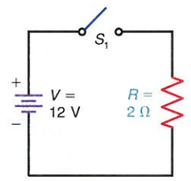
Problems

SECTION 22–1 RESPONSE OF RESISTANCE ALONE

22–1 In Fig. 22–13, how long does it take for the current, I, to reach its steady-state value after S_1 is closed?

Figure 22–13



22–2 In Fig. 22–13, what is the current with S_1 closed?

22–3 Explain how the resistor in Fig. 22–13 reacts to the closing or opening of S_1.

SECTION 22–2 *L/R* TIME CONSTANT

22–4 In Fig. 22–14,

a. what is the time constant of the circuit with S_1 closed?

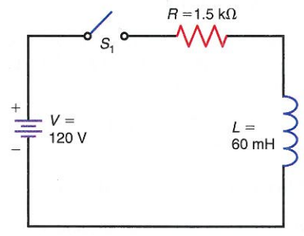
b. what is the eventual steady-state current with S_1 closed?

c. what is the value of the circuit current at the first instant S_1 is closed? ($t = 0$ s)

d. what is the value of the circuit current exactly one time constant after S_1 is closed?

e. how long after S_1 is closed will it take before the circuit current reaches its steady-state value?

Figure 22–14



22–5 Repeat Prob. 22–4 if $L = 100$ mH and $R = 500\ \Omega$.

22–6 Calculate the time constant for an inductive circuit with the following values:

a. $L = 10$ H, $R = 1$ kΩ.

b. $L = 500$ mH, $R = 2$ kΩ.

c. $L = 250\ \mu$H, $R = 50\ \Omega$.

d. $L = 15$ mH, $R = 7.5$ kΩ.

22–7 List two ways to

a. increase the time constant of an inductive circuit.

b. decrease the time constant of an inductive circuit.

SECTION 22–3 HIGH VOLTAGE PRODUCED BY OPENING AN *RL* CIRCUIT

22–8 Assume that the switch, S_1, in Fig. 22–14 has been closed for more than five L/R time constants. If a 1-MΩ resistor is placed across the terminals of the switch, calculate

a. the approximate time constant of the circuit with S_1 open.

b. the peak inductor voltage, V_L, when S_1 is opened.

c. the di/dt value at the instant S_1 is opened.

d. how long it takes for the current to decay to zero after S_1 is opened (approximately).

22–9 Without a resistor across S_1 in Fig. 22–14, is it possible to calculate the time constant of the circuit with the switch open? Also, what effect will probably occur inside the switch when it is opened?

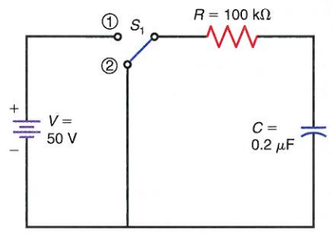
SECTION 22–4 *RC* TIME CONSTANT

22–10 In Fig. 22–15, what is the time constant of the circuit with the switch, S_1, in Position

a. 1?

b. 2?

Figure 22–15



22–11 Assume that the capacitor in Fig. 22–15 is fully discharged with S_1 in Position 2. How much is the capacitor voltage, V_C,

a. exactly one time constant after S_1 is moved to Position 1?

b. five time constants after S_1 is moved to Position 1?

c. 1 week after S_1 is moved to Position 1?

22–12 Assume that the capacitor in Fig. 22–15 is fully charged with S_1 in Position 1. How much is the capacitor voltage, V_C,

a. exactly one time constant after S_1 is moved to Position 2?

b. five time constants after S_1 is moved to Position 2?

c. 1 week after S_1 is moved to Position 2?

22–13 Calculate the time constant of a capacitive circuit with the following values:

a. $R = 1$M Ω, $C = 1\ \mu$F.

b. $R = 150\ \Omega$, $C = 0.01\ \mu$F.

c. $R = 330$ kΩ, $C = 270$ pF.

d. $R = 5$ kΩ, $C = 40\ \mu$F.

22–14 List two ways to

a. increase the time constant of a capacitive circuit.

b. decrease the time constant of a capacitive circuit.

22–15 Assume that the capacitor in Fig. 22–15 is discharging from 50 V with S_1 in Position 2. At the instant the capacitor voltage reaches 25 V, S_1 is moved back to Position 1. What is

a. the net charging voltage at the first instant S_1 is put back in Position 1?

b. the value of the capacitor voltage exactly one time constant after S_1 is moved back to Position 1?

c. the value of the capacitor voltage five time constants after S_1 is moved back to Position 1?

22–16 Assume that the capacitor in Fig. 22–15 is charging from 0 V with S_1 in Position 1. At the instant the capacitor voltage reaches 35 V, S_1 is moved back to Position 2. What is

a. the value of the capacitor voltage exactly one time constant after S_1 is moved back to Position 2?

b. the value of the capacitor voltage five time constants after S_1 is moved back to Position 2?

SECTION 22–5 *RC* CHARGE AND DISCHARGE CURVES

22–17 Assume that the capacitor in Fig. 22–15 is fully discharged with S_1 in Position 2. What is

a. the value of the charging current at the first instant S_1 is moved to Position 1?

b. the value of the charging current five time constants after S_1 is moved to Position 1?

c. the value of the resistor voltage exactly one time constant after S_1 is moved to Position 1?

d. the value of the charging current exactly one time constant after S_1 is moved to Position 1?

22–18 Assume that the capacitor in Fig. 22–15 is fully charged to 50 V with S_1 in Position 1. What is the value of the discharge current

a. at the first instant S_1 is moved to Position 2?

b. exactly one time constant after S_1 is moved to Position 2?

c. five time constants after S_1 is moved to Position 2?

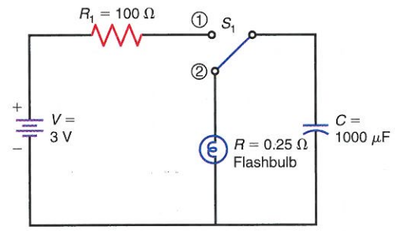
SECTION 22–6 HIGH CURRENT PRODUCED BY SHORT-CIRCUITING AN *RC* CIRCUIT

22–19 In Fig. 22–16, what is the RC time constant with S_1 in Position

a. 1?

b. 2?

Figure 22–16



22–20 In Fig. 22–16, how long will it take the capacitor voltage to

a. reach 3 V after S_1 is moved to Position 1?

b. discharge to 0 V after S_1 is moved to Position 2?

22–21 Assume that the capacitor in Fig. 22–16 is fully discharged with S_1 in Position 2. At the first instant S_1 is moved to Position 1, how much is

a. the voltage across the capacitor?

b. the voltage across the resistor?

c. the initial charging current?

22–22 Assume that the capacitor in Fig. 22–16 is fully charged with S_1 in Position 1. At the first instant S_1 is moved to Position 2, what is

a. the dc voltage across the flashbulb?

b. the initial value of the discharge current?

c. the initial rate of voltage change, dv/dt?

22–23 How much energy is stored by the capacitor in Fig. 22–16 if it is fully charged to 3 V?

SECTION 22–7 *RC* WAVESHAPES

22–24 For the circuit in Fig. 22–17,

a. calculate the RC time constant.

b. draw the capacitor voltage waveform and include voltage values at times t_0, t_1, t_2, t_3, and t_4.

c. draw the resistor voltage waveform and include voltage values at times t_0, t_1, t_2, t_3, and t_4.

d. draw the charge and discharge current waveform and include current values at times t_0, t_1, t_2, t_3, and t_4.