PHYS 1304, CH 30, 7th Ed Solutions

P30.1 $B=\frac{\mu_0 I}{2R}=\frac{\mu_0 q(v/2\pi R)}{2R}=\boxed{12.5\text{ T}}$

P30.10 For the straight sections $d\vec{s}\times\hat{r}=0$. The magnetic field for the part of the loop:

$$B=\frac{\mu_0 I}{4\pi R}\theta=\frac{(4\pi\times10^{-7})(3)}{4\pi(0.6)}\cdot\frac{\pi}{6}=\boxed{2.62\times10^{-7}\text{ T}}$$

P30.18 Let both wires carry current in the x direction, the first at $y=0$ and the second at $y=10.0$ cm.

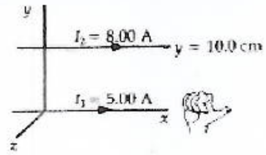

FIG. P30.16(a)

(a) $\mathbf{B}=\frac{\mu_0 I}{2\pi r}\hat{\mathbf{k}}=\frac{(4\pi\times10^{-7}\text{ T}\cdot\text{m/A})(5.00\text{ A})}{2\pi(0.100\text{ m})}\hat{\mathbf{k}}$

$\mathbf{B}=\boxed{1.00\times10^{-5}\text{ T out of the page}}$

(b) $\mathbf{F}_B=I_2\boldsymbol{\ell}\times\mathbf{B}=(8.00\text{ A})\left[(1.00\text{ m})\hat{\mathbf{i}}\times(1.00\times10^{-5}\text{ T})\hat{\mathbf{k}}\right]=(8.00\times10^{-5}\text{ N})(-\hat{\mathbf{j}})$

$\boxed{\mathbf{F}_B=8.00\times10^{-5}\text{ N toward the first wire}}$

(c) $\mathbf{B}=\frac{\mu_0 I}{2\pi r}(-\hat{\mathbf{k}})=\frac{(4\pi\times10^{-7}\text{ T}\cdot\text{m/A})(8.00\text{ A})}{2\pi(0.100\text{ m})}(-\hat{\mathbf{k}})=(1.60\times10^{-5}\text{ T})(-\hat{\mathbf{k}})$

$\mathbf{B}=\boxed{1.60\times10^{-5}\text{ T into the page}}$

(d) $\mathbf{F}_B=I_1\boldsymbol{\ell}\times\mathbf{B}=(5.00\text{ A})\left[(1.00\text{ m})\hat{\mathbf{i}}\times(1.60\times10^{-5}\text{ T})(-\hat{\mathbf{k}})\right]=(8.00\times10^{-5}\text{ N})(+\hat{\mathbf{j}})$

$\mathbf{F}_B=\boxed{8.00\times10^{-5}\text{ N towards the second wire}}$

P30.25 From Ampere's law, the magnetic field at point a is given by $B_a=\frac{\mu_0 I_a}{2\pi r_a}$, where I_a is the net current through the area of the circle of radius r_a. In this case, $I_a=1.00$ A out of the page (the current in the inner conductor), so

$$B_a=\frac{(4\pi\times10^{-7}\text{ T}\cdot\text{m/A})(1.00\text{ A})}{2\pi(1.00\times10^{-3}\text{ m})}=\boxed{200\ \mu\text{T toward top of page}}.$$

Similarly at point b: $B_b=\frac{\mu_0 I_b}{2\pi r_b}$, where I_b is the net current through the area of the circle having radius r_b.

Taking out of the page as positive, $I_b=1.00\text{ A}-3.00\text{ A}=-2.00\text{ A}$, or $I_b=2.00$ A into the page. Therefore,

$$B_b=\frac{(4\pi\times10^{-7}\text{ T}\cdot\text{m/A})(2.00\text{ A})}{2\pi(3.00\times10^{-3}\text{ m})}=\boxed{133\ \mu\text{T toward bottom of page}}.$$

P30.39 a) $\phi=\int\vec{B}\cdot d\vec{A}=\vec{B}\cdot\vec{A}=(5\hat{i}+4\hat{j}+3\hat{k})\cdot\ell^2\hat{i}$

$=5\ell^2=5\times(0.025^2)=\boxed{3.13\times10^{-3}\text{ Wb}}$

b) $\phi_T=\phi_x+\phi_y+\phi_z+\phi_{(-x)}+\phi_{(-y)}+\phi_{(-z)}$

$=\vec{B}\cdot A\hat{i}+\vec{B}\cdot A\hat{j}+\vec{B}\cdot A\hat{k}+\vec{B}\cdot(-A\hat{i})+\vec{B}\cdot(-A\hat{j})+\vec{B}\cdot(-A\hat{k})$

$=\boxed{0}$