

## Chem 442: Homework HT1 (1st TA lecture)

(only turn in **BOLD** assignment; do all assignments by 1<sup>st</sup> lecture next week)

1. Find the inverse of the complex number  $z = 8 - 3i$ , and write it in the same form, that is  $z^{-1} = a + bi$ , where you need to figure out  $a$  and  $b$ .

Tip: We did not discuss how to divide complex numbers in class. But consider the following. The inverse of any number is just 1 divided by that number. You also know that the ratio of any number over itself, like  $z^*/z^*$ , is equal to one. And you know from class that  $z z^*$  is a real number. You can combine these facts to get rid of the complex denominator and bring the inverse into the same form as the original number, that is  $z^{-1} = a + bi$ .

2. The  $n^{\text{th}}$  root of a number  $x$  is defined by the following relationship ( $n$  is a positive integer):

$$y^n = x \quad (1)$$

where  $y$  is the  $n^{\text{th}}$  root, and where  $n$  is the degree of the root, and there are  $n$  distinct  $n^{\text{th}}$  degree roots. Not all roots of a number are real, however. To illustrate this point, find the 3 distinct cube roots of the number 27, and write them in the Cartesian representation  $z = x + iy$ .

Tip: You can think of this as solving the cubic equation  $y^3=27$ . Obviously “3” is one of the solutions you should get, but the other two are not real numbers. Try to actually solve this problem, not have your calculator just do it! One way is to use polar notation  $y = r e^{i\phi}$ , remembering that multiplying complex numbers is multiplying magnitudes  $r$  and adding phases  $\phi$ . Obviously  $r=3$  and  $\phi=0$  would be one of the roots, namely just “3”.

**Turn in 3.** Make two separate plots of the real and of the imaginary parts of the wavefunction

$$\Psi(x) = \exp[-x^2] \exp[ikx]$$

where  $k=10 \text{ m}^{-1}$ . Plot from  $x=-5$  to  $5 \text{ m}$ . You can use a graphing calculator, Excel, or other plotting software if you want. This is a very common type of wavefunction, as we'll see in a few lectures. Why do you think they call wavefunctions “WAVEfunctions”?

Tip:  $\exp[n]$  is just another way to write  $e^n$ . You will see it often. Remember how  $e^{ikx} = \exp[ikx]$  is related to cos and sin waves. Now you should be able to just plot the real (cosine) and imaginary (sine) parts separately.