Exercise 31.13 - Enhanced - with Feedback

You have a resistor of resistance 160 Ω , an inductor of inductance 0.450 H, a capacitor of capacitance 5.70 $\mu\mathrm{F}$ and a voltage source that has a voltage amplitude of 27.0 V and an angular frequency of 270 $\mathrm{rad/s}$. The resistor, inductor, capacitor, and voltage source are connected to form an *L-R-C* series circuit.

Review | Constants

Part A

What is the impedance of the circuit?

Express your answer in ohms.

Z = 550 Ω

Submit Previous Answers

Correct

Correct answer is shown. Your answer $551.97\ \Omega$ was either rounded differently or used a different number of significant figures than required for this part.
Important: If you use this answer in later parts, use the full unrounded value in your calculations.

Part B

What is the current amplitude?

Express your answer in amperes.

I = A

Part C

What is the phase angle of the source voltage with respect to the current?

Express your answer in degrees.

$\phi =$ ____ °

Submit Request Answer

Part D

Does the source voltage lag or lead the current?

- ○ the voltage lags the current
- ○ the voltage leads the current

Submit Request Answer

Part E

What is the voltage amplitude across the resistor?

Express your answer in volts.

V_R = 7.8 V

Submit Previous Answers

Correct

Correct answer is shown. Your answer 7.824 V was either rounded differently or used a different number of significant figures than required for this part.

Part F

What is the voltage amplitude across the inductor?

Express your answer in volts.

V_L = V

Part G

What is the voltage amplitudes across the capacitor?

Express your answer in volts.

V_C = V

Submit Request Answer

Part H

Explain how it is possible for the voltage amplitude across the capacitor to be greater than the voltage amplitude across the source.

Drag the terms on the left to the appropriate blanks on the right to complete the sentences.

Reset Help

- 90°
- 180°
- $v_L - v_R$
- $v_L + v_R$
- $v_R + v_C - v_L$
- negative
- $v_R - v_C - v_L$
- $v_R + v_C + v_L$
- positive
- $v_R - v_C + v_L$

At any instant, v is equal to [ ].

But v_C and v_L are [ ] out of phase, so v_C can be larger than v at a value of t, if [ ] is [ ] at that t.

Exercise 31.14

A 220 Ω resistor, a 0.800 H inductor, and a 6.00 $\mu\mathrm{F}$ capacitor are connected in series across a voltage source that has voltage amplitude 28.0 V and an angular frequency of 260 $\mathrm{rad/s}$.

Review | Constants

Part A

What is v at $t = 21.0\ \mathrm{ms}$?

Express your answer with the appropriate units.

v = Value Units

Submit Request Answer

Part B

What is v_R at $t = 21.0\ \mathrm{ms}$?

Express your answer with the appropriate units.

v_R = Value Units

Part C

What is v_L at $t = 21.0\ \text{ms}$?

Express your answer with the appropriate units.

v_L = Value Units

Submit Request Answer

Part D

What is v_C at $t = 21.0\ \text{ms}$?

Express your answer with the appropriate units.

v_C = Value Units

Submit Request Answer

Part E

Compare $v_C + v_L + v_R$ and v at this instant:

- $v_C+v_L+v_R<v$
- $v_C+v_L+v_R=v$
- $v_C+v_L+v_R>v$

Submit Request Answer

Part F

What is V_R?

Express your answer with the appropriate units.

V_R = Value Units

Submit Request Answer

Part G

What is V_C?

Express your answer with the appropriate units.

V_C = Value Units

Submit Request Answer

Part H

What is V_L?

Express your answer with the appropriate units.

V_L = Value Units

Submit Request Answer

Part I

Compare V and $V_L+V_C+V_R$:

- $V_L+V_R+V_C>V$
- $V_L+V_R+V_C<V$
- $V_L+V_R+V_C=V$

Submit Request Answer

Exercise 31.15 - Enhanced - with Feedback

In an *L-R-C* series circuit, the rms voltage across the resistor is 35.0 V, across the capacitor it is 90.0 V, and across the inductor it is 55.0 V.

Review | Constants

Part A

What is the rms voltage of the source?

Express your answer with the appropriate units.

