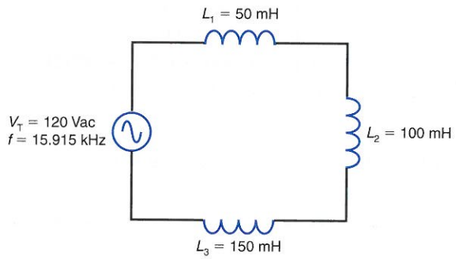
Figure 20–13



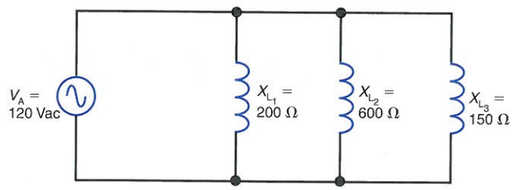
20–25 In Fig. 20–14, solve for

a. I_{L_1}, I_{L_2}, and I_{L_3}.

b. I_T.

c. $X_{L_{EQ}}$.

Figure 20–14



20–26 In Fig. 20–14, solve for L_1, L_2, L_3, and L_T if the frequency of the applied voltage is 6.366 kHz.

20–27 In Fig. 20–15, solve for

a. X_{L_1}, X_{L_2}, and X_{L_3}.

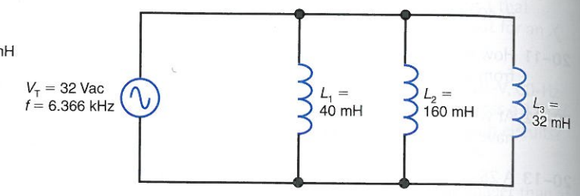
b. I_{L_1}, I_{L_2}, and I_{L_3}.

c. I_T.

d. $X_{L_{EQ}}$.

e. L_{EQ}.

Figure 20–15



SECTION 20–5 APPLICATIONS OF X_L FOR DIFFERENT FREQUENCIES

20–28 Calculate the value of inductance, L, required to produce an X_L value of 500 Ω at the following frequencies:

a. f = 250 Hz.

b. f = 636.6 Hz.

c. f = 3.183 kHz.

d. f = 7.957 kHz.

SECTION 20–6 WAVESHAPE OF V_L INDUCED BY SINE-WAVE CURRENT

20–29 For an inductor, what is the phase relationship between the induced voltage, V_L, and the inductor current, i_L? Explain your answer.

20–30 For a sine wave of alternating current flowing through an inductor, at what angles in the cycle will the induced voltage be

a. maximum?

b. zero?

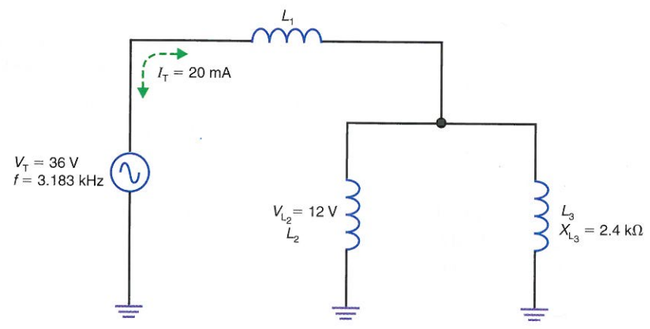
Critical Thinking

20–31 In Fig. 20–16, calculate L_1, L_2, L_3, L_T, X_{L_1}, X_{L_2}, X_{L_T}, V_{L_1}, V_{L_3}, I_{L_2}, and I_{L_3}.

20–32 Two inductors in series without L_M have a total inductance L_T of 120 μH. If L_1/L_2 = 1/20, what are the values for L_1 and L_2?

20–33 Three inductors in parallel have an equivalent inductance L_{EQ} of 7.5 mH. If $L_2 = 3\ L_3$ and $L_3 = 4\ L_1$, calculate L_1, L_2, and L_3.

Figure 20–16 Circuit for Critical Thinking Prob. 20–31.



Answers to Self-Reviews

20–1 a. 0 Ω
b. 1000 Ω

20–2 a. 628 Ω
b. 314 Ω
c. 6280 Ω

20–3 a. 500 Ω
b. 120 Ω

20–4 a. 0.5 A
b. 100 V

20–5 a. 100 MHz
b. 2000 Ω

20–6 a. 90°
b. 0° or 360°
c. 90°

Laboratory Application Assignment

In this lab application assignment you will examine how the inductive reactance, X_L, of an inductor increases when the frequency, f, increases. You will also see that more inductance, L, at a given frequency results in more inductive reactance, X_L. Finally, you will observe how X_L values combine in series and in parallel.

Equipment: Obtain the following items from your instructor.

- Function generator
- 33-mH and 100-mH inductors
- DMM

DC Resistance, r_i, of a Coil

With a DMM, measure and record the dc resistance of each inductor. Set the DMM to the lowest resistance range when measuring r_i.

r_i = _____ (33 mH)
r_i = _____ (100 mH)

Inductive Reactance, X_L

Refer to Fig. 20–17*a*. Calculate and record the value of X_L for each of the following frequencies listed below. Calculate X_L as $2\pi fL$.

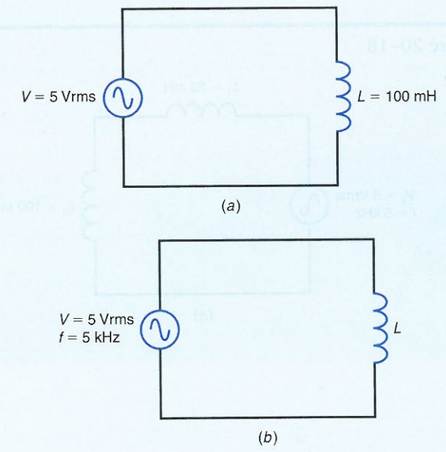
X_L = _____ @ f = 500 Hz
X_L = _____ @ f = 1 kHz
X_L = _____ @ f = 2 kHz

Connect the circuit in Fig. 20-17*a*. Set the voltage source to exactly 5 Vrms. For each of the following frequencies listed below, measure and record the current, I. (Use a DMM to measure I.) Next, calculate X_L as V/I.

I = _____ @ f = 500 Hz; X_L = _____
I = _____ @ f = 1 kHz; X_L = _____
I = _____ @ f = 2 kHz; X_L = _____

How do the experimental values of X_L compare to the calculated values? _____
Based on your experimental values, what happens to the value of X_L every time the frequency, f, doubles? _____
Is X_L proportional or inversely proportional to the frequency, f?
_____

Figure 20–17



Refer to Fig. 20–17*b*. With the frequency, f, set to 5 kHz, calculate and record the value of X_L for each of the following inductance values listed below. Calculate X_L as $2\pi fL$.

X_L = _____ when L = 33 mH
X_L = _____ when L = 100 mH

Connect the circuit in Fig. 20–17*b*. Adjust the frequency, f, of the function generator to exactly 5 kHz. For each inductance value listed below, measure and record the current, I. (Use a DMM to measure I.) Next, calculate X_L as V/I.

I = _____ when L = 33 mH; X_L = _____
I = _____ when L = 100 mH; X_L = _____

Is X_L proportional or inversely proportional to the value of inductance? _____

Did the dc resistance, r_i, of the inductors affect any of your measurements? _____
If so, explain. _____