1. (a), because unlike poles attract.
2. (a).
3. (c).

[4]. The magnet would attract the unmagnetized iron bar when a pole end is placed at the center of its long side. If the end of the unmagnetized bar were placed at the center of the long side of the magnet, it would not be attracted.

6. (b), according to the right-hand rule.
7. (a).
8. (c), into the page, according to the right-hand rule.
9. (d). When $\theta = 0°$, there is no magnetic force because $F = qvB \sin \theta$.
10. (a) The magnitude of the magnetic force on them is the $\boxed{\text{same}}$. The magnitude of the force depends on charge ($F = qvB \sin \theta$,) and proton and electron has the same magnitude of charge.

    (b) $\boxed{\text{Electron has greater acceleration}}$ due to its smaller mass. Since $F = ma$, the smaller the mass, the greater the acceleration.

[14]. (a) According to the right-hand force rule, the magnetic force is directed $\boxed{\text{(1) into the page}}$.

17. The magnetic field has to be to the left, looking in the direction of the beam, so the magnetic force points upward.

    $F = qvB \sin \theta = mg$, so $B = \dfrac{mg}{qv \sin \theta} = \dfrac{(1.67 \times 10^{-27}\text{ kg})(9.80\text{ m/s}^2)}{(1.6 \times 10^{-19}\text{ C})(5.0 \times 10^6\text{ m/s}) \sin 90°} = \boxed{2.0 \times 10^{-14}\text{ T}}$.

    The direction is to the $\boxed{\text{left, looking in the direction of the velocity}}$, so the magnetic force points upward, opposite to the gravitational force.

[18]. (a) According to the right-hand force rule and the fact that electron carries negative charge, the magnetic field is directed in the $\boxed{(4)\ -z}$ direction.

    (b) From $F = qvB \sin \theta$, $B = \dfrac{F}{qv \sin \theta} = \dfrac{5.0 \times 10^{-19}\text{ N}}{(1.6 \times 10^{-19}\text{ C})(3.0 \times 10^6\text{ m/s}) \sin 90°} = \boxed{1.0 \times 10^{-6}\text{ T}}$.

    (b) $F = qvB \sin \theta$, ☞ $B = \dfrac{F}{qv \sin \theta} = \dfrac{20\text{ N}}{(0.25\text{ C})(2.0 \times 10^2\text{ m/s}) \sin 90°} = \boxed{0.40\text{ T}}$.

22. (c), because $r = \dfrac{mv}{qB}$.
23. (b), because $r = \dfrac{mv}{qB}$.
24. (a).
25. The $\boxed{\text{magnetic force on the electron beam}}$, which "prints" pictures, causes the deflection of the electrons.
28. $v = \dfrac{V}{Bd} = \dfrac{E}{B} = \dfrac{8.0 \times 10^3\text{ V/m}}{0.040\text{ T}} = \boxed{2.0 \times 10^5\text{ m/s}}$.
29. (a) $v = \dfrac{V}{Bd}$, ☞ $V = vBd = (8.0 \times 10^4\text{ m/s})(1.5\text{ T})(0.015\text{ m}) = \boxed{1.8 \times 10^3\text{ V}}$.

    (b) It is the $\boxed{\text{same voltage}}$, 1.8×10^3 V, because it is $\boxed{\text{independent of charge}}$ on the particle.

[30]. (a) $v = \dfrac{V}{Bd} = \dfrac{E}{B} = \dfrac{3000\text{ N/C}}{0.030\text{ T}} = \boxed{1.0 \times 10^5\text{ m/s}}$.

    (b) It is the $\boxed{\text{same speed}}$, 1.0×10^5 m/s, because it is $\boxed{\text{independent of charge}}$ on the particle.

31. $K = \frac{1}{2}mv^2$, ☞ $v = \sqrt{\dfrac{2K}{m}} = \sqrt{\dfrac{2(10 \times 10^3\text{ eV})(1.6 \times 10^{-19}\text{ J/eV})}{2.25 \times 10^{-28}\text{ kg}}} = 3.77 \times 10^6$ m/s.

$v = \frac{E}{B}$, ☞ $B = \frac{E}{v} = \frac{2.0 \times 10^3 \text{ V/m}}{3.77 \times 10^6 \text{ m/s}} = \boxed{5.3 \times 10^{-4} \text{ T}}$.

35. (d), according to the force right-hand rule.
36. (a), according to the force right-hand rule.
37. (b).
39. $\boxed{\text{It shortens}}$, because the coils of the spring attract each other due to the magnetic fields created in the coils. (Parallel wires with current in same direction will attract each other.)
43. $F = ILB \sin\theta = (20 \text{ A})(2.0 \text{ m})(0.050 \text{ T}) \sin 37° = \boxed{1.2 \text{ N perpendicular to the plane of } \vec{\mathbf{B}} \text{ and } I}$.

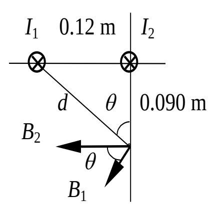
$\boxed{44}$. (a) To the $\boxed{\text{right}}$. (b) $\boxed{\text{Toward top of the page}}$.
(c) $\boxed{\text{Into the page}}$. (d) To the $\boxed{\text{left}}$.
(e) $\boxed{\text{Into or out of the page}}$.

45. $F = ILB \sin\theta$, ☞ $B = \frac{F}{IL \sin\theta} = \frac{1.0 \times 10^{-2} \text{ N}}{(4.0 \text{ A})(0.50 \text{ m}) \sin 90°} = \boxed{5.0 \times 10^{-3} \text{ T north to south}}$.

