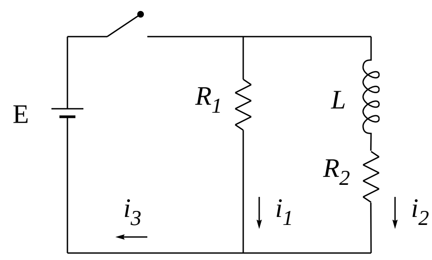
Inductor in a circuit



Condition I: Initial State. The current in branch 1 jumps instantly to its final value, while in branch 2 the inductance prevents this discontinuous shift. The inductor acts like a break in the wire.

a. $i_1 = \Delta V_1/R_1 = \mathcal{E}/R_1 = 2.0$ A

b. $i_2 = 0$

c. $i_3 = i_1 + i_2 = 2.0$ A

d. $\Delta V_2 = i_2 R_2$ so, from part (b), $\Delta V_2 = 0$

e. $\mathcal{E}_{\text{battery}} = \Delta V_L + \Delta V_2$, so $\Delta V_L = \mathcal{E} = 10$ V

f. $\Delta V_L = L\dfrac{di_2}{dt}$ so $\dfrac{di_2}{dt} = \dfrac{10 \text{ V}}{5.0 \text{ H}} = 2.0$ A/s

Condition II: Equilibrium. A long time has passed and everything has settled down. Because the currents don't change with time, there is no voltage drop across the inductor. The inductor acts like a piece of resistanceless wire.

g. $i_1 = \Delta V_1/R_1 = \mathcal{E}/R_1 = 2.0$ A

h. $i_2 = \Delta V_2/R_2 = \mathcal{E}/R_2 = 1.0$ A because $\Delta V_L = 0$

i. $i_3 = i_1 + i_2 = 3.0$ A

j. $\mathcal{E}_{\text{battery}} = \Delta V_L + \Delta V_2$, so $\Delta V_2 = \mathcal{E} = 10$ V

k. $\Delta V_L = 0$

ℓ. $di_2/dt = 0$

Grading: One point for each correct letter, maximum of 10. For this problem only, no explanation is required.