Assignment #3
Non-Trivial Pursuit
Due on Wednesday, 11 July.

A straight train track running west to east on a flat and otherwise featureless plain* meets a straight road running south to north at right angles. As the STlast car of a train heading east at 100 km/h passes this intersection, a drone† flying north over the road at 200 km/h is 1 km south of the intersection. At this instant, the drone's controller decides to have it chase the train and thereafter keeps the drone headed directly towards the last car of the train until it catches up.

1. If the train and drone maintain their speeds of 100 km/h and 200 km/h, how far from the crossing does the drone catch up with the last car of the train? *[10]*

Hint: Find a differential equation describing the drone's path and take it from there. If you set things up so that the x-axis runs along the train tracks and the y-axis along the road, with the origin at the intersection, all scaled in kilometres, the differential equation should be $2x \dfrac{d^2y}{dx^2} = \sqrt{1 + \left(\dfrac{dy}{dx}\right)^2}$, with $y = 0$ and $\dfrac{dy}{dx} = 0$ when $x = 1$. You will need to explain why in your solution ... It's probably a good idea to solve for $\dfrac{dy}{dx}$ first, and then solve for y.

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* The plain is plainly a plain plane and a plane plain.

† Is the drone a plain plane flying over the plane plain?