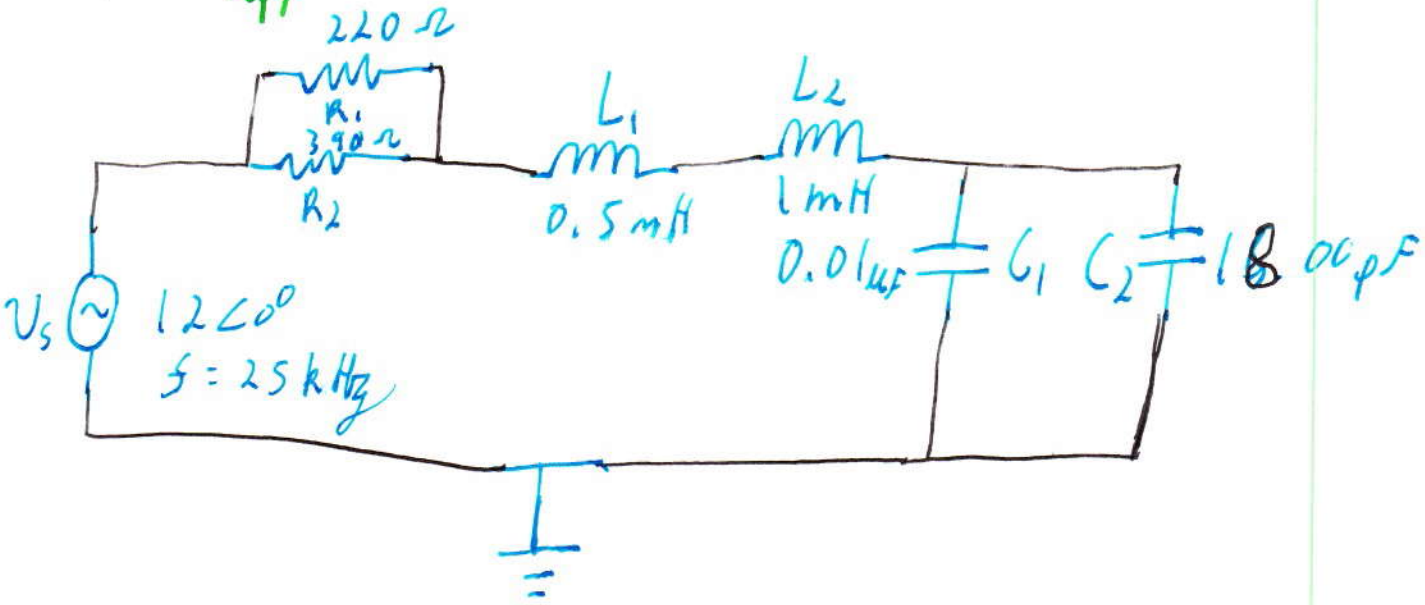
7) analyze the circuit in Figure 17-67 for:

a) I_{total}

b) P_{true}

c) $P_{reactive}$

d) $P_{apparent}$



$$\frac{R_1 \times R_2}{R_1 + R_2} = R_{1112} = \frac{220 \times 390}{220 + 390}$$

$$R_{1112} = 140.655\ \Omega$$

$$L_1 + L_2 = 0.5\ mH + 1\ mH = 1.5\ mH = L_{total}$$

$$X_L = 2\pi L f$$

$$X_L = 2\pi (1.5 \times 10^{-3})(25 \times 10^{3})$$

$$X_L = 235.619\,j$$

$$C_1 + C_2 = 0.01\ \mu F + 1800\ pF$$

$$C_{total} = 10\ nF + 1.8\ nF$$

$$C_{total} = 11.8\ nF$$

$$X_C = \frac{-j}{2\pi f C} = \frac{1}{2\pi (25 \times 10^{3})(11.8 \times 10^{-9})}$$

$$X_C = -539.51\,j$$

$$R_{1112} + X_C + X_L = Z_{total}$$

$$140.655\ \Omega + 235.619j - 534.51j$$

$$Z_{total} = 334.863 \angle -65.163^\circ$$

$$\frac{V}{Z} = i_{total}$$

$$\frac{12 \angle 0}{334.863 \angle -65.163^\circ} = ~~15~~.$$

~~3.583~~

$$35.836 \times 10^{-3} \angle 65.163^\circ$$

$$i_{total} = 35.836 \angle 65.163^\circ \text{ mA}$$

d)

$P_{apparent} = V I$

$12 \times 35.836 \angle 65.163 \text{ mA}$

$P_{apparent} = 0.430 \angle 65.163^\circ \text{ VA}$

$0.1806 + 0.3902j$

~~Real~~

Real Reactive

b) $P_{real} = 0.1806$ watts

c) $P_{reactive} = 0.3902j$ var

11) a certain series resonant circuit has a maximum current of 50 mA and V_L of 100 V.

