Problem Set 1
Due Sept. 7

1) Consider the two complex exponential sinusoids $x(t) = Xe^{st}$ and $y(t) = Ye^{rt}$
with different phasors and complex frequencies. Consider the new signals below:

$$a(t) = x(t) - y(t), \quad b(t) = x(t)y(t), \quad c(t) = 1 / x^2(t),$$

(a) Use Matlab to investigate which of these new signals are complex exponentials.

(b) Use algebra to determine the new phasor and complex frequency of each of these
new complex exponentials; express your answers in terms of the phasors and complex
frequencies of $x(t)$ and $y(t)$.

2) (a) In class it was shown that the derivative of a sinusoid was a sinusoid at the same
frequency but shifted in phase by $\pi/2$ and with the amplitude multiplied by the frequency.
Use Matlab and the command `diff(x)` to verify this result for several sinusoids.

(b) In class it was shown that the sum of sinusoids at the same frequency was a
sinusoid at that frequency but shifted in phase and amplitude. Use Matlab to verify this
result for several cases.

3) (a) Consider the series connection of a resistor, a capacitor, and an inductor with a
sinusoidal voltage source. Find an expression for the phasor that represents the voltage
across the resistor.

(b) Consider the parallel connection of a resistor, a capacitor, and an inductor with a
sinusoidal current source. Find an expression for the phasor that represents the current
through the resistor.
4) The input to each of the circuits below is a sinusoid at the frequency \( w \) with unity amplitude; carefully plot the amplitude of the output voltage as a function of the frequency for each of the circuits below.