Review topics for the Math 226 midterm exam 2.

This is a rough list of the things you should definitely be able to do. I think the best way to use this review sheet is to try to recall or come up with an example for each concept or technique listed below. Then try to solve that example, and if you cannot (or could not come up with one to begin with), then re-read the corresponding section in the book. It is very important to try to think of all these concepts without opening the book, at first. Copies of this review sheet will not be allowed at the exam. Good luck!

The midterm will cover Sections 12.1-12.7 and the easy part of 12.8. Topics:

- The definition of partial derivatives of a function.
- The notions of continuity and differentiability for functions of two variables. You will not have to do $\epsilon - \delta$ proofs, but you need to know the *definitions* of a continuous and especially of *differentiable* function of two variables well. You will also need to know (and understand) examples: of a function that is continuous in every direction but not continuous, and also of a function whose partial derivatives at a point exist, but that is not differentiable. You might be asked to do proofs that rely on properties of continuous/differentiable functions (similar to the latest written homework problem 3).
- contour maps (and the fact that at every point, gradient is perpendicular to the level curve through this point).
- Directional derivatives; the directions of the steepest ascent and the steepest descent.
- Chain rule (for functions of any number of variables).
- Implicit differentiation: in the situation when z is defined implicitly as a function of x, y by the equation $F(x, y, z) = 0$.
- You need to know how to write the formulas for the coordinates of an object moving along a straight line at the constant speed v, and know how to use this in word problems involving chain rule.
- How to use gradient vector of a function of 3 variables to write an equation of the tangent plane to a surface given by some equation in x, y, z-variables.
- Linear approximations and differentials.
- You need to know what a Jacobian matrix of a transformation $f : \mathbb{R}^n \to \mathbb{R}^m$ is, and how to write the Chain Rule using Jacobian matrices (see Section 12.6 pp.709-711; we also did it in class).