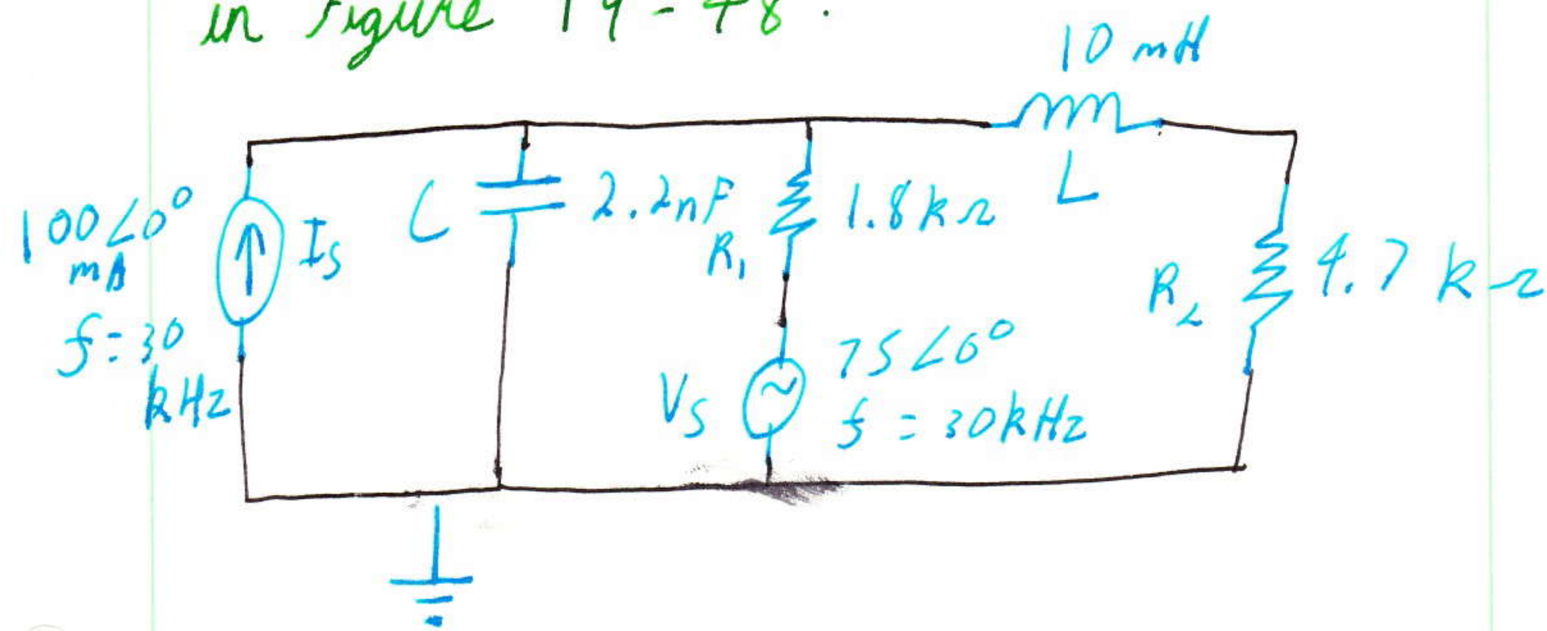
