35. Equation 29-13 gives the magnitude of the force between the wires, and finding the x-component of it amounts to multiplying that magnitude by $\cos\phi = \frac{d_2}{\sqrt{d_1^2 + d_2^2}}$. Therefore, the x-component of the force per unit length is

$$\frac{F_x}{L} = \frac{\mu_0 i_1 i_2 d_2}{2\pi(d_1^2 + d_2^2)} = \frac{(4\pi\times10^{-7}\ \mathrm{T\cdot m/A})(4.00\times10^{-3}\ \mathrm{A})(6.80\times10^{-3}\ \mathrm{A})(0.050\ \mathrm{m})}{2\pi[(0.0240\ \mathrm{m})^2 + (0.050\ \mathrm{m})^2]}.$$

$$= 8.84\times10^{-11}\ \mathrm{N/m}.$$

36. We label these wires 1 through 5, left to right, and use Eq. 29-13. Then,

(a) The magnetic force on wire 1 is

$$\vec{F}_1 = \frac{\mu_0 i^2 l}{2\pi}\left(\frac{1}{d} + \frac{1}{2d} + \frac{1}{3d} + \frac{1}{4d}\right)\hat{\mathrm{j}} = \frac{25\mu_0 i^2 l}{24\pi d}\,\hat{\mathrm{j}} = \frac{25\left(4\pi\times10^{-7}\ \mathrm{T\cdot m/A}\right)\left(3.00\mathrm{A}\right)^2(10.0\mathrm{m})}{24\pi\left(8.00\times10^{-2}\mathrm{m}\right)}\,\hat{\mathrm{j}}$$

$$= (4.69\times10^{-4}\,\mathrm{N})\,\hat{\mathrm{j}}.$$

(b) Similarly, for wire 2, we have

$$\vec{F}_2 = \frac{\mu_0 i^2 l}{2\pi}\left(\frac{1}{2d} + \frac{1}{3d}\right)\hat{\mathrm{j}} = \frac{5\mu_0 i^2 l}{12\pi d}\,\hat{\mathrm{j}} = (1.88\times10^{-4}\mathrm{N})\,\hat{\mathrm{j}}.$$

(c) $F_3 = 0$ (because of symmetry).

(d) $\vec{F}_4 = -\vec{F}_2 = (-1.88\times10^{-4}\mathrm{N})\hat{\mathrm{j}}$, and

(e) $\vec{F}_5 = -\vec{F}_1 = -(4.69\times10^{-4}\,\mathrm{N})\hat{\mathrm{j}}$.

44. We use Ampere's law: $\oint \vec{B}\cdot d\vec{s} = \mu_0 i$, where the integral is around a closed loop and i is the net current through the loop.

(a) For path 1, the result is

$$\oint_1 \vec{B}\cdot d\vec{s} = \mu_0\left(-5.0\mathrm{A} + 3.0\mathrm{A}\right) = (4\pi\times10^{-7}\ \mathrm{T\cdot m/A})\left(-2.0\mathrm{A}\right) = -2.5\times10^{-6}\mathrm{T\cdot m}.$$

(b) For path 2, we find

$$\oint_2 \vec{B}\cdot d\vec{s} = \mu_0\left(-5.0\mathrm{A} - 5.0\mathrm{A} - 3.0\mathrm{A}\right) = (4\pi\times10^{-7}\ \mathrm{T\cdot m/A})\left(-13.0\mathrm{A}\right) = -1.6\times10^{-5}\mathrm{T\cdot m}.$$

48. (a) The field at the center of the pipe (point C) is due to the wire alone, with a magnitude of

$$B_C = \frac{\mu_0 i_{\text{wire}}}{2\pi(3R)} = \frac{\mu_0 i_{\text{wire}}}{6\pi R}.$$

For the wire we have $B_{P,\text{ wire}} > B_{C,\text{ wire}}$. Thus, for $B_P = B_C = B_{C,\text{ wire}}$, i_{wire} must be into the page:

$$B_P = B_{P,\text{wire}} - B_{P,\text{pipe}} = \frac{\mu_0 i_{\text{wire}}}{2\pi R} - \frac{\mu_0 i}{2\pi(2R)}.$$

Setting $B_C = -B_P$ we obtain $i_{\text{wire}} = 3i/8 = 3(8.00\times10^{-3}\text{ A})/8 = 3.00\times10^{-3}\text{ A}$.

(b) The direction is into the page.