6 pts  AC Power Systems
Calculate the power factor as seen by the source. Indicate whether the PF is leading or lagging. Note – the source is sinusoidal.

\[
\text{PF} = \cos(\Theta_v - \Theta_i)
\]
also, \(\Theta_2 = \Theta_v - \Theta_i\) so we can find \(\Theta_2\) as seen by the source.

\[
\begin{align*}
\Theta_2 &= 10 + j4 \parallel (8-j6) \\
&= 11.88 + j4.47 \quad \text{in degrees} \\
\end{align*}
\]

\[
\text{PF} = \cos(20.618^\circ)
\]
= 0.936 lagging since \(\theta_2\) is positive.
10 pts  Phasor and Thévenin Analysis
Find the Thévenin voltage and Thévenin impedance between points a and b. Express your answers in rectangular, polar, and sinusoidal forms.

\[ Z_{th} = \frac{(10+j5) || -j5}{10+j5 -j5} \]

\[ Z_{th} = \frac{1}{2.5 - j5} \]

\[ Z_{th} = 5.59 \ \Omega \]

\[ V_{th} = 16.77 \ \text{V} \]

\[ V_{th} = 16.77 \text{ cos}(\omega t - 33.43^\circ) \text{ V} \]
The following three problems are worth one point each and refer to the figure at the right. Circle the best answer.

The DC voltage source has been applied for a long time before the switch opens at $t = 0$ seconds. The initial capacitor voltage $V_C(0)$ is

- [ ] 8 V
- [ ] 10 V
- [X] 5 V
- [ ] 0 V
- [ ] None of the above

The time constant ($\tau$) of this circuit for $t > 0$ seconds is

- [X] 5 s
- [ ] 3 s
- [ ] 4 s
- [ ] 0.2 s
- [ ] None of the above

The voltage across the capacitor, $V_C$, at time infinity, i.e., $V_C(\infty)$, is

- [X] 0 V
- [ ] 2 V
- [ ] 22 V
- [ ] -2 V
- [ ] None of the above

7 pts Find the expression for $V_C(t)$ for $t > 0$ seconds.

$$V_C(t) = V_C(0) e^{-\frac{t}{\tau C}} = 8 e^{-\frac{t}{5}}$$