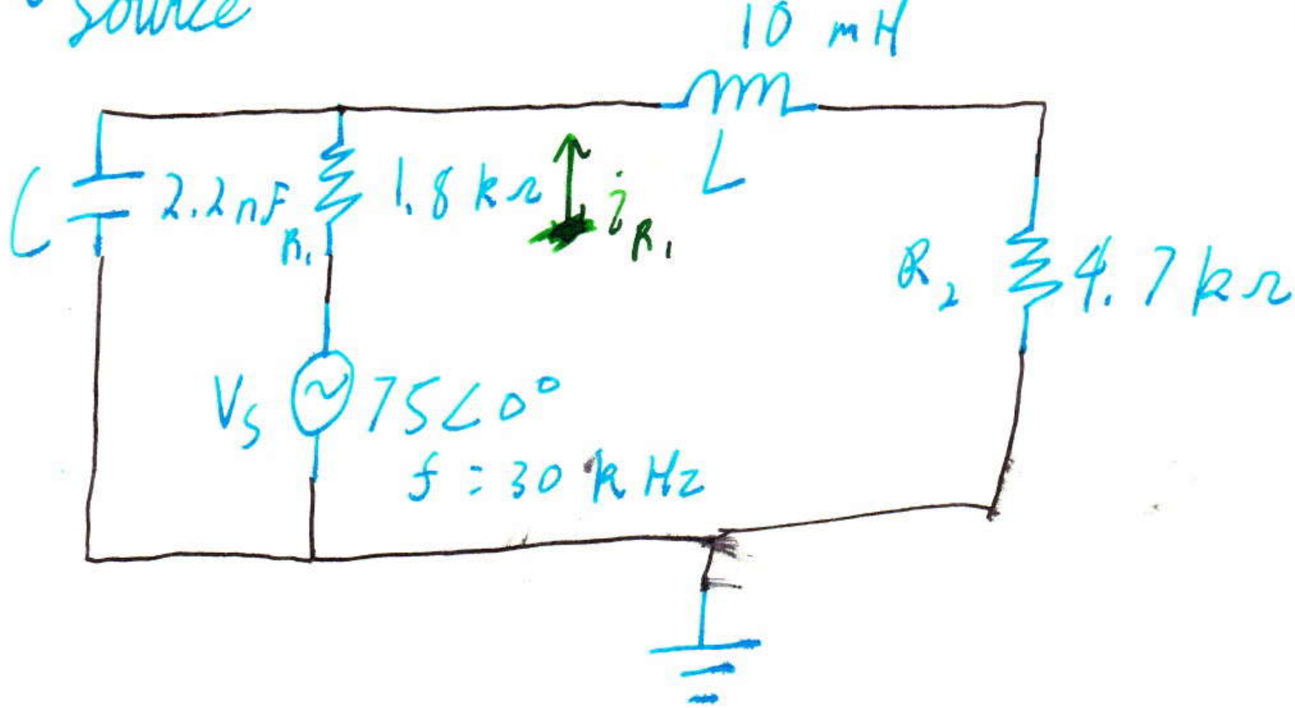
CPE 1150 | Hw 5 | Bruce Liu

