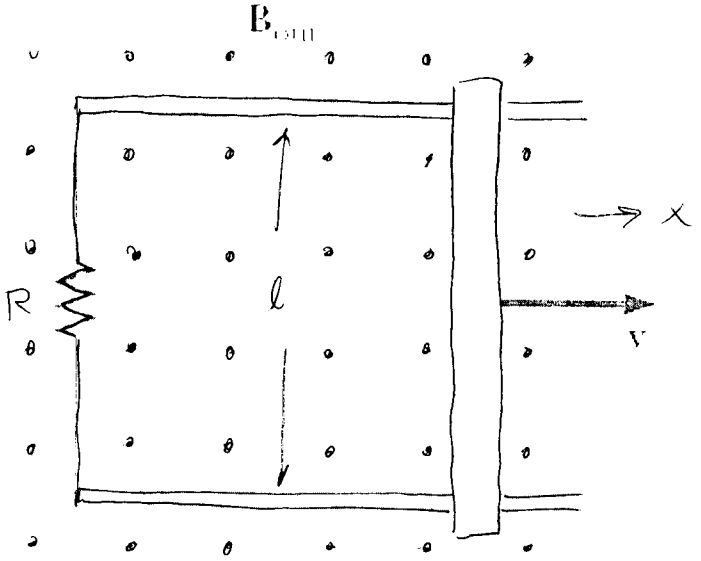
NAME:

Solution

Quiz #7:
Phys142



The conducting bar moves to the right at constant velocity "v" on two frictionless conducting rails which are parallel and separated by a distance "L". The conducting rails are connected to a resistor "R" to form a complete circuit as depicted in the diagram. A uniform magnetic field "B" out of the page exists everywhere.

(a) [7 pts] What is the magnitude of the current through the resistor in terms of v, B, L, and R?

Faraday's law: $\mathcal{E} = -\frac{d\Phi}{dt}$; $\Phi = \vec{B}\cdot\vec{A} = BA\cos 0^\circ$;

$$\frac{d\Phi}{dt} = \frac{d}{dt}(BA) = \frac{d}{dt}(B\times\ell) = B\ell\frac{dx}{dt} = B\ell v$$

$$\Rightarrow \mathcal{E} = -B\ell v \; ; \; \mathcal{E} = IR \; ; \Rightarrow I = \frac{\mathcal{E}}{R} = \frac{-B\ell v}{R}$$

(b) [3 pts] What direction is the current through resistor R? Explain your answer.

Φ is growing in the out-of-the-page direction

$\Rightarrow \mathcal{E}$ is into the page $\Rightarrow$ current is clockwise by RHR

$\Rightarrow$ current through R is upward