Calculus 251:C3   Reading Guide - 6/29/2020

Section 16.1 Vector Fields

This section introduces the concept of a vector field. We have actually already seen one type of vector field (although we didn't call it that), the gradient. Recall that the gradient of a function is the vector of its partial derivatives, so if you evaluate the gradient at a particular point you get back a vector representing the rate of change at that point.

Find the following definitions/concepts/formulas/theorems:

- vector field
- domain (for a vector field - basically the same as for any other function)
- constant vector field, unit vector field, radial vector field
- del operator (∇)
- divergence
- source/sink
- incompressible
- curl
- irrotational
- conservative vector field
- potential function
- Theorem: Curl of a Conservative Vector Field
- Theorem: Uniqueness of Potential Functions

Examples 1 and 2 are an introduction to what a vector field is and how we would describe one.

Examples 3 and 4 show how to calculate divergene and curl. Both divergence and curl will be used often in the rest of the course.

Examples 5, 6, 7, and 8 involve potential functions and showing whether or not a given vector field is conservative. We had a preview of this when we discussed gradients. We saw several problems where we were trying to find a function which had a particular gradient. We didn't call it that back in chapter 14, but we were actually finding the potential function for a vector field.

You should probably read through all of the material between the examples, including the proofs of both theorems. There is a lot of terminology, and there is a lot of discussion about how you should think about vector fields and their properties. None of it is particularly mathematically heavy, so hopefully you will get a good sense of what's going on.