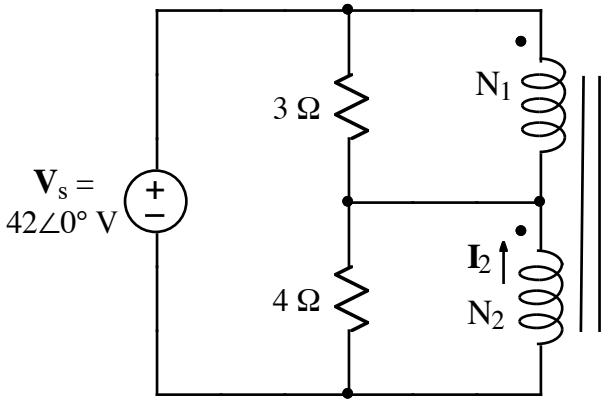
HOMEWORK #8 prob 5 solution

EX:



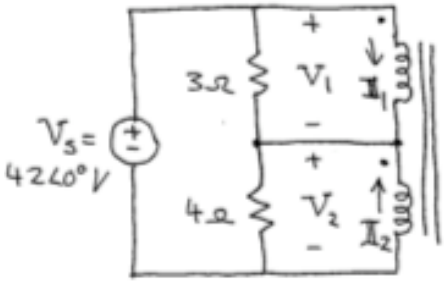
Given $N_1/N_2 = 1/6$, calculate the phasor current, $\mathbf{I}_2$, flowing upward in the bottom coil of the transformer. Note: the transformer is ideal.

SOL'N:

Ideal transformer relationships:

$$\frac{V_1}{V_2} = \frac{N_1}{N_2} = N, \qquad \frac{I_2}{I_1} = \frac{N_1}{N_2} = N$$

We draw the circuit and label I's and V's.



From an outside V-loop, we have

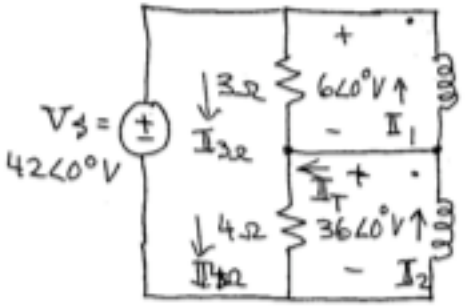
$$V_s = V_1 + V_2 = NV_2 + V_2 = (1+N)V_2$$

or $42\angle 0^\circ V = \left(1 + \frac{1}{6}\right) V_2$ or $V_2 = 42\angle 0^\circ V \cdot \frac{6}{7}$

or $V_2 = 36\angle 0^\circ V$

Then $V_1 = N V_2 = \frac{1}{6} \cdot 36\angle 0^\circ V = 6\angle 0^\circ V$

Adding these voltages to our diagram allows us to calculate currents in R's.



$$I_{3\Omega} = \frac{V_1}{3\Omega} = \frac{6\angle 0^\circ V}{3\Omega} = 2\angle 0^\circ A$$

$$I_{4\Omega} = \frac{V_2}{4\Omega} = \frac{36\angle 0^\circ V}{4\Omega} = 9\angle 0^\circ A$$

Now consider I_T flowing in the wire between the transformer coils toward the R's.

$$I_T = I_1 + I_2 = \frac{I_2}{N} + I_2 = \left(1 + \frac{1}{N}\right) I_2 = 7 I_2$$

and $I_T + I_{3\Omega} = I_{4\Omega}$ or $I_T = 9A - 2A = 7A\angle 0^\circ$

$\therefore 7 I_2 = 7A\angle 0^\circ$

or $I_2 = 1A\angle 0^\circ$