

Solutions to Quiz 1

- (5 marks) 1. In a certain Chemical reaction molecules of type a and molecules of type b combine to form molecules of type c at a certain rate which is proportional to the concentrations of a and b in the inert solvent. At the same time the molecule c converts to d at a certain rate which depends on the concentration of c .

Let the symbols C_a , C_b , C_c and C_d denote the concentrations of these molecules as a function of time. Formulate a suitable differential equation that expresses the dynamics of this reaction.

Solution: We are given that the rate at which the reaction takes place is kC_aC_b for a suitable constant k . This decreases the amounts of a and b and increases the amount of c . At the same time c converts into d at a certain rate mC_c . (1 mark for each of these terms. Or 1 mark for directly writing the equations below without this explanation.)

So the equations are

$$\begin{aligned}\frac{dC_a}{dt} &= -kC_aC_b \\ \frac{dC_b}{dt} &= -kC_aC_b \\ \frac{dC_c}{dt} &= kC_aC_b - mC_c \\ \frac{dC_d}{dt} &= mC_c\end{aligned}$$

(1 mark for the first two equations, 1 mark for the last equation and 1 mark for the third equation.)