V = Value Units

Submit Request Answer

Provide Feedback

Next

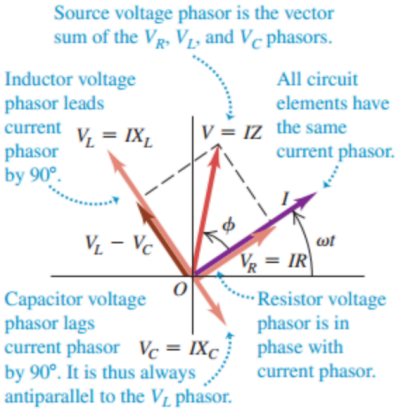
Exercise 31.21

Review | Constants

Figure

1 of 2

(b) Phasor diagram for the case $X_L > X_C$



Part A

Use (Figure 1) and (Figure 2) to find $\cos\phi$ for a series L-R-C circuit.

Express your answer in terms of the variables V, I, and R.

$\cos\phi = \frac{IR}{V}$

Submit | Previous Answers

Correct

Part B

Use the result of part A in Equation $P_{av} = \frac{1}{2}VI\cos\phi$ to find the average power delivered by the source.

Express your answer in terms of the variables I and R.

$P_{av} =$

Part C

In an L-R-C series circuit the amplitude of the source voltage is 120 V, the source voltage leads the current by 53.1°, and the average power supplied by the source is 80.0 W. What is the resistance R of the resistor in the circuit?

Express your answer with the appropriate units.

R = *Value* *Units*

Submit Request Answer

Exercise 31.23 - Enhanced - with Feedback

An *L*-*R*-*C* series circuit $L = 0.115\ \text{H}$, $R = 240\ \Omega$, and $C = 7.31\ \mu\text{F}$ carries an rms current of $0.448\ \text{A}$ with a frequency of $400\ \text{Hz}$.

Review | Constants

Part A

What is the phase angle?

Express your answer in radians.

$\phi =$ radians

Submit Request Answer

Part B

What is the power factor for this circuit?

Submit Request Answer

Exercise 31.23 - Enhanced - with Feedback

An *L*-*R*-*C* series circuit L = 0.115 H, R = 240 Ω, and C = 7.31 $\mu\mathrm{F}$ carries an rms current of 0.448 A with a frequency of 400 Hz.

Review | Constants

Part A

What is the phase angle?

Express your answer in radians.

ϕ = 0.77 radians

Submit Previous Answers

Correct

Correct answer is shown. Your answer 0.774 $\mathrm{radians}$ was either rounded differently or used a different number of significant figures than required for this part.

Part B

What is the power factor for this circuit?

0.72

Submit Previous Answers

Part C

What is the impedance of the circuit?

Express your answer in ohms.

$Z = 340\ \Omega$

Submit Previous Answers

Correct

Correct answer is shown. Your answer $335.61\ \Omega$ was either rounded diff
significant figures than required for this part.
Important: If you use this answer in later parts, use the full unrounded va

Part D

What is the rms voltage of the source?

Express your answer in volts.

$V_{rms} =$ V

Submit Request Answer

Part E

What average power is delivered by the source?

Express your answer in watts.

$P =$ W

Submit Request Answer

Part F

What is the average rate at which electrical energy is converted to thermal energy in the resistor?

Express your answer in watts.

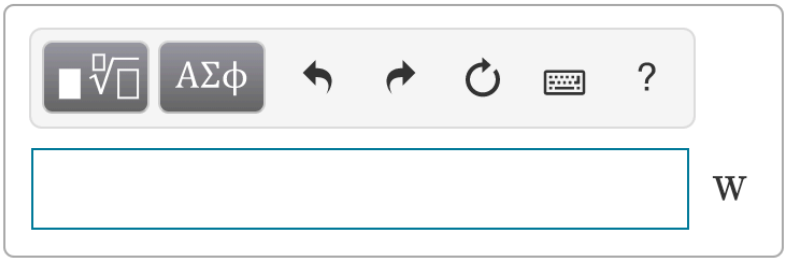
$P_R =$ W

Submit Request Answer

Part G

What is the average rate at which electrical energy is dissipated (converted to other forms) in the capacitor?

Express your answer in watts.

