Concept Review for Exam 1

- Geometric idea of a vector (i.e. has a “tail” and a “head”)
- Algebraic idea of a vector (a 3-tuple of real numbers)
- How to reconcile geometric and algebraic viewpoints: define vectors to be equivalent if they are translates of one another.
- Manipulating vectors: know how to add, subtract, multiple by a scalar, etc.
- Two vectors are parallel if the one is a scalar multiple of the other.
- Two vector are orthogonal if they are at right angles to one another.
- Know what the standard basis vectors are: \( \hat{i} = (1, 0, 0), \hat{j} = (0, 1, 0), \text{ and } \hat{k} = (0, 0, 1) \).
- The norm of a vector is its length; know how to find this quantity.
- Know what a linear combination of vectors is, and how to represent a given vector as a linear combination of some specified set.
- Know the triangle inequality: \( \| \vec{v} + \vec{w} \| \leq \| \vec{v} \| + \| \vec{w} \| \).
- Know what a right handed coordinate system is.
- Know two ways to write a line through point \( P \) in direction \( \vec{v} \): a vector equation and a parametric equation.
- Know how to form the dot product of two vectors (and that the dot product is a scalar.)
- Know the relations \( \vec{v} \cdot \vec{v} = \| \vec{v} \|^2 \) and \( \vec{v} \cdot \vec{w} = \| \vec{v} \| \| \vec{w} \| \cos \theta \).
- Know how to find the projection of a vector \( \vec{u} \) along another vector \( \vec{v} \).
- Know how to form the cross product of two vectors.
- Know the formula \( \| \vec{v} \times \vec{w} \| = \| \vec{v} \| \| \vec{w} \| \sin \theta \).
- Know that the basic formula for a plane is \( ax + by + cz = d \).
- Know how to find the equation of a plane if you know three points through which the plane passes, or one point and the direction of a normal vector.
- Know that a quadratic surface is the set of solutions to an equation of the form \( Ax^2 + By^2 + Cz^2 + Dxy + Exz + Fyz + Gx + Hy + Iz = d \).
- Be able to identify the form of the graph of a quadratic equation when it happens to factor into one of nine canonical forms. (You do not need to memorize these forms, but you should be able to do the identification with a table of forms at hand.)
- Understand how to convert from Cartesian to cylindrical and spherical coordinates, and vice versa.
- Understand how to write the equations of certain elementary surfaces in cylindrical and spherical coordinates.