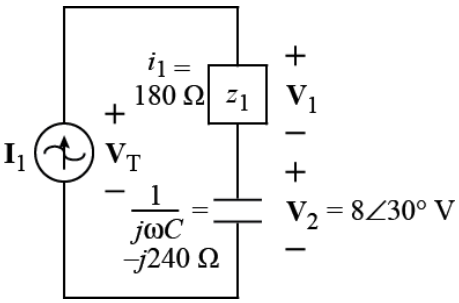
Ex:



a) Find $\mathbf{I}_1$ in rectangular form.

b) Find $\mathbf{V}_T$

c) Find the numerical value of the phase angle between $\mathbf{V}_T$ and $\mathbf{I}_1$?

Sol'n: a) The current is the same everywhere around the loop. Use Ohm's law for z_2:

$$\mathbf{I}_1 = \frac{\mathbf{V}_2}{-j240\Omega} = \frac{8\angle 30°}{240\angle -90°}\text{A} = \frac{1}{30}\angle 120°\text{ A}$$

or

$$\mathbf{I}_1 = 33.3\angle 120°\text{ mA} = -16.65 + j28.84\text{ mA}$$

b) Use a voltage sum with Ohm's law for z_1:

$$\mathbf{V}_T = \mathbf{V}_1 + \mathbf{V}_2 = \mathbf{I}_1 z_1 + 8\angle 30°\text{V}$$

or

$$\mathbf{V}_T = \frac{1}{30}\angle 120° \cdot 180\Omega + 8\angle 30°\text{V}$$

or

$$\mathbf{V}_T = 8\cos(30°) + j8\sin(30°) + 6\cos(120°) + j6\sin(120°)\text{ V}$$

or

$$\mathbf{V}_T = 8\frac{\sqrt{3}}{2} + j8\frac{1}{2} - 6\frac{1}{2} + j6\frac{\sqrt{3}}{2}\text{V}$$

or

$$\mathbf{V}_T = -3 + 4\sqrt{3} + j4 + j3\sqrt{3}\text{ V} = 10\angle 66.87°\text{ V}$$

c) Take the absolute value of the difference of the angles.

$$\left|\angle\mathbf{V}_T - \angle\mathbf{I}_1\right| = \left|66.87°\text{ V} - 120°\right| = 53.13°$$