MA2431 Name: Solutions

Quiz 3 B Term, 2014

Show all work needed to reach your answers.

1. (10 points) Consider the reaction system

9-4a

$$X \underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}} A \qquad B \xrightarrow{k_2} Y \qquad 2X + Y \xrightarrow{k_3} 3X$$

Please set up a dimensional system of ODEs for this reaction system (assume A & B are constant).

$$\dot{X} = k_{-1}A - k_1 X + k_3 X^2 Y \quad (2)(2)(2)$$

$$\dot{Y} = k_2 B - k_3 X^2 Y \quad (2)(2)$$

5 2. (5 points) For the system $\dot{x} = p(x,y)$, $\dot{y} = q(x,y)$, what equations must one solve to find the equilibrium points?

$\dot{x} = 0$, $\dot{y} = 0$ (+4)

First Equation: $p(x,y) = 0$

Second Equation: $q(x,y) = 0$

3. (10 points) Consider the dimensional system of ODEs

$$\begin{aligned} \dot{X} &= k_1 X^2 Y - k_2 B X - k_3 X \\ \dot{Y} &= k_2 B X - k_3 X - k_1 X^2 Y \end{aligned}$$

Please define x, y and β and write this as a nondimensional system in the box below.

3

$x = \dfrac{k_3}{k_1} X$

$y = \dfrac{k_1}{k_3^2} Y$

$\beta = \dfrac{k_2}{k_3} B$

7 (r_i not required.)

$$\dot{x} = r_1(x^2 y - \beta x - x)$$

$$\dot{y} = r_2(\beta x - x - x^2 y)$$