

# Mathematics 1110H – Calculus I: Limits, Derivatives, and Integrals

TRENT UNIVERSITY, Fall 2023

## Assignment #4

### Chase and Drag

*Due\* just before midnight on Friday, 10 November.*

Minimax is walking Big Dog in the Cartesian plane, with the leash between them at its full 10 *cubit*<sup>†</sup> They walk along the negative  $x$ -axis, moving towards the origin, but just as Big Dog reaches the origin a Showy Squirrel is spotted far down the negative  $y$ -axis. Big Dog starts running down the negative  $y$ -axis towards the Showy Squirrel, dragging Minimax along. The leash stays straight and at full extension throughout and at any given instant the leash is tangent to the curve Minimax is dragged along.

1. If  $(x, y)$  is a point on the curve Minimax is being dragged along, find  $\frac{dy}{dx}$  as a function of  $x$ . [5]

*Hint:* If Big Dog is at  $(0, a)$  on the  $y$ -axis at the instant that Minimax is  $(x, y)$ , then the distance between them is 10, but can also be computed another way. Similarly, the slope of the curve Minimax is being dragged along can be computed in two different ways at that instant.

2. Use SageMath to solve the differential equation you obtained in solving 1. (Initial conditions included!) [3]
3. Use SageMath to plot the curve Minimax is dragged along for  $-10 \leq y \leq 0$ . [1]
4. Assuming Big Dog keeps running down the  $y$ -axis and continues to drag Minimax, does Minimax ever reach the  $y$ -axis? Explain why or why not. [1]

---

\* You should submit your solutions via Blackboard's Assignments module, preferably as a single pdf. If submission via Blackboard fails, please submit your work to your instructor by email or on paper.

† A cubit is an unit of length based on the length of the forearm from the elbow to the tip of the middle finger. Cubits – of various lengths! – were commonly used in ancient times in the “Fertile Crescent” running from Mesopotamia at one end to Egypt at the other, and in adjacent regions.