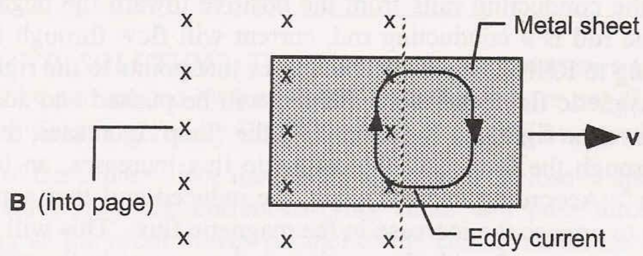
3. ***REASONING AND SOLUTION*** A metal sheet moves to the right at a velocity **v** in a magnetic field **B** that is directed into the sheet. At the instant shown in the figure, the magnetic field only extends over half of the sheet. An induced emf leads to the eddy current shown.



We can apply RHR-1 (modified for currents) to the portion of the eddy current that exists in the portion of the sheet that is in the magnetic field. With the thumb of the right hand pointing toward the top of the page (direction of I), and the fingers of the right hand pointing into the page (direction of **B**), the palm of the right hand faces the left (direction of **F**). Thus, there is a retarding magnetic force **F** that acts on the sheet due to the interaction of the eddy current with the magnetic field. Hence, the eddy current causes the sheet to slow down.

5. SSM WWW ***REASONING AND SOLUTION*** For the three rods in the drawing, we have the following:

***Rod A*:** The motional emf is zero, because the velocity of the rod is parallel to the direction of the magnetic field, and the charges do not experience a magnetic force.

***Rod B*:** The motional emf is, according to Equation 22.1,

$$\text{Emf} = vBL = (2.7\text{ m/s})(0.45\text{ T})(1.3\text{ m}) = \boxed{1.6\text{ V}}$$

The positive end of Rod B is end 2.

***Rod C*:** The motional emf is zero, because the magnetic force F on each charge is directed perpendicular to the length of the rod. For the ends of the rod to become charged, the magnetic force must be directed parallel to the length of the rod.

14. ***REASONING*** The magnetic flux is defined in Equation 22.2 as $\Phi = BA\cos\phi$, where B is the magnitude of the magnetic field, A is the area of the loop, and ϕ is the angle between the normal to the surface of the loop and the magnetic field. The change $\Delta\Phi$ in flux is the final flux Φ minus the initial flux Φ_0; $\Delta\Phi = \Phi - \Phi_0$.

SOLUTION Let L_1 and L_2 be the lengths of the left and bottom edges of the loop. The initial area is the area of this rectangular loop plus the area of the semicircle: $A_0 = L_1 \times L_2 + \frac{1}{2}\pi r^2$. The initial magnetic flux is $\Phi_0 = B\left(L_1 \times L_2 + \frac{1}{2}\pi r^2\right)\cos 0°$. The final area is the area of the rectangular loop minus the area of the semicircle: $A_0 = L_1 \times L_2 - \frac{1}{2}\pi r^2$. The final magnetic flux is $\Phi = B\left(L_1 \times L_2 - \frac{1}{2}\pi r^2\right)\cos 0°$. The change in flux is

$$\Delta\Phi = \Phi - \Phi_0 = B\left(L_1 \times L_2 - \tfrac{1}{2}\pi r^2\right)\cos 0° - B\left(L_1 \times L_2 + \tfrac{1}{2}\pi r^2\right)\cos 0°$$

$$= -B\pi r^2 \cos 0° = -(0.75\ \text{T})\pi(0.20\ \text{m})^2 \cos 0° = \boxed{-9.4 \times 10^{-2}\ \text{Wb}}$$

Note that the change in flux does not depend on L_1 or L_2.

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26. ***REASONING AND SOLUTION*** In time, Δt, the flux change through the loop ABC is $\Delta\Phi = B\Delta A$, where

$$\Delta A = [\omega\Delta t/(2\pi)](\pi R^2)$$

Faraday's law gives the magnitude of the induced emf to be

$$\text{Emf} = \Delta\Phi/\Delta t = B\omega R^2/2 = (3.8 \times 10^{-3}\ \text{T})(15\ \text{rad/s})(0.50\ \text{m})^2/2 = 7.1 \times 10^{-3}\ \text{V}$$

The current through the resistor is

$$I = (\text{Emf})/R = (7.1 \times 10^{-3}\ \text{V})/(3.0\ \Omega) = \boxed{2.4 \times 10^{-3}\ \text{A}}$$

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32. ***REASONING AND SOLUTION*** If the applied magnetic field is decreasing in time, then the flux through the circuit is decreasing. Lenz's law requires that an induced magnetic field be produced which attempts to counteract this decrease; hence its direction is out of the paper. The sense of the induced current in the circuit must be CCW. Therefore, the lower plate of the capacitor is positive while the upper plate is negative. The electric field between the plates of the capacitor points from positive to negative so the electric field points $\boxed{\text{upward}}$.