3) Using the superposition theorem, Solve for the current through R_L in Figure 19-48.



V_{source}



$X_L = 2\pi f L$

$X_L = 2\pi(30 \times 10^{+3})(10 \times 10^{-3})$

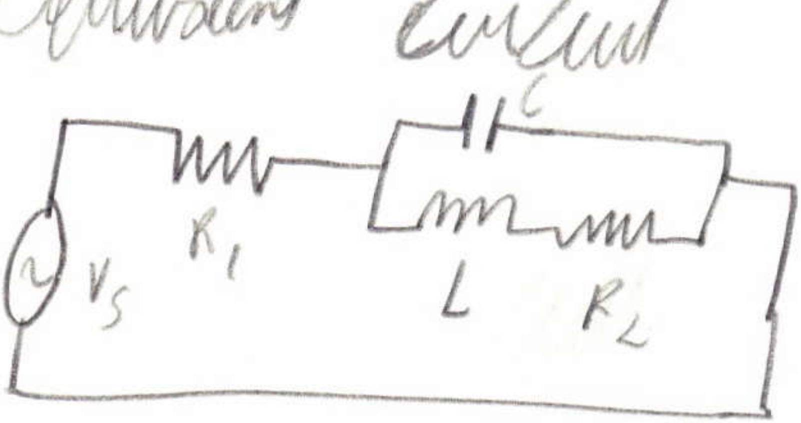
$X_L = 600\pi = 1.885 \times 10^3 j$

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

$X_C = \frac{1}{2\pi(30 \times 10^{+3})(2.2 \times 10^{-9})}$

$X_C = -2.4114 \times 10^3 j$

equivalent circuit



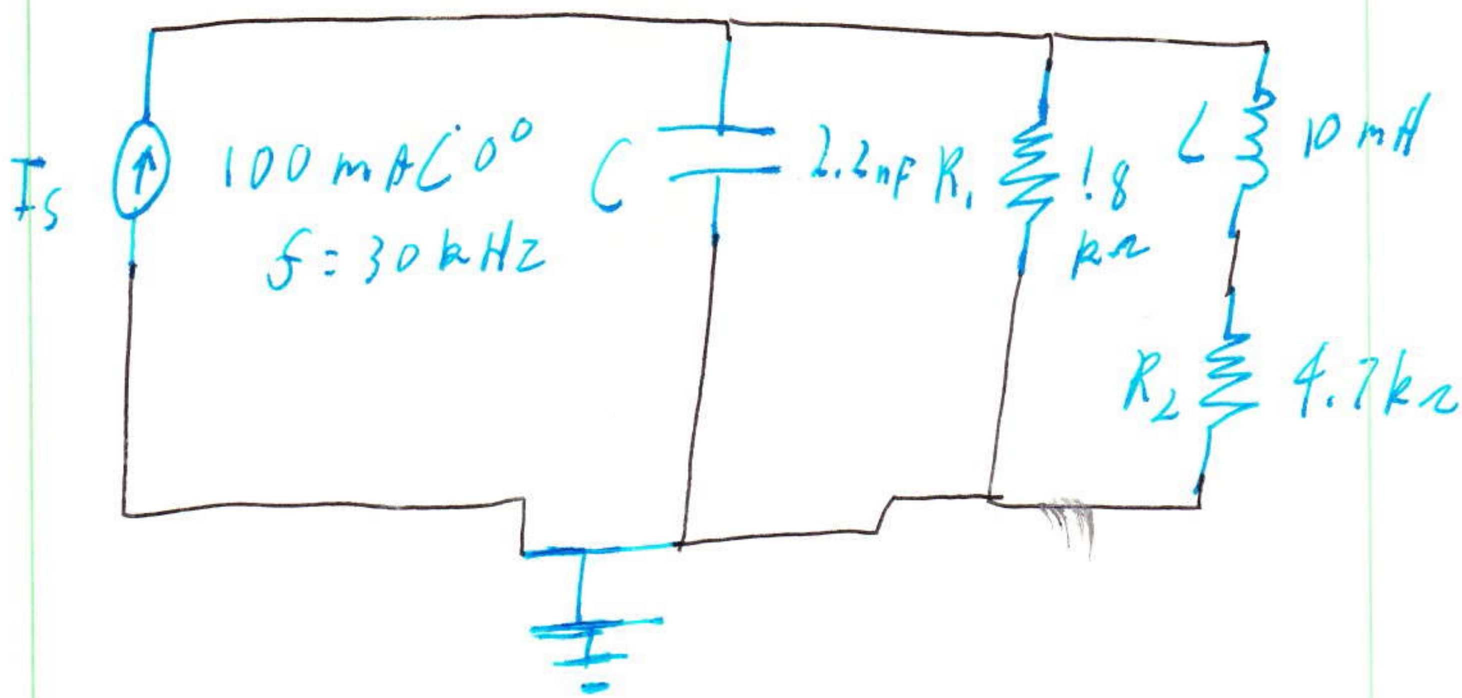
$$\frac{(4.7\times10^{3} + 1.885\times10^{3} j)\times(-2.4114\times10^{3} j)}{(4.7\times10^{3} + 1.885\times10^{3} j) + (-2.4114\times10^{3} j)}$$

$$Z_{C \| L+R_2} = 2.5818\times10^{3} \angle 61.724^\circ$$

$$Z_T = R_1 + Z_{C \| L+R_2} = 3.7827\times10^{3} \angle -36.948^\circ$$

$$\frac{V_s}{Z_T} = i_{R_1} = 19.827\times10^{-3} \angle 36.948$$

I_S circuit



$$Z_{C \parallel R_1} = \frac{(-2.4114 \times 10^3 j)(1.8 \times 10^3)}{(1.8 \times 10^3) + (-2.4119 \times 10^3 j)}$$

$$Z_{C \parallel R_1} = 1.4415 \times 10^3 \angle -36.71$$

$$Z_t = Z_{C\|R} + Z_{L+R_2}$$

$$Z_T = 1.4415 \times 10^3 \angle 36.71 + (1.885 \times 10^3 j) + (4.7 \times 10^3)$$

