Problem 1.

$\mathcal{E} = \frac{\mu_0 I b}{2\pi} \frac{2v}{a + r_0 + vt}$ clockwise

If the loop is stationary, $\mathcal{E} = 0$. If the loop is thin it is the same as for a single rod with length b. If the loop is far away (at large t), $\mathcal{E} \to 0$.

Problem 2.

$Q(t) = Q_+ e^{\omega_+ t} + Q_- e^{\omega_- t}$ for $\omega_\pm = \frac{-R \pm \sqrt{R^2 - 4L/C}}{2L}$, $Q_- = \frac{-\omega_+ Q_0}{\omega_- - \omega_+}$, and $Q_+ = Q_0 + \frac{\omega_+ Q_0}{\omega_- - \omega_+}$.

Problem 3.

Q decays exponentially from t_1 to t_2 with time constant $(R_1 + R_3)C$ and exponentially from t_2 onward with time constant $(R_3 + 1/((1/R_1) + (1/R_2)))C$. $\mathcal{E}_{R_3} = IR_3 = R_3\, dQ/dt$ is a scaled version of Q (flipped from the $-$ in the exponential and scaled by R_3).

Problem 4.

$Z_{\text{circuit}} = R + \frac{1}{\frac{1}{i\omega L} + \frac{1}{i\omega 2L}} = R + i\omega \frac{2}{3} L$

The current through the resistor is $I(t) = I_0 \cos(\omega t)$.

The current through the inductor L as a function of time is $2I_0 \cos(\omega t)/3$.

The phase difference is always zero.