MATH 271, Homework 1
Due September 3rd

Problem 1. Look up how to do ***integration by parts***. Use this technique to compute the integral

$$\int te^{3t}dt.$$

Problem 2. Convert the following numbers in Cartesian coordinates to polar coordinates and compute all pairwise products after converting.

(a) $z_1 = \frac{1}{2} - \frac{1}{2}i$;

(b) $z_2 = -1 + 3i$;

(c) $z_3 = -2 - 3i$.

Problem 3. Find the square roots of $-i$ using a geometrical argument. *Hint: think of polar coordinates and rotation!*

Problem 4. Draw the unit circle in the complex plane. Plot the complex numbers z_1 and z_2 given above and find their inverses and conjugates. Explain what taking the inverse and conjugate does geometrically.

Problem 5. What is an (ordinary) differential equation? Explain what it means to be a general and particular solution to a differential equation.

Problem 6. Look up an ordinary differential equation in chemistry that interests you. Write it down, and explain what it attempts to model. Why does it interest you?

Problem 7. Objects near Earth fall due to the force of gravity. The acceleration of an object due to gravity (regardles of mass) is then

$$y'' = g,$$

where $y(t)$ represents the height above the ground at time t and $g \approx -9.8\frac{m}{s^2}$ is constant.

(a) Find the general solution to the equation.

(b) Given the initial data $y(0) = 0$ and $y'(0) = 1$, find the particular solution.

(c) At what time $t > 0$ does the object first contact the ground?

(d) Plot your solution only over the range of time that makes physical sense.