$$Z_T = 5.9443 \times 10^3 \angle 9.913^\circ$$

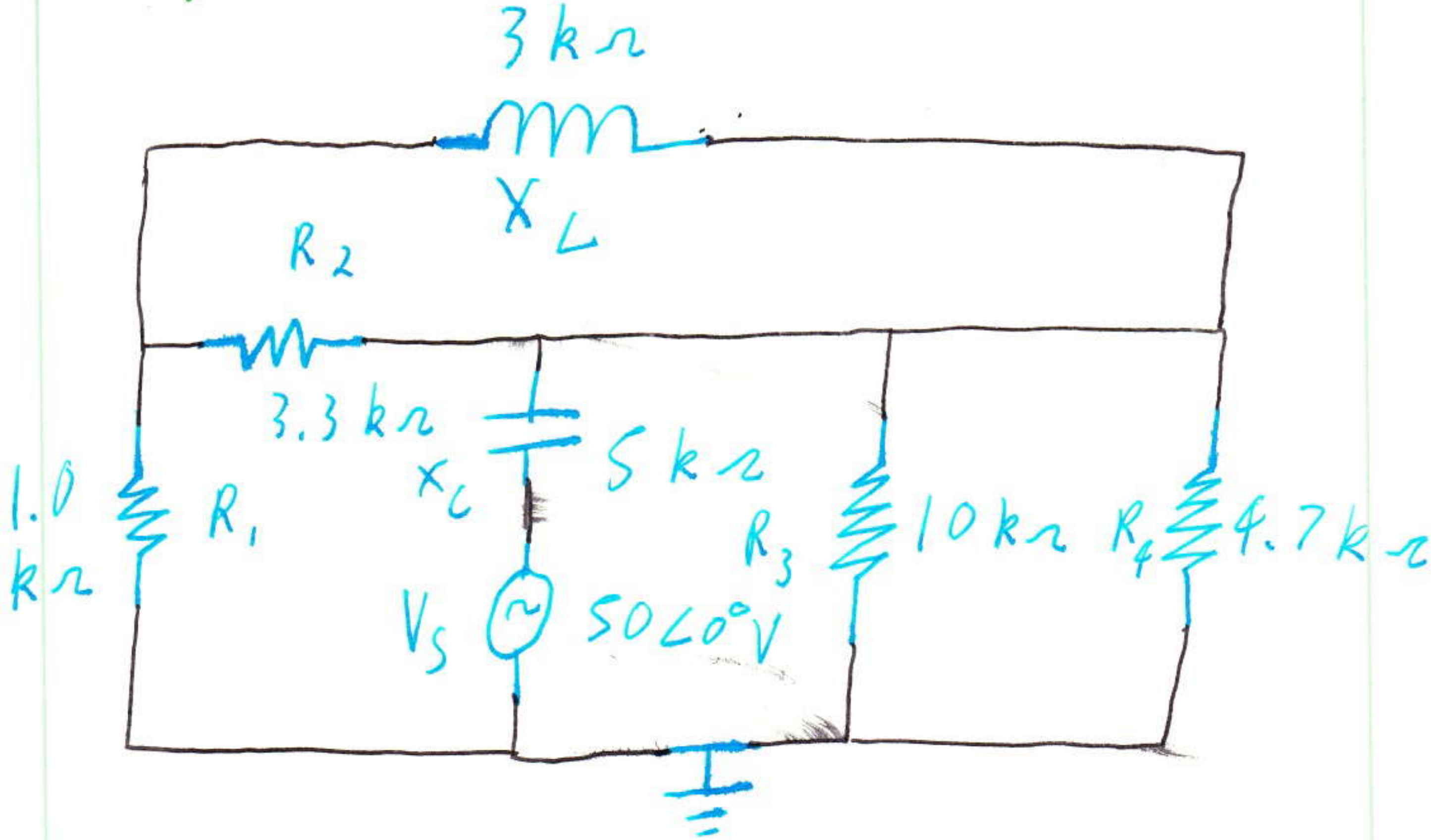
$$i_{R_1} = \frac{Z_T}{Z_{R_1}} i_s$$

$$i_{R_{1 I_s}} = 0.33024 \angle 9.9132^\circ$$

$$i_{R_{1 I_s}} + i_{R_{1 V_s}} = 0.33024 \angle 9.9132 + 19.827 \angle 36.948^\circ$$

$$\boxed{i_{R_1} = 0.34802 \angle 11.397}$$

10) Using Thevenin's, find the Voltage accross R_4 in Figure 19-54.



