the junction

The outgoing currents are 

by symmetry

the upper segment (by R.H.R.) gives B into page at the point while the lower segment gives B out of page. By symmetry, the B-field magnitudes are the same so they cancel.

33-13



a) $|\vec{B}_{out}| = |\vec{B}_{in}| = \frac{\mu_0}{2\pi}\frac{I}{d} = \frac{\mu_0}{2\pi}\frac{(10A)}{(10^{-2}\sqrt{2}\,m)}$

$(B_{in})_y = -(B_{out})_y$ so $(B_{tot})_y = 0$

$(B_{in})_x = (B_{out})_x = \frac{\mu_0}{2\pi}\frac{(10A)}{(10^{-2}\sqrt{2}m)}\cos\overset{45°}{\theta} = \frac{\mu_0(10A)}{2\pi(10^{-2}\cdot 2m)}$

$\vec{B}_{tot} = \frac{\mu_0(10A)}{2\pi(10^{-2}m)}\hat{i} = \frac{(4\pi\times10^{-7}\,T\,m/A)}{2\pi}\frac{(10A)}{(10^{-2}m)}\hat{i}$

$$\boxed{\vec{B}_{tot} = (2\times10^{-4}\,T)\hat{i}}$$

b) again, $|\vec{B}_{out}| = |\vec{B}_{in}|$, but $d = 10^{-2}$ m and $\theta = 0°$

$|\vec{B}_{out}| = |\vec{B}_{in}| = \frac{\mu_0}{2\pi}\frac{(10A)}{(10^{-2}m)} \Rightarrow \boxed{\vec{B}_{tot} = \frac{\mu_0}{\pi}\frac{10A}{10^{-2}m}\hat{i} = (4\times10^{-4}\,T)\hat{i}}$

c) $\boxed{\vec{B}_c = \vec{B}_a = (2\times10^{-4}T)\hat{i}}$

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a) On axis, $\vec{B}_{dipole} = \frac{\mu_0}{4\pi}\frac{2\vec{\mu}}{z^3} \Rightarrow |\vec{\mu}| = \frac{4\pi|\vec{B}|}{\mu_0}\frac{z^3}{2}$

$$\boxed{|\vec{\mu}| = \frac{4\pi}{\mu_0}(5\times10^{-6}T)\frac{(.1m)^3}{2} = 2.5\times10^{-2}\ A\cdot m^2}$$

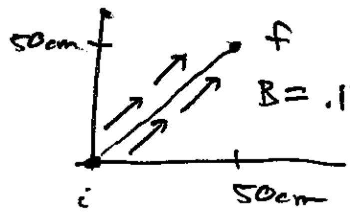
b) B decreases as $z^3 \Rightarrow B(15cm) = B(10cm)\left(\frac{10cm}{15cm}\right)^3$

$$= (5\times10^{-6}T)\left(\frac{8}{27}\right) = 1.48\times10^{-6}T$$

$$\boxed{B(15cm) = 1.45\times10^{-6}T}$$

33-19

$$\int_i^f \vec{B}\cdot d\vec{s}$$



$B = .1T$, parallel to straight line path from i to f

$$\int_i^f \vec{B}\cdot d\vec{s} = \int_i^f |B||ds|\underbrace{\cos\theta}_{=1\text{ along straight line path}} = |B|\int_i^f |ds| = |\vec{B}|(10^{-2}\tfrac{m}{cm})\sqrt{2(50cm)^2}$$

since $|B|$ is constant

$$\boxed{\int_i^f \vec{B}\cdot d\vec{s} = (.1T)\left(10^{-2}\frac{m}{cm}\right)\sqrt{2(50cm)^2} = .071\ T\cdot m}$$

33-20

$\int_i^f \vec{B}\cdot d\vec{s} = 0$ since $\vec{B}$ is $\perp$ to $d\vec{s}$ along straight line path connecting i and f.

33-21 Ampere's law

$$\oint \vec{B}\cdot d\vec{s} = \mu_0 I_{through} = \mu_0(6A - 4A + I_3)$$

closed path

$$= 3.77\times10^{-6}T\cdot m$$

$$I_3 = \frac{3.77\times10^{-6}T\cdot m}{\mu_0} - 6A + 4A = 1A \qquad \boxed{I_3 = 1A}$$

$\boxed{33-22}$ I_1 and I_4 are irrelevant (not through closed loop)

$$\oint \vec{B}\cdot d\vec{s} = \mu_0(8A + I_3) = 1.38\times10^{-5}\ T\cdot m$$

closed lopp

$$\boxed{I_3 = +3A}$$ out of page

+ sign indicates it is same direction as I_2

$\boxed{33-25}$ for a Solenoid, $B = \dfrac{\mu_0 N I}{\ell}$ (inside solenoid)

diameter of wire is $2\times10^{-3}m$, length of sol. is $1.8m$

$\Rightarrow$ ~~[illegible]~~ $N = \ell/d$ diameter of wire

$$B = \frac{\mu_0(\cancel{\ell}/d)I}{\cancel{\ell}} \qquad B = \frac{\mu_0 I}{d} \quad \Rightarrow I = \frac{Bd}{\mu_0} = \frac{(1.5T)(2\times10^{-3}m)}{(4\pi\times10^{-7}T\cdot m/A)}$$

$$\boxed{I = 2{,}400\ A}$$ WOW!