The best preparation for the midterm is to solve as many more exercises as you can from the textbook. Like with everything in life practice makes the master! I invite you to see me if you have trouble with these problems.

1. A booster rocket carrying an observation satellite is launched into space. The rocket and satellite have mass $m$ and are subject to air resistance proportional to the velocity $v$ at any time $t$. Of course they also receive gravity’s pull. Thus, a differential equation that models the velocity of the rocket and satellite is

$$m \frac{dv}{dt} = -mg - kv,$$

where $g$ is the acceleration due to gravity. Solve the differential equation for $v$ as a function of $t$.

2. A wet towel hung from a clothesline to dry loses moisture through evaporation at a rate proportional to its moisture content. If after 1 hour the towel has lost 40% of its original moisture content, after how long will it have lost 80%?

3. sketch the following surfaces or region
   (a) $x^2 + y^2 + z^2 - 2x + 4y - 6z + 5 = 0$. In this case only, what are the level sets in the $x,y,z$ directions?
   (b) $z = 9x + 3y - 5$.
   (c) The domain of $ln(x - y)$.

4. find any critical points and relative extrema of the function

$$z = y^2 + xy + 3y - 2x + 5.$$ 

5. A company manufactures a product at two locations. The costs of manufacturing $x_1$ units at plant 1 and $x_2$ at plant 2 are

$$C_1 = 0.03x_1^2 + 4x_1 + 300, \quad C_2 = 0.05x_2^2 + 7x_2 + 175$$

If the product sells for $10 per unit, find $x_1, x_2$ such that the profit $p = 10(x_1 + x_2) - C_1 - C_2$ is maximized.