$$V_{R_4} = \frac{4.7 \times 10^3}{-5 \times 10^{3} j + 4.7 \times 10^3} \; 50\angle 0^\circ \text{ V}$$

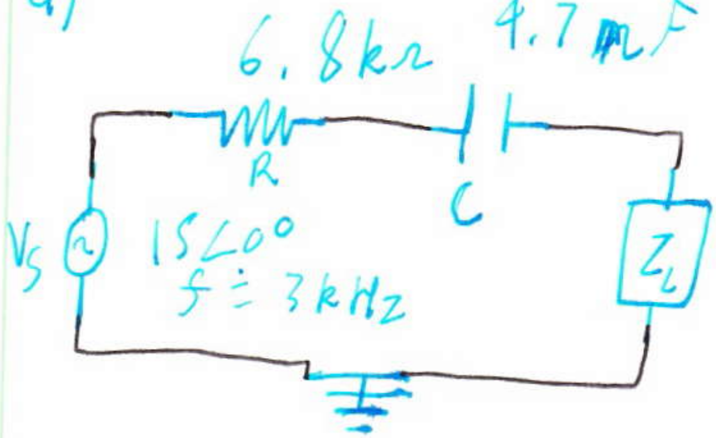
$$V_{R_4} = 34.246 \angle 46.771$$

$$\cancel{V_{R_4} = 34.2 \angle 46.8^\circ}$$

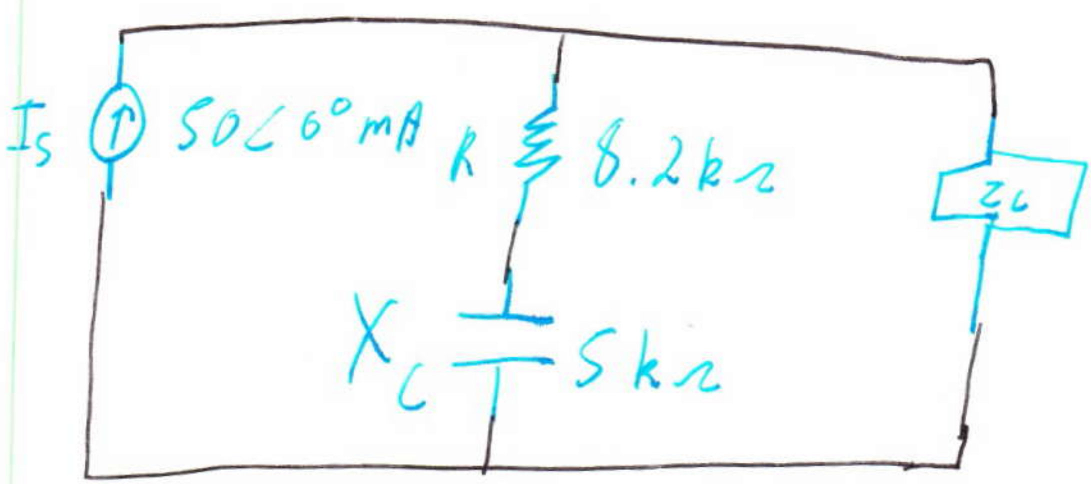
$$\boxed{V_{R_4} = 34.2 \angle 46.8^\circ}$$

16) For each circuit in Figure 19-56, maximum power is to be trasferred to the load R_L, Determine the appropriate value for the load impedance in each case.

