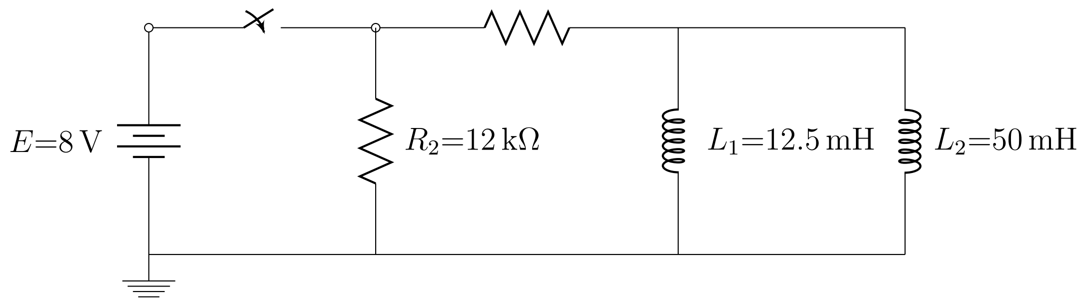


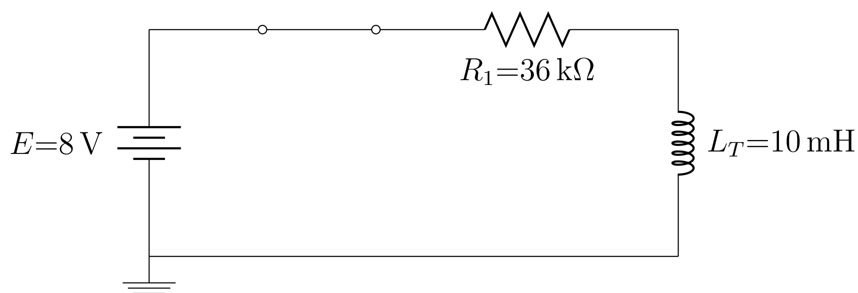
Figure 1: Use this circuit for questions 1 through 3

1. **Calculate the total inductance L_T of the circuit in Fig. 1**

$$L_T = \frac{1}{\frac{1}{L_1} + \frac{1}{L_2}} = \frac{L_1 \cdot L_2}{L_1 + L_2} = \frac{12.5\,\mathrm{mH} \cdot 50\,\mathrm{mH}}{12.5\,\mathrm{mH} + 50\,\mathrm{mH}} = \boxed{10\,\mathrm{mH}}$$

2. **Storage Phase (switch is closed)**

   (a) **Redraw the circuit in Fig. 1 for the storage phase**



   (b) **Determine the time constant τ of the circuit in Fig. 1 during the storage phase**

$$\tau = \frac{L_T}{R_1} = \frac{10\,\mathrm{mH}}{36\,\mathrm{k\Omega}} = \boxed{0.278\,\mu\,\mathrm{sec}}$$

   (c) **The switch closes at $t = 0$. Write a mathematical expression for the current i_L through the total inductor L_T**

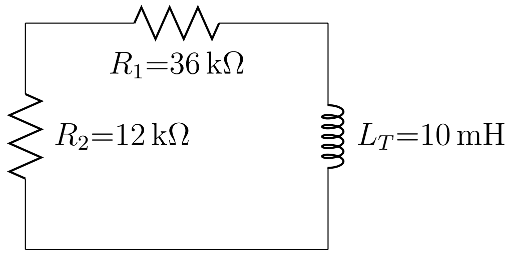
$$i_L = \frac{E}{R_1}(1 - e^{-t/\tau}) = \frac{8\,\mathrm{V}}{36\,\mathrm{k\Omega}}(1 - e^{-t/0.278\,\mu\,\mathrm{sec}}) = \boxed{0.222\,\mathrm{mA}(1 - e^{-t/0.278\,\mu\,\mathrm{sec}})}$$

   (d) **The switch closes at $t = 0$. Write a mathematical expression for the voltage v_L across the total inductor L_T**

$$v_L = E(1 - e^{-t/\tau}) = \boxed{8\,\mathrm{V}(e^{-t/0.278\,\mu\,\mathrm{sec}})}$$

3. **Decay Phase (switch is opened after reaching steady state)**

   (a) **Redraw the circuit in Fig. 1 for the decay phase**



   (b) **Determine the time constant τ of the circuit in Fig. 1 during the decay phase**

$$\tau = \frac{L_T}{R_1 + R_2} = \frac{10\,\mathrm{mH}}{36\,\mathrm{k\Omega} + 12\,\mathrm{k\Omega}} = \boxed{0.208\,\mu\,\mathrm{sec}}$$

   (c) **The switch is opened after reaching steady state, write a mathematical expression for the current i_L through the total inductor L_T.**

$$i_L = i_{Lmax}(e^{-t/0.208\,\mu\,\mathrm{sec}}) = \boxed{0.222\,\mathrm{mA}(e^{-t/0.208\,\mu\,\mathrm{sec}})}$$

