Figure 17–14

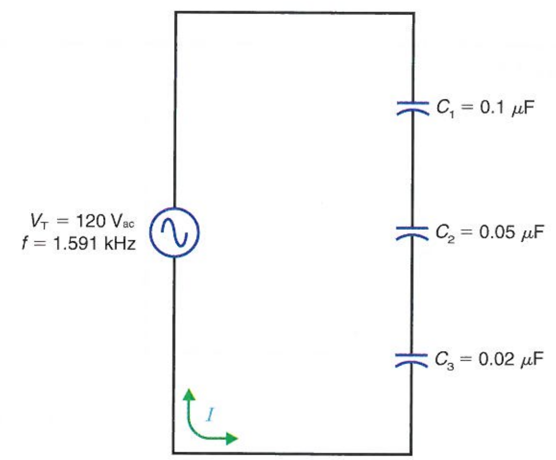
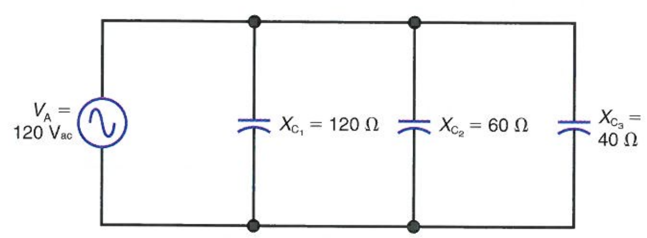


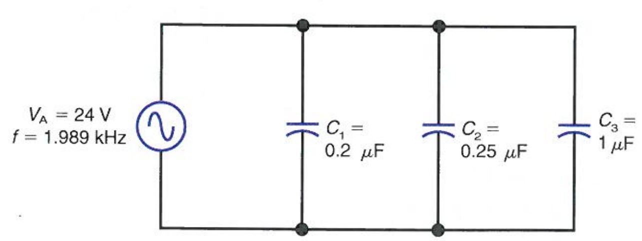
Figure 17–15



17–25 In Fig. 17–16, solve for

a. X_{C_1}, X_{C_2}, and X_{C_3}.
b. I_{C_1}, I_{C_2}, and I_{C_3}.
c. I_T.
d. $X_{C_{EQ}}$.
e. C_T.

Figure 17–16



17–26 In Fig. 17–15, solve for C_1, C_2, C_3, and C_T if the frequency of the applied voltage is 6.366 kHz.

SECTION 17–5 APPLICATIONS OF CAPACITIVE REACTANCE

17–27 Calculate the value of capacitance, C, required to produce an X_C value of 500 Ω at the following frequencies:

a $f = 100$ Hz.
b. $f = 2$ kHz.
c. $f = 50$ kHz.
d. $f = 10$ MHz.

SECTION 17–6 SINE-WAVE CHARGE AND DISCHARGE CURRENT

17–28 Calculate the instantaneous charging current, i_C, for a 0.33-μF capacitor if the voltage across the capacitor plates changes at the rate of 10 V/1 ms.

17–29 Calculate the instantaneous charging current, i_C, for a 0.01-μF capacitor if the voltage across the capacitor plates changes at the rate of

a. 100 V/s.
b. 100 V/ms.
c. 50 V/μs.

17–30 What is the instantaneous discharge current, i_C, for a 100-μF capacitor if the voltage across the capacitor plates decreases at the rate of

a. 10 V/s.
b. 1 V/ms.
c. 50 V/ms.

17–31 For a capacitor, what is the phase relationship between the charge and discharge current, i_C, and the capacitor voltage, v_C? Explain your answer.

17–32 A capacitor has a discharge current, i_C, of 15 mA when the voltage across its plates decreases at the rate of 150 V/μs. Calculate C.

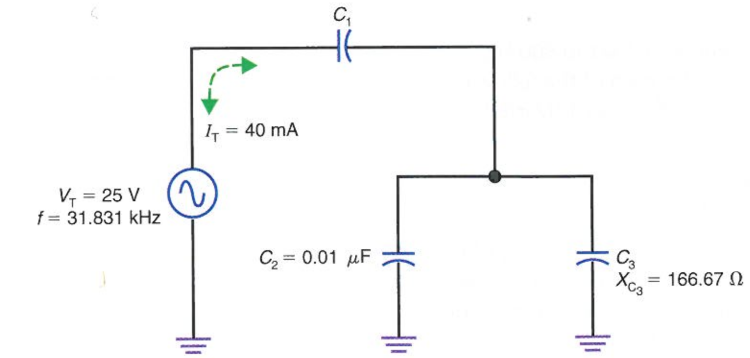
17–33 What rate of voltage change, $\frac{dv}{dt}$, will produce a charging current of 25 mA in a 0.01-μF capacitor? Express your answer in volts per second.

Critical Thinking

17–34 Explain an experimental procedure for determining the value of an unmarked capacitor. (Assume that a capacitance meter is not available.)

17–35 In Fig. 17–17, calculate X_{C_T}, X_{C_1}, X_{C_2}, C_1, C_3, V_{C_1}, V_{C_2}, V_{C_3}, I_{C_2}, and I_{C_3}.

Figure 17–17 Circuit for Critical Thinking Prob. 17–35.



Answers to Self-Reviews

17–1 a. 0.1 μF
b. 0.5 μF

17–2 a. 200 Ω
b. 800 Ω
c. larger

17–3 a. 500 Ω
b. 120 Ω

17–4 a. 300 Ω
b. 66.7 Ω

17–5 a. 50 Ω
b. 1000 Ω

17–6 a. 90°
b. 0 or 360°
c. 90°

Laboratory Application Assignment

In this lab application assignment you will examine how the capacitive reactance, X_C, of a capacitor decreases when the frequency, f, increases. You will also see that more capacitance, C, at a given frequency results in less capacitive reactance, X_C. Finally, you will observe how X_C values combine in series and in parallel.

Equipment: Obtain the following items from your instructor.

- Function generator
- Assortment of capacitors
- DMM

Capacitive Reactance, X_C

Refer to Fig. 17–18*a*. Calculate and record the value of X_C for each of the following frequencies listed below. Calculate X_C as $1/(2\pi fC)$.

X_C = __________ @ $f = 100$ Hz
X_C = __________ @ $f = 200$ Hz
X_C = __________ @ $f = 400$ Hz

Connect the circuit in Fig. 17–18*a*. Set the voltage source to exactly 5 V_{rms}. For each of the following frequencies listed below, measure and record the current, I. (Use a DMM to measure I.) Next, calculate X_C as V/I.

I = __________ @ $f = 100$ Hz; X_C = __________
I = __________ @ $f = 200$ Hz; X_C = __________
I = __________ @ $f = 400$ Hz; X_C = __________

How do the experimental values of X_C compare to those initially calculated? __________

Based on your experimental values, what happens to the value of X_C each time the frequency, f, is doubled? __________

Figure 17–18