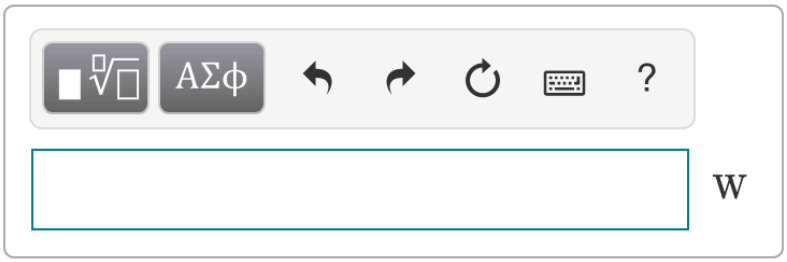


Submit Request Answer

Part H

What is the average rate at which electrical energy is dissipated (converted to other forms) in the inductor?

Express your answer in watts.



Submit Request Answer

Part A

At what frequency will the current in the circuit be greatest?

Express your answer in radians per second.

$\omega =$ rad/s

Submit Request Answer

Part B

What will be the current amplitude at this frequency?

Express your answer with the appropriate units.

$I =$ Value Units

Part C

What will be the current amplitude at an angular frequency of 395 $\mathrm{rad/s}$?

Express your answer with the appropriate units.

I = Value Units

Submit Request Answer

Part D

At this frequency, will the source voltage lead or lag the current?

- the source voltage leads the current
- the source voltage lags the current

Submit Request Answer

Exercise 31.30

Complete

An *L*-*R*-*C* series circuit consists of a source with voltage amplitude 120 V and angular frequency 50.0 $\mathrm{rad/s}$, a resistor with R = 400 Ω, an inductor with L = 3.00 H, and a capacitor with capacitance C.

Review | Constants

For what value of C will the current amplitude in the circuit be a maximum?

Express your answer with the appropriate units.

C = 1.3×10^{-4} F

Submit | Previous Answers

Correct

Correct answer is shown. Your answer $1.33{\cdot}10^{-4}\ \mathrm{F}$ was either rounded differently or used a different number of significant figures than required for this part.

Part B

When C has the value calculated in the previous part, what is the amplitude of the voltage across the inductor?

Express your answer with the appropriate units.

V = 45 V

Submit | Previous Answers

Exercise 31.35 - Enhanced - with Solution

A transformer connected to a 150 V (rms) ac line is to supply 15.0 V (rms) to a portable electronic device. The load resistance in the secondary is 5.10 Ω.

For related problem-solving tips and strategies, you may want to view a Video Tutor Solution of Wake up and smell the (transformer)! .

Review | Constants

Part A

What should the ratio of primary to secondary turns of the transformer be?

$\frac{N_1}{N_2}$ =

Submit Request Answer

Part B

What rms current must the secondary supply?

Express your answer with the appropriate units.

I_{rms} = Value Units

Submit Request Answer

Part C

What average power is delivered to the load?

Express your answer with the appropriate units.

$P =$ 44.1 W

Submit Previous Answers

Correct

Correct answer is shown. Your answer $44.12\ \text{W}$ was either rounded differently or used a different number of significant figures than required for this part.

$$P_{\text{av}} = I_2^2 R = (2.94\ \text{A})^2 (5.10\ \Omega) = 44.1\ \text{W}.$$

Part D

What resistance connected directly across the source line (which has a voltage of 150 V) would draw the same power as the transformer?

Express your answer with the appropriate units.

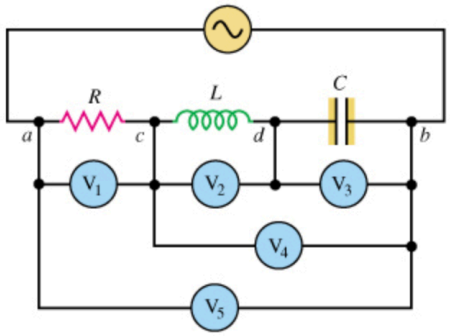
$R =$ Value Units

Problem 31.40

Five infinite-impedance voltmeters, calibrated to read rms values, are connected as shown in figure (Figure 1). Let $R = 200\ \Omega$, $L = 0.400\ \text{H}$, $C = 6.00\ \mu\text{F}$ and $V = 30.0\ \text{V}$.

Figure

1 of 1



Review | Constants

Part A

What is the reading of the voltmeter V_1 if $\omega = 200\ \text{rad/s}$?

Express your answer in volts.

V_1 = V

Submit Request Answer

Part B

What is the reading of the voltmeter V_2 if $\omega = 200\ \text{rad/s}$?

