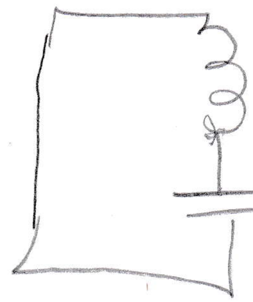
Homework 31.1

An oscillating LC circuit consists of a 75.0 mH inductor and a 3.60 μF capacitor. If the maximum chargo on the capacitor is 2.90 μC, what are the (a) total energy in the circuit and (b) the maximum current?



$$U_e = \frac{1}{2} C V^2 = \frac{1}{2} \frac{Q^2}{C}$$

$$\frac{1}{2} \frac{Q^2}{C} = \frac{\frac{1}{2}(2.9 \times 10^{-6})^2}{3.60 \times 10^{-6}}$$

a) $$= U = 1.17 \, \mu J$$

b) $$U = \frac{1}{2} L I_{MAX}^2$$

$$I_{max} = \sqrt{\frac{2U}{L}} = \sqrt{\frac{2 * 1.168 \times 10^{-6}}{75 \times 10^{-3}}}$$

$$= \sqrt{.0311 \times 10^{-3}} = \sqrt{0.311 \times 10^{-4}}$$

$$= \sqrt{0.311} \times 10^{-2}$$

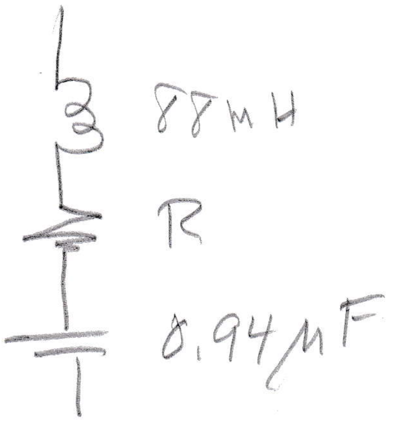
$$= 0.558 \times 10^{-2}$$

$$I_{max} = 5.58 \, mA$$

Homework 31.35

A coil of inductance 88 mH and an unknown resistance and a 0.94 μF capacitor are connected in series with an alternating emf of frequency 930 Hz. If the phase constant between the applied voltage and the current is 75°, what is the resistance of the coil

$$\omega = 2\pi * 930$$



$$\theta = 75^\circ$$

$$= \tan^{-1}\left(\frac{\omega L - \frac{1}{\omega C}}{R}\right)$$

$$\omega L = 2\pi 930 * 88 \times 10^{-3}$$

$$X_L = \omega L = 514\ \Omega$$

$$X_C = \frac{1}{\omega C} = \frac{1}{2\pi 930 * 0.94 \times 10^{-6}} = 182\ \Omega$$

$$\tan 75^\circ = \frac{\omega L - \frac{1}{\omega C}}{R} = 3.73$$

$$R = \frac{332}{3.73} = 89.0\ \Omega$$

Homework 31.39

Remove the inductor from the circuit in Fig. 31-7 and set R = 200 Ω, C = 15.0 μF, f_d = 60.0 Hz, and ξ_m = 36.0 V. What are (a) Z, (b) φ, and (c) *I*? (d) Draw a phasor diagram.

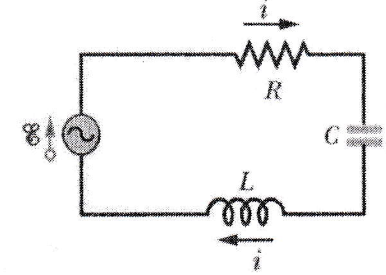
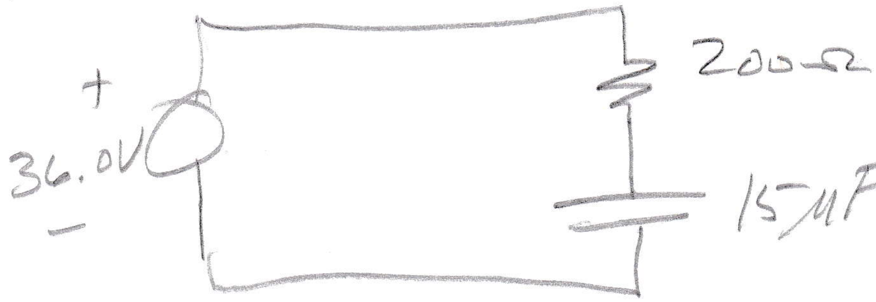


Figure 31-7 A single loop circuit containing, a resistor, a capacitor, and an inductor. A generator, represented by a sine wave in a circle, produces an alternating emf that establishes an alternating current; the direction of the emf and current are indicated here at only one instant.



