MA104 - WPR III Topics

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1. Parametric Equations

   - Know what parametric equations are (both in $\mathbb{R}^2$ and $\mathbb{R}^3$).
   - Know how to sketch a parametric curve (including direction), given the equations.
   - Know how to plot a parametric curve in Mathematica, and use Mathematica to determine starting point, direction, etc.
   - Know the parametric equations for various circles.
   - Know how to go back and forth between parametric equations and cartesian equations. (i.e. know how to eliminate the parameter.)
   - Given parametric equations describing the paths of two objects over time, know how to find (by hand and with Mathematica) whether the two objects collide, and/or if their paths intersect. Also, be able to say *when* and *where* these take place.

2. $\mathbb{R}^3$ and Vectors

   - Be familiar with $\mathbb{R}^3$, the 3-dimensional coordinate system, including coordinate planes and basic sketching.
   - Know how to find the distance between a point and one of the coordinate planes, without using the distance formula.
   - Know how to compute the distance between two points in $\mathbb{R}^3$.
   - Know how to find the equation of a sphere.
   - Know the basics of vectors, including what is a vector, both notations (bracket and $\mathbf{i}, \mathbf{j}, \mathbf{k}$) how to draw one, how to add/subtract them (algebraically and geometrically), and how to multiply by a scalar (algebraically and geometrically).
   - Know how to compute the vector between two points.
   - Know how to find a unit vector.
   - Know how to find the magnitude of a vector.
   - Know how to compute the dot product between two vectors. (including by hand).
   - Know how to compute the cross product between two vectors (Mathematica only). Also, know what the cross product vector represents, and how to tell its direction using the right hand rule.
   - Know how to write down the x and y components of a force applied at an angle using vectors.
   - Know how to compute the angle between two vectors.
   - Know how to determine (quickly) whether two vectors are orthogonal (perpendicular) or parallel.
   - Know how to use the dot product to solve work problems. (See the Lesson 33 supplement I emailed out, and/or the book.)
   - Know how to compute the vector projection of one vector onto another.

3. Lines and Planes

- Know what two things are required to write down the equation for a line in $\mathbb{R}^3$.
- Know how to write down the vector and/or parametric equations for a line in $\mathbb{R}^3$.
- Know what two things are required to write down the equation for a plane in $\mathbb{R}^3$.
- Know how to write down the vector and/or scalar equation for a plane in $\mathbb{R}^3$.
- Know what a normal vector is, and how to find it, given, for example: 3 points in a plane, two vectors in a plane, a line perpendicular to the plane, a line that lies in the plane, an equation for a known plane.
- Know how to find the angle between 2 planes. (In particular, be able to tell whether two planes are parallel or perpendicular.)

4. Vector Functions and Projectile Motion

- Know what a vector function is, and how to find its domain.
- Know how to take the derivative of a vector function. (In particular, you must remember how to take derivatives!!)
- Know how to find the equation of a tangent line to a vector function at a particular point.
- Know how position, velocity, acceleration, and speed are all related to each other.
- Know the x and y components of the position vector of a projectile. (i.e. know the equations of motion.)
- Know how to use the above projectile motion equations to solve problems of many types! (See the do problems from Lesson 39-40.)

5. Mathematica commands to know

- `ParametricPlot`
- `ParametricPlot3D`
- `Solve` (both to solve one equation, and to solve a system of more than one equation)
- Know how to name a vector in Mathematica.
- `Cross`
- `Norm`