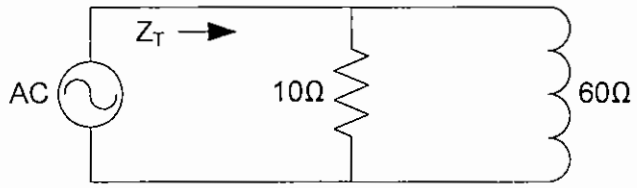
KEY 1/3

EE 301 HW#21
AC Parallel

1) Given:

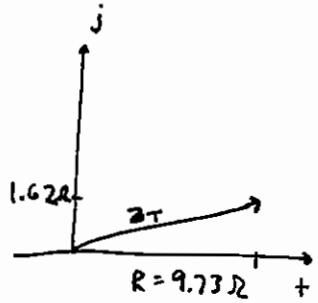


Find the total impedance for the given network and draw the impedance diagram.

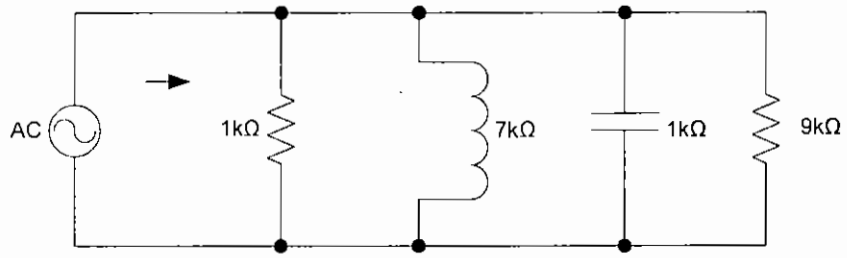
$$Z_T = \left(\frac{1}{10\Omega} + \frac{1}{j60\Omega}\right)^{-1}$$

$$Z_T = 9.87\Omega \angle 9.5^\circ$$

$$= 9.73\Omega + j1.62\Omega$$



2) Given:

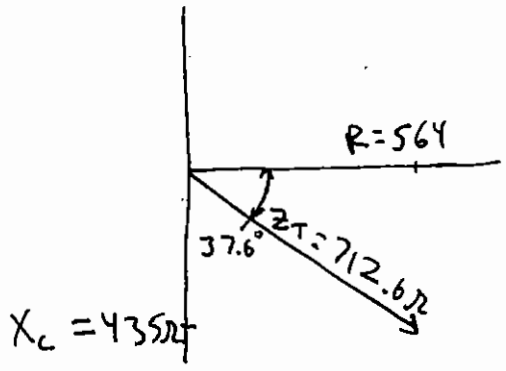


Find the total impedance for the given network and draw the impedance diagram.

$$Z_T = \left(\frac{1}{1000\Omega} + \frac{1}{j7000\Omega} + \frac{1}{-j1000\Omega} + \frac{1}{9000\Omega}\right)^{-1}$$

$$Z_T = 712.6\Omega \angle -37.6^\circ$$

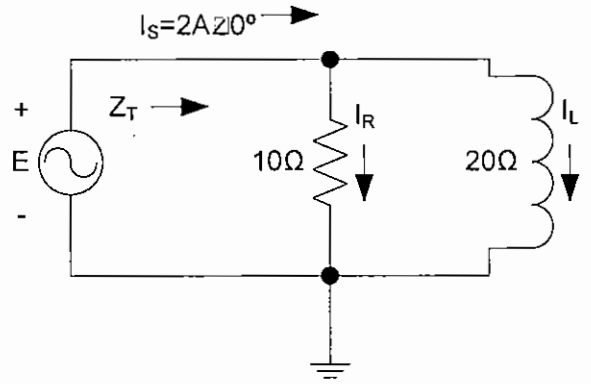
$$= 564.2 - j435.3\Omega$$



KEY 2/3

EE 301 HW#21
AC Parallel

3) Given

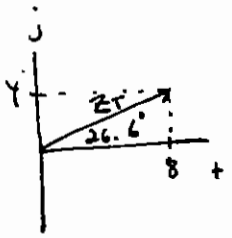


a. Find the total impedance Z_T in polar form.

$$Z_T = \left(\frac{1}{10} + \frac{1}{j20}\right)^{-1} = \boxed{8.94\,\Omega \angle 26.6^\circ}$$

b. Draw the impedance diagram.