$$X_c = \frac{1}{\omega C} = \frac{10^6}{120\pi \times 15} = 176.8\,\Omega$$

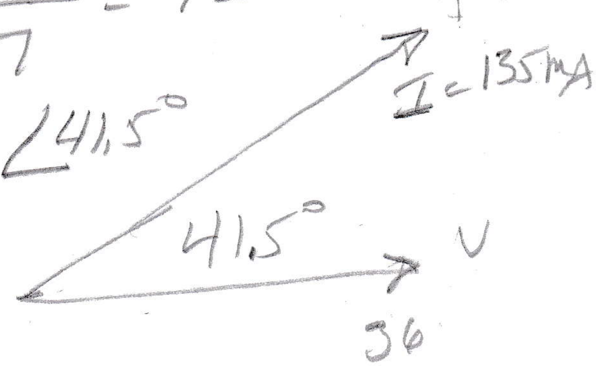
$$a)\ Z = R - jX_c = 200 - j176.8\ \Omega$$

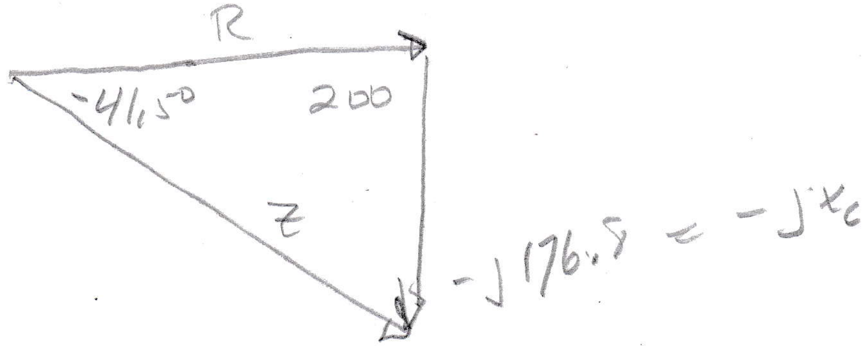
$$(a)\ |Z| = \sqrt{(200)^2 + (176.8)^2} = 267\,\Omega$$

$$(b)\ \phi = \tan^{-1}\left(\frac{-X_c}{R}\right) = \tan^{-1}\left(\frac{-176.8}{200}\right) = -41.5^\circ$$

$$(c)\quad V = IZ \qquad I = \frac{V}{Z} = \frac{36.0}{267} = 135\ \text{mA}$$

$$I = \frac{V}{Z} = \frac{36}{267\angle -41.5^\circ} = 135\ \text{mA}\angle 41.5^\circ$$





Homework 31.53

An air conditioner connected to a 120 V rms ac line is equivalent to a 12 Ω resistance and a 1.3 Ω inductive reactance in series. Calculate (a) the impedance of the air conditioner and (b) the average rate at which energy is supplied to the appliance.

a) $Z = 12 + j\,1.3$

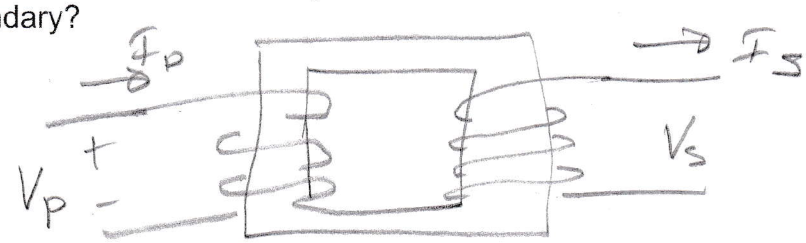
$|Z| = \sqrt{12^2 + 1.3^2} = 12.07\ \Omega$

$|I| = \frac{V}{|Z|} = \frac{120}{12.07}$

b) $P = I^2 R = \left(\frac{120}{12.07}\right)^2 \times 12 = 1.19\ \text{kW}$

Homework 31.63

A transformer has 500 primary turns and 10 secondary turns. (a) If V_p is 120 V (rms), what is V_s with an open circuit? If the secondary now has a resistive load of 15 Ω, what is the current in the (b) primary and (c) secondary?



$N_p = 500$ $N_s = 10$

$$\frac{V_s}{V_p} = \frac{N_s}{N_p} = \frac{10}{500}$$

a) $V_s = \frac{V_p}{50} = \frac{120}{50} = 2.4$ Volts

$$\frac{I_s}{I_p} = \frac{500}{10} = 50$$

(c) $I_s = \frac{2.4}{15} = 160$ mA

(b) $I_p = \frac{I_s}{50} = \frac{160}{50} = 3.2$ mA