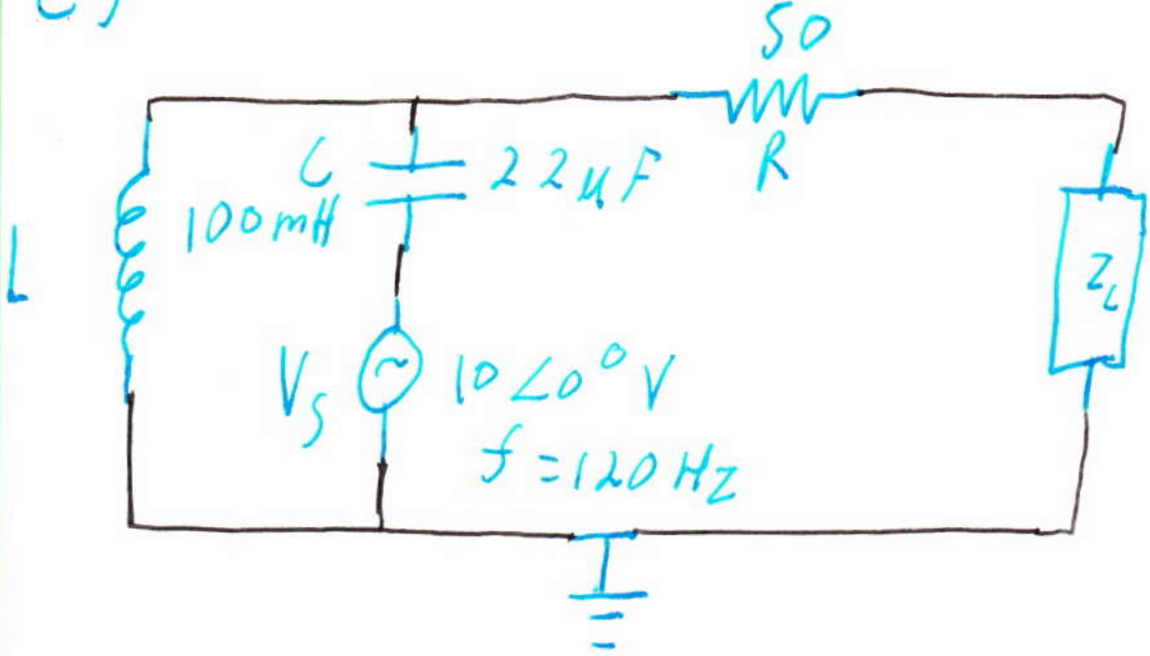
a)



b)



c)



d)

a) $6.8 \times 10^3 = R$

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

$$X_C = \frac{1}{2\pi(3\times10^3)(4.7\times10^{-9})}$$

$$X_C = 11.288\times10^3 j$$

$$Z_{Th} = R + (-X_C)$$

$$Z_{Th} = 6.8\times10^3 - 11.288\times10^{3} j$$

$$Z_{Th} = Z_L = 13.178\times10^3 \angle 58.93$$

$$\boxed{Z_L = 13.2 \angle 58.9^\circ \, k\Omega}$$

b)

$X_C + R = 8.2\times10^3 + (-5\times10^3 j)$

$\boxed{Z_{R+X_C} = 9.6042\times10^3 \angle -31.373^\circ}$

$\underline{V_S}$

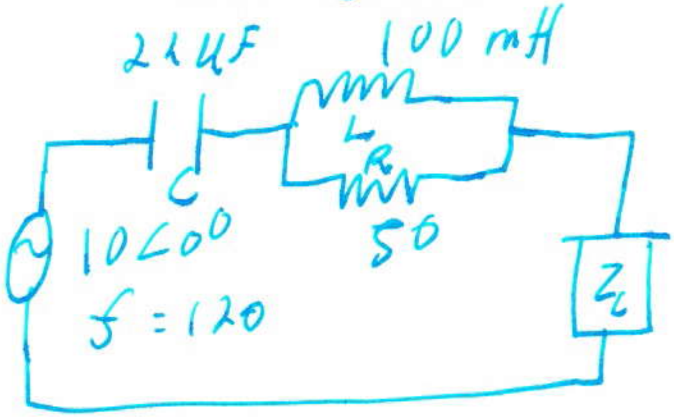
$\dot{V} = \dot{i} Z = (50\times10^{-3} \angle 0^\circ) \times (9.604\times10^3 \angle 31.373^\circ)$

