Calculus 251:C3 Reading Guide - 5/26/2020

Section 12.1 Vectors in the Plane

The textbook (as most textbooks do) will use boldface for some objects. You will see vectors $\mathbf{u}, \mathbf{v}, \mathbf{F}$, Euclidean spaces $\mathbf{R}, \mathbf{R}^3$, standard basis vectors **i,j,k** and later vector functions $\mathbf{r}(t), \mathbf{r}_2(x, y, z)$, etc. Note that when we are writing these symbols by hand (you on assessments or any of us on the whiteboard), we can't effectively make something bold. We will therefore use the common notations $\vec{u}, \vec{v}, \vec{F}, \mathbb{R}, \mathbb{R}^3, \hat{\mathbf{i}}, \hat{\mathbf{j}}, \hat{\mathbf{k}}, \vec{r}(t), \vec{r_2}(x, y, z)$. These notations mean the same thing, so don't let that be a distraction.

Note that this is a very vocabulary intensive section. Most sections won't have definition and formula lists this long!

Find definitions for the following terms:

- vector
- initial point (a/k/a tail, basepoint)
- terminal point (a/k/a head, tip)
- length (a/k/a magnitude)
- position vector
- parallel (meaning for vectors)
- translation
- equivalent (for vectors)
- component (of a vector)
- zero vector
- scalar
- scalar multiple
- linear combination (of vectors)
- spanning a parallelogram
- unit vector
- standard basis vector

Find notation and formulas for the following:

- Notation for magnitude of a vector
- Formula for components of a vector (in $\mathbb{R}^2$)

- Make an educated guess: what do you think the components of a vector in $\mathbb{R}^3$ would be? You can check your guess in section 12.2.
- Notation for vector (contrast with notation for a point). Note that the homework system cares deeply about this one!
- Formula for magnitude of a vector (in $\mathbb{R}^2$)
- Make an educated guess: what do you think the magnitude of a vector in $\mathbb{R}^3$ would be? You can check your guess in section 12.2.
- Two different ways to add vectors
- Scalar multiplication ($\|\lambda\vec{v}\| = \dots$)
- Vector operations using components
- (Vector) Commutative Law
- (Vector) Associative Law
- (Vector/scalar) Distributive Law
- Unit vector in the direction of $\vec{v}$ (Notation and formula)
- What does the formula $\vec{v} = \langle v_1, v_2 \rangle = \|\vec{v}\|\, \vec{e}_{\vec{v}} = \|\vec{v}\|\, \langle \cos\theta, \sin\theta \rangle$ mean?
- What are the standard basis vectors in $\mathbb{R}^2$?
- Make an educated guess: but what do you think the standard basis vectors would be in $\mathbb{R}^3$? You can check your guess in section 12.2.
- Triangle inequality

Look through the examples. Example 6 is a bit tricky, but the first five are fairly straightforward.

Section 12.2 Three-Dimensional Space: Surfaces, Vectors, and Curves

Find definitions for the following terms:

- right-hand-rule
- 3-space (a/k/a three-dimensional space)
- coordinate planes in $\mathbb{R}^3$
- octant (remember quadrants from high school algebra?)
- surface (not really defined in the book, but what do the examples have in common?)
- curve (also not really defined, but what do the examples have in common? How is a curve different from a surface?)

- direction vector

Find the following formulas:

- Distance Formula in $\mathbb{R}^3$
- Equation of a Sphere
- Equation of a cylinder (with central axis parallel to z-axis)
- Scalar multiplication of vectors in $\mathbb{R}^3$
- Vector addition in $\mathbb{R}^3$
- Equation of a line in $\mathbb{R}^3$ (vector parameterization)
- Equation of a line in $\mathbb{R}^3$ (Parametric equations)

Again, look through the examples. For the most part, they are really just using algebra and arithmetic you already know. The most uncomfortable part of these examples is going to be notation and terminology. I promise that we will discuss all of these things in lecture! But you should really take some time to try and visualize what is going on with lines, curves, and surfaces in $\mathbb{R}^3$ when you are not under any time pressure. Perhaps while sipping a nice cup of coffee or tea and staring into space. That's what I do.