Sección 16.2 - Redes de Ca En serie - paralelo

1. Para la red en serie - paralelo de la figura 16.39

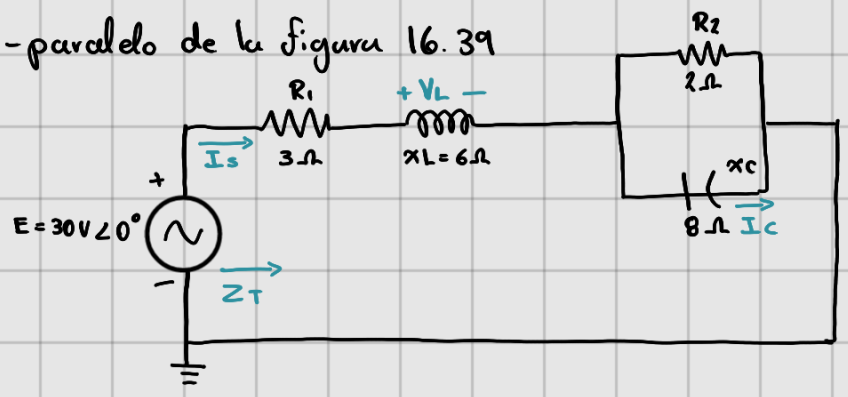
a) Calcule Z_T

b) Determine I

c) Determine I_1

d) Encuentre I_2 e I_3

e) Encuentre V_L



$$I_{D_1} = \frac{V_{R_1}}{R_1} = \frac{0.7}{3.3} = 0.212$$

$$I_{D_2} = I_2 - I_1 = 3.32 - 0.212 = 3.108\ mA$$

$$Z_L = 6\angle +90°$$

$$Z_{C_1} = 8\angle -90°$$

$$Z_{C_2} = 12\angle -90°$$

$$Z_C = \frac{(6\angle -90°)(12\angle -90°)}{8\angle -90 + 12\angle 90°} = \frac{18\angle -180°}{-8j + 12j} = \frac{16\angle -150}{20\angle -90°}$$

$$Z_C = 4.8\angle -90°$$

a) $Z_T = 6\angle 90° + 4.8\angle -90° + 6j - 4.8j + 4.2j$

$= 1.2\angle 90°\ \Omega$

b) $I = \frac{E}{Z_T} = \frac{12\angle 0°}{1.2\angle 90} = 10\angle -90°\ A = I_1$

c)

ROC

$I_R = I_T = \frac{Z_T}{Z_R}$ $I_2 = 10\angle -90 \left(\frac{4.8\angle -90°}{12\angle -90°}\right) = 10\angle -90° (0.6\angle 0°) = 6\angle -90°\ A$

d) $I_3 = 10\angle -90 \left(\frac{4.8\angle -90°}{12\angle -90°}\right) = 10\angle -90° (0.4\angle 0°) = 4\angle -90°\ A$

e) $V_L = (10\angle -90)(6\angle +90°) = 60\angle 0°\ V$

2. Para la red

a) Encuentre la impedancia total Z_T

b) Determine la corriente I_s

c) Calcule I_c utilizando la regla del divisor de corriente

d) Calcule V_L utilizando la regla del divisor de voltaje

$Z_{R_1} = 3\angle 0°$ $\quad Z_{R_2} = 2\angle 0°$

$Z_L = 6\angle 90°$ $\quad Z_C = 8\angle -90$

$$Z_{R_2C} = \frac{(2\angle 0°)(8\angle -90°)}{2\angle 0° + 8\angle -90°} = \frac{16\angle -90°}{2 - 8j} = \frac{16\angle -90}{2\sqrt{17}\angle -72.96°} = 1.94\angle -14.04°$$

