8. (*a*) As the resistance is increased, the current in the outer loop will decrease. Thus the flux through
the inner loop, which is out of the page, will decrease. To oppose this decrease, the induced current in the inner loop will produce a flux out of the page, so the direction of the induced current will be $\boxed{\text{counterclockwise}}$.

(*b*) If the small loop is placed to the left, the flux through the small loop will be into the page and
will decrease. To oppose this decrease, the induced current in the inner loop will produce a flux into the page, so the direction of the induced current will be $\boxed{\text{clockwise}}$.

9. As the solenoid is pulled away from the loop, the magnetic flux to the right through the loop decreases. To oppose this decrease, the flux produced by the induced current must be to the right, so the induced current is $\boxed{\text{counterclockwise}}$ as viewed from the right end of the solenoid.

10. (*a*) The average induced emf is given by the "difference" version of Eq. 29-2b.

$$\mathcal{E} = -\frac{\Delta\Phi_B}{\Delta t} = -\frac{A\Delta B}{\Delta t} = -\frac{\pi\left(0.040\,\text{m}\right)^2\left(-0.45\,\text{T}-0.52\,\text{T}\right)}{0.18\,\text{s}} = \boxed{2.7\times10^{-2}\,\text{V}}$$

(*b*) The positive result for the induced emf means the induced field is away from the observer, so
the induced current is $\boxed{\text{clockwise}}$.

17. The charge that passes a given point is the current times the elapsed time, $Q = I\Delta t$. The current will be the emf divided by the resistance, $I = \frac{\mathcal{E}}{R}$. The resistance is given by Eq. 25-3, $R = \frac{\rho l}{A_{\text{wire}}}$, and the emf is given by the "difference" version of Eq. 29-2a. Combine these equations to find the charge during the operation.

$$\left|\mathcal{E}\right| = \frac{\Delta\Phi_B}{\Delta t} = \frac{A_{\text{loop}}\left|\Delta B\right|}{\Delta t} \;;\; R = \frac{\rho l}{A_{\text{wire}}} \;;\; I = \frac{\mathcal{E}}{R} = \frac{\dfrac{A_{\text{loop}}\left|\Delta B\right|}{\Delta t}}{\dfrac{\rho l}{A_{\text{wire}}}} = \frac{A_{\text{loop}}A_{\text{wire}}\left|\Delta B\right|}{\rho l\,\Delta t}$$

$$Q = I\Delta t = \frac{A_{\text{loop}}A_{\text{wire}}\left|\Delta B\right|}{\rho l} = \frac{\pi r_{\text{loop}}^2\pi r_{\text{wire}}^2\left|\Delta B\right|}{\rho\left(2\pi\right)r_{\text{loop}}} = \frac{r_{\text{loop}}\pi r_{\text{wire}}^2\left|\Delta B\right|}{2\rho}$$

$$= \frac{\left(0.091\,\text{m}\right)\pi\left(1.175\times10^{-3}\,\text{m}\right)^2\left(0.750\,\text{T}\right)}{2\left(1.68\times10^{-8}\,\Omega\cdot\text{m}\right)} = \boxed{8.81\,\text{C}}$$

29. (*a*) Because the velocity is perpendicular to the magnetic field and the rod, we find the induced emf
from Eq. 29-3.

$$\mathcal{E} = B\ell v = (0.35\,\mathrm{T})(0.250\,\mathrm{m})(1.3\,\mathrm{m/s}) = 0.1138\,\mathrm{V} \approx \boxed{0.11\,\mathrm{V}}$$

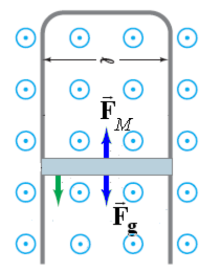
(*b*) Find the induced current from Ohm's law, using the **total** resistance.

$$I = \frac{\mathcal{E}}{R} = \frac{0.1138\,\mathrm{V}}{25.0\,\Omega + 2.5\,\Omega} = 4.138\times10^{-3}\,\mathrm{A} \approx \boxed{4.1\,\mathrm{mA}}$$

(*c*) The induced current in the rod will be down. Because this current is in an upward magnetic field, there will be a magnetic force to the left. To keep the rod moving, there must be an equal external force to the right, given by Eq. 27-1.

$$F = I\ell B = (4.138\times10^{-3}\,\mathrm{A})(0.250\,\mathrm{m})(0.35\,\mathrm{T}) = 3.621\times10^{-4}\,\mathrm{N} \approx \boxed{0.36\,\mathrm{mN}}$$

$\boxed{31.}$ The rod will descend at its terminal velocity when the magnitudes of the magnetic force (found in Example 29-8) and the gravitational force are equal. We set these two forces equal and solve for the terminal velocity.



$$\frac{B^2\ell^2 v_t}{R} = mg \quad \rightarrow$$

$$v_t = \frac{mgR}{B^2\ell^2} = \frac{(3.6\times10^{-3}\ \mathrm{kg})(9.80\ \mathrm{m/s^2})(0.0013\ \Omega)}{(0.060\ \mathrm{T})^2(0.18\ \mathrm{m})^2} = \boxed{0.39\ \mathrm{m/s}}$$