The applied voltage is 10 V.

What is Z? what are x_L and x_C

Known information

Series Resonance circuit $f_R = \frac{1}{2\pi\sqrt{LC}}$

$i_{max} = 50\,mA$

$V_L = 100\,V$

$V_S = 10\,V$

objective

Z

x_L

x_C

$$V = iR$$

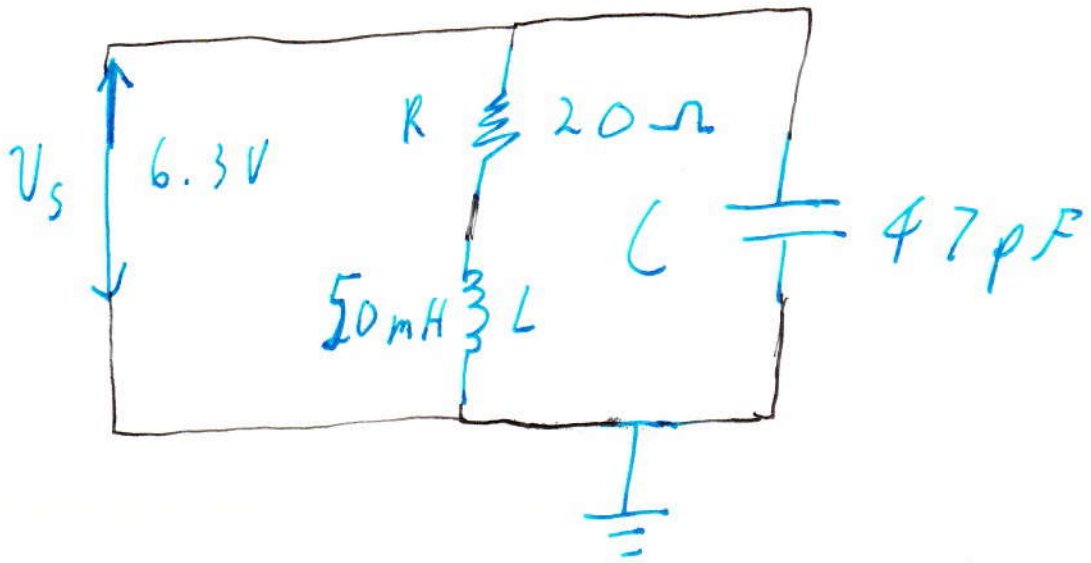
$$\frac{V}{i} = R$$

$$\frac{10}{5 \text{ mA}} =$$

$$\frac{1}{5 \times 10^{-3}} = \boxed{200 = R = Z}$$

$$\boxed{X_L \text{ and } X_C = 0}$$

23) Find Z at resonance and f_r for the tank circuit in Figure 17–71.



$$X_L = 2\pi f L \quad j$$

$$X_C = \frac{-j}{2\pi f C}$$

$$Q = \frac{X_L}{R_W}$$

$$Z_R = R_W (Q^2 + 1)$$

$$f_r = \frac{\sqrt{1 - (R_W^2 C)}}{\frac{L}{2\pi\sqrt{LC}}}$$

$$f_{Resonance} = \frac{\sqrt{1 - \frac{(20^2) \times 47 \times 10^{-12}}{50 \times 10^{-3}}}}{2\pi\sqrt{(50 \times 10^{-3}) \times (47 \times 10^{-12})}}$$

