MA205 - Integral Calculus
Lesson 34: Vector Functions II

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1. Suppose a spaceship is traveling through space with acceleration given by $3\sin(t)\mathbf{i} + t\mathbf{j} + 3\cos(t)\mathbf{k}$.

   (a) Find the function that describes the position of the ship, if its initial velocity is $3\mathbf{i} + \mathbf{j} - \mathbf{k}$ and its position after 2 minutes is represented by $\mathbf{i} + 8\mathbf{j} + \mathbf{k}$.

   (b) What is the *speed* of the spaceship at 3 minutes?

2. Suppose a paper airplane which starts at the origin travels through the air with a velocity given by $\langle \sin(t), t^2, \sqrt{t} \rangle$. When does the paper airplane achieve a height of 8 feet in the air? (Please refrain from any demonstrations relating to this problem!)

3. A pitcher throws a curve ball with an acceleration vector $\mathbf{a}(t) = 24\mathbf{j} - 32\mathbf{k}$ and an initial velocity of $120\mathbf{i} - 3\mathbf{j} + 4\mathbf{k}$. The acceleration in the $\mathbf{j}$ direction is caused by spin that will result in a curveball. The origin of the coordinate system is at field level directly underneath the center of the pitcher's mound, with the positive x axis located from that point toward home plate. If the initial position of the ball is five feet above the origin and one foot to the right, find the y and z coordinates of the ball whenever $x = 60$ feet (i.e., when the ball reaches home plate). Using the fact that home plate is 17 inches wide and one of your team members is the batter, should the pitch be called a strike?

4. Continuing with the problem above, what is the speed of the ball as it goes over home plate?