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

P30.7 For the straight sections $d\mathbf{s} \times \hat{\mathbf{r}} = 0$. The quarter circle makes one-fourth the field of a full loop:

$\mathbf{B} = \frac{1}{4}\frac{\mu_0 I}{2R} = \frac{\mu_0 I}{8R}$ into the paper $\qquad \mathbf{B} = \frac{(4\pi \times 10^{-7}\ \text{T}\cdot\text{m/A})(5.00\ \text{A})}{8(0.030\,0\ \text{m})} = \boxed{26.2\ \mu\text{T into the paper}}$

P30.16 Let both wires carry current in the x direction, the first at $y = 0$ and the second at $y = 10.0$ cm.

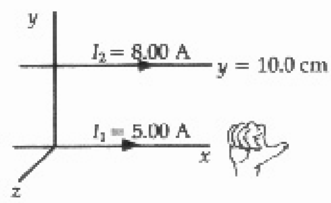

FIG. P30.16(a)

(a) $\mathbf{B} = \frac{\mu_0 I}{2\pi r}\hat{\mathbf{k}} = \frac{(4\pi \times 10^{-7}\ \text{T}\cdot\text{m/A})(5.00\ \text{A})}{2\pi(0.100\ \text{m})}\hat{\mathbf{k}}$

$\mathbf{B} = \boxed{1.00 \times 10^{-5}\ \text{T out of the page}}$

(b) $\mathbf{F}_B = I_2 \boldsymbol{\ell} \times \mathbf{B} = (8.00\ \text{A})\left[(1.00\ \text{m})\hat{\mathbf{i}} \times (1.00 \times 10^{-5}\ \text{T})\hat{\mathbf{k}}\right] = (8.00 \times 10^{-5}\ \text{N})(-\hat{\mathbf{j}})$

$\boxed{\mathbf{F}_B = 8.00 \times 10^{-5}\ \text{N toward the first wire}}$

(c) $\mathbf{B} = \frac{\mu_0 I}{2\pi r}(-\hat{\mathbf{k}}) = \frac{(4\pi \times 10^{-7}\ \text{T}\cdot\text{m/A})(8.00\ \text{A})}{2\pi(0.100\ \text{m})}(-\hat{\mathbf{k}}) = (1.60 \times 10^{-5}\ \text{T})(-\hat{\mathbf{k}})$

$\mathbf{B} = \boxed{1.60 \times 10^{-5}\ \text{T into the page}}$

(d) $\mathbf{F}_B = I_1 \boldsymbol{\ell} \times \mathbf{B} = (5.00\ \text{A})\left[(1.00\ \text{m})\hat{\mathbf{i}} \times (1.60 \times 10^{-5}\ \text{T})(-\hat{\mathbf{k}})\right] = (8.00 \times 10^{-5}\ \text{N})(+\hat{\mathbf{j}})$

$\mathbf{F}_B = \boxed{8.00 \times 10^{-5}\ \text{N towards the second wire}}$

P30.23 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

$$B_a = \frac{(4\pi \times 10^{-7}\ \text{T}\cdot\text{m/A})(1.00\ \text{A})}{2\pi(1.00 \times 10^{-3}\ \text{m})} = \boxed{200\ \mu\text{T toward top of page}}.$$

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,

$$B_b = \frac{(4\pi \times 10^{-7}\ \text{T}\cdot\text{m/A})(2.00\ \text{A})}{2\pi(3.00 \times 10^{-3}\ \text{m})} = \boxed{133\ \mu\text{T toward bottom of page}}.$$

P29.1 (a) up

(b) out of the page, since the charge is negative.