Express your answer in volts.

V_2 = V

Part C

What is the reading of the voltmeter V_3 if $\omega = 200\,\mathrm{rad/s}$?

Express your answer in volts.

V_3 = V

Submit Request Answer

Part D

What is the reading of the voltmeter V_4 if $\omega = 200\,\mathrm{rad/s}$?

Express your answer in volts.

V_4 = V

Submit Request Answer

Part E

What is the reading of the voltmeter V_5 if $\omega = 200\ \mathrm{rad/s}$?

Express your answer in volts.

$V_5 =$ [ ] V

Submit Request Answer

Part F

What is the reading of the voltmeter V_1 if $\omega = 1000\,\mathrm{rad/s}$?

Express your answer in volts.

V_1 = V

Submit Request Answer

Part G

What is the reading of the voltmeter V_2 if $\omega = 1000\,\mathrm{rad/s}$?

Express your answer in volts.

V_2 = V

Part H

What is the reading of the voltmeter V_3 if $\omega = 1000\,\mathrm{rad/s}$?

Express your answer in volts.

V_3 = V

Submit Request Answer

Part I

What is the reading of the voltmeter V_4 if $\omega = 1000\,\mathrm{rad/s}$?

Express your answer in volts.

V_4 = V

Submit Request Answer

Part J

What is the reading of the voltmeter V_5 if $\omega = 1000\,\mathrm{rad/s}$?

Express your answer in volts.

V_5 = V

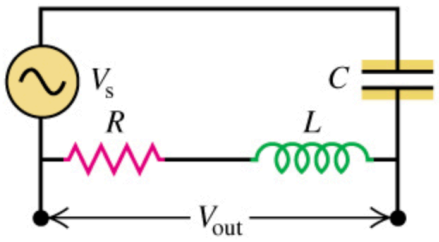
Submit Request Answer

Problem 31.47

One application of L-R-C series circuits is to high-pass or low-pass filters, which filter out either the low- or high-frequency components of a signal. A high-pass filter is shown in the figure (Figure 1), where the output voltage is taken across the L-R combination. (The L-R combination represents an inductive coil that also has resistance due to the large length of wire in the coil.)

Figure

1 of 1



Review | Constants

Part A

Derive an expression for $\frac{V_{out}}{V_s}$, the ratio of the output and source voltage amplitudes, as a function of the angular frequency ω of the source.

Express your answer in terms of some or all of the variables L, R, C, and ω.

$\frac{V_{out}}{V_s} =$

Submit | Request Answer

Part B Complete previous part(s)

Part C Complete previous part(s)

Provide Feedback

Next

Part B

What will be the ratio when ω is *small*?

Express your answer in terms of some or all of the variables L, R, C, and ω.

$\frac{V_{\text{out}}}{V_{\text{s}}} =$

Submit Request Answer

Part C

What will be the ratio when ω is *large*?

Express your answer in terms of some or all of the variables L, R, C, and ω.

$\frac{V_{\text{out}}}{V_{\text{s}}} =$

Submit

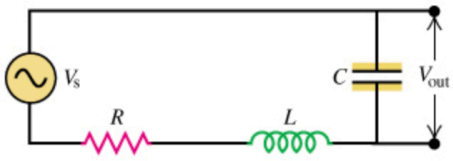
Request Answer

Problem 31.48

Figure shows (Figure 1) a low-pass filter; the output voltage is taken across the capacitor in an *L*-*R*-*C* series circuit.

Figure

1 of 1



Review | Constants

Part A

Derive an expression for $V_{\text{out}}/V_{\text{s}}$, the ratio of the output and source voltage amplitudes, as a function of the angular frequency ω of the source.

- $\frac{V_{out}}{V_s} = \frac{1}{\omega C \sqrt{R^2+(\omega L-\frac{1}{\omega C})^2}}$
- $\frac{V_{out}}{V_s} = \frac{1}{\omega C \sqrt{R^2-(\omega L-\frac{1}{\omega C})^2}}$
- $\frac{V_{out}}{V_s} = \frac{1}{\omega C \sqrt{R^2-(\omega L+\frac{1}{\omega C})^2}}$
- $\frac{V_{out}}{V_s} = \frac{1}{\omega C \sqrt{R^2+(\omega L+\frac{1}{\omega C})^2}}$

Submit | Request Answer

Part B

Part B

Find an expression for $V_{\text{out}}/V_{\text{s}}$ when ω is large.

