

## 10.1 Three dimensional coordinate systems

Be familiar with the distance formula in three dimensions. Be able to recognize and use the equation of a sphere.

## 10.2 Vectors

Be familiar with vectors and all of the vector operations. Be familiar with vector notations and the idea of a unit vector.

## 10.3 The dot product

Be familiar with the properties of the vector dot product. Be able to use the dot product to find the length of a vector, the angle between two vectors, and test if two vectors are orthogonal. Be able to calculate the projection of one vector onto another vector.

## 10.4 The cross product

Be able to calculate the cross product of two vectors and be able to calculate the area of a parallelogram and the volume of a parallelepiped. Be able to use the cross product to determine if two vectors are parallel. Be familiar with the properties of the cross product.

## 10.5 Equations of line and planes.

Given two points in  $\mathbb{R}^3$  find a vector equation of the line that goes through the points. Be able to rewrite the vector equation of a line as a set of parametric equations and symmetric equations. Given a point and a vector, be able to find an equation of the plane that is orthogonal to the vector and goes through the point (be able to find the scalar equation).

## 10.6 Cylinders and quadric surfaces

Be familiar with the quadric equations discussed in class and be able to match equations to their graphs.

## 10.7 Vector functions and space curves.

Given a vector function be able to find its derivative and antiderivative. Be familiar with the differentiation rules for vector functions. Be able to find the limit of a vector function,  $\lim_{t \rightarrow a} r(t)$ . Don't forget L'Hospital's rule.

## 10.8 Arc length and curvature.

Given a vector function be able to calculate its arc length for a given interval of  $t$ . i.e  $a \leq t \leq b$ . Also be able to reparametrize a vector function in terms of arc length. Be able to calculate the curvature of a vector function. Be able to calculate the unit tangent and unit normal vectors for a vector function.

## 10.9 Motion in Space: Velocity and Acceleration

Given a vector function that represents acceleration, be able to calculate the associated velocity and position vector functions. Be able to calculate the tangential and normal components of acceleration,  $a_T$  and  $a_N$ .