(c) no deflection

(d) into the page

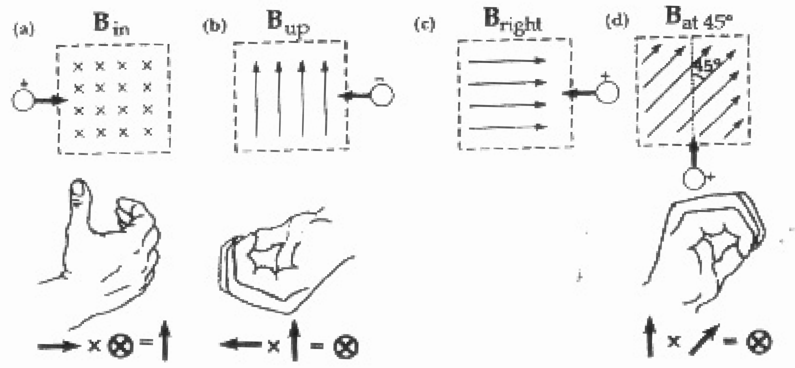

FIG. P29.1

P29.3 $\mathbf{F}_B = q\mathbf{v} \times \mathbf{B}$; $|\mathbf{F}_B|(-\hat{\mathbf{j}}) = -e|\mathbf{v}|\hat{\mathbf{i}} \times \mathbf{B}$

Therefore, $B = |\mathbf{B}|(-\hat{\mathbf{k}})$ which indicates the $\boxed{\text{negative } z \text{ direction}}$.

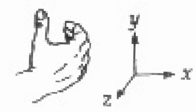

FIG. P29.3

P29.8 Gravitational force: $F_g = mg = (9.11 \times 10^{-31} \text{ kg})(9.80 \text{ m/s}^2) = \boxed{8.93 \times 10^{-30} \text{ N down}}$.

Electric force: $F_e = qE = (-1.60 \times 10^{-19} \text{ C})(100 \text{ N/C down}) = \boxed{1.60 \times 10^{-17} \text{ N up}}$.

Magnetic force: $\mathbf{F}_B = q\mathbf{v} \times \mathbf{B} = (-1.60 \times 10^{-19} \text{ C})(6.00 \times 10^6 \text{ m/s } \hat{\mathbf{E}}) \times (50.0 \times 10^{-6} \text{ N} \cdot \text{s/C} \cdot \text{m } \hat{\mathbf{N}})$.

$\mathbf{F}_B = -4.80 \times 10^{-17} \text{ N up} = \boxed{4.80 \times 10^{-17} \text{ N down}}$.

P29.11 $F_B = ILB\sin\theta$ with $F_B = F_g = mg$

$mg = ILB\sin\theta$ so $\frac{m}{L}g = IB\sin\theta$

FIG. P29.11

$I = 2.00 \text{ A}$ and $\frac{m}{L} = (0.500 \text{ g/cm})\left(\frac{100 \text{ cm/m}}{1\,000 \text{ g/kg}}\right) = 5.00 \times 10^{-2} \text{ kg/m}$.

Thus $(5.00 \times 10^{-2})(9.80) = (2.00)B\sin 90.0°$

$B = \boxed{0.245 \text{ Tesla}}$ with the direction given by right-hand rule: $\boxed{\text{eastward}}$.

P29.13 (a) $F_B = ILB\sin\theta = (5.00 \text{ A})(2.80 \text{ m})(0.390 \text{ T})\sin 60.0° = \boxed{4.73 \text{ N}}$

(b) $F_B = (5.00 \text{ A})(2.80 \text{ m})(0.390 \text{ T})\sin 90.0° = \boxed{5.46 \text{ N}}$

(c) $F_B = (5.00 \text{ A})(2.80 \text{ m})(0.390 \text{ T})\sin 120° = \boxed{4.73 \text{ N}}$

P29.21 $\tau = \mu B\sin\theta$ so $4.60 \times 10^{-3} \text{ N} \cdot \text{m} = \mu(0.250)\sin 90.0°$

$\mu = 1.84 \times 10^{-2} \text{ A} \cdot \text{m}^2 = \boxed{18.4 \text{ mA} \cdot \text{m}^2}$