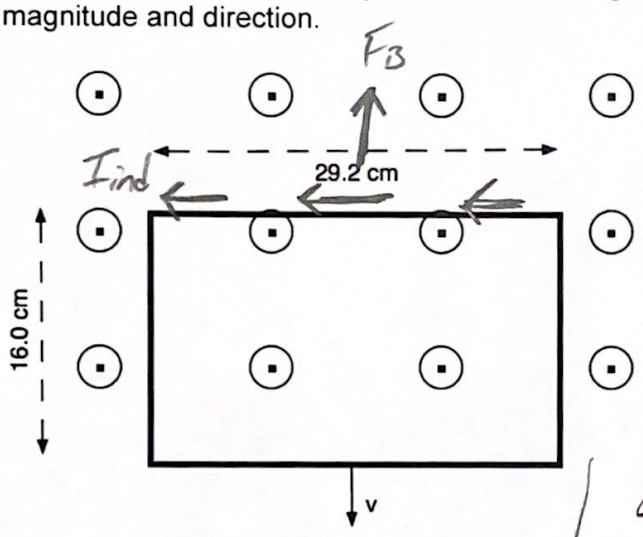
Quiz 22.1C

The loop shown below has 435 turns and a resistance of 0.282 Ohms. It is moving toward the bottom of the page with a constant speed of 24.0 cm/s. The loop is currently emerging from a region filled with a uniform 3.11 Tesla magnetic field directed out of the page. At the instant when 25.0% of the loop has emerged from the magnetic field while 75.0% of the loop is still within the field,

(a) what is the magnitude and direction of the induced current in the loop?
(b) what is the magnitude and direction of the magnetic force acting on the loop?

As always, be sure to show your work and/or logic for your determination of both magnitude and direction.



a) $\mathcal{E}_{ind} = \frac{NB\Delta A \cos\theta}{\Delta t}$

$\Delta A = (0.16)(0.292)$
$= .04672\ m^2$

$\Delta t = \frac{16\ cm}{24\ cm/s} = 0.67\ s$

$\mathcal{E}_{ind} = \frac{(435)(3.11)(.04672)(1)}{.667}$

$= 94.81$ Volts

$I_{ind} = \frac{\mathcal{E}_{ind}}{R} = \boxed{336\ A}$

$\Phi_B = \odot$, decreasing

$\Rightarrow B_{ind} = \odot$

$\Rightarrow \boxed{I_{ind} = CCW}$

b)

On top wire, RHR #1 says

F_B points ↑

$\vec{F}_B = \ell I B \sin 90$

$= (.292)(336)(3.11)$

$= \boxed{305\ N, \uparrow}$

No force on bottom wire.

Left + right wire forces cancel out.