33.65. Model: Assume we can ignore the edges when the potential difference changes abruptly.

Visualize: The existence of a potential difference indicates there is a changing current. If the potential difference is zero, the current is constant.

Solve: Break the potential difference into time intervals and determine the corresponding rate of change of the current for each time interval. Knowing the starting current for an interval, we can determine the current at the end of the interval by finding the change. For the intervals 10 to 20 ms and 30 to 40 ms, the potential difference is zero, so the current remains the same as at the start of the interval. For the interval 0 to 10 ms, the potential difference is –1 V. The rate of change of the current is calculated as follows:

$$\Delta V_L = -L\frac{dI}{dt} = -L\frac{\Delta I}{\Delta t} \Rightarrow \Delta I_{0\to 10} = \frac{-\Delta V_L \Delta t}{L} = -\frac{(-1\text{ V})(10\text{ s} - 0\text{ s})\times 10^{-3}\text{ s}}{50\times 10^{-3}\text{ H}} = 0.20\text{ A}$$

To find the current at 10 ms we need the current at the start of the interval. We have

$$I(10\text{ ms}) = I(0\text{ ms}) + \Delta I_{0\to 10} = 0.20\text{ A} + (0.20\text{ A}) = 0.40\text{ A}$$

A constant potential difference implies that the current is changing linearly. So, the current starts at 0.2 A and goes linearly to 0.40 A over the first 10 ms. For the interval 10 to 20 ms, the current remains at 0.40 A. For the interval 20 to 30 ms, the current goes linearly from 0.40 to 0 A. For the interval 30 to 40 ms, the current remains at 0 A.