SHS homework 4: complex numbers

Study complex numbers: Appendix A.16 and A.16.1 (not A.16.2; that's next time).

1. Compute the real and imaginary part of $z = \frac{i-4}{2i-3}$. Please do not automate this on a website or so. That is, the teacher should be able to see the intermediate steps.

2. Compute the absolute value and the conjugate of $z = (1+i)^6$. To accomplish this, you don't have to actually compute the real and imaginary part of this number.

3. Construct $z = (1+i)^6$ geometrically, i.e. think of $1+i$ in terms of polar coordinates, so that you can write *z* is polar coordinates as well. From this, compute the real and imaginary part of this *z*.

4. Write $z = (3+3i)^8$ in the form $a + bi$, where a and b are expressions that may contain parentheses themselves (i.e., you don't have to compute the actual real and imaginary part of this number).

5. Compute the square root of $-1 - i$.

6. From the definition of $e^{i\varphi}$, show that $\cos\varphi = \frac{e^{i\varphi}+e^{-i\varphi}}{2}$.

Multiplication of sound signals

Here are some exercises to get more familiar with referring to objects in Praat.

7. With **Create Sound from formula...** command in Praat, create a sine wave called "sine", with a frequency of 377 Hz and an amplitude of 1. There are several Praat commands that can help you change the amplitude to 2. Which is the one in the Modify menu? Have a look at how the sound changes as you click Apply when you have the sound open in the Sound window.

8. That was the built-in way. If you did not have that specific command in the Modify menu, you would have to use the more general **Formula...** command (also under Modify). What very simple formula will multiply the sound by 2? You may find the answer in the Scripting tutorial or in the Formulas tutorial (reachable under Help).

9. Now also create a cosine wave called "cosine", with the same frequency of 377 Hz as the sine. **Copy** the cosine and call it "product". Apply a formula that multiplies this cosine with the sine wave. The multiplication will be performed for each sample. Write two versions of the formula in your report: one with the *name* of the sine wave, the other with the *ID* of the sine wave.

10. The resulting product of sine and cosine has some regularity. Describe this regularity. Perhaps you even have a formula for this result that use less ink than $\sin(2\pi\ 377\ t) \cdot \cos(2\pi\ 377\ t)$?