across the 10-kΩ resistor in parallel with the switch for $t \geq 0$.

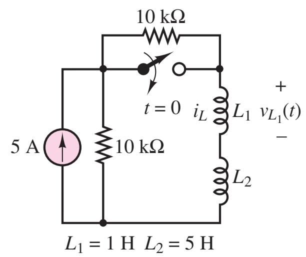


**Figure P5.52**

**5.54** We use an analogy between electrical circuits and thermal conduction to analyze the behavior of a pot heating on an electric stove. We can model the heating element as shown in the circuit of Figure P5.54. Find the "heat capacity" of the burner, $C_S$, if the burner reaches 90 percent of the desired temperature in 10 seconds.

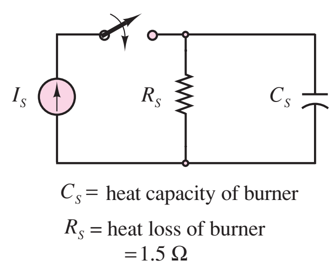


**Figure P5.54**

**5.55** With a pot placed on the burner of Problem 5.54, we can model the resulting thermal system with the circuit shown in Figure P5.55. The thermal loss between the burner and the pot is modeled by the series resistance $R_L$. The pot is modeled by a heat storage (thermal capacitance) element $C_P$, and a loss (thermal resistance) element, $R_P$.

a. Find the final temperature of the water in the pot—that is, find $v(t)$ as $t \to \infty$ – if: $I_S = 75$ A; $C_P = 80$ F; $R_L = 0.8\Omega$; $R_P = 2.5\Omega$, and the burner is the same as in Problem 5.54.

b. How long will it take for the water to reach 80 percent of its final temperature?

[*Hint*: Neglect $C_S$ since $C_S \ll C_P$.]

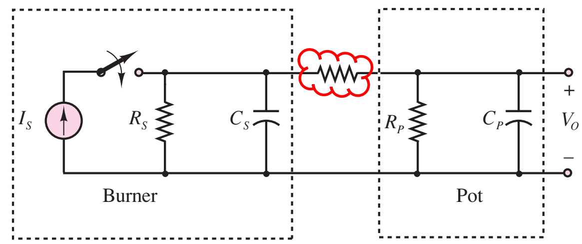


**Figure P5.55**

**5.56** The circuit of Figure P5.56 is used as a variable delay in a burglar alarm. The alarm is a siren with internal resistance of 1 kΩ. The alarm will not sound until the current $i_L$ exceeds 100 $\mu$A. Find the range of the variable resistor, $R$, for which the delay is between 1 and 2 s. Assume the capacitor is initially uncharged. This problem will require a graphical or numerical solution.

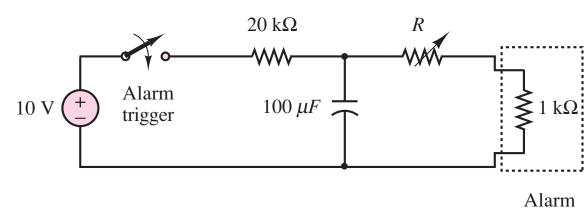


**Figure P5.56**

**5.57** Find the voltage across $C_1$ in the circuit of Figure P5.57 for $t > 0$. Let $C_1 = 5\mu$F; $C_2 = 10\mu$F. Assume the capacitors are initially uncharged.

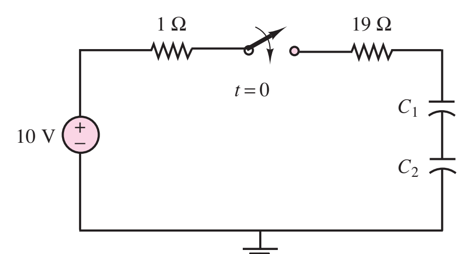


**Figure P5.57**

**5.58** The switch in the circuit of Figure P5.58 opens at $t = 0$. It closes at $t = 10$ seconds.

a. What is the time constant for $9 < t < 10$ s?

b. What is the time constant for $t > 10$ s?