P23.3 Noting unit conversions from $\vec{\mathbf{F}} = q\vec{\mathbf{v}} \times \vec{\mathbf{B}}$ and $U = qV$, the induced voltage is

$$\mathcal{E} = -N\frac{d\left(\vec{\mathbf{B}}\cdot\vec{\mathbf{A}}\right)}{dt} = -N\left(\frac{0 - B_i A\cos\theta}{\Delta t}\right) = \frac{+200\,(1.60\text{ T})\left(0.200\text{ m}^2\right)\cos 0°}{20.0\times10^{-3}\text{ s}}\left(\frac{1\text{ N}\cdot\text{s}}{1\text{ T}\cdot\text{C}\cdot\text{m}}\right)\left(\frac{1\text{ V}\cdot\text{C}}{\text{N}\cdot\text{m}}\right) = 3\,200\text{ V}$$

$$I = \frac{\mathcal{E}}{R} = \frac{3\,200\text{ V}}{20.0\ \Omega} = \boxed{160\text{ A}}$$

P23.6 $\Phi_B = (\mu_0 nI)A_{\text{solenoid}}$

$$\mathcal{E} = -N\frac{d\Phi_B}{dt} = -N\,\mu_0 n\left(\pi r_{\text{solenoid}}^2\right)\frac{dI}{dt}$$

$$\mathcal{E} = -15.0\left(4\pi\times10^{-7}\text{ T}\cdot\text{m/A}\right)\left(1.00\times10^{3}\text{ m}^{-1}\right)\pi\,(0.020\,0\text{ m})^2\,(600\text{ A/s})\cos(120t)$$

$$\boxed{\mathcal{E} = -14.2\cos(120t)\text{ mV}}$$

P23.7 $$|\mathcal{E}| = \left|\frac{\Delta\Phi_B}{\Delta t}\right| = N\left(\frac{dB}{dt}\right)A = N\,(0.010\,0 + 0.080\,0t)A$$

At $t = 5.00$ s, $|\mathcal{E}| = 30.0\,(0.410\text{ T/s})\left[\pi\,(0.040\,0\text{ m})^2\right] = \boxed{61.8\text{ mV}}$

*** P23.8** (a) Each coil has a pulse of voltage tending to produce counterclockwise current as the projectile approaches, and then a pulse of clockwise voltage as the projectile recedes.

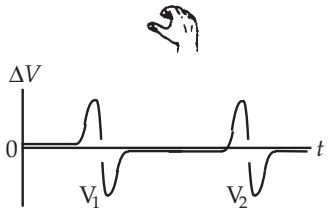

FIG. P23.8

(b) $$v = \frac{d}{t} = \frac{1.50\text{ m}}{2.40\times10^{-3}\text{ s}} = \boxed{625\text{ m/s}}$$

P23.13 (a) $\left|\vec{\mathbf{F}}_B\right| = I\left|\vec{\ell} \times \vec{\mathbf{B}}\right| = I\ell B$

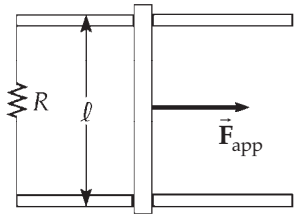

FIG. P23.13

When $I = \dfrac{\mathcal{E}}{R}$

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

we get $F_B = \dfrac{B\ell v}{R}(\ell B) = \dfrac{B^2\ell^2 v}{R} = \dfrac{(2.50)^2(1.20)^2(2.00)}{6.00} = 3.00 \text{ N}$.

The applied force is $\boxed{\text{3.00 N to the right}}$.

(b) $P = I^2R = \dfrac{B^2\ell^2 v^2}{R} = 6.00 \text{ W}$ or $P = Fv = \boxed{\text{6.00 W}}$

P23.20 (a) $\vec{\mathbf{B}}_{ext} = B_{ext}\hat{\mathbf{i}}$ and B_{ext} decreases; therefore, the induced field is $\vec{\mathbf{B}}_0 = B_0\hat{\mathbf{i}}$ (to the right) and the current in the resistor is directed $\boxed{\text{to the right}}$.

