P31.10 $\Phi_B = (\mu_0 nI)A_{\text{solenoid}}$

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

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

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

P31.12 $|\varepsilon| = \left|\frac{\Delta\Phi_B}{\Delta t}\right| = N\left(\frac{dB}{dt}\right)A = N(0.010\,0 + 0.080\,0t)A$

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

P31.22 $F_B = I\ell B$ and $\varepsilon = B\ell v$

$I = \frac{\varepsilon}{R} = \frac{B\ell v}{R}$ so $B = \frac{IR}{\ell v}$

(a) $F_B = \frac{I^2\ell R}{\ell v}$ and $I = \sqrt{\frac{F_B v}{R}} = \boxed{0.500\ \text{A}}$

(b) $I^2R = \boxed{2.00\ \text{W}}$

(c) For constant force, $\mathcal{P} = \mathbf{F}\cdot\mathbf{v} = (1.00\ \text{N})(2.00\ \text{m/s}) = \boxed{2.00\ \text{W}}$.

P31.28 (a) $\mathbf{B}_{ext} = B_{ext}\hat{\mathbf{i}}$ and B_{ext} decreases; therefore, the induced field is $\mathbf{B}_0 = B_0\hat{\mathbf{i}}$ (to the right) and the current in the resistor is directed $\boxed{\text{to the right}}$.

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

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

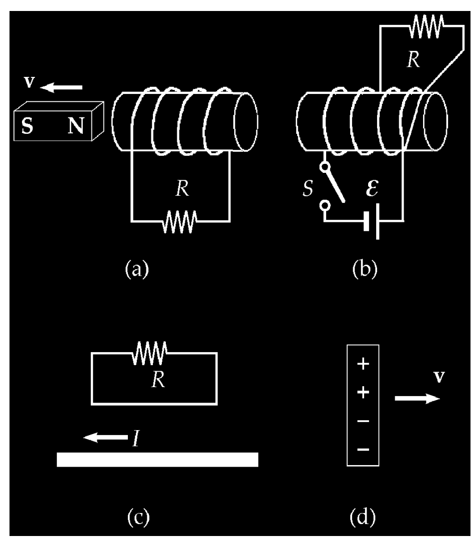

FIG. P31.28

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

P31.59 (a) At time t, the flux through the loop is

$$\Phi_B = BA\cos\theta = (a+bt)(\pi r^2)\cos 0° = \pi(a+bt)r^2.$$

At $t = 0$, $\Phi_B = \boxed{\pi a r^2}$.

(b) $\varepsilon = -\frac{d\Phi_B}{dt} = -\pi r^2 \frac{d(a+bt)}{dt} = \boxed{-\pi b r^2}$

(c) $I = \frac{\varepsilon}{R} = \boxed{-\frac{\pi b r^2}{R}}$

(d) $\mathsf{P} = \varepsilon I = \left(-\frac{\pi b r^2}{R}\right)\left(-\pi b r^2\right) = \boxed{\frac{\pi^2 b^2 r^4}{R}}$

P32.8 $|\varepsilon| = L\frac{dI}{dt} = \left(90.0\times 10^{-3}\right)\frac{d}{dt}\left(t^2 - 6t\right)$ V

(a) At $t = 1.00$ s, $\varepsilon = \boxed{360 \text{ mV}}$

(b) At $t = 4.00$ s, $\varepsilon = \boxed{180 \text{ mV}}$

(c) $\varepsilon = \left(90.0\times 10^{-3}\right)(2t - 6) = 0$
when $\boxed{t = 3.00 \text{ s}}$.

P32.18 $I = \frac{\varepsilon}{R}\left(1 - e^{-t/\tau}\right) = \frac{120}{9.00}\left(1 - e^{-1.80/7.00}\right) = 3.02$ A

$\Delta V_R = IR = (3.02)(9.00) = 27.2$ V

$\Delta V_L = \varepsilon - \Delta V_R = 120 - 27.2 = \boxed{92.8 \text{ V}}$

P32.46 At different times, $(U_C)_{\max} = (U_L)_{\max}$ so $\left[\frac{1}{2}C(\Delta V)^2\right]_{\max} = \left(\frac{1}{2}LI^2\right)_{\max}$

$$I_{\max} = \sqrt{\frac{C}{L}}(\Delta V)_{\max} = \sqrt{\frac{1.00\times 10^{-6}\text{ F}}{10.0\times 10^{-3}\text{ H}}}(40.0 \text{ V}) = \boxed{0.400 \text{ A}}.$$

P32.32 (a) $U = \frac{1}{2}LI^2 = \frac{1}{2}L\left(\frac{\varepsilon}{2R}\right)^2 = \frac{L\varepsilon^2}{8R^2} = \frac{(0.800)(500)^2}{8(30.0)^2} = \boxed{27.8 \text{ J}}$

(b) $I = \left(\frac{\varepsilon}{R}\right)\left[1 - e^{-(R/L)t}\right]$ so $\frac{\varepsilon}{2R} = \left(\frac{\varepsilon}{R}\right)\left[1 - e^{-(R/L)t}\right] \to e^{-(R/L)t} = \frac{1}{2}$

$\frac{R}{L}t = \ln 2$ so $t = \frac{L}{R}\ln 2 = \frac{0.800}{30.0}\ln 2 = \boxed{18.5 \text{ ms}}$

P32.51 (a) $f = \frac{1}{2\pi\sqrt{LC}} = \frac{1}{2\pi\sqrt{(0.082\,0\text{ H})(17.0\times10^{-6}\text{ F})}} = \boxed{135\text{ Hz}}$

(b) $Q = Q_{\max}\cos\omega t = (180\ \mu\text{C})\cos(847\times0.001\,00) = \boxed{119\ \mu\text{C}}$

(c) $I = \frac{dQ}{dt} = -\omega Q_{\max}\sin\omega t = -(847)(180)\sin(0.847) = \boxed{-114\text{ mA}}$