1.

units? 20 ft = 6.1 meters

$$B(r) = \frac{\mu_0 I}{2\pi r} = \frac{4\pi \times 10^{-7}(100)}{2\pi(6.1\text{m})} = 33 \times 10^{-7}\ \text{T}$$

Seems to be comparable to Earth's B – field.

3.

$$B(r) = \frac{\mu_0 I}{2\pi r} = 39 \times 10^{-6}\,\text{T}$$

$$\frac{4\pi \times 10^{-7} I}{2\pi(.08\text{m})} = 39 \times 10^{-6}$$

I = 15.6 amps and heading east.

5.

Notice the difference in the equations used for the straight line segments for point a and b. They are equations (30-6) and (30-9) respectively.

At point a:

$$\text{curved section}, dB = \frac{\mu_0 i}{4\pi}\frac{d\vec{s} \times \vec{r}}{r^2} = \frac{\mu_0 i ds}{4\pi r^2}$$

$$B = \int dB = \frac{\mu_0 i}{4\pi r^2}\int ds$$

$$B = \frac{\mu_0 i}{4\pi r^2}\left(\frac{1}{2}2\pi r\right) = \frac{\mu_0 i}{4r}$$

$$B = \frac{4\pi \times 10^{-7}(10)}{4(.005\text{m})} = .628\text{mT}$$

$$\text{straight section}, B = \frac{\mu_0 i}{4\pi r}$$

$$B = \frac{4\pi \times 10^{-7}(10)}{4\pi(.005\text{m})} = .200\text{mT per wire.}$$

Total B@a = .628 + .200 + .200 = 1.028mT

At point b:

$$B \sim 2\left(\frac{\mu_0 i}{2\pi r}\right) = \frac{4\pi \times 10^{-7}(10)}{\pi(.005\text{m})} = .8\text{mT}$$

7.

The straight segments do not contribute (B=0).

Top, radius = a:

Let ϕ be the angle between $\vec{r}$ and $d\vec{s}$. Then $\phi = 90^\circ$.

$$B = \frac{\mu_0 i}{4\pi}\int \frac{\sin\phi\, ds}{a^2} = \frac{\mu_0 i}{4\pi}\int \frac{\sin(90^\circ)(a\, d\Theta)}{a^2}$$

$$B = \frac{\mu_0 i}{4\pi a}\int_0^\Theta d\Theta = \frac{\mu_0 i}{4\pi a}(\Theta - 0) = \frac{\mu_0 i\Theta}{4\pi a}$$

Bottom, radius = b:

$$B = \frac{\mu_0 i\Theta}{4\pi b}$$

$$\text{Total } B = \frac{\mu_0 i\Theta}{4\pi}\left(\frac{1}{b} - \frac{1}{a}\right)$$

8.

$$dB = \frac{\mu_0}{4\pi}\frac{I\, d\vec{s}\times\vec{r}}{r^2}$$

$A \rightarrow H$ and $J \rightarrow D$ don't contribute.

Circular parts:

$I\, d\vec{s}\times\vec{r}$ out of page for R_2

and into the page for R_1.

$$B = \frac{\mu_0 i}{4\pi R^2}\int ds = \frac{\mu_0 i}{4\pi R^2}\left(\frac{1}{2}2\pi R\right)$$

$$B = \frac{\mu_0 i}{4\pi R^2}(\pi R) = \frac{\mu_0 i}{4}\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

10.

$$dB = \frac{\mu_0}{4\pi}\frac{I d\vec{s}\times\vec{r}}{r^2}$$

a) $d\vec{s}\times\vec{r} = |\vec{r}||d\vec{s}|\sin\Theta$

$\Theta = 0$, so $B = 0$ at C due to the straight segments.

b) $B = \frac{\mu_0 i}{4\pi R^2}\oint ds = \frac{\mu_0 i}{4\pi R^2}\ \frac{1}{2}2\pi\pi \ = \frac{\mu_0 i}{4R}$ into the page.

41.

Near side:

$$B = \frac{\mu_0 I}{2\pi r} = \frac{(4\pi \times 10^{-7})(30\,\text{amps})}{2\pi(.01\text{m})} = 6 \times 10^{-4}\,\text{T down}$$

$$F = ILB = (20\,\text{amps})(.30\text{m})(6 \times 10^{-4}\,\text{T})$$

$$F = 36 \times 10^{-4}\,\text{newtons up}$$

Far side:

$$B = \frac{\mu_0 I}{2\pi r} = \frac{(4\pi \times 10^{-7})(30\,\text{amps})}{2\pi(.09\text{m})} = 6.67 \times 10^{-5}\,\text{T down}$$

$$F = ILB = (20\,\text{amps})(.30\text{m})(6.67 \times 10^{-5}\,\text{T})$$

$$F = 4 \times 10^{-4}\,\text{newtons}$$

$$\text{Total force} = 36 - 4 = 32 \times 10^{-4}\,\text{newtons}$$

43.