(b) $\vec{\mathbf{B}}_{ext} = B_{ext}\left(-\hat{\mathbf{i}}\right)$ increases; therefore, the induced field $\vec{\mathbf{B}}_0 = B_0\left(+\hat{\mathbf{i}}\right)$ is to the right, and the current in the resistor is directed $\boxed{\text{to the right}}$.

(c) $\vec{\mathbf{B}}_{ext} = B_{ext}\left(-\hat{\mathbf{k}}\right)$ into the paper and B_{ext} decreases; therefore, the induced field is $\vec{\mathbf{B}}_0 = B_0\left(-\hat{\mathbf{k}}\right)$ into the paper, and the current in the resistor is directed $\boxed{\text{to the right}}$.

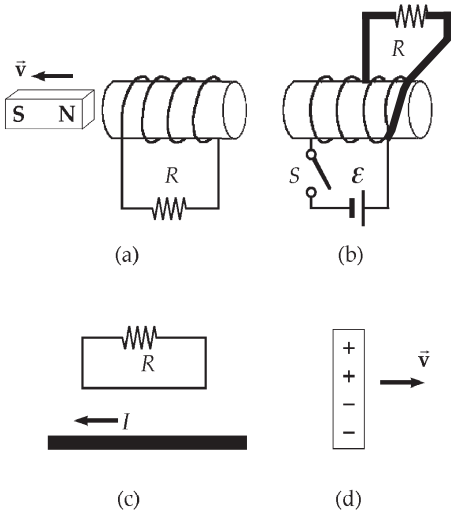

FIG. P23.20

(d) By the magnetic force law, $\vec{\mathbf{F}}_B = q\left(\vec{\mathbf{v}} \times \vec{\mathbf{B}}\right)$. Therefore, a positive charge will move to the top of the bar if $\vec{\mathbf{B}}$ is $\boxed{\text{into the paper}}$.

P23.20 (a) $\vec{\mathbf{B}}_{ext} = B_{ext}\hat{\mathbf{i}}$ and B_{ext} decreases; therefore, the induced field is $\vec{\mathbf{B}}_0 = B_0\hat{\mathbf{i}}$ (to the right) and the current in the resistor is directed $\boxed{\text{to the right}}$.

(b) $\vec{\mathbf{B}}_{ext} = B_{ext}\left(-\hat{\mathbf{i}}\right)$ increases; therefore, the induced field $\vec{\mathbf{B}}_0 = B_0\left(+\hat{\mathbf{i}}\right)$ is to the right, and the current in the resistor is directed $\boxed{\text{to the right}}$.

(c) $\vec{\mathbf{B}}_{ext} = B_{ext}\left(-\hat{\mathbf{k}}\right)$ into the paper and B_{ext} decreases; therefore, the induced field is $\vec{\mathbf{B}}_0 = B_0\left(-\hat{\mathbf{k}}\right)$ into the paper, and the current in the resistor is directed $\boxed{\text{to the right}}$.

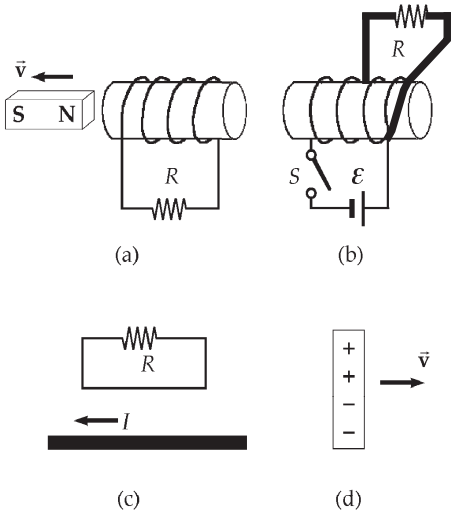

FIG. P23.20

(d) By the magnetic force law, $\vec{\mathbf{F}}_B = q\left(\vec{\mathbf{v}} \times \vec{\mathbf{B}}\right)$. Therefore, a positive charge will move to the top of the bar if $\vec{\mathbf{B}}$ is $\boxed{\text{into the paper}}$.