46. $F = ILB \sin\theta = (15 \text{ A})(0.75 \text{ m})(1.0 \times 10^{-4} \text{ T}) \sin 30° = \boxed{5.6 \times 10^{-4} \text{ N}}$.

$\boxed{56}$. (a) Use the result of Exercise 51(a). The top wire must attract the lower wire so it can stay in equilibrium.
For the forces to attract, the currents should be in $\boxed{\text{(1) the same}}$ direction.
(b) Magnetic force cancels gravity. $F = mg$. So $\frac{F}{L} = \frac{\mu_o I_1 I_2}{2\pi d} = \frac{mg}{L}$.
For a 1.0-m length, $I = I_1 = I_2 = \sqrt{\frac{2\pi dmg}{\mu_o}} = \sqrt{\frac{2\pi(0.020 \text{ m})(1.5 \times 10^{-3} \text{ kg})(9.80 \text{ m/s}^2)}{4\pi \times 10^{-7} \text{ T·m/A}}} = \boxed{38 \text{ A}}$.

61. (a), according to the right-hand source rule.
62. (b), according to the right-hand source rule.
63. (b), according to the right-hand source rule.
68. The direction of the current should be $\boxed{\text{counterclockwise}}$ so to cancel the magnetic field of the outer loop.
Its current should be $\boxed{\text{smaller}}$ than 10 A, because the magnetic field created by a loop is $B = \frac{\mu_o I}{2r}$. With a smaller radius of the inner loop, its current should be smaller than 10 A.
76. $d = \sqrt{(0.12 \text{ m})^2 + (0.090 \text{ m})^2} = 0.15 \text{ m}$, $\theta = \tan^{-1}\frac{0.12 \text{ m}}{0.090 \text{ m}} = 53.1°$.



$B_2 = \frac{\mu_o I_2}{2\pi d_2} = \frac{(4\pi \times 10^{-7} \text{ T·m/A})(2.0 \text{ A})}{2\pi(0.090 \text{ m})} = 4.44 \times 10^{-6} \text{ T}$,
so $\vec{\mathbf{B}}_2 = (-4.44 \times 10^{-6} \text{ T})\,\hat{\mathbf{x}}$.
$B_1 = \frac{(4\pi \times 10^{-7} \text{ T·m/A})(8.0 \text{ A})}{2\pi(0.15 \text{ m})} = 1.07 \times 10^{-5} \text{ T}$.
$\vec{\mathbf{B}}_1 = (1.07 \times 10^{-5} \text{ T})(-\cos 53.1°\,\hat{\mathbf{x}} - \sin 53.1°\,\hat{\mathbf{y}}) = (-6.42 \times 10^{-6} \text{ T})\,\hat{\mathbf{x}} + (-8.56 \times 10^{-6} \text{ T})\,\hat{\mathbf{y}}$.
So the net field is $\vec{\mathbf{B}} = \vec{\mathbf{B}}_1 + \vec{\mathbf{B}}_2 = (-1.09 \times 10^{-5} \text{ T})\,\hat{\mathbf{x}} + (-8.56 \times 10^{-6} \text{ T})\,\hat{\mathbf{y}}$,
or $B = \sqrt{(1.09 \times 10^{-5} \text{ T})^2 + (8.56 \times 10^{-6} \text{ T})^2} = \boxed{1.4 \times 10^{-5} \text{ T}}$. The angle between the field and a horizontal line to the left is $\alpha = \tan^{-1}\frac{8.56 \times 10^{-6} \text{ T}}{1.09 \times 10^{-5} \text{ T}} = \boxed{38° \text{ below a horizontal line to the left}}$.
79. $B = N\frac{\mu_o I}{2r} = \frac{4(4\pi \times 10^{-7} \text{ T·m/A})(2.0 \text{ A})}{2(0.050 \text{ m})} = \boxed{1.0 \times 10^{-4} \text{ T, away from the observer}}$.

83. (a) n_1 = 200 /cm = 200 × 10^2 /m and n_2 = 180 /cm = 180 × 10^2 /m.
The fields by the two coils are opposite. So the net field is
$B = B_2 - B_1 = \mu_o n_2 I_2 - \mu_o n_1 I_1 = (4\pi \times 10^{-7}\ \text{T·m/A})[(180 \times 10^2\ \text{/m})(15\ \text{A}) - (200 \times 10^2\ \text{/m})(10\ \text{A})] =$
$\boxed{8.8 \times 10^{-2}\ \text{T}}$.

(b) The direction of the magnetic field at the center is $\boxed{\text{to the right}}$.

87. (b).

88. (d).

89. The direction of the magnetic field is $\boxed{\text{away from you}}$, according to the right-hand source rule (electron has negative charge).

90. It is $\boxed{\text{to increase the magnetic permeability and magnetic field}}$, because the magnetic field is proportional to the magnetic permeability of the material.

91. You can destroy or reduce the magnetic field of a permanent magnet $\boxed{\text{by hitting or heating it}}$.

$\boxed{92}$. (a) $B = \mu nI = K_m \mu_o nI = (2000)(4\pi \times 10^{-7}\ \text{T·m/A})(100 \times 10^2\ \text{/m})(0.040\ \text{A}) = \boxed{1.0\ \text{T}}$.

(b) $B_o = \mu_o nI$, ☞ $\dfrac{B}{B_o} = K_m = 2.0 \times 10^3$. So $\boxed{B = (2.0 \times 10^3)B_o}$.