SCS 43XX – Quantum……

Tutorial 02

We can represent a complex number a+ib as r(cos(θ)+isin(θ)) = reiθ

where r is the distance from the origin of the complex number and θ is the angle it makes with the positive x-axis.

1. Plot each of these complex numbers on the complex plane

(a) $2 + 3i$

(b) $2(\cos(\pi/4) + i*\sin(\pi/4))$

(c) $3e^{5\pi*i/4}$

2. Plot each of these complex numbers on the complex plane. What happens to the angle they make with the positive x-axis when multiplied together?

(a) $e^{7\pi i/8}$

(b) $e^{\pi i/4}$

(c) $e^{7\pi i/8}$

(d) $e^{\pi i/4}$

3. Represent each of these numbers in polar and exponential form

(a) $1 + i$ (b) i (c) -1

4. Plot $1 + i$ on the complex plane then plot $i(1 + i) = -1 + i$ on the complex plane. In

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Question 3 we found $i = e^{i\pi/2}$, so what happens when we multiply a complex number by i?

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5. Given $a=1+2i$ and $b=-3+4i$, calculate and draw in the complex plane the numbers:

   a. $a+b$,

   b. ab,

   c. b/a.

6. Evaluate:

   a. $i^{1/4}$,

   b. $(1+i\sqrt{3})^{1/2}$,

   c. $\exp(2i^3)$

7. Find the three 3rd roots of 1 and i.
(i.e. all possible solutions to the equations $x^3=1$ and $x^3=i$ respectively).

8. Quotients

   a. Find the real and imaginary part of $(1+i)/(2+3i)$

   b. Evaluate for real a and b: $(a+bi)/(a-bi)$.

9. For any given complex number z, we can take the inverse $1/z$.

   a. Visualize taking the inverse in the complex plane.

   b. What geometric operation does taking the inverse correspond to?
   (Hint: first consider what geometric operation $1/z^*$ corresponds to.)

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