Physics 350 Problem Set 2 (Spring Semester 2009)
Due Thu., January 29 at 4:30PM

Some of the problems below should be done on Maple and some should be done by hand (no Maple!).

1. Use **Maple** to make a plot showing each of the four complex numbers below on the same plot. Look at the examples given in the help for the command `complexplot`. You want the last form shown: `complexplot(1, style=point)`. Note that in **Maple** the imaginary number i is written as a capital letter `I`.

$$4\left(\cos\frac{2\pi}{3} - i\sin\frac{2\pi}{3}\right), \quad \sqrt{2}e^{-i\pi/4}, \quad \left(i+\sqrt{3}\right)^2, \quad \frac{5-2i}{5+2i}. \quad (1)$$

2. (Do this by hand!) Solve for the possible values of the real numbers x and y for $(x+iy)^3 = -1$. **Hint:** One approach to this is to find the three complex solutions to the equation $z^3 = -1$ in polar form (***subhint****: write* -1 *in polar form)* and then get the real and imaginary parts of the solutions from the answer in polar form. (*Boas* Problem 2.5.47, p. 54)

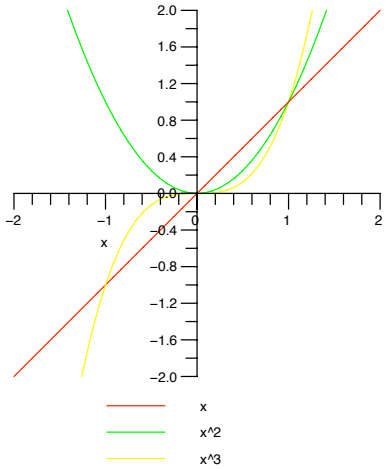
3. (Do this by hand!) Express the following complex numbers in $x = iy$ form.

   (a) $\left(\frac{1+i}{1-i}\right)^4$ (*Boas* Problem 2.9.18, p. 63)

   (b) $\left(\frac{i\sqrt{2}}{1+i}\right)^{12}$ (*Boas* Problem 2.9.25, p. 64)

4. (Do this by hand!) The voltage drop across a parallel plate capacitor in an RC circuit is given by $V(t) = V_0\left(1 - e^{-t/(RC)}\right)$. Find the first two non-zero terms in the Taylor expansion of this potential about $t = 0$.

5. (a) In **Maple**, plot $\cos x$ and the Taylor series expansion of $\cos x$ accurate to second, fourth, sixth, eighth and twentieth order. Your plot should have a separate line for each approximation, and should have a legend; for an example of the kind of legend you should make, see plot below, which I made using the command `plot([x,x^2,x^3],x=-2..2,-2..2,legend=["x","x^2","x^3"]);`



(b) Describe how the value of x at which the approximation starts to significantly differ from $\cos x$ changes as the order of the approximation increases.