a) $Z_T = 3\angle 0° + 6\angle 90° + 1.94\angle -14.04 = 3 + 6j + 1.88 - 0.47j$

$= 4.88 + 5.52j = \underline{7.37\angle 48.55° \Omega}$

b) $I_s = \frac{30\angle 0°}{7.37\angle 48.55°} = 4.06\angle -48.55 A$

$$I_c = \frac{(2\angle 0°)(4.06\angle -48.55)}{2\angle 0° + 8\angle -90°} = \frac{8.13\angle -48.55}{2 - 8j}$$

$$= \frac{8.13\angle -48.55°}{2\sqrt{17}\angle -75.90°}$$

c) $I_c = 0.986\angle 27.41° A$

b) $V_L = \frac{(6\angle 90°)(30\angle 0°)}{7.37\angle 48.56°} = \frac{180\angle 90°}{7.37\angle 48.55°}$

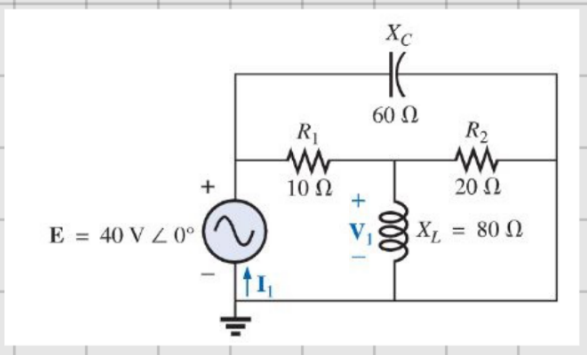
$= 24.40\angle 41.45 V$

7. Para la red

a) Encuentre la corriente I_1

b) Encuentre el voltaje V_1

c) Calcule la potencia promedio entregada a la red



$Z_{R_1} = 10\angle 0°$

$Z_{R_2} = 20\angle 0°$

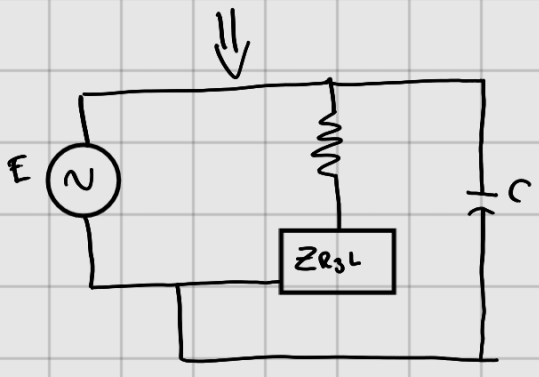
$Z_C = 60\angle -90°$

$Z_L = 80\angle 90°$

$$Z_{R_2L} = \frac{(20)(80\angle 90°)}{20\angle 0° + 80\angle 90°}$$

$$= \frac{160\angle 90°}{20 + 30j} = \frac{160\angle 90°}{20\sqrt{17}\angle 71°}$$

$$= 19.40\angle 19.24$$



$$Z_{R_1R_2L} = 10 + 4.70j + 18.82 = 28.82 + 4.70j = 29.20\angle 9.27°$$

$$Z_T = \frac{(29.20\angle 9.27°)(60\angle -90°)}{29.20\angle 9.27° + 60\angle -90°} = \frac{1752.36\angle -80.72°}{28.82 + 4.70j - 60j} = \frac{1752.36\angle -80.72°}{28.82 - 55.29j}$$

$$= \frac{1752.36\angle -80.72°}{62.356\angle -62.468°} = 28.103\angle -18.25°$$

a) $I_1 = \frac{E}{Z_T} = \frac{40\angle 0°}{28.103\angle -18.25} = 1.42\angle 18.25\ A$