   (d) **The switch is opened after reaching steady state, write a mathematical expression for the voltage drop v_L across the total inductance L_T.**

$$v_L = -V_i(e^{-t/0.208\,\mu\,\mathrm{sec}})$$

where

$$V_i = (1 + \frac{R_2}{R_1})E = -(1 + \frac{12\,\mathrm{k\Omega}}{36\,\mathrm{k\Omega}})8 = 10.67\,\mathrm{V}$$

therefore

$$v_L = -v_i(e^{-t/0.208\,\mu\,\mathrm{sec}}) = \boxed{-10.67(e^{-t/0.208\,\mu\,\mathrm{sec}})}$$

or use KVL.

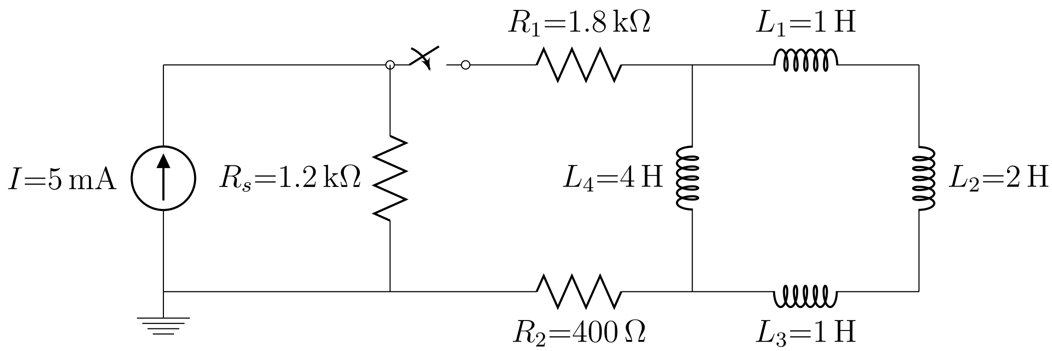


Figure 2: Use this circuit for questions 4 through 8

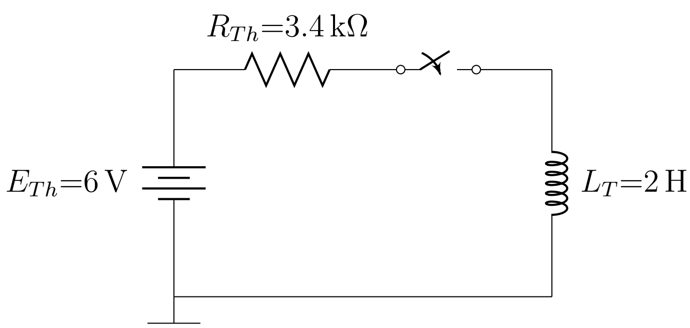
4. **Determine the total inductance of the circuit L_T in Fig. 2**

$$L_1^{'} = L_1 + L_2 + L_3 = 1\,\text{H} + 2\,\text{H} + 1\,\text{H} = 4\,\text{H}$$
$$L_T = L_4 || L_1^{'} = \frac{L_4 \cdot L_1^{'}}{L_4 + L_1^{'}} = \frac{4\,\text{H} \cdot 4\,\text{H}}{4\,\text{H} + 4\,\text{H}} = \boxed{2\,\text{H}}$$

5. **Determine the Thevenin voltage E_{Th} and Thevenin resistance R_{Th} of the circuit in Fig. 2**

$$E_{Th} = I \cdot R_s = 5\,\text{mA} \cdot 1.2\,\text{k}\Omega = \boxed{6\,\text{V}}$$
$$R_{Th} = R_1 + R_s + R_2 = 1.8\,\text{k}\Omega + 1.2\,\text{k}\Omega + 400\,\Omega = \boxed{3.4\,\text{k}\Omega}$$

6. **Redraw the circuit in Fig. 2 using the Thevenin voltage E_{Th}, Thevenin resistance R_{Th}, and total inductance L_T**



7. **Determine the time constant τ of the circuit in Fig. 2 during the storage cycle**

$$\tau = \frac{L_T}{R_{Th}} = \frac{2\,\mathrm{H}}{3.4\,\mathrm{k\Omega}} = \boxed{588.2\,\mu\,\mathrm{sec}}$$

8. **After closing the switch, what is the final steady-state voltage value across R_{Th}?**

$$v_R = E(1 - e^{-t/\tau})$$

Therefore the final steady state voltage is

$$E = 6\,\mathrm{V}$$

Alternate:
1) Use KVL (with I_{Lmax} flowing through R_{TH})
or
2) Recall: since we are in steady-state, L_T acts like a short-circuit and hence $V_{RTH} = E_{TH} = 6V$.