Math 53, Discussions 116 and 118 **2022-09-26**

Vector functions

Questions

Question 1 (Adapted from an exercise on the current homework)**.** Consider the trajectory

$$\mathbf{r}(t) = \langle \cos t, \sin t, t \rangle.$$

(a) Find the acceleration $\mathbf{a}(t)$.
(b) Decompose the acceleration as the sum of a tangential vector and a normal vector.

Note that the actual textbook problem only asks for the tangential and normal components of acceleration (which are scalars) and you could compute them directly using the formulas in the book skipping (a).

Question 2. A cannon has the ability to fire a projectile at a fixed speed v but at an adjustable angle θ measured with respect to flat ground. If the goal is to have the projectile land as far away as possible, what is the optimal angle θ?

Assume that the acceleration experienced by the particle at all times is $\langle 0, -g \rangle$ where g is a constant. Here x is the horizontal coordinate and y is the vertical coordinate.

HW problems

Here are a couple of problems from the current assigned homework. Consider if you'd be willing to present a solution to one of them at the board!

Problem (§13.1 #29)**.** Find three different surfaces that contain the curve

$$\mathbf{r}(t) = 2t\mathbf{i} + e^t\mathbf{j} + e^{2t}\mathbf{k}$$

Problem (§13.2 #25)**.** Find parametric equations for the tangent line o the curve with the given parametric equations at the specified point.

$$x = e^{-t}\cos t, \qquad y = e^{-t}\sin t, \qquad z = e^{-t}; \qquad (1, 0, 1)$$

Problem (§13.2 #49)**.** Find $f'(2)$, where $f'(t) = \mathbf{u}(t) \cdot \mathbf{v}(t)$, $\mathbf{u}(2) = \langle 1, 2, -1 \rangle$, $\mathbf{u}'(2) = \langle 3, 0, 4 \rangle$, and $\mathbf{v}(t) = \langle t, t^2, t^3 \rangle$.