

BioE 1410 - Homework 1

1. Express each of the following complex numbers in Cartesian form $x + jy$, drawing a picture of each on the complex plane.

A. $\frac{1}{2}e^{j2\pi}$

B. $-e^{(2-j\pi)}$

C. $\frac{\sqrt{2}}{5}(e^{j\pi t^4})$

D. $3e^{0j}$

E. $j(e^{j7\pi})$

F. $-e^{j3\pi}$

G. $2e^{\left(1+j\frac{\pi}{2}\right)}$

H. $\pi\sqrt{2}\left(e^{-j\pi/4}\right)$

- 2.** Specify r and θ in the polar form $re^{j\theta}$ for following complex numbers,
drawing a picture of each on the complex plane.
 $(-\pi < \theta \leq \pi, \quad r \geq 0)$ <--- note range of variables

A. $(1-j)/(1+j)$

B. $3(1+j)$

C. -17

D. $\sqrt{-4}$

E. $-\sqrt{2} - (j\sqrt{2})$

F. $-\sqrt{2}$

G. $\sqrt{-\left(\frac{1}{4}\right)}$

H. $2j/(\sqrt{3} - j)$

3. For each signal, draw the signal with correct scales for both ordinate and abscissa.

A. $f(t) = \cos(4\pi t - \frac{\pi}{2})$

B. $f(t) = -e^{-t}$

4. Given $z = \frac{1}{\sqrt{2}}(1 + j)$

First in Cartesian coordinates, and then using phasors, solve for z^k , $k = 0, 1, 2, 3, \dots, 8$
Draw a diagram of the nine vectors on the complex plane.

5. Using the phasor representations, prove the following trigonometric identity:

$$\sin(2t) = 2\sin(t)\cos(t)$$

6. Fill in the blanks.

The sine and cosine functions are both examples of a general class of waveform known as _____, and differ only in their _____. Any two sinusoids with the same _____, when added together, create another sinusoid. Systems obeying Hooke's Law produce sinusoidal motion because the _____ of a sinusoid equals a constant times that sinusoid. Taking the derivative of a sinusoid shifts the phase by _____ degrees, which can also be expressed as _____ radians. The only function whose first derivative equals itself is _____. A phasor (complex exponential) has special properties, including that multiplying one phasor by another shifts the phase of one by the _____ of the other.

7. True / False (enter "T" or "F" in each blank).

___ Every complex number can be represented by a phasor, and visa versa.

___ Any sinusoid can be expressed as the sum of two complex exponentials.

___ The sum of a complex number and its conjugate can have a non-zero imaginary component.

___ The square root of a phasor always has half the angle.