Review sheet for Exam 1

Be sure to practice the practice problems listed on Piazza (also available from a link on the syllabus in compact form). You should skip around and work on things that you find difficult or confusing first. While studying, try your best not to refer to your notes or the book so that you can better internalize the formulas and techniques.

Here are some problems from the chapter review sections:

- Chapter 12 review: Think through the "concept check" and "true–false quiz". Also try 1-8, 10, 11, 15-38.
- Chapter 13 review: Think through the "concept check" and "true–false quiz". Also try 1-3, 5, 6, 8-13, 15.

12.1: Coordinates on 3–space

- Be familiar with the Cartesian coordinate system on $\mathbb{R}^3$ and the relevant objects.
- Know how to measure distance in $\mathbb{R}^3$.
- Know how to find the equation for a sphere.

12.2: Vectors

- Know what a vector is. Understand equivalence of vectors.
- Know how to add vectors and multiply them by scalars, both geometrically and algebraically in terms of components.
- Be able to compute the length of vectors.
- Know what a unit vector is.
- Know the standard basis vectors.

12.3: Dot product

- Know how to compute the dot product of two vectors in terms of their components.
- Know the algebraic behavior of the dot product.

- Know the theorem relating the dot product of two vectors, their lengths, and the angle between them.
- Be able to determine whether or not two vectors are orthogonal.
- We didn't talk about direction angles or direction cosines. Don't worry about these things for the exam.
- Know how to compute the scalar and vector projections of one vector onto another.

12.4: Cross product

- Know how to find the cross product of two vectors, both geometrically and in terms of components.
- Be able to compute 3×3 determinants.
- Know the theorem relating the length of the cross product of two vectors, the length of each, and the angle between them.
- The length of the cross product of two vectors is equal to the area of the parallelogram that they span.
- Know how the cross product behaves algebraically.
- Know how to compute the scalar triple product of three vectors and what it means geometrically.

12.5: Lines and planes

- Know how to find the vector equation for a line. What data are necessary? Can you convert to parametric or symmetric equations?
- Be able to parameterize a line segment.
- Know how to find the various equations for planes. Be able to do so given various types of initial data.
- Can you compute the angle between two intersecting planes? How about the distance between two parallel planes?

12.6: Cylinders and quadratic surface

- Understand what is meant by a cylinder in the context of this course.
- Know how to find the traces of surfaces defined in terms of equations.
- Know how to decide which quadratic equations correspond to which quadratic surfaces (See Table 1.)

13.1: Vector functions and space curves

- Understand what is meant by a vector valued function.
- Know how to compute limits of these functions and what it means to say that a vector function is continuous.
- Know how these functions correspond to space curves.
- Be able to roughly sketch the space curves coming from some basic vector functions.
- Be able to find the curve of intersection between surfaces.

13.2: Derivatives and integrals of vector functions.

- Know how to compute derivatives and integrals of vector functions.
- Know how to interpret derivatives as tangent vectors and how to find equations for tangent lines.
- Know the differentiation rules.

13.3: Arc length and curvature

- Know how to compute arc length and how to reparameterize a curve by arc length.
- Know how to compute the curvature of a space curve. Have an intuitive idea of the meaning of curvature.
- Know how to compute the vectors in the Frenet frame: $\vec{T}, \vec{N}$, and $\vec{B}$.

13.4: Motion in space