- 1
- $\frac{1}{(L\,C)\,\omega^2}$
- $\frac{1}{(L\,C)\,\omega}$
- $(L\,C)\,\omega^2$

Submit Request Answer

Part C

Find an expression for $V_{\text{out}}/V_{\text{s}}$ in the limit of small frequency

- 1
- $\frac{1}{(L\,C)\,\omega^2}$
- $\frac{1}{(L\,C)\,\omega}$
- $(L\,C)\,\omega^2$

Problem 31.49

An L-R-C series circuit is connected to an ac source of constant voltage amplitude V and variable angular frequency ω.

Review | Constants

Part A

Find the current amplitude, as a function of ω.

Express your answer in terms of the variables V, R, L, C, and ω.

$$I(\omega) = \frac{V}{\sqrt{R^2+\left(\frac{1}{\omega C}-\omega L\right)^2}}$$

Submit | Previous Answers

✔ Correct

Part B

Find the average power dissipated in the resistor.

Express your answer in terms of the variables V, R, L, C, and ω.

$$P_{\text{av}} = \frac{V^2 R}{2\left(R^2+\left(\frac{1}{\omega C}-\omega L\right)^2\right)}$$

Submit | Previous Answers

Part C

At what angular frequency will I and P_{av} be *both* maximum?

Express your answer in terms of some or all of the variables R, L, and C.

$$\omega = \sqrt{\frac{1}{LC}}$$

Submit

Previous Answers

Correct

This is the resonance frequency of the circuit.

Problem 31.50

An *L-R-C* series circuit is connected to an ac source of constant voltage amplitude V and variable angular frequency ω.

Review | Constants

Part A

Find an expression for the amplitude V_L of the voltage across the inductor as a function of ω.

Express your answer in terms of some or all of the variables V, ω, L, R, and C.

$V_L =$

Submit Request Answer

Part B

Find an expression for the amplitude V_C of the voltage across the capacitor as a function of ω.

Express your answer in terms of some or all of the variables V, ω, L, R, and C.

$V_C =$

Part C

Discuss the behavior of V_L and V_C relative to V in the limits $\omega = 0$ and $\omega \rightarrow \infty$.

Drag the terms on the left to the appropriate blanks on the right to complete the sentences.

Reset Help

V

0

$\frac{1}{2}V$

When the angular frequency is zero, the voltage across the inductor is equal to [ ] and the voltage across the capacitor is equal to [ ].

At very high frequencies, the voltage across the inductor is equal to [ ] and the voltage across the capacitor is equal to [ ].

Part D

For what value of ω is $V_L = V_C$?

Express your answer in terms of some or all of the variables L, R, and C.

$\omega =$

Submit

Request Answer

Problem 31.54

A resistor, inductor, and capacitor are connected in parallel to an ac source with voltage amplitude V and angular frequency ω. Let the source voltage be given by $v = V\cos\omega t$.

Review | Constants

Part A

Compare the instantaneous voltages v_R, v_L, and v_C at any instant with the source voltage v.

- $v = v_R + v_L + v_C$
- $v > v_R + v_L + v_C$
- $v = v_R = v_L = v_C$
- $v < v_R + v_L + v_C$

Submit Request Answer

Part B

Compare the instantaneous currents i_R, i_L, and i_C at any instant with the source current i.

- $i = i_R + i_L + i_C$
- $i < i_R + i_L + i_C$
- $i > i_R + i_L + i_C$
- $i = i_R = i_L = i_C$

Part C

What is the phase of i_{R} with respect to v?

Express your answer in degrees.

i_{R} leads the voltage v by $\phi =$ °

Submit Request Answer

Part D

What is the phase of i_{L} with respect to v?

Express your answer in degrees.

i_{L} lags the voltage v by $\phi =$ °

Part E

What is the phase of i_C with respect to v?

Express your answer in degrees.

i_C leads the voltage v by $\phi =$ ____ °

Part G

Use the phasor diagram of part (e) to find the current amplitude I for the current i through the source..

Express your answer in terms of the variables I_R, I_C and I_L .

$I =$

Submit

Request Answer

Problem 31.57

An L-R-C series circuit consists of a 2.40 μF capacitor, a 6.00 mH inductor, and a 65.0 Ω resistor connected across an ac source of voltage amplitude 20.0 V having variable frequency.