$Z_T = 8 + j4\,\Omega$

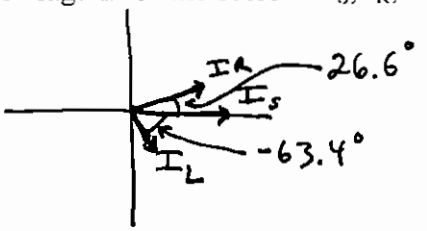


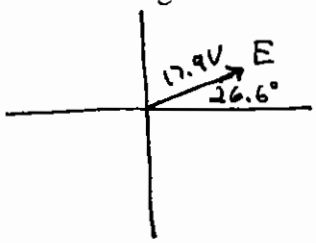
c. Find the voltage E and the currents I_R and I_L in phasor form.

$$E = I Z_T = 2A\angle 0\,(8.94\Omega \angle 26.6) = 17.9V \angle 26.6^\circ$$
$$I_R = \frac{E}{R} = \frac{17.9V\angle 26.6^\circ}{10} = 1.79A \angle 26.6^\circ$$

KCL: $I_S = I_R + I_L \Rightarrow I_L = I_S - I_R = 2A\angle 0 - 1.79A\angle 26.6^\circ = 0.894A \angle -63.4^\circ$

d. Draw the phasor diagram of the currents I_S, I_R, and I_L, and the voltage E.





e. Verify Kirchhoffs current law at one node.

$$I_L = \frac{E}{X_L} = \frac{17.9V\angle 26.6^\circ}{j20\Omega} = 0.895 \angle -63.4$$

KCL was used in part c for I_L thus using a different method (Ohm's Law) and getting the same answer verifies KCL was correct for this problem.

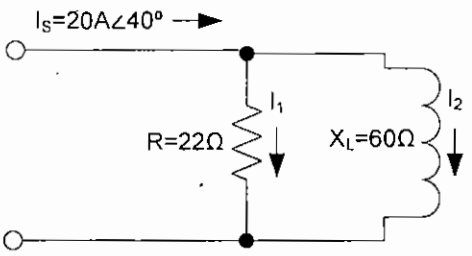
f. Find the average power delivered to the circuit.

$$P = EI\cos\theta_T = 17.9V(2A)\cos(26.6)$$
$$\boxed{P = 32W}$$

KEY 3/3

EE 301 HW#21
AC Parallel

4) Calculate the currents I_1 and I_2 in phasor form for each of the following circuits using the current divider rule.



a)

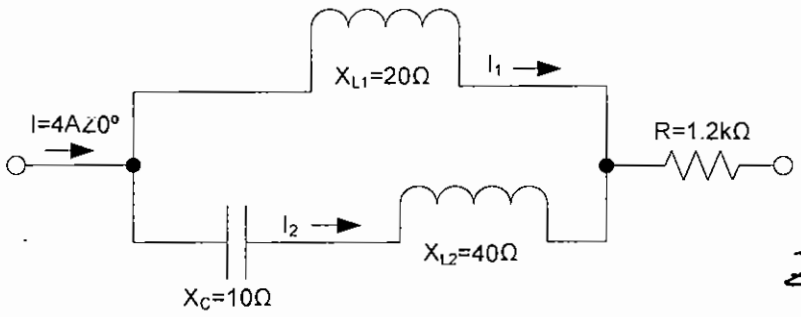
$$Z_T = \left(\frac{1}{R} + \frac{1}{jX_L}\right)^{-1} = \left(\frac{1}{22} + \frac{1}{j60}\right)^{-1}$$

$$Z_T = 20.655\angle 20.136$$

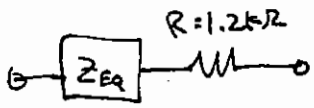
$$I_1 = I_S \frac{Z_T}{Z_R}$$

$$= 20A\angle 40 \; \frac{20.655\angle 20.136}{22\angle 0} = \boxed{18.8A\angle 60.1^\circ = I_1}$$

$$I_2 = I_S \frac{Z_T}{Z_L} = 20A\angle 40 \; \frac{20.655\angle 20.1}{60\angle 90} = \boxed{6.89A\angle -30^\circ = I_2}$$



b)



$$Z_{EQ} = \left(\frac{1}{j20} + \frac{1}{j40 - j10}\right)^{-1}$$

$$= 12\Omega\angle 90$$

$$I_1 = I \frac{Z_{EQ}}{Z_{L1}} = 4A\angle 0 \; \frac{12\Omega\angle 90}{20\Omega\angle 90} = \boxed{2.4A\angle 0^\circ = I_1}$$

$$I_2 = I \frac{Z_{EQ}}{Z_{L2} + Z_C} = 4A\angle 0 \; \frac{12\Omega\angle 90}{30\Omega\angle 90} = \boxed{1.6A\angle 0^\circ = I_2}$$