Physics II
Final Exam Review

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Outline

1. Multiple Choice
   - Chapter 30: INDUCTION AND INDUCTANCE
   - Chapter 31: ALTERNATING CURRENT

2. Problems
   - Problem 1
   - Problem 2

Multiple Choice

Chapter 30: INDUCTION AND INDUCTANCE

Question 1

The diagram shows an inductor that is part of a circuit. The direction of the emf induced in the inductor is indicated. Which of the following is possible?

A The current is constant and rightward

B The current is constant and leftward

C The current is increasing and rightward

D The current is increasing and leftward

E None of the above

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B The current is constant and leftward

C The current is increasing and rightward

D The current is increasing and leftward

E None of the above

Answer: D

Question 2

An inductor with inductance L resistor with resistance R are wired in series to an ideal battery with emf ε . A switch in the circuit is closed at time 0, at which time the current is zero. A long time after the switch is thrown the potential dierences across the inductor and resistor:

A $0,\varepsilon$

B $\varepsilon,0$

C $\frac{\varepsilon}{2},\varepsilon$

D $\frac{L}{R}\varepsilon,\frac{R}{L}\varepsilon$

E Cannot be computed unless the rate of change of the current is given

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C $\frac{\varepsilon}{2}, \varepsilon$

D $\frac{L}{R}\varepsilon, \frac{R}{L}\varepsilon$

E Cannot be computed unless the rate of change of the current is given

Answer: A

Question 3

If both the resistance and the inductance in an *LR* series circuit are doubled the new inductive time constant will be:

A Twice the old

B Four times the old

C Half the old

D One-fourth the old

E Unchanged

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- A Twice the old
- B Four times the old
- C Half the old
- D One-fourth the old
- E Unchanged

Answer: E

Question 4

The diagrams show three circuits with identical batteries, identical inductors, and identical resistors. Rank them according to the current through the battery just after the switch is closed, from least to greatest.

A 3,2,1

B 2 and 3 ties, then 1

C 1,3,2

D 1,2,3

E 3,1,2

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B 2 and 3 ties, then 1

C 1,3,2

D 1,2,3

E 3,1,2

Answer: C

Chapter 31:ALTERNATING CURRENT

Question 1

The angular frequency of a certain *RLC* series circuit is ω_0 . A source of sinusoidal emf, with angular frequency 2ω, is inserted into the circuit. After transients die out the angular frequency of the current oscillations is::

A $\frac{\omega_0}{2}$

B ω

C 2ω

D 1.5ω

E 3ω

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A $\frac{\omega_0}{2}$

B ω

C 2ω

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E 3ω

Answer: C

Question 2

In a purely capacitive circuit the current:

A Leads the voltage by one-fourth of a cycle

B Leads the voltage by one-half of a cycle

C Lags the voltage by one-fourth of a cycle

D Lags the voltage by one-half of a cycle

E Is in phase with the potential dierence across the plates

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Answer: A

Question 3

In a purely resistive circuit the current:

A Leads the voltage by one-fourth of a cycle

B Leads the voltage by one-half of a cycle

C Lags the voltage by one-fourth of a cycle

D Lags the voltage by one-half of a cycle

E Is in phase with the voltage

Question 3

In a purely resistive circuit the current:

A Leads the voltage by one-fourth of a cycle

B Leads the voltage by one-half of a cycle

C Lags the voltage by one-fourth of a cycle

D Lags the voltage by one-half of a cycle

E Is in phase with the voltage

Answer: E

Question 4

In a purely inductive circuit, the current lags the voltage by:

A 0

B One-fourth of a cycle

C One-half of a cycle

D Three-fourths of a cycle

E One cycle

Question 4

In a purely inductive circuit, the current lags the voltage by:

A 0

B One-fourth of a cycle

C One-half of a cycle

D Three-fourths of a cycle

E One cycle

Answer: B

Question 5

A series *RL* circuit is connected to an emf source of angular frequency ω. The current:

A Leads the applied emf by $\tan^{-1}\frac{\omega L}{R}$

B Lags the applied emf by $\tan^{-1}\frac{\omega L}{R}$

C Lags the applied emf by $\tan^{-1}\frac{\omega R}{L}$

D Leads the applied emf by $\tan^{-1}\frac{\omega R}{L}$

E Is 0

Question 5

A series *RL* circuit is connected to an emf source of angular frequency ω. The current:

A Leads the applied emf by $\tan^{-1}\frac{\omega L}{R}$

B Lags the applied emf by $\tan^{-1}\frac{\omega L}{R}$

C Lags the applied emf by $\tan^{-1}\frac{\omega R}{L}$

D Leads the applied emf by $\tan^{-1}\frac{\omega R}{L}$

E Is 0

Answer: A

Question 6

A series RC circuit is connected to an emf source having angular frequency ω. The current:

A Leads the source emf by $\tan^{-1} \frac{1}{\omega CR}$

B Lags the source emf by $\tan^{-1} \frac{1}{\omega CR}$

C Leads the source emf by $\tan^{-1}(\omega CR)$

D Lags the source emf by $\tan^{-1}(\omega CR)$

E Leads the source emf by $\frac{\pi}{4}$

Question 6

A series *RC* circuit is connected to an emf source having angular frequency ω. The current:

A Leads the source emf by $\tan^{-1} \frac{1}{\omega CR}$

B Lags the source emf by $\tan^{-1} \frac{1}{\omega CR}$

C Leads the source emf by $\tan^{-1}(\omega CR)$

D Lags the source emf by $\tan^{-1}(\omega CR)$

E Leads the source emf by $\frac{\pi}{4}$

Answer: A

Question 7

When the amplitude of the oscillator in a series *RLC* circuit is doubled:

A The impedance is doubled

B The voltage across the capacitor is halved

C The capacitive reactance is halved

D The power factor is doubled

E The current amplitude is doubled

Question 7

When the amplitude of the oscillator in a series *RLC* circuit is doubled:

A The impedance is doubled

B The voltage across the capacitor is halved

C The capacitive reactance is halved

D The power factor is doubled

E The current amplitude is doubled

Answer: E

Question 8

When the frequency of the oscillator in a series *RLC* circuit is doubled:

A The capacitive reactance is doubled

B The capacitive reactance is halved

C The impedance is doubled

D The current amplitude is doubled

E The current amplitude is halved

Question 8

When the frequency of the oscillator in a series *RLC* circuit is doubled:

A The capacitive reactance is doubled

B The capacitive reactance is halved

C The impedance is doubled

D The current amplitude is doubled

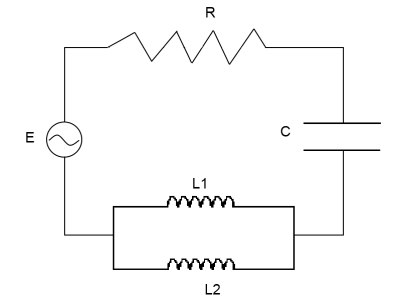
E The current amplitude is halved

Answer: B

Problems

Problem 1

The following series RLC circuit has is being forced by the emf $\varepsilon = 285 \sin(\omega_d t)$ where $\omega_d = 340 \frac{rad}{s}$. The pair inductors are in parallel have inductance $L_1 = L_2 = .5H$ and the capacitor has a capacitance of $1\mu F$. The resistor has a resistance of 500Ω.



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A Find the peak current and voltage in each element of the circuit.

B Find an expression for the instantaneous current and instantaneous voltage across each part of the circuit.

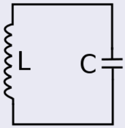
C What is the average power dissipated by the resistor? At resonant frequency?

D What is the total amount of energy stored in the inductors at time $t = 0$?

E Draw a phasor diagram of voltages of the circuit

Problem 2

A LC circuit has an initial charge of 200μC on a 1μF capacitor. The inductor has an inductance of 2.75H.



A What is the resonant frequency of the circuit.

B Find an expression for the charge and current on the capacitor.

C Find an expression for the energy stored in the capacitor and the inductor through time

D Does the total energy decrease over time? Plot the energies with t on the x-axis.

E When is the total energy of the circuit maximum?