Review | Constants

Part A

At what frequency is the average power delivered to the circuit equal to $\frac{1}{2}V_{\text{rms}}I_{\text{rms}}$?

Express your answer in radians per second.

ω = rad/s

Submit Request Answer

Part B

Under the conditions of part A, what is the average power delivered to each circuit element?

Express your answers in watts separated by commas.

P_R, P_C, P_L = W

Part C

What is the maximum current through the capacitor?

Express your answer in amperes.

I_C = A

Submit Request Answer

Problem 31.61

✔ Complete

A resistance R, capacitance C, and inductance L are connected in series to a voltage source with amplitude V and variable angular frequency ω.

Review | Constants

Part A ✔

If $\omega = \omega_0$, the resonance angular frequency, find the maximum current in the resistor.

Express your answer in terms of some or all of the variables R, C, L, and V.

$I_{max} = \frac{V}{R}$

Submit Previous Answers

✔ **Correct**

Part B ✔

Find the maximum voltage across the capacitor.

Express your answer in terms of some or all of the variables R, C, L, and V.

$V_C = \frac{V\sqrt{LC}}{RC}$

Submit Previous Answers

Part C

Find the maximum voltage across the inductor.

Express your answer in terms of some or all of the variables R, C, L, and V.

$$V_L = \frac{VL}{R\sqrt{LC}}$$

Submit Previous Answers

✔ **Correct**

Part D

Find the maximum energy stored in the capacitor.

Express your answer in terms of some or all of the variables R, C, L, and V.

$$U_C = \frac{1}{2}\frac{V^2 L}{R^2}$$

Submit Previous Answers

Part E

Find the maximum energy stored in the inductor.

Express your answer in terms of some or all of the variables R, C, L, and V.

$$U_L = \frac{1}{2}\frac{LV^2}{R^2}$$

Submit

Previous Answers

✔ **Correct**

Challenge Problem 31.67

In an L-R-C series circuit the current is given by $i = I cos\omega t$. The voltage amplitudes for the resistor, inductor, and capacitor are V_R, V_L and V_C.

Review | Constants

Part A

Find the instantaneous power into the resistor is p_R.

Express your answer in terms of the variables V_R, I, ω, and t.

$p_R =$ $IV_R \cos \omega t$

Submit Previous Answers Request Answer

Part B

What does this expression give for the average power into the resistor?

Express your answer in terms of the variables V_R and I.

$p_{\text{av}}(R) = \frac{1}{2} V_R I$

Submit | Previous Answers

✔ Correct

Part C

Find the instantaneous power into the inductor is p_{L}.

Express your answer in terms of the variables V_L, I, ω, and t.

$p_{\text{L}} =$

Submit | Request Answer

Part D

What does this expression give for the average power into the inductor?

Express your answer in terms of the variables V_L and I.

$p_{\text{av}}(L) =$

Submit Request Answer

Part E

Find the instantaneous power into the capacitor is p_C.

Express your answer in terms of the variables V_C, I, ω, and t.

$p_C =$

Submit Request Answer

Part F

What does this expression give for the average power into the capacitor?

Express your answer in terms of the variables V_C and I.

$p_{\text{av}}(C)$ =

Submit Request Answer

Part G

If the instantaneous power delivered by the source is $p = VI\cos\omega t\,(\cos\phi\cos\omega t - \sin\phi\sin\omega t)$, compare it with $p_R + p_L + p_C$ at each instant of time.

- $p = p_R + p_L + p_C$
- $p < p_R + p_L + p_C$
- $p > p_R + p_L + p_C$

Submit Request Answer

Challenge Problem 31.68

Review | Constants

Part A

At what angular frequency is the voltage amplitude across the *resistor* in an L-R-C series circuit at maximum value?

Express your answer in terms of some or all of the variables L, C, and R.

$\omega =$

Submit Request Answer

Part B

At what angular frequency is the voltage amplitude across the *inductor* at maximum value?

Express your answer in terms of some or all of the variables L, C, and R.

$\omega =$

Part C

At what angular frequency is the voltage amplitude across the *capacitor* at maximum value?

Express your answer in terms of some or all of the variables L, C, and R.

$\omega =$

Submit

Request Answer