Complex Numbers Homework (#5)
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1. Calculate the sum $(4+3j)+(3+4j)$. Convert to polar form.

2a. Calculate the product, $(4+3j)(3+4j)$. Do this in rectangular form.

2b. Convert both numbers to polar form and compute the product. Do your answers agree?

Write the following in rectangular form.

3. $10\sqrt{2}\angle\pi/6$.
4. $e^{3+j\pi/4}$.
5. j^{282}.
6. j^{2016}.

Write the following in polar form.

7. $\sqrt{j}$.
8. $13\,\text{Ohms} + j20\,\text{Ohms}$.
9. $(3+2j)\,e^{j/2}$.
10. $j\,(3+2j)$.

Compute the complex conjugate in the same form as the given expression.

11. $7\angle\pi/3$
12. $4+3j$
13. $36e^{j\pi/4}$

14. A mixer is an electronic device that accepts two analog inputs and produces an output that is the product of the two inputs. Consider the real function of time,

$$S = S_0 e^{j\omega t} + S_0^* e^{-j\omega t}.$$

14a. Verify that the function is real for all t. Hint: Write S_0 and $e^{j\omega t}$ in rectangular form.

14b. Use S as one input to the mixer and the reference,

$$R = R_0 e^{j\omega t} + R_0 e^{-j\omega t},$$

where R_0 is real. Compute the output of the mixer, which we will call

$$I = S \times R.$$

What is the DC part of I?

14c. Now let's use another mixer with the same signal but with the reference shifted by a quarter cycle so that this reference is jR. Explain why multiplication by j expresses a shift of a quarter cycle. Calculate the output of this mixer,

$$Q = S \times jR.$$

Again, what is the DC part?