Michaelis-Menten Kinetics

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As derived in course website

- $c_s(t) = KW_0(\frac{c_s^0}{K} e^{(c_s^0 - V_0 t)/K})$

$c_s^0 = c_s(t = 0)$ is the initial starch concentration

V_0 is the initial velocity

K is the Michaelis constant

$W_0(\cdot)$ is the primary branch of the Lambert-W function

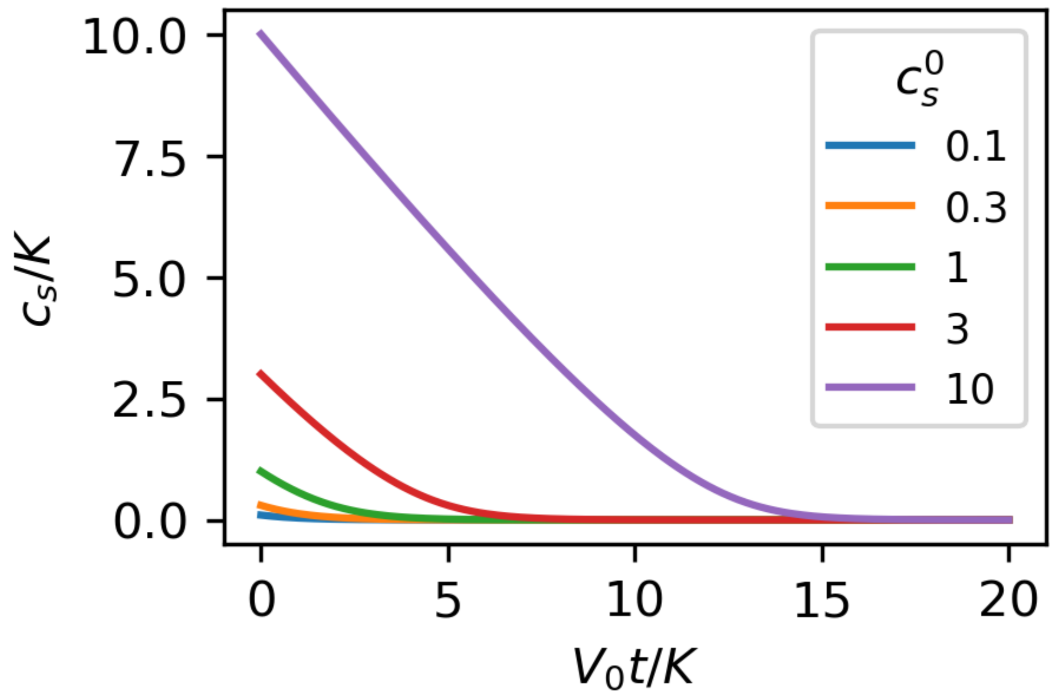
Basically, we want to fit our experiment data with this function.

What does this function look like?

$$c_s(t) = KW_0(\frac{C_s^0}{K} e^{(c_s^0 - V_0 t)/K})$$

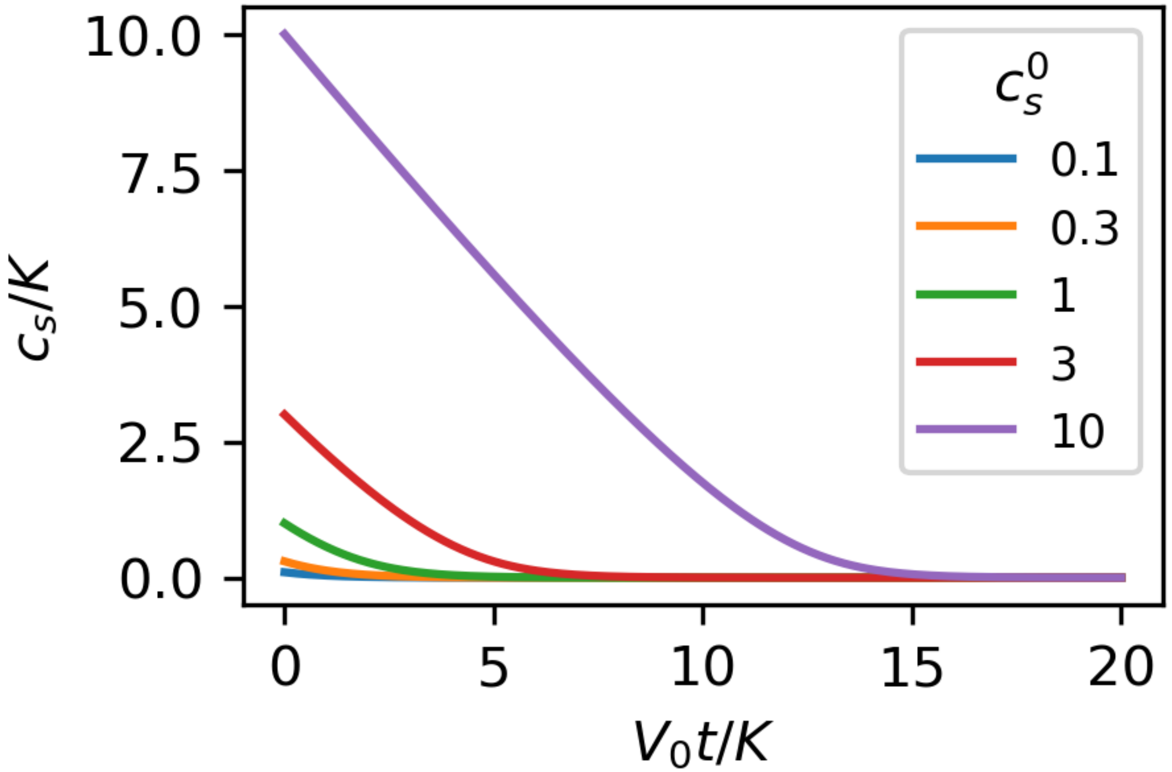
Let us define unitless $\tilde{c}_s = c_s/K$
and unitless $\tilde{t} = V_0 t/K$

