CheggSolutions - Thegdp

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## Subject: Electrical Engineering

### Topic: Time Constants in RC and RL Circuits

**Given:**

- Time constant in RC circuit, $\tau_{RC} = R \times C = 9.3 \times 10^{6}$ seconds
- Inductance in RL circuit, $L = 3.9$ mH $= 3.9 \times 10^{-3}$ H

**Required:**

Determine the value of resistance **R** in the RL circuit such that the time constant in the RL circuit matches the time constant in the RC circuit.

**Solution:**

**Step 1:** Formulate the given information

The time constant in an RC circuit is given by: $\tau_{RC} = R \times C$

From the given information: $\tau_{RC} = 9.3 \times 10^{6}$ seconds

The time constant in an RL circuit is given by: $\tau_{RL} = L / R$

**Explanation:**

The time constants for the RC and RL circuits must be equal. Therefore: $\tau_{RC} = \tau_{RL}$

Supporting Statement: To find the resistance **R** for the RL circuit, both time constants need to be equated as they must have the same value to ensure an equal response.

**Step 2:**

Set the equality of time constants and solve for **R**

Equate the time constants: $\tau_{RC} = \tau_{RL}$
$9.3 \times 10^{6} = L / R$

Substitute the value of **L** (3.9 mH): $9.3 \times 10^{6} = 3.9 \times 10^{-3} / R$

Supporting Statement: By substituting the given value for the inductance into the time constant equation for an RL circuit, the value of the resistance **R** can be found.

**Step 3:**

Solve for **R**

Rearrange the equation to solve for **R**:
$R = 3.9 \times 10^{-3} / 9.3 \times 10^{6}$

Calculate:
$R = 3.9 \times 10^{-3} / 9.3 \times 10^{6}$
$R = 4.19355 \times 10^{-10}$ Ω

Convert to kilo-ohms:
$R = 4.19355 \times 10^{-7}$ kΩ
Round to two decimal places:
$R \approx 0.42 \times 10^{-3}$ kΩ $= 0.42$ kΩ

Supporting Statement: The final value of **R** has been converted to kilo-ohms and rounded as specified.
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Final Solution:

The value of the resistance **R** in the RL circuit should be `0.42 kΩ` to match the given time constant of the RC circuit.

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