103. (a) As the switch closes at $t = 0$, the current being zero in the inductor serves as an initial condition for the building-up of current in the circuit. Thus, at $t = 0$ the current through the battery is also zero.

(b) With no current anywhere in the circuit at $t = 0$, the loop rule requires the emf of the inductor $\mathcal{E}_L$ to cancel that of the battery ($\mathcal{E} = 40$ V). Thus, the absolute value of Eq. 31-37 yields

$$\frac{di}{dt} = \frac{|\mathcal{E}_L|}{L} = \frac{40}{0.050} = 800 \text{ A/s} .$$

(c) This circuit becomes equivalent to that analyzed in §31-9 when we replace the parallel set of 20000 Ω resistors with $R = 10000\ \Omega$. Now, with $\tau_L = L/R = 5 \times 10^{-6}$ s, we have $t/\tau_L = 3/5$, and we apply Eq. 31-43:

$$i = \frac{\mathcal{E}}{R}\left(1 - e^{-3/5}\right) \approx 1.8 \times 10^{-3} \text{ A} .$$

(d) The rate of change of the current is figured from the loop rule (and Eq. 31-37):

$$\mathcal{E} - i\,R - |\mathcal{E}_L| = 0 .$$

Using the values from part (c), we obtain $|\mathcal{E}_L| \approx 22$ V. Then,

$$\frac{di}{dt} = \frac{|\mathcal{E}_L|}{L} = \frac{22}{0.050} \approx 440 \text{ A/s} .$$

(e) and (f) As $t \to \infty$, the circuit reaches a steady state condition, so that $di/dt = 0$ and $\mathcal{E}_L = 0$. The loop rule then leads to

$$\mathcal{E} - i\,R - |\mathcal{E}_L| = 0 \implies i = \frac{40}{10000} = 4.0 \times 10^{-3} \text{ A} .$$