

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

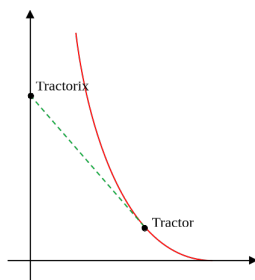
TRENT UNIVERSITY, Fall 2025

Assignment #4

Tractor Pull Curve?

Due on Friday, 7 November.*

A modern relative of Obelix[†], Tractorix, is pulling a tractor in the Cartesian plane using a 10 *m* cable. At the beginning, Tractorix is at the origin and the tractor is 10 *m* away on the positive *x*-axis. Tractorix then begins to walk up the positive *y*-axis, pulling the tractor along. At each instant, the cable is straight and taut, without stretching, and is tangent to the curve the tractor is dragged along.



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

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

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

NOTE. You shouldn't need to learn anything new about SageMath for this assignment, but you might want to review the `diff` operator, the `desolve` command, and `function` declarations before tackling question 2.

* 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 as soon as you can. You may work together, look things up, and use whatever tools you like, so long as you write up your submission by yourself and give due credit to your collaborators and any sources and tools you actually used.

[†] With apologies to René Goscinny (1926-1977) and Albert Uderzo (1927-2020), the creators of the comic *Asterix*, in which Obelix is a character.