~~$V = 4.8$~~

$480.21 \angle -31.373\ V = V$

c)

redrawn circuit



$$X_C = \frac{1}{2\pi(22\times10^{-6})(120)}$$

$$X_C = -60.286j$$

$$X_L = 2\pi f L$$

$$X_L = 2\pi\, 120\, 100\times10^{-3}$$

$$X_L = 12\pi$$

$$X_L = 37.699j$$

$$R \parallel L = \frac{50 \times 37.699j}{50 + 37.699j}$$

$$Z_{R \parallel L} = 30.102 \angle -37.016$$

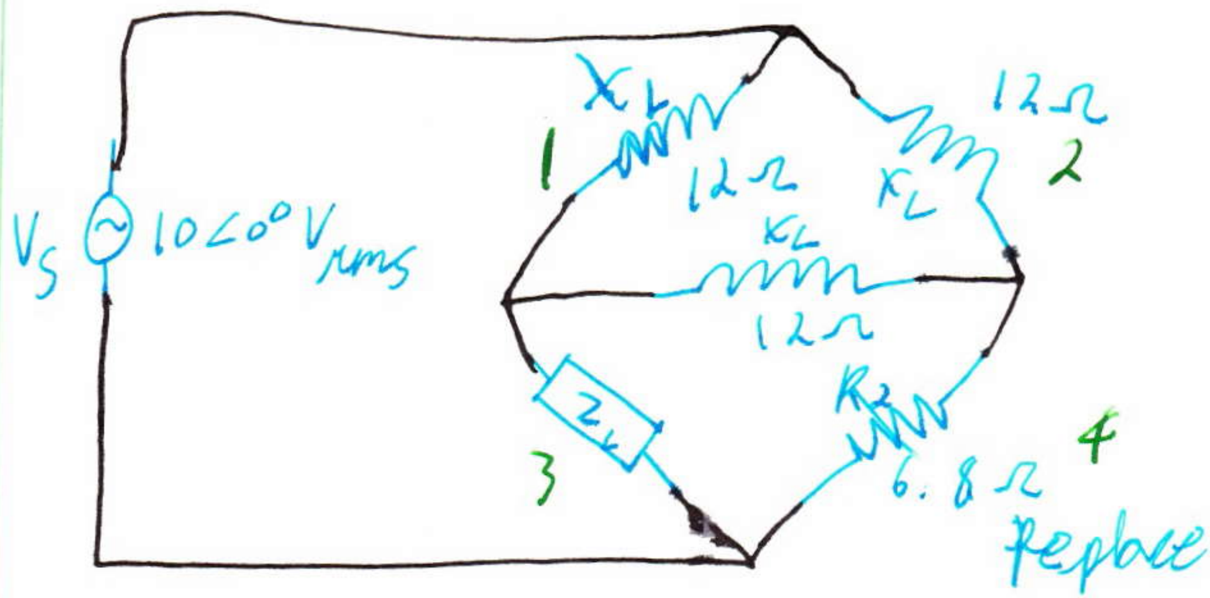
$$Z_T = C + R \parallel L$$

$$Z_T = -60.286j + 30.102 \angle -37.016$$

$$Z_T = 82.009 \angle -72.458^\circ$$

$$\boxed{Z_T = Z_L = 82.009 \angle -72.458^\circ}$$

18) a load is to be connected in place of R_2 in Figure 19-55 to achieve maximum power transfer. Determine the type of load, and express it in rectangular form.



balanced wheatstone bridge

$$\frac{V_{Z_1}}{V_{Z_3}} = \frac{V_{Z_2}}{V_{Z_4}}$$

$$\frac{Z_1}{Z_L} = \frac{Z_2}{Z_{R_2}}$$

$$\frac{Z_{R_2}}{Z_L} = \frac{Z_2}{Z_1}$$

$$\frac{Z_{R_2}}{Z_L} = \frac{12j}{12j}$$

$$\frac{Z_{R_2}}{Z_L} = 1$$

$$\boxed{Z_{R_2} = Z_L = 12j}$$