(a) It is clear that the upward flux in region 1 cancels the downward flux in region 2. The net flux in the coil flux is region 3.

Choose a small strip \( dA \) width \( dr \) and length \( b \) on that strip \( B = \mu_0 I / 2\pi r \).

Flux through strip \( dB = B \ dA = \mu_0 I / 2\pi r \\

Total flux: \( \int_B = \frac{\mu_0 I b}{2\pi} \int_{b-a}^{a} \frac{dr}{r} = \frac{\mu_0 I b}{2\pi} \ln \left( \frac{a}{b-a} \right) \)

(b) \( \frac{dI}{dt} = \frac{\mu_0 b}{2\pi} \left( \ln \frac{a}{b-a} \right) \frac{dt}{dt} \quad \frac{dt}{dt} = 9t + 10 \\

\quad = (2 \times 10^{-7})(0.16) \ln \left( \frac{0.22}{0.04} \right) (9 \times 3 - 10) \\

\quad = 5.98 \times 10^{-7} V \\

(c) \( I \) is increasing so (downward) flux is increasing. Induced current must produce upward flux, so induced current is counterclockwise.

Consider induced emf in vertical sides.

\( U = \mu_0 \frac{B}{2} \quad E_{ind} = BLV \) in each side

Total \( E_{ind} = 2BLV \times N = 2BLW \frac{P}{2} \times N = BLW \times DN \)

\( = (0.5 \text{T})(0.5 \text{m})(0.30 \text{m})(100 \text{ turn})(1050 \text{ rev} \times \frac{1 \text{ turn}}{100 \text{ rev}})(\frac{1 \text{ rev}}{1 \text{ rev}}) \\

\quad = 5500 \text{ V} \).
(3) (a) Just after the switch is closed, no current flows through the inductor, so \( I_2 = 0 \).

\[ I = I_1 + I_2 = 2.0 \, \text{A} \]

\[ V_L + V_{R_2} = 0 \quad \text{but} \quad V_{R_2} = 0 \quad (\text{because} \quad I_2 = 0) \]

\[ V_L = 10 \, \text{V} \quad \text{and} \quad \frac{dI_2}{dt} = \frac{V_L}{L} = \frac{10 \, \text{V}}{5 \, \text{H}} = 2.0 \, \text{A/s} \]

(b) \[ I_1 = \frac{V}{R_1} = 2.0 \, \text{A} \]

\[ \frac{dI_2}{dt} = 0 \quad \Rightarrow \quad V_L = 0 \quad \Rightarrow \quad V_{R_2} = 10 \, \text{V} \]

\[ I_2 = \frac{V_{R_2}}{R_2} = \frac{10 \, \text{V}}{10 \, \text{R}} = 1.0 \, \text{A} \]

\[ I = I_1 + I_2 = 3.0 \, \text{A} \]

\[ \frac{dI_2}{dt} = 0 \quad \text{and} \quad V_L = 0. \]