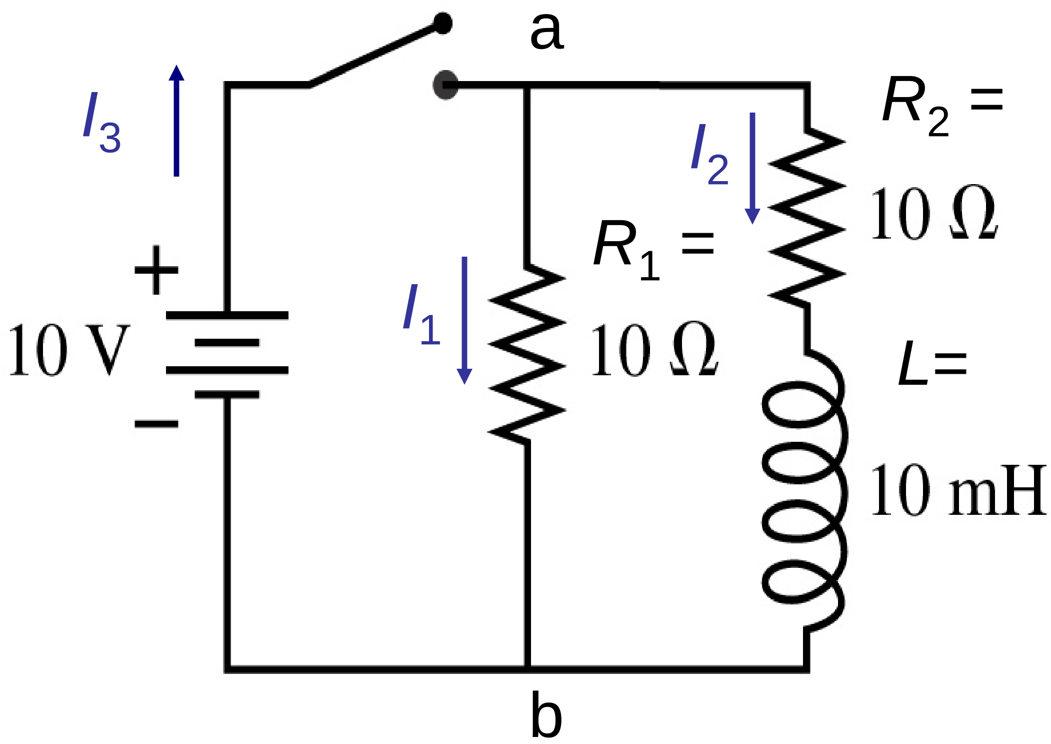
Review for Quiz 9



Consider *RL* circuit shown in the figure in two cases:

1. Switch just closed
2. Switch closed for a long time

Calculate the following parameters in these two cases and present your answers as a table.

Provide a speculation explaining the results in all cases

V_R – voltage across resistor R_2

V_L – voltage across inductor L

Case	I_1	I_2	I_3	V_R	V_L
1					
2					

1. In the beginning of transient process the inductor can be modeled as a “break” or as an infinitely high resistance.

This behavior is explained by the ability of inductor to accommodate very high voltage V_L due to variations of the current:

$$V_L = -L(dI_2/dt)$$

Due to the fact that $I_2 = 0$ before connecting the switch the derivative (dI_2/dt) can reach very high values immediately after connecting the switch. In fact inductor simply accommodates all the voltage which is made available to it by the circuit. It is obvious that all 10V voltage from the battery is applied between points “a” and “b”. By modeling an inductor as a break we have $V_L = 10V$ and $V_R = 0V$. The currents are easy to calculate: $I_2 = 0A$ – since there is a “break” in this branch, $I_1 = I_3 = 10V/10\Omega = 1A$.

2. The current through the inductor increases as time passes. Once the current (I_2) reaches a steady state value and is no longer changing, the potential difference across the inductor is $V_L = -L(dI_2/dt) = 0$ V.

An ideal inductor has no resistance, so the inductor simply acts like a wire or a "short" in a steady state.

As a result the circuit is that of two 10 Ω in parallel. This means that $V_R = 10$ V and that $I_1 = I_2 = 10\text{V}/10\Omega = 1\text{A}$. The total current $I_3 = I_1 + I_2 = 2\text{A}$.

Since this is relatively easy problem you will get additional simple question on *LC* circuit. To prepare for this question you should study *LC* circuit and solve HW problem 67 from Chapter 33.