

MATH 271, HOMEWORK 1  
DUE SEPTEMBER 4<sup>TH</sup>

**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 (regardless 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.