

# Baritugo Baranne PDIK CHEMIE 1110

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## Problem 2

$$v_1 = \frac{V_{\max}(A)}{\left(1 + \frac{[C]}{K_{I_1}}\right) / (k_{S_1} + [A])}$$

$$v_2 = \frac{V_{\max}(A)}{\left(1 + \frac{[C]}{K_{I_2}}\right) / (k_{S_2} + [A])}$$

$$v_3 = \frac{V_{\max}(B)}{k_{S_3} + [B]}$$

$$v_4 = \frac{V_{\max}(C)}{k_{S_4} + [C]}$$

$$\frac{d(S)}{dt} = v_1 - v_3 \quad \frac{d(C)}{dt} = v_2 - v_4 \quad [A] = S_{\text{tot}} - [B] - [C] \quad S_{\text{tot}} = [A] + [B] + [C]$$

$$a) V_{\max_1} = V_{\max_2} = 5 \quad V_{\max_3} = V_{\max_4} = 1 \quad k_{S_1} = k_{S_2} = k_{S_3} = k_{S_4} = 5 \quad K_{I_1} = K_{I_2} = 1 \quad S_{\text{tot}} = 100$$

so with  $[C] > [B] = 0$

$$0 = \frac{5[A]}{(5+[A])} - \frac{1[B]}{5+[B]}$$

$$0 = \frac{5[A]}{5+[A]} - \frac{1[C]}{5+[C]}$$

$$\frac{[B]}{5+[B]} = \frac{5[A]}{5+[A]} \quad 5[B] + [A][B] = 25[A] + 5[A][B] \quad [B] = \frac{25[A]}{5+[A]-5[A]}$$

$$5[B] + [A][B] - 5[A][B] = 25[A]$$

$$[B](5 + [A] - 5[A]) = 25[A]$$

$[C]$  is of some form as  $[B]$

$$\Rightarrow [C] = \frac{25[A]}{5+[A]-5[A]}$$

$$[A] = 100 - 2 \left( \frac{25[A]}{5+[A]-5[A]} \right) \quad 100 - [A] = \frac{50[A]}{5+[A]-5[A]}$$

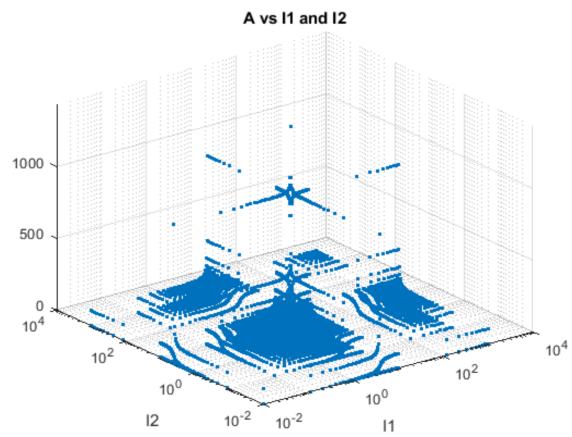
$$(100 - [A])(5 + [A] - 5[A]) = 50[A] \Rightarrow 500 + 100[A] - 500[A] - [A]^2 + 5[A]^2 = 50[A]$$

$$500 - 450[A] + 4[A]^2 = 0$$

$$\text{Wolfram Alpha: } [A] = \frac{450}{4} \pm \frac{\sqrt{19600}}{4}$$

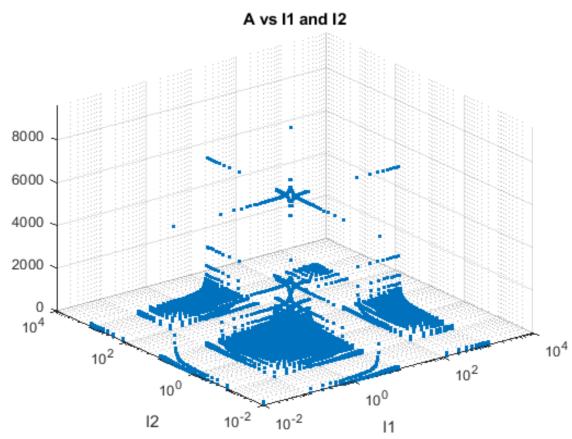
$$\Rightarrow [B] = \frac{1}{2}(100 - [A]) \quad [C] = \frac{1}{2}(100 - [A])$$

b)



c) This would resemble a NOR gate

d)  $\frac{[B]}{[S]} = \frac{S[A]}{(SS+[B])}$   $[B](1+I)(SS+[A]) = S A (SS+[B])$   
 $D(SS+A+SSI+AI) = 17SA + SA^2B$



this gate might be considered a fuzzy operator because the values are not just explicitly 0 or 1 on output but can be somewhere in between. In other words not all the way on or all the way off. Not just min or max

e) zero order sensitivity allows the tuning of gate outputs so gates can be modified to exhibit a large change in amplification on small input change or the gate can be set to be less responsive and resistant to perturbations in input