8. Referring to Fig. 17–8, draw three similar curves but for a sine wave of voltage with a period $T = 12\ \mu s$ for the full cycle. Use the same C of 240 pF. Compare the value of X_C obtained as $1/(2\pi fC)$ and v_C/i_C.

9. (a) What is the relationship between charge q and current i? (b) How is this comparison similar to the relation between the two formulas $Q = CV$ and $i_c = C(dv/dt)$?

Problems

SECTION 17–1 ALTERNATING CURRENT IN A CAPACITIVE CIRCUIT

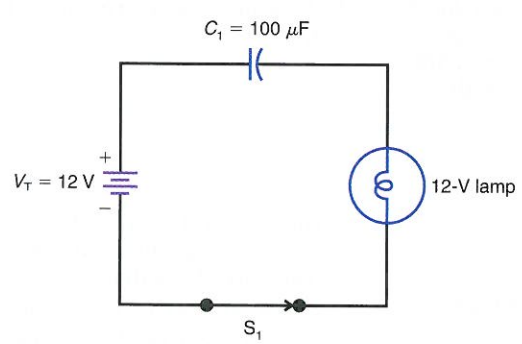
17–1 With the switch, S_1, closed in Fig. 17–9, how much is

a. the current, I, in the circuit?

b. the dc voltage across the 12-V lamp?

c. the dc voltage across the capacitor?

Figure 17–9



17–2 In Fig. 17–9 explain why the bulb will light for just an instant when S_1 is initially closed.

17–3 In Fig. 17–10, the capacitor and the lightbulb draw 400 mA from the 120-Vac source. How much current flows

a. to and from the terminals of the 120-Vac source?

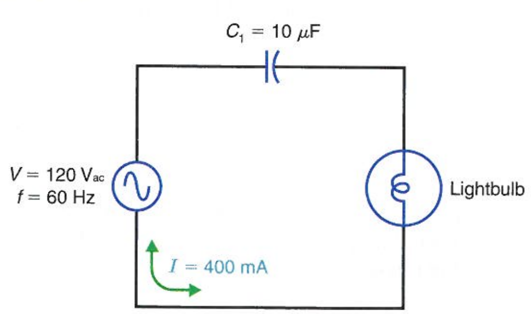
b. through the lightbulb?

c. to and from the plates of the capacitor?

d. through the connecting wires?

e. through the dielectric of the capacitor?

Figure 17–10



17–4 In Fig. 17–11, calculate the capacitive reactance, X_C, for the following values of Vac and I?

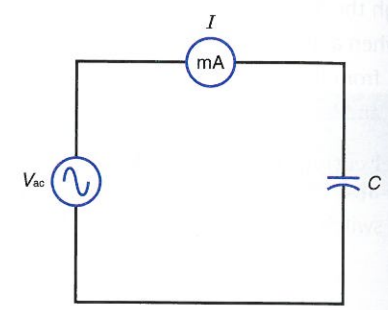
a. $Vac = 10$ V and $I = 20$ mA.

b. $Vac = 24$ V and $I = 8$ mA.

c. $Vac = 15$ V and $I = 300\ \mu$A.

d. $Vac = 100$ V and $I = 50\ \mu$A.

Figure 17–11



17–5 In Fig. 17–11, list three factors that can affect the amount of charge and discharge current flowing in the circuit.

SECTION 17–2 THE AMOUNT OF X_C EQUALS $\frac{1}{2\pi fC}$

17–6 Calculate the capacitive reactance, X_C, of a 0.1-μF capacitor at the following frequencies:

a. $f = 10$ Hz.

b. $f = 50$ Hz.

c. $f = 200$ Hz.

d. $f = 10$ kHz.

17–7 Calculate the capacitive reactance, X_C, of a 10-μF capacitor at the following frequencies:

a. $f = 60$ Hz.

b. $f = 120$ Hz.

c. $f = 500$ Hz.

d. $f = 1$ kHz.

17–8 What value of capacitance will provide an X_C of 1 kΩ at the following frequencies?

a. $f = 318.3$ Hz.

b. $f = 1.591$ kHz.

c. $f = 3.183$ kHz.

d. $f = 6.366$ kHz.

17–9 At what frequency will a 0.047-μF capacitor provide an X_C value of

a. 100 kΩ?

b. 5 kΩ?

c. 1.5 kΩ?

d. 50 Ω?

17–10 How much is the capacitance of a capacitor that draws 2 mA of current from a 10-Vac generator whose frequency is 3.183 kHz?

17–11 At what frequency will a 820-pF capacitance have an X_C value of 250 Ω?

17–12 A 0.01-μF capacitor draws 50 mA of current when connected directly across a 50-Vac source. What is the value of current drawn by the capacitor when

a. the frequency is doubled?

b. the frequency is decreased by one-half?

c. the capacitance is doubled to 0.02 μF?

d. the capacitance is reduced by one-half to 0.005 μF?

17–13 A capacitor has an X_C value of 10 kΩ at a given frequency. What is the new value of X_C when the frequency is

a. cut in half?

b. doubled?

c. quadrupled?

d. increased by a factor of 10?

