Objective

1. (Theoretical Understanding)Understand the definitions of position, velocity and acceleration. Understand the relations among those.
2. (Intuition) Be able to visualize an object travelling.
3. (Practical) Be able to find velocity vector given acceleration and enough details. Given any one of the value among sinx,cosx,tanx, how are we going to find the others?

Useful Formulas

1. **Relations between position, velocity and acceleration:**

$$\text{Position} \iff \text{Velocity} \iff \text{Acceleration}$$
$$\rightarrow \text{ by taking derivative, } \leftarrow \text{ by integration (don't forget the constant!)}$$

2. Gravity = $(0, -9.8m/s^2)$ (Careful with unit)
3. Recall, the **scalar equation of the plane** through point $P_0(x_0, y_0, z_0)$ with normal vector n = (a,b,c) is, $a(x - x_0) + b(y - y_0) + c(z - z_0) = 0$
4. Recall, two vectors v_1, v_2 are orthogonal if $v_1 \cdot v_2 = 0$

Question

1. A baseball is hit from 3ft above home plate with an initial velocity $\vec{v}(0) = (80, 80)ft/s$. Neglect all forces other than gravity. How far does the ball travel horizontally? Does the ball clear a 20ft fence that is 380ft from the home plate?
   (a) Intuition: Sketch the graph
   (b) Setup Model: What are the terms that might be useful for this question?
   (c) Computation: Don't forget the constant when you take integration
2. Find the point on the curve $r = (2cost, 2sint, e^t)$ where $0 \leq t \leq \pi$ where the tangent line is parallel to the plane $\sqrt{3}x + y = 1$
   (a) Recall, a line is parallel to a plane if the line is orthogonal to the normal vector of the plane. Now the question is, what is the normal vector?