Solutions

Each answer shows the steps, then the **result**.

2.1

- LR time constant:
$$\tau = \frac{L}{R} = \frac{0.40\ \text{H}}{20\ \Omega}$$
- $\tau = \mathbf{0.020}$ s

2.2

- zero (the inductor opposes the sudden change)

2.3

- in the steady state the inductor has no back emf, so only R limits the current:
$$I = \frac{\varepsilon}{R} = \frac{12\ \text{V}}{6.0\ \Omega} = \mathbf{2.0}\ \text{A}$$

3.1 B

- L/R.

3.2 B

- a break (no current).

3.3

(a)

- LR time constant:
$$\tau = \frac{L}{R} = \frac{0.25\ \text{H}}{5.0\ \Omega}$$
- $\tau = \mathbf{0.050}$ s

(b)

- once the current is steady, $dI/dt = 0$ and the inductor drops no voltage:
$$I = \frac{\varepsilon}{R} = \frac{10\ \text{V}}{5.0\ \Omega}$$
- $I = \mathbf{2.0}$ A

3.4

(a)

- $\varepsilon - IR - L\dfrac{dI}{dt} = 0$

(b)

- at $t = 0$, $I = 0$, so $\dfrac{dI}{dt} = \dfrac{\varepsilon}{L} = \dfrac{10}{0.25} = \mathbf{40}\ \text{A s}^{-1}$

(c)

- $(40\ \text{A s}^{-1})(0.050\ \text{s}) = 2.0$ A, which is the final current ε/R

(d)

- $I = \dfrac{\varepsilon}{R}(1 - e^{-1}) = (2.0)(0.632) = \mathbf{1.3}$ A

(e)

- $U = \frac{1}{2}LI^2 = \frac{1}{2}(0.25)(2.0)^2 = \mathbf{0.50}$ J

3.5 A

- the current is zero at first, so there is no potential difference across the resistor; the inductor's emf opposes the change and cancels the battery's

3.6

- $I = (3.0)e^{-1} = \mathbf{1.1}$ A (about 37% of the starting current)