First thing to note is that, by symmetry, the forces on the 18 cm part of the loop are equal and opposite for opposite sides, and hence cancel. Force on 12 cm side near wire is given by

\[ F_1 = B_1 I^\prime L \]

\[ B = \frac{\mu_0 I_0}{2\pi R} \]

\[ = 2.0 \times 10^{-7} \times \frac{40}{0.06} \text{ T} = 1.3 \times 10^{-4} \text{ T} \]

\[ F_1 = (1.3 \times 10^{-4} \times 60 \times 0.12) N = 9.6 \times 10^{-4} N \]

Force on other side is

\[ F_2 = B_2 I^\prime L, B_2 = 2.0 \times 10^{-7} \times \frac{40}{0.24} = 3.33 \times 10^{-5} \text{ T} \]

\[ F_2 = 3.33 \times 10^{-5} \times 60 \times 0.12 \text{ N} = 2.4 \times 10^{-4} \text{ N} \]

Since forces are in opposite directions, net force is

\[ 9.6 \times 10^{-4} - 2.4 \times 10^{-4} \text{ N} = 7.2 \times 10^{-4} \text{ N} \text{ towards long wire} \]

\[ I = \frac{ma}{BL} = \frac{(1.2 \times 10^5 \text{ m/s}^2)}{(0.2 \text{ T} \times 0.1 \text{ m})} \]

\[ I = 1 \times 10^6 \text{ A} \]
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\[ \vec{I} = \mu \times \vec{B} = \]

\[ \vec{I} = \frac{N I A B \sin \theta}{N} \]

\[ I = (120)(1 \times 10^{-3})(0.01)(0.02)(0.01) = 2.4 \times 10^{-2} \text{ N.m} \]
\[ \varepsilon = vB\ell; \text{ therefore, } v = \frac{\varepsilon}{B\ell} \quad B = 0.70 \text{ gauss} = 0.70 \times 10^{-4} \text{ Tm} \]
\[ v = \frac{7.0 \times 10^{-5} \text{ V}}{(0.70 \times 10^{-4} \times 200) \text{ Tm}} = 0.5 \text{ ms}^{-1} \]

By Example 5 in the text, \( \varepsilon = Be^2v\pi \Rightarrow v = \frac{\varepsilon}{Be^2\pi} \)
\[ = \frac{6.0 \nu}{6.0 \times 10^{-2} T \times (1.2)^2 \pi} \text{ s}^{-1} = 22 \text{ s}^{-1} \]

\[ \varepsilon = BA\omega \sin \omega t \quad (12); \text{ therefore, amplitude of the voltage is } BA\omega \]
\[ BA\omega = \text{Ampl} \Rightarrow \omega = \frac{\text{Ampl}}{BA} \Rightarrow v = \frac{\omega \text{Ampl}}{2\pi \ BA} \]
\[ = \frac{12.0 \nu}{2\pi \left(2.0 \times 10^{-3} \text{ T} \right) \left(0.02 \text{ m}^2\right)} = \frac{4.8 \times 10^3 \text{ s}^{-1}}{120} = 40 \]
(a) $B = \mu_0 n I \frac{dB}{dt} = \mu_0 n \frac{dl}{dx} = (4\pi \times 10^{-7})(300)50 = 1.9 \times 10^{-2} \ T/s$

(b) In every turn of the coil, $\varepsilon = -\frac{d\Phi}{dt} = -\frac{d}{dt} (BA)$; therefore, for every 120 turns, $\varepsilon = -120 \frac{d}{dt} (BA) = -120 (A) \frac{dB}{dl} = -120 [\pi(0.03)^2] \frac{dB}{dl} = -6.45 \times 10^{-3} \ V$

(c) $\varepsilon$ is unchanged. Changing flux only depends on radius of inner coil in this problem, for outer coil radius larger than that of inner coil.

Force on the rod $= \int \text{de} \cdot \hat{B} = B_0 I e$, since $\hat{B}$ is perpendicular to $e$, and constant, and $I = \frac{e}{R}$, and by Faraday's law $\varepsilon = -\frac{d\Phi}{dt} = -(\text{Area}) \frac{dB}{dl} = -x_0 e \frac{dB}{dl}$; therefore,

$I = \frac{e}{R} = -\frac{x_0 e \frac{dB}{dl}}{R}$

Therefore, acceleration $a = F/m$

$a = \frac{B_0 I e}{m} = \frac{B_0 e}{m} \left( -x_0 e \frac{dB}{dl} \frac{1}{R} \right)$

$= -\frac{B_0 e^2 x_0}{mR} \frac{dB}{dl}$

(Minus sign indicates that force is in direction shown.)
In breaking the circuit, you cause an abrupt change in the magnetic fields in the circuit. This will cause a large, momentary EMF that opposes the change. This EMF might be large enough to cause a spark.

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(a) At distance $r$, $B = \frac{\mu_0 I}{2\pi r}$

$$\frac{dB}{dt} = \frac{\mu_0}{2\pi r} \left( \frac{dI}{dt} \right)$$

(b) Total flux thru loop under assumption acc $r$

$$\Phi_B = Bal$$

$$\mathcal{E} = -\frac{d\Phi_B}{dt} = -a l \frac{dB}{dt} = -a l \frac{\mu_0}{2\pi r} \left( \frac{dI}{dt} \right)$$