NDS in 6 steps

Dimerization $\quad A + A \underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}} C$

Forward

	molecular Stochiometry
A	-2
C	$+1$

Reverse

A	$+2$
C	-1

$L^{-3} T^{-1}$

$$\frac{dA}{dt} = -2k_1 A^2 + 2k_{-1} C$$

$$\frac{dC}{dt} = k_1 A^2 - k_{-1} C$$

1\. Determine dimensions of each parameter and variable.

$k_1, k_{-1}, A_0 \leftarrow$ parameters

$[A] = L^{-3} \quad [A_0] = L^{-3} \quad [C] = L^{-3}$

$[k_{-1}] = T^{-1} \quad [k_1] = L^3 T^{-1}$

2\. Introduce dimensionless variables.

$t^* = k_{-1} t \; ; \quad a^* = \frac{A}{A_0} \; ; \quad c^* = \frac{C}{A_0}$

3\. Rewrite eqns in terms of dimensionless variable.

$$\frac{dA}{dt} = -2k_1 A^2 + 2k_{-1} C \qquad \Longrightarrow \qquad \frac{da^*}{dt^*} = -2\boxed{\frac{k_1}{k_{-1}} A_0}\, a^{*2} + 2c^*$$

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$$\frac{dC}{dt} = k_1 A^2 - k_{-1} C \qquad\qquad \frac{dc^*}{dt^*} = \frac{k_1}{k_{-1}} A_0\, a^{*2} - c^*$$

$$\frac{da^*}{dt^*} = -2\varphi a^{*2} + 2c^*$$

$$\frac{dc^*}{dt^*} = \varphi a^{*2} - c^*$$

$A(t) + 2C(t) = \overset{M}{\text{const.}}$

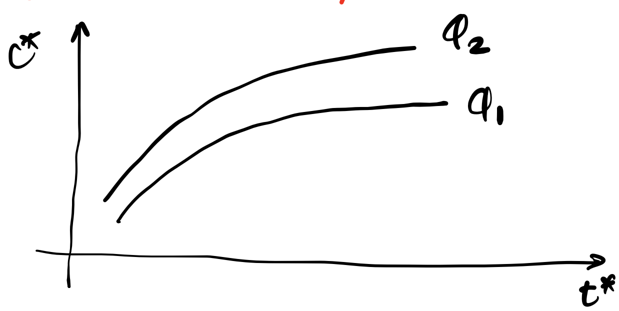
$C^*_{ss} = f(\varphi)$

4. Interpret the dimensionless variables and 'composite parameter'

$a^* = \frac{A}{A_0}$; $c^* = \frac{C}{A_0}$

$\varphi = \frac{K_1 A_0}{K_{-1}}$ $\qquad \frac{L^3 T^{-1}}{T^{-1}} L^{-3} = L^0 T^0$

5. Analyse the behavior of the dimensionless model



6. Convert the equations back into dimension-carrying form.

$a^* = \frac{A}{A_0}$; $c^* = \frac{C}{A_0}$