Calculus 251:C3 Reading Guide - 6/1/2021

Section 12.1 Three-Dimensional Coordinate Systems

Note that these first two sections are very vocabulary and notation intensive. Most sections won't have definition and formula lists this long!

Find definitions for the following terms:

- right-handed coordinate system (what would a left-handed system look like?)
- rectangular coordinates
- xy-plane, xz-plane, yz-plane
- origin
- coordinate plane
- octant/first octant
- half-space
- quadrant

Find notation and formulas for the following:

- Distance Formula in $\mathbb{R}^3$ (How would it extend to higher dimensions?
- Equation of a Sphere

Examples 1, 2, and 5 are good examples of how we try to visualize what equations and inequalities mean in $\mathbb{R}^3$. Translating between symbolic and geometric interpretations will be critical for this entire course.

The proof of the distance formula should look familiar, although the third dimension forces us to use the Pythagorean Theorem twice. Example 3 is a straightforward calculation. Example 4 is a reminder that you have seen the technique of completing the square previously, probably in high school algebra class.

Section 12.2 Vectors

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 $\vec{u}, \vec{v}, \vec{F}, \mathbb{R}, \mathbb{R}^3, \hat{\mathbf{\imath}}, \hat{\mathbf{\jmath}}, \hat{\mathbf{k}}, \vec{r}(t), \vec{r_2}(x, y, z)$. These notations mean the same thing, so don't let that be a distraction.

Find definitions for the following terms:

- vector
- directed line segment
- initial point (a/k/a tail, basepoint)
- terminal point (a/k/a head, tip)
- length (a/k/a magnitude)
- equal (for vectors) (a/k/a equivalent)
- standard position
- component form
- component (of a vector)
- zero vector
- scalar
- scalar multiple
- parallelogram law
- resultant vector
- difference of two vectors
- parallel (for vectors)
- linear combination (of vectors)
- coplanar
- standard unit vector (a/k/a standard basis vector)
- translation
- unit vector
- midpoint

Find the following formulas/notation:

- Notation for component form of a vector
- Notation for magnitude of a vector
- 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 $\mathbb{R}^2$)
- Formula for magnitude of a vector (in $\mathbb{R}^3$)

- Vector addition in $\mathbb{R}^3$
- Scalar multiplication of vectors in $\mathbb{R}^3$
- Two different ways to add vectors
- Scalar multiplication ($\|\lambda \vec{v}\| = \dots$)
- Vector operations using components
- Properties of Vector Operations
- (Vector) Commutative Law
- (Vector) Associative Law
- (Vector/scalar) Distributive Law
- Unit vector in the direction of $\vec{v}$ (Notation and formula)
- What are the standard basis vectors in $\mathbb{R}^2$?
- What are the standard basis vectors in $\mathbb{R}^3$?
- Midpoint formula
- What do you think the formula $\vec{v} = \langle v_1, v_2 \rangle = \|\vec{v}\| \, \vec{e}_{\vec{v}} = \|\vec{v}\| \, \langle \cos\theta, \sin\theta \rangle$ means?

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 vectors and vector operations 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.