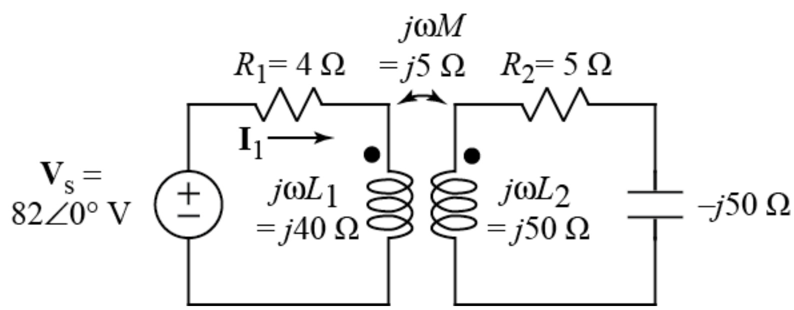
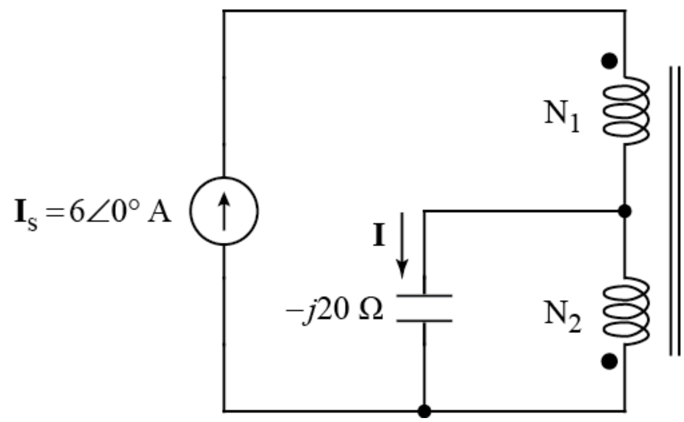
Ex:



a) Calculate the numerical value of phasor current, $\mathbf{I}_1$, flowing into the primary side of the transformer. Note: the transformer is linear.

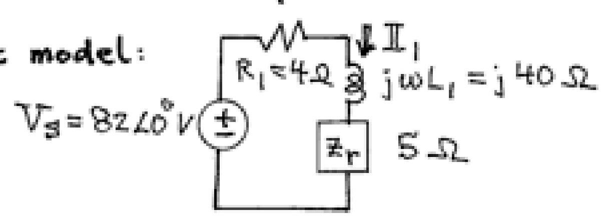


b) The turns ratio of the transformer is $N_1/N_2 = 6$. Calculate the numerical value of phasor current, $\mathbf{I}$, flowing down through the capacitor. Note: the transformer is ideal.

sol'n: a) We account for the secondary of the transformer by using the reflected impedance, z_r:

$$z_r = \frac{(\omega M)^2}{z_{secondary\ tot}} = \frac{5^2}{+j50+5-j50}\,\Omega = 5\,\Omega$$

Circuit model:



$$\mathbb{I}_1 = \frac{\mathbb{V}_s}{R_1 + j\omega L_1 + Z_r} = \frac{82\angle 0^\circ \text{ V}}{4\Omega + j40\Omega + 5\Omega}$$

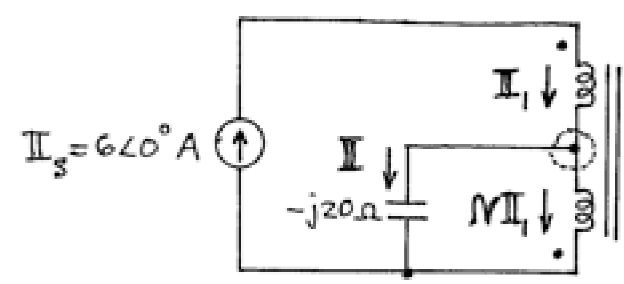
$$'' = \frac{82\angle 0^\circ \text{ V}}{9 + j40\Omega} = \frac{82\angle 0^\circ \text{ V}}{41\angle 77.3^\circ \Omega}$$

$$\mathbb{I}_1 = 2\angle -77.3^\circ \text{ A}$$

b) We use the ideal transformer eq'ns:

$$\frac{\mathbb{V}_1}{\mathbb{V}_2} = \frac{N_1}{N_2} = \mathcal{N}, \quad \frac{\mathbb{I}_1}{\mathbb{I}_2} = \frac{N_2}{N_1} = \frac{1}{\mathcal{N}}$$

Applying these eq'ns to the circuit diagram reveals that we can solve the circuit by considering a current summation.



A current summation at the node with the dashed circuit, and the observation that $\mathbb{I}_1 = \mathbb{I}_s$ yields the following equations:

$$\mathbb{I}_1 = \mathbb{I}_s, \quad \mathcal{N} = 6$$

$$-\mathbb{I}_1 + \mathcal{N}\mathbb{I}_1 + \mathbb{I} = 0$$

Thus, $\mathbb{I} = (1-\mathcal{N})\mathbb{I}_1 = -5\,\mathbb{I}_s = -30$ A

or $\mathbb{I} = 30\angle 180^\circ$ A