17–14 Calculate the capacitive reactance, X_C, for the following capacitance and frequency values:

a. $C = 0.47\ \mu$F, $f = 1$ kHz.

b. $C = 100\ \mu$F, $f = 120$ Hz.

c. $C = 250$ pF, $f = 1$ MHz.

d. $C = 0.0022\ \mu$F, $f = 50$ kHz.

17–15 Determine the capacitance value for the following frequency and X_C values:

a. $X_C = 1$ kΩ, $f = 3.183$ kHz.

b. $X_C = 200\ \Omega$, $f = 63.66$ kHz.

c. $X_C = 25$ kΩ, $f = 1.592$ kHz.

d. $X_C = 1$ MΩ, $f = 100$ Hz.

17–16 Determine the frequency for the following capacitance and X_C values:

a. $C = 0.05\ \mu$F, $X_C = 4$ kΩ.

b. $C = 0.1\ \mu$F, $X_C = 1.591$ kΩ.

c. $C = 0.0082\ \mu$F, $X_C = 6.366$ kΩ.

d. $C = 50\ \mu$F, $X_C = 100\ \Omega$.

SECTION 17–3 SERIES OR PARALLEL CAPACITIVE REACTANCES

17–17 How much is the total capacitive reactance, X_{C_T}, for the following series capacitive reactances:

a. $X_{C_1} = 1$ kΩ, $X_{C_2} = 1.5$ kΩ, $X_{C_3} = 2.5$ kΩ.

b. $X_{C_1} = 500\ \Omega$, $X_{C_2} = 1$ kΩ, $X_{C_3} = 1.5$ kΩ.

c. $X_{C_1} = 20$ kΩ, $X_{C_2} = 10$ kΩ, $X_{C_3} = 120$ kΩ.

d. $X_{C_1} = 340\ \Omega$, $X_{C_2} = 570\ \Omega$, $X_{C_3} = 2.09$ kΩ.

17–18 What is the equivalent capacitive reactance, $X_{C_{EQ}}$, for the following parallel capacitive reactances:

a. $X_{C_1} = 100\ \Omega$ and $X_{C_2} = 400\ \Omega$.

b. $X_{C_1} = 1.2$ kΩ and $X_{C_2} = 1.8$ kΩ.

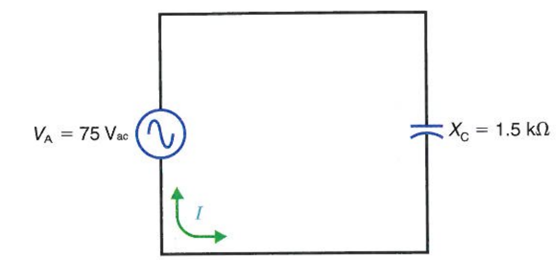
c. $X_{C_1} = 15\ \Omega$, $X_{C_2} = 6\ \Omega$, $X_{C_3} = 10\ \Omega$.

d. $X_{C_1} = 2.5$ kΩ, $X_{C_2} = 10$ kΩ, $X_{C_3} = 2$ kΩ, $X_{C_4} = 1$ kΩ.

SECTION 17–4 OHM'S LAW APPLIED TO X_C

17–19 In Fig. 17–12, calculate the current, I.

Figure 17–12



17–20 In Fig. 17–12, what happens to the current, I, when the frequency of the applied voltage

a. decrease?

b. increase?

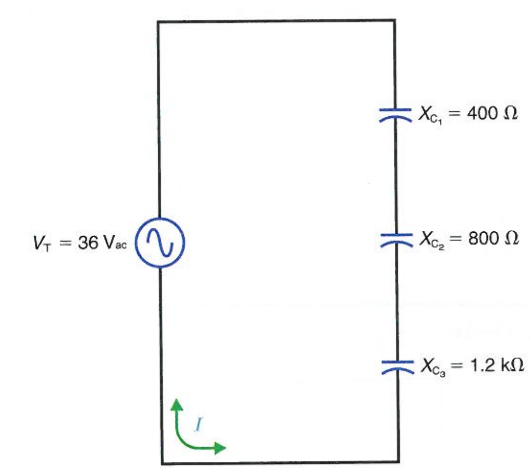
17–21 In Fig. 17–13, solve for

a. X_{C_T}.

b. I.

c. V_{C_1}, V_{C_2}, and V_{C_3}.

Figure 17–13



17–22 In Fig. 17–14, solve for

a. X_{C_1}, X_{C_2}, and X_{C_3}.

b. X_{C_T}.

c. I.

d. V_{C_1}, V_{C_2}, and V_{C_3}.

e. C_{EQ}.

17–23 In Fig. 17–13, solve for C_1, C_2, C_3, and C_{EQ} if the applied voltage has a frequency of 318.3 Hz.

17–24 In Fig. 17–15, solve for

a. I_{C_1}, I_{C_2}, and I_{C_3}.

b. I_T.

c. $X_{C_{EQ}}$.