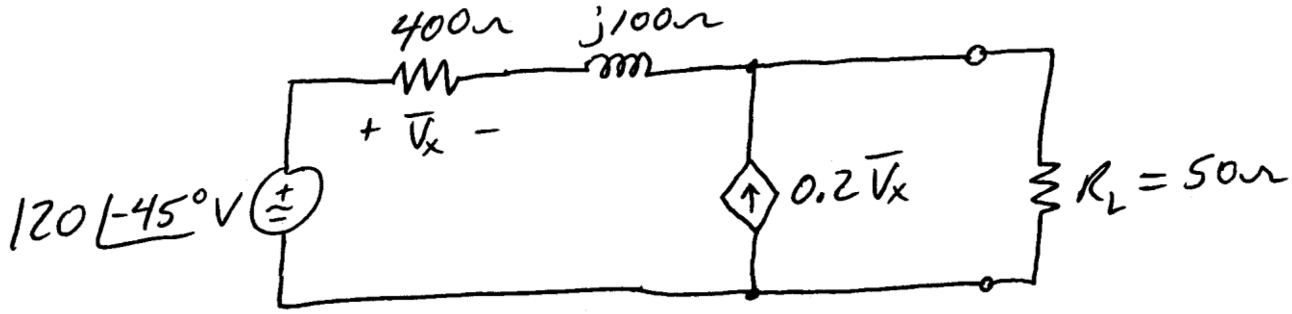
Ex. For the circuit shown, find the Thevenin and Norton Equivalent Circuits

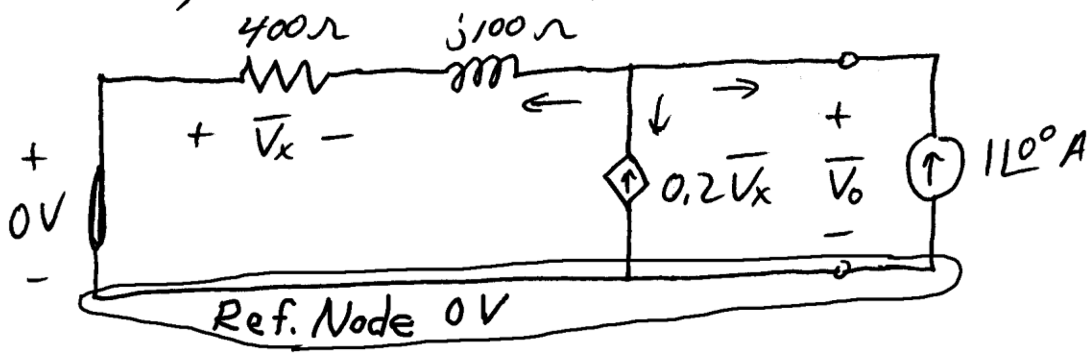


Find $\bar{Z}_T$ and $\bar{Z}_N$

→ Set independent voltage source to zero (short)

→ Replace load with 1∠0° A test source

→ Find $\bar{V}_o$, $\bar{Z}_T = \bar{Z}_N = \bar{V}_o / 1\angle 0°\,A$



Apply KCL to top right node: $\dfrac{\bar{V}_o - 0}{400+j100} - 0.2\bar{V}_x - 1\angle 0° = 0$

By voltage divison: $\bar{V}_x = \left(\dfrac{400}{400+j100}\right)(0 - \bar{V}_o)$

Substituting this into the KCL eq'n yields:

$$\frac{\bar{V}_o}{400+j100} + 0.2\left(\frac{400}{400+j100}\right)\bar{V}_o = 1\angle 0°$$

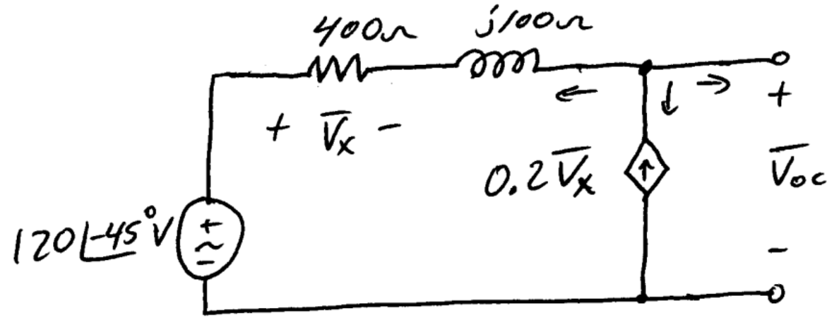
↳ $\bar{V}_o = 4.9383 + j1.2346\ V$ ⇒

$$\bar{Z}_T = \bar{Z}_N = \bar{V}_o / 1\angle 0° = \underline{\underline{4.9383 + j1.2346\ \Omega}}$$

ex. cont.

Find $\bar{V}_T$

→ Remove R_L & find $\bar{V}_{oc} = \bar{V}_T$



Apply KCL to top right node:
$$\frac{\bar{V}_{oc} - 120\angle{-45°}}{400+j100} - 0.2\bar{V}_x + 0 = 0$$

By voltage division:
$$\bar{V}_x = \left(120\angle{-45°} - \bar{V}_{oc}\right)\frac{400}{400+j100}$$

Substituting this into the KCL eq'n:
$$\frac{\bar{V}_{oc} - 120\angle{-45°}}{400+j100} - 0.2\left(120\angle{-45°} - \bar{V}_{oc}\right)\frac{400}{400+j100} = 0$$

$$\bar{V}_{oc} - 120\angle{-45°} - 9600\angle{-45°} + 80\bar{V}_{oc} = 0$$

$$\bar{V}_{oc} = \frac{9600\angle{-45°} + 120\angle{-45°}}{81} = \underline{\underline{120\angle{-45°}\text{ V} = \bar{V}_T}}$$

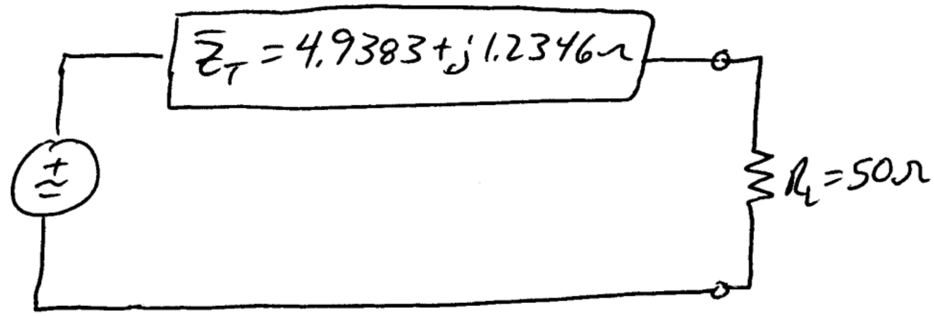
By source transformation:
$$\bar{I}_N = \frac{\bar{V}_T}{\bar{Z}_T} = \frac{120\angle{-45°}}{4.9383 + j1.2346}$$

$$\underline{\underline{\bar{I}_N = 23.574\angle{-59.04°}\text{ A}}}$$

ex. cont.

Thevenin Equivalent Circuit

$\overline{V}_T = 120\angle{-45^\circ}$ V



Norton Equivalent Circuit

$\overline{I}_N = 23.574\angle{-59.04^\circ}$ A