Rewrite: $\tilde{c}_s(t) = W_0(\tilde{c}_s^0 e^{\tilde{c}_s^0 - \tilde{t}})$

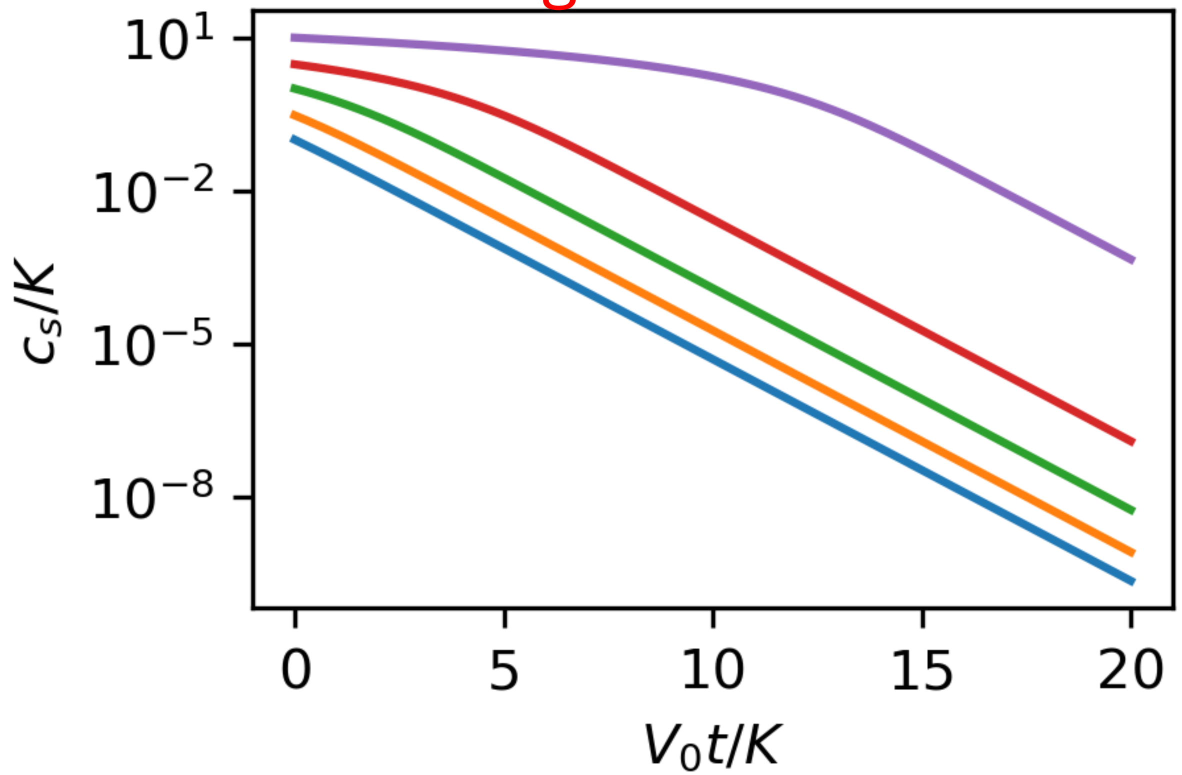


We can plot the curve in different axes

Linear Axis



Log Vertical Axis



When $c_s \gg K$, $\tilde{c}_s$ decreases linearly with $\tilde{t}$

When $c_s \ll K$, $\tilde{c}_s$ decreases exponentially with $\tilde{t}$

A bit more in depth

- When $c_s \gg K$, (beginning of the experiment)
  - Linear regime
  - $\frac{dc_s}{dt} \approx -V_0$
  - $c_s \approx -V_0 t$

- When $c_s \ll K$, (towards the end of the experiment)
  - Exponential regime
  - $\frac{dc_s}{dt} \approx c_s^0 - \frac{V_0}{K} c_s$
  - $c_s(t) \approx c_s^0 e^{-\frac{V_0}{K}t}$

Two ways to analyze with curve fit

1. Fit the full $c_s(t)$ expression
2. Fit the asymptotic behaviors with linear and exponential curves

To accurately measure K, you need to move quick and begin measuring data soon after you put the saliva in the starch-iodine solution.

Nevertheless, with the exponential tail, you should be able to measure V_0/K

If you use such assumptions, you should justify like how I did.