

## Answer on Question #48588, Physics, Electromagnetism

A RLC AC circuit has resistance 80 ohms, inductance 0.6 henry, and capacitance 2  $\mu\text{F}$ , frequency 60 Hz, and rms voltage 110 V. Find a) inductive reactance, b) capacitance reactance, c) impedance, d) rms current of the circuit, e) the AC frequency at which the RLC is in resonance, f) the rms current at resonance frequency, g) rms current if the frequency is at 50 Hz.

### Solution:

Given:

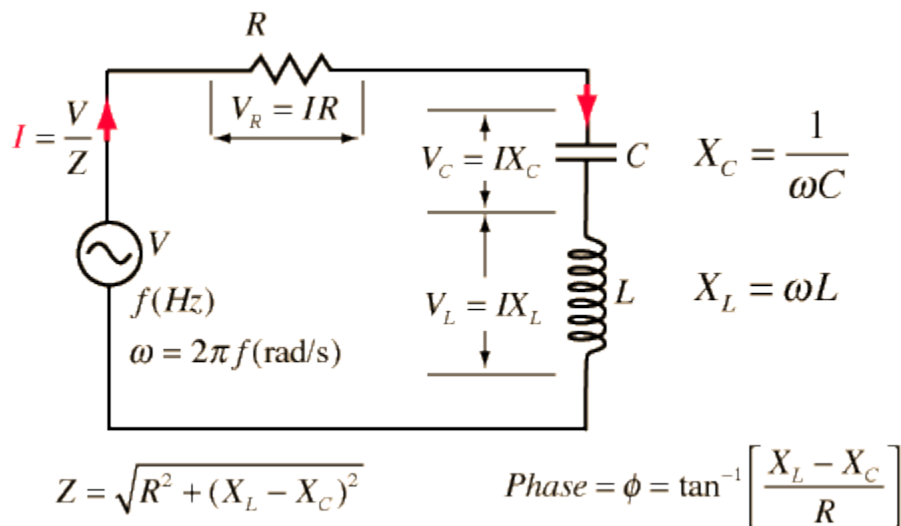
$$R = 80 \Omega,$$

$$L = 0.6 \text{ H},$$

$$C = 2 \mu\text{F},$$

$$V = 110 \text{ V},$$

$$f = 60 \text{ Hz}$$



The angular frequency  $\omega = 2\pi f = 2 \cdot 3.1416 \cdot 60 = 376.992 \text{ rad/s}$ .

a) inductive reactance

$$X_L = 2\pi fL = 2 \cdot 3.1416 \cdot 60 \cdot 0.6 = 226.2 \Omega$$

b) capacitance reactance

$$X_C = \frac{1}{2\pi fC} = \frac{1}{2 \cdot 3.1416 \cdot 60 \cdot 2 \cdot 10^{-6}} = 1326.6 \Omega$$

c) impedance

The circuit impedance is

$$Z = \sqrt{R^2 + (X_L - X_C)^2} = \sqrt{80^2 + (226.2 - 1326.6)^2} = 1103.3 \Omega$$

d) rms current of the circuit

The circuit current is

$$I = \frac{V}{Z} = \frac{110}{1103.3} \approx 0.1 \text{ A}$$

e) the AC frequency at which the RLC is in resonance  
the resonant frequency is

$$f_r = \frac{1}{2\pi\sqrt{LC}} = \frac{1}{2 \cdot 3.1416 \cdot \sqrt{0.6 \cdot 2 \cdot 10^{-6}}} = 145.3 \text{ Hz}$$

g) rms current if the frequency is at 50 Hz

The angular frequency  $\omega = 2\pi f = 2 \cdot 3.1416 \cdot 50 = 314.16 \text{ rad/s}$ .

The circuit impedance is

$$Z = \sqrt{R^2 + (X_L - X_C)^2} = \sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}$$
$$Z = \sqrt{80^2 + \left(314.16 \cdot 0.6 - \frac{1}{314.16 \cdot 2 \cdot 10^{-6}}\right)^2} = 1405.33 \text{ } \Omega$$

The circuit current is

$$I = \frac{V}{Z} = \frac{110}{1405.33} \approx 0.078 \text{ A}$$

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