Inside: $B(r) = \frac{\mu_0 ir}{2\pi R^2}$

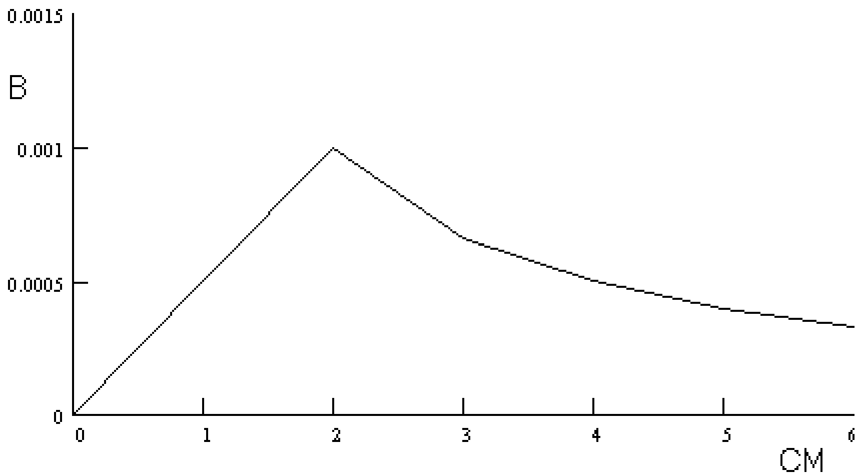
$$B(r) = \frac{4\pi \times 10^{-7}(100)r}{2\pi(.02)^2} = \frac{r}{20}$$

$$B(r) = \frac{r}{20} \quad \text{for} \quad 0 < r \le .02\,\text{m}$$

Outside: $B(r) = \frac{\mu_0 i}{2\pi r}$

$$B(r) = \frac{4\pi \times 10^{-7}(100)}{2\pi r} = \frac{2 \times 10^{-5}}{r}$$

$$B(r) = \frac{2 \times 10^{-5}}{r} \quad \text{for } r > .02\text{ m}$$



49.

a) For a toroid, $B = \frac{\mu_0 IN}{2\pi r}$.

$$B = \frac{(4\pi \times 10^{-7})(.80)(500)}{2\pi(.15)}$$

$$B = 533\,\mu T$$

b) $B = \frac{(4\pi \times 10^{-7})(.80)(500)}{2\pi(.15+.05)}$

$$B = 400\,\mu T$$

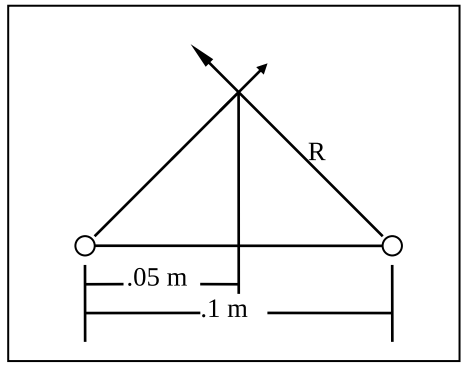
50.

$$B = \mu_0 nI$$

$$n = \frac{1200\,\text{turns}}{.95\,\text{meters}} = 1263\frac{\text{turns}}{\text{meter}}$$

$$B = (4\pi \times 10^{-7})(1263)(3.6) = 5.71\,\text{mT}$$

76.



Left hand out of page.

Right hand current into page.

Both currents running out of the page.

$$\cos(45^\circ) = \frac{.05\text{m}}{R} \Rightarrow R = .071\text{m}$$

Magnitude of one vector.

$$B = \frac{(4\pi \times 10^{-7})(100)}{2\pi(.071)}$$

Now add the two vectors.

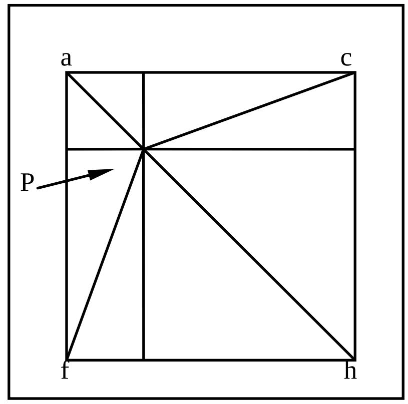
x – comps cancel.

$$\text{y – comps } 2(B\cos(45^\circ))$$

$$\text{answer} = 4 \times 10^{-4} = 400\,\mu\text{T}$$

83.

Use the Pythagorean Theorem to find the distances. The wire will be done in triangular sections.



$$B = \frac{\mu_0 i}{4\pi R}\frac{s}{\sqrt{s^2 + R^2}}$$

For $\Delta apc = \Delta apf$, double the answer.

$$B = 2\left[\frac{(4\pi \times 10^{-7})(10)}{4\pi(.02)}\left(\frac{.02}{\sqrt{.0008}} + \frac{.06}{\sqrt{.004}}\right)\right]$$

$$B = 165\,\mu T$$

For $\Delta fph = \Delta cph$, double the answer.

$$B = 2\left[\frac{(4\pi \times 10^{-7})(10)}{4\pi(.06)}\left(\frac{.02}{\sqrt{.004}} + \frac{.06}{\sqrt{.0072}}\right)\right]$$

$$B = 34\,\mu T$$

$$\text{Total } B = 200\,\mu T$$