b) $V_1 = 26.574\angle 4.76°\ V$

c) $P = E \cdot I \cos\theta$

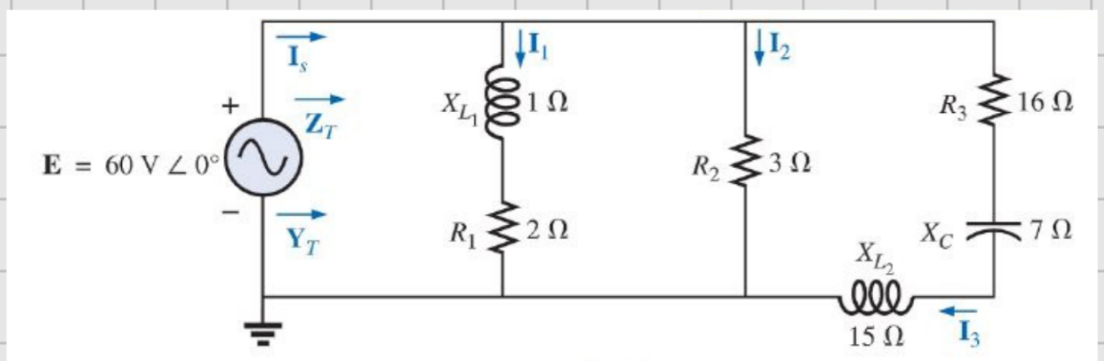
$= (40)(1.42)(\cos 18.25)$

$= 54.054\ W$

$$V_1 = \frac{Z_{R_1}E}{Z_{R_1R_2L}} = \frac{(19.4\angle 14.04°)(40\angle 0°)}{29.20\angle 9.27°}$$

$$= \frac{72.12\angle 14.04°}{29.20\angle 9.273°}$$

8. Para la red



a. Encuentre la impedancia total $\mathbf{Z}_T$ y la admitancia $\mathbf{Y}_T$.
b. Encuentre las corrientes $\mathbf{I}_1$, $\mathbf{I}_2$ e $\mathbf{I}_3$.
c. Verifique la ley de corriente de Kirchhoff demostrando que $\mathbf{I}_s = \mathbf{I}_1 + \mathbf{I}_2 + \mathbf{I}_3$.
d. Encuentre el factor de potencia de la red, e indique si se encuentra adelantado o atrasado.

$Z_{L1} = 1\angle 90°$ $Z_{R1} = 2\angle 0°$ $Z_{R3} = 16\angle 0°$

$Z_{L2} = 15\angle 90°$ $Z_{R2} = 3\angle 0°$ $Z_C = 7\angle -90°$

$$Z_{L_1R_2} = 1\angle 90° + 2\angle 0° = 1j + 2$$
$$= 2.23\angle 26.56°$$

$$Z_{R_3C_2} = 16\angle 0° + 7\angle -90° + 15\angle 90°$$
$$= 16 - 7j + 15j$$
$$= 16 + 8j$$
$$= 17.88\angle 26.56°$$

$$Y_T = \frac{1}{Z_{L_1R_1}} + \frac{1}{Z_{R_2}} + \frac{1}{Z_{R_3C_2}}$$
$$= \frac{1}{2.23\angle 26.56} + \frac{1}{3\angle 0°} + \frac{1}{17.88\angle 26.56}$$
$$= 0.44\angle -26.56 + 0.33\angle 0° + 0.05\angle -26.56$$
$$= (0.4 - 0.2j) + (0.05 - 0.025j) + 0.33$$
$$= 0.783 - 0.225j$$
$$Y_T = 0.815\angle -16.03°$$

a) $$Z_T = \frac{1}{Y_T}$$
$$= \frac{1}{0.81\angle -16.03°}$$
$$= 1.22\angle 16.03°$$

b) $$I_1 = \frac{E}{Z_{R_1}} = \frac{60\angle 0°}{2.23\angle 26.56°}$$
$$= 26.83\angle -26.56° A$$

$$I_2 = \frac{E}{Z_{R_2}} = \frac{60\angle 0°}{3\angle 0°}$$
$$= 20\angle 0° A$$

$$I_3 = \frac{E}{Z_{R_3C_2}} = \frac{60\angle 0°}{17.88\angle 26.56°}$$
$$= 3.35\angle -26.56° A$$