$$\boxed{f_{Resonance} = 1.0382 \times 10^5 \text{ Hz}}$$

~~$X_L = 2\pi L f$~~ $X_C = \frac{-1}{2\pi f C}$

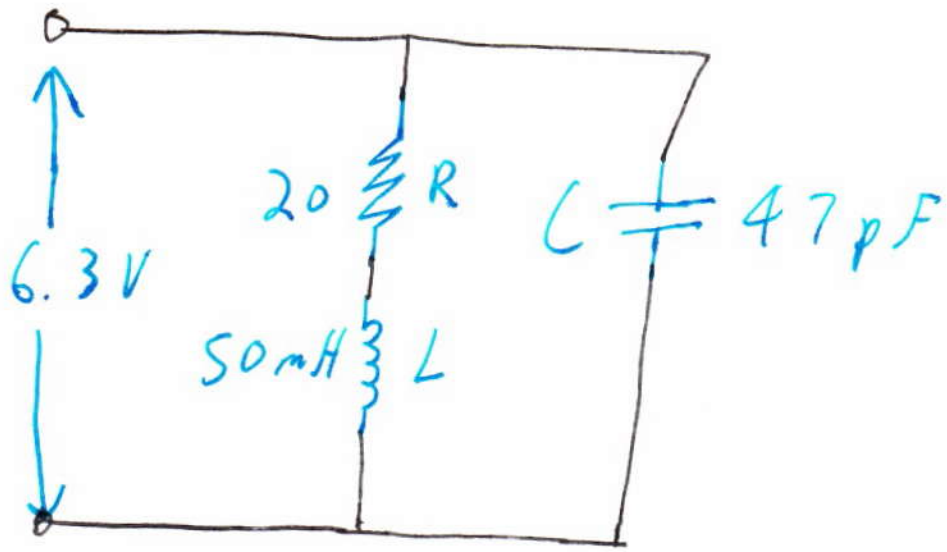
$$Z_H = R_W (Q^2 + 1) \qquad Q = \frac{X_C}{R_W}$$

$$Z_r = 20\left(\frac{50 \times 10^{-3}}{20}\right)^2 + 1$$

$$\boxed{Z_r = 1.0001\ \Omega}$$

24) How much current is drawn from the source in Figure 17-71 at Resonance?

What are the inductive current and capacitive current at the Resonant frequency?



information from 23)

$f_{resonance} = 1.0382 \times 10^5 \text{ Hz}$

$Z_r = 1,0001\ \Omega$

equations

$X_L = 2\pi f L$

$X_C = 2\pi f C$

$i_{branch} = \frac{Z_{total}}{Z_{branch}} i_{source}$

$$X_L = 2\pi f L$$

$$X_L = 2\pi (1.0382 \times 10^5)(50 \times 10^{-3})$$

$$X_L = 32.616 \times 10^3$$

$$X_C = \frac{1}{2\pi f C}$$

$$X_C = \frac{1}{2\pi (1.0382 \times 10^5)(47 \times 10^{-12})}$$

$$X_C = 32.617 \times 10^3$$

$$Z_{L\,line} = 20 + 32.616j \times 10^3$$

$$Z_{C\,line} = -32.617 \times 10^3 j$$

$$\frac{Z_L Z_C}{Z_L + Z_C} = \frac{(32.616j \times 10^3)(-32.616 \times 10^3 j)}{20 + 0.001j}$$

$$Z_{total} = 5.319 \times 10^7 \angle 0.00286°$$

$$\frac{V}{Z} = i$$

$$\frac{6.3}{5.319 \times 10^7 \angle 0.00286°} = 11.844 \times 10^{-6} \angle -2.864 \angle 0.00286°$$

$$\boxed{i_{total} = 11.844\ \mu A}$$

phase is negligible

$$\frac{5.319 \times 10^{7}}{20 + 32.616j} \; 11.894 \times 10^{-6} = \dot{i}_{L_{branch}}$$

$$\dot{i}_{L_{branch}} = 1.630 \text{ mA} \angle -89.965^{\circ}$$

$$\frac{5.319 \times 10^{7}}{-32.616j} = \dot{i}_{C_{branch}}$$

$$\dot{i}_{C_{branch}} = 1.6308 \angle 90^{\circ} \text{ mA}$$

25) Find P_{true}, $P_{reactive}$ and $P_{apparent}$ in the circuit of Figure 17-71 at resonance.

