1. (a) clockwise. The direction of $\vec{B}$ in the loop is downward and diminishing. Induced current must flow in the sense to replace the flux.
2. (c) upward. An electron is negatively charged, so the force is opposite to the right-hand-rule result.
3. (a) $0.97. \frac{r_1}{r_2} = \frac{m_1}{m_2}$.
4. (d) 7.7 cm from the 5A current. The fields created by each wire oppose each other in the region between the wires, since the currents are parallel. There must be a cancellation, and it must occur closer to the smaller current. You can verify the result using the formula for the magnetic field produced by a long straight wire.
5. (d)
7. (b) Input power equals output power and $P=IV$.
8. (a) Kinetic Energy: $K = 300 \text{ keV} = (3.00 \times 10^5)(1.6 \times 10^{-19} \text{ J/eV}) = 4.8 \times 10^{-14} \text{ J}$

$$K = \frac{1}{2}mv^2$$

$$v = \sqrt{\frac{2K}{m}} = \sqrt{\frac{2(4.8 \times 10^{-14} \text{ J})}{1.67 \times 10^{-27} \text{ kg}}} = 7.6 \times 10^6 \text{ m/s}$$

(b)

$$r = \frac{mv}{qB} = \frac{(1.67 \times 10^{-27} \text{ kg})(7.6 \times 10^6 \text{ m/s})}{(1.6 \times 10^{-19} \text{ C})(0.30 \text{ T})} = 0.264 \text{ m}$$

(c)

$$T = \frac{2\pi r}{v} = \frac{2\pi(0.264 \text{ m})}{7.6 \times 10^6 \text{ m/s}} = 2.2 \times 10^{-7} \text{ s}$$

9. (a)

$$|\mathcal{E}| = |B\ell v|$$

$$= (2.4 \text{ T})(0.35 \text{ m})(0.3 \text{ m/s})$$

$$= 0.252 \text{ V}$$

(b) i.

$$I = \frac{\mathcal{E}}{R} = \frac{0.252 \text{ V}}{0.15 \text{ } \Omega} = 1.68 \text{ A}$$

ii. The falling bar is lessening the inward magnetic flux in the loop. The induced current must flow clockwise to replace it.

(c) Magnetic force points up; gravitational force (weight) is down.

(d)

$$\Sigma F_y = 0$$

$$I\ell B = mg$$

$$m = \frac{I\ell B}{g} = \frac{(1.68 \text{ A})(0.35 \text{ m})(2.4 \text{ T})}{9.8 \text{ m/s}^2} = 0.144 \text{ kg}$$

11. (a) Linear polarization of unpolarized light diminishes the intensity by a factor of 2

$$I = \frac{I_0}{2} = \frac{12 \text{ W/m}^2}{2} = 6 \text{ W/m}^2$$
(b) Law of Malus:

\[ I = I_0 \cos^2 \theta = (6 \text{ W/m}^2) \cos^2(30^\circ) = 4.5 \text{ W/m}^2 \]

(c) Malus again:

\[ I = I_0 \cos^2 \theta = (4.5 \text{ W/m}^2) \cos^2(90^\circ - 30^\circ) = 1.125 \text{ W/m}^2 \]

(d) In this case the final intensity would be zero.