12.1 Vectors in the Plane

1. How do you find the length of a vector?
2. How do you add vectors? Can you illustrate this geometrically?
3. What is a unit vector?

Homework 12.1: 2, 6, 14, 18, 22, 28, 30, 24, 48

12.2 Rectangular Coordinates and Three-Dimensional Vectors

1. What is the distance formula in space?
2. What is the equation for a sphere in space?
3. What are the three basic unit vectors?
4. What is the dot product? How can we interpret it geometrically?
5. How can you tell if two vectors are perpendicular?
6. What are the direction angles?

Homework 12.2: 4, 10, 16, 20, 24, 26, 32, 48, 50, 54, 62

12.3 The Cross Product of Two Vectors

1. The cross product \( \mathbf{a} \times \mathbf{b} \) is perpendicular to both \( \mathbf{a} \) and \( \mathbf{b} \). Can you show this?
2. The length of the cross product has what geometric significance?
3. What are the algebraic properties of the cross product?
4. What is the triple scalar product and what is its relationship to volume?

Homework 12.3: 4, 6, 8, 10, 14, 16, 24, (36 is extra credit)

12.4 Lines and Planes in Space.

1. What is the vector equation for a line? Is it unique?
2. How can you tell if two lines intersect? are parallel? are skew?
3. What are the symmetric equations of a line?
4. What is the equation for a plane? How do we find the normal vector?
5. What are the parametric equations for a plane?

Homework 12.4: 10, 12, 18, 16, 22, 32, 40, 44, 56

12.5 Curves and Motion in Space

1. How is a parametric curve in space different from one in the plane?
2. What is a vector-valued function? How does it relate to a parametric curve?
3. How do you differentiate a vector-valued function? What geometric interpretation does this derivative have?
4. If the vector-valued function is position, what does the derivative measure? How about the second derivative?
5. How do you integrate vector-valued functions?

Homework 12.5: 1 – 4, 6, 16, 18, 32, 38, 47, 48, 58
12.6 Curvature and Acceleration

1. What is the arc-length parametrization?
2. What does curvature measure? Is it independent of parametrization?
3. What is the osculation circle (or circle of curvature)? What is the radius of curvature? What is the center of curvature?
4. What is the principal unit normal vector?

Homework 12.6: 2, 6, 8, 10, 14, 20, 30, 54

12.7 Cylinders and Quadric Surfaces

1. What is a surface? What is the trace of a surface?
2. What is a cylinder? What are the rulings of a cylinder?
3. What equation does a quadric surface satisfy?

Homework 12.7: 6, 16, 18, 24, 34, 40, 44, 48, 50

12.8 Cylindrical and Spherical Coordinates

1. How do cylindrical coordinates relate to polar coordinates? Why are they called cylindrical coordinates?
2. How do you convert from rectangular to cylindrical coordinates and vice-versa?
3. What are spherical coordinates? Why are they called spherical coordinates?
4. How do you convert from rectangular to spherical coordinates and vice-versa?

Homework 12.8: 2, 4, 8, 10, 16, 20, 24, 28, 32, 40, 48, 55