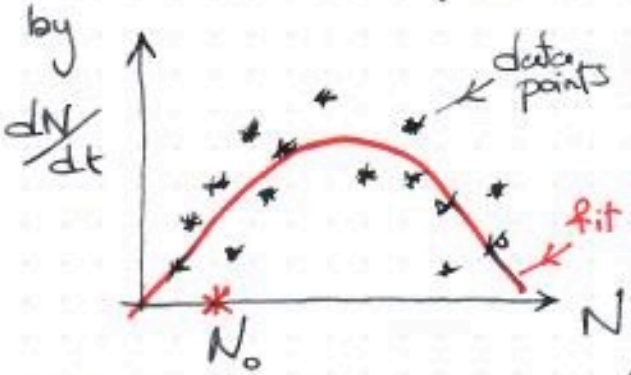
Q1

An astrobiologist observes a colony of Martian sheep, observing that data for the growth of the population can be curve fit by



$$\frac{dN}{dt} = N(\gamma - \delta N)$$

γ, δ = fitting parameters.

the initial population is $N(0) = N_0$.

* Use the graph to argue that $N(t)$ will slowly increase from N_0 up to γ/δ.
* Solve for $N(t)$ & confirm this prediction.

Q2

A cyclist loses control descending the hill on 16th Av. They hit a new crash barrier at $x=0$ with speed $\dot{x}(0) = V$, which has been designed as a big spring with constant k. If the cyclist has mass m and the road has constant slope, such that $g\cos\theta$ is the gravitational acceleration down the slope, show that

$$\ddot{x} + \omega_0^2 x = G$$

for two constants ω_0 & G.

Write the solution in the form

$$x(t) = A + R\cos(\alpha t + \gamma)$$

for some constants A, R, α and γ

Sketch the solution to show what happens subsequently, and comment on the effectiveness of the crash barrier.