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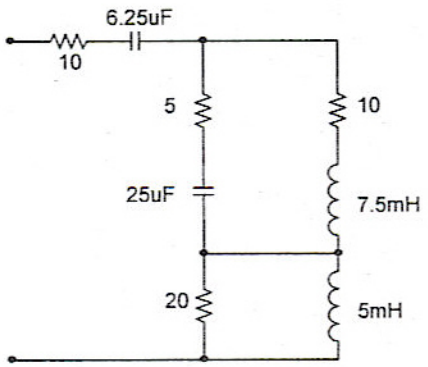
1. (30 points)



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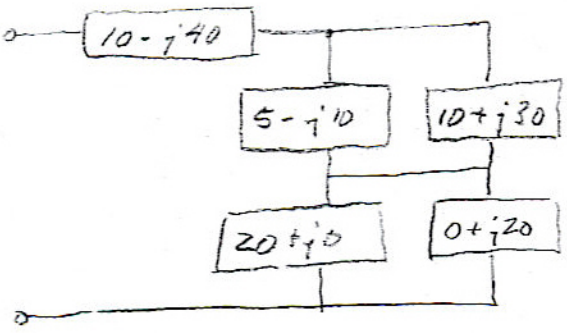
Find the equivalent impedance of this network if ω=4000.

$X_{C_1} = \frac{1}{\omega C_1} = \frac{1}{(4e3)(6.25e-6)} = \frac{10^3}{25} = 40$

$X_{C_2} = \frac{1}{(4e3)(25e-6)} = \frac{10^3}{100} = 10$

$X_{L_1} = \omega L_1 = (4e3)(7.5e-3) = 30$

$X_{L_2} = (4e3)(5e-3) = 20$



$\frac{(5-j10)(10+j30)}{15+j20} = 10 - j10$

$\frac{(20)(j20)}{20+j20} = 10+j10$

$Z_{eq} = 10 - j40 + 10 - j10 + 10 + j10 = 30 - j40 = 50 \angle -53.13°$

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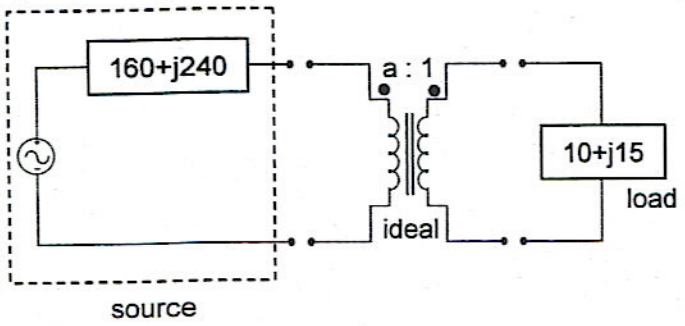
2. (15 points)



The transformer is to be inserted between the source and the load with a turns ratio that makes the load impedance appear to be the same as the source impedance. Find the value of "a" necessary to make this happen. Assume that the voltages are plus at the top and the currents are clockwise.

$\frac{V_1}{a} = \frac{V_2}{1}$ and $I_1 a = I_2$

$Z_L = \frac{V_2}{I_2} = 10 + j15$

$Z_S = \frac{V_1}{I_1} = 160 + j240$

$\frac{V_2}{I_2} = \frac{\frac{V_1}{a}}{I_1 a} = \frac{1}{a^2}\frac{V_1}{I_1}$

$a^2 = \frac{V_1/I_1}{V_2/I_2} = \frac{160 + j240}{10 + j15} = 16$

$a = 4$

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3. (40 points)

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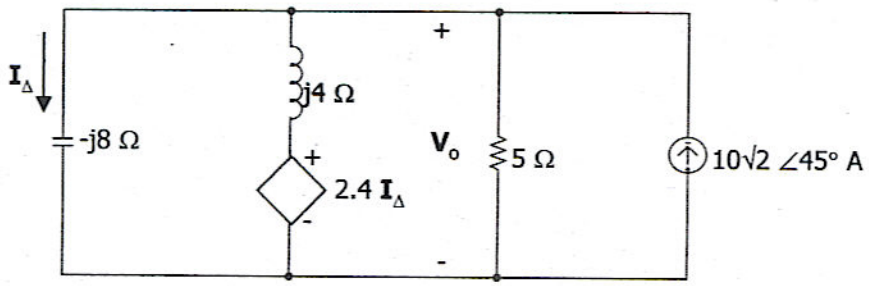

All voltages and currents are rms. Find $\mathbf{V}_o$.

NODE-VOLTAGE METHOD

$$\frac{\underline{V}_o}{-j8} + \frac{\underline{V}_o - 2.4\underline{I}_\Delta}{j4} + \frac{\underline{V}_o}{5} - (10 \angle 0) = 0$$

$$\underline{I}_\Delta = \frac{\underline{V}_o}{-j8}$$

$$\therefore \underline{V}_o = j80$$

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4. (15 points)

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A circuit element has voltage across it and current through it that are described by:

$$v(t) = 50\cos(377t + 38°)$$

and

$$i(t) = 10\sin(377t + 75°)$$

NOTE THE SINE FUNCTION!
Find the real power associated with that circuit element.

$i(t) = 10\cos(377t + 75° - 90°) = 10\cos(377t - 15°)$

By inspection, $P = \frac{V_m I_m}{2}\cos(\phi_v - \phi_i) = \frac{500}{2}\cos(38° - (-15°))$

$= 250\cos 53° = 150.45\ W$