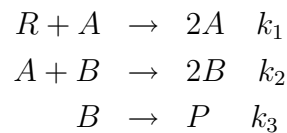


# Mathematical Biology, Kazanci

## Homework Assignment 2 (due 2/24/08)

1. Exercise 3.9.3 from textbook.
2. Exercise 3.9.4 from textbook.
3. Consider the following chemical reaction system (Lotka):



Amount of molecule  $R$  is kept constant in the following reaction system, and  $P$  is the product. Therefore the only molecules of interest are  $A$  and  $B$ . The rates are given as  $k_1[R] = 5$ ,  $k_2 = 0.1$  and  $k_3 = 5$ .

- (a) Derive the ODE for this system.
  - (b) Write down the state shift matrix ( $V$ ) and propensity vector ( $a$  or  $p$ ).
  - (c) Find all fixed points and analyze their stability.
4. Exercise 3.9.10 from textbook.
  5. Consider the following predator-prey model ( $a > 0$ ).<sup>1</sup>

$$\begin{aligned}x' &= x(x(1-x) - y) \\y' &= y(x - a)\end{aligned}$$

Analyze the fixed points and their stability. Identify all different cases for  $a > 0$ , and draw the phase-planes including the nullclines for each case.

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<sup>1</sup>Please do not use a computer on Problem 5, 6 and 7.