$$\dot{I}_{total} = 11.844 \times 10^{-6} \angle 0.00286°$$

$$V = 6.3\ V$$

$$P_{apparent} = V\dot{I}$$

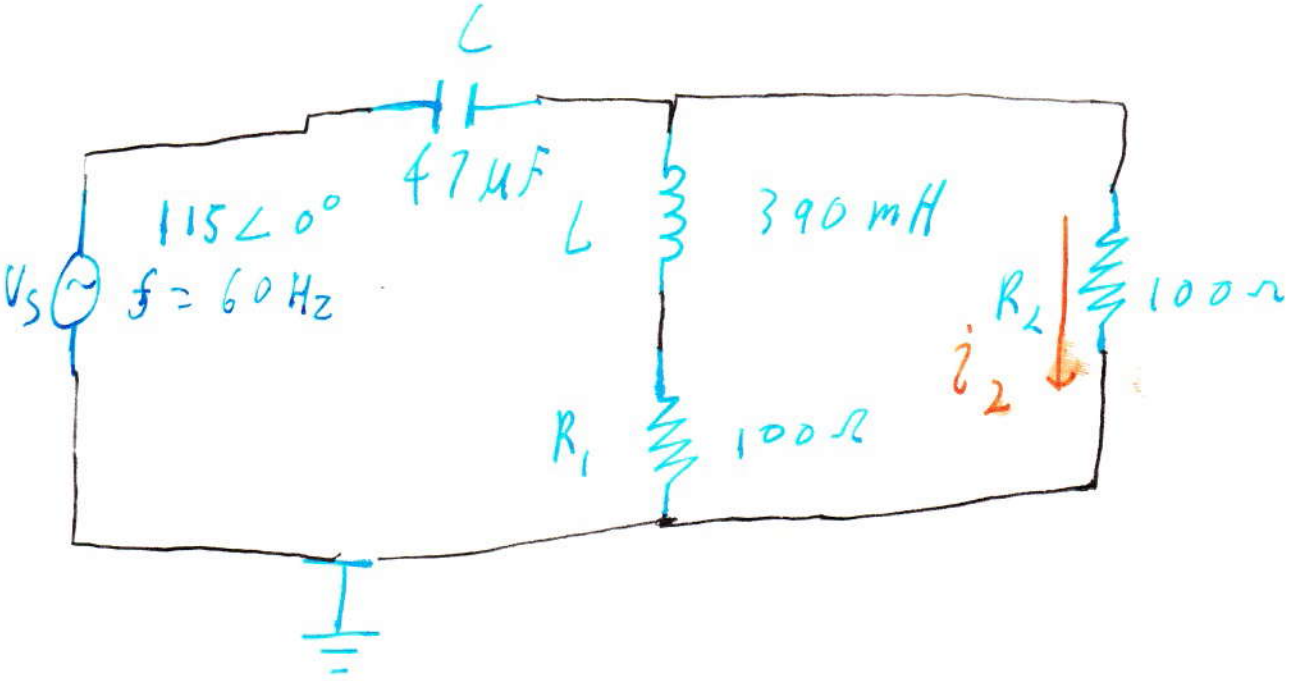
$$P_{apparent} = 6.3 \times 11.844 \times 10^{-6} \angle 0.00286°$$

$$P_{apparent} = 0.796 \times 10^{-6} \angle 2.86 \times 10^{-3}\ VA$$

$$P_{real} = 0.746 \times 10^{-6}\ watt$$

$$P_{reactive} = 3.7296 \times 10^{9}\ Var$$

31) In Figure 17-74, what is the phase angle between i_2 and the source voltage?



$X_L = 2\pi f L j$

$X_C = \frac{-j}{2\pi f C}$

$\frac{Z_{total}}{Z_{target}} i_S = i_{target}$

$$X_L = 2\pi(60)(390\times10^{-3})$$

$$X_L = 147.026j$$

$$X_C = \frac{-1}{2\pi(60)(47\times10^{-6})}$$

$$X_C = -56.437j$$

$$Z_{L\,line} = 100 + 147.026j$$

$$Z_{11} = \frac{Z_{L\,line}\,R_2}{Z_{L\,line} + R_2} = \frac{200 + 147.026j}{}$$

$$Z_{11} = 67.541 + 23.861j$$

$$Z_{total} = Z_{11} + X_C$$

$$Z_{total} = 74.986 \angle -25.748^\circ$$

$$\frac{V}{Z} = \dot{I}_{total}$$

$$\frac{115}{74.986 \angle -25.748^\circ} = 1.533 \angle 25.748^\circ$$

$$\frac{Z_{total}}{R_2} \dot{I}_{total} = \dot{I}_{R_2}$$

$$\frac{74.986 \angle -25.748^\circ}{100} (1.533 \angle 25.7489^\circ =$$

$$\dot{I}_{R_2} = 1.149 \text{ A}$$

$$\angle \dot{I}_{R_2} - \angle V_S = 0^\circ$$