

LECTURE 9

NCERT

Table 4.4 summarises the mathematical features of integrated laws of zero and first order reactions.

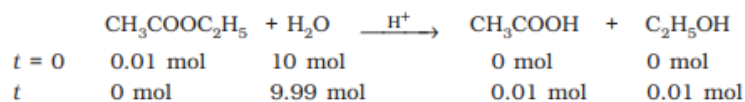
Table 4.4: Integrated Rate Laws for the Reactions of Zero and First Order

Order	Reaction type	Differential rate law	Integrated rate law	Straight line plot	Half-life	Units of k
0	R → P	$d[R]/dt = -k$	$kt = [R]_0 - [R]$	[R] vs t	$[R]_0/2k$	conc time ⁻¹ or mol L ⁻¹ s ⁻¹
1	R → P	$d[R]/dt = -k[R]$	$[R] = [R]_0 e^{-kt}$ or $kt = \ln\{[R]_0/[R]\}$	ln[R] vs t	ln 2/ k	time ⁻¹ or s ⁻¹

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The order of a reaction is sometimes altered by conditions. There are many reactions which obey first order rate law although they are higher order reactions. Consider the hydrolysis of ethyl acetate which is a chemical reaction between ethyl acetate and water. In reality, it is a second order reaction and concentration of both ethyl acetate and water affect the rate of the reaction. But water is taken in large excess for hydrolysis, therefore, concentration of water is not altered much during the reaction. Thus, the rate of reaction is affected by concentration of ethyl acetate only. For example, during the hydrolysis of 0.01 mol of ethyl acetate with 10 mol of water, amounts of the reactants and products at the beginning ($t = 0$) and completion (t) of the reaction are given as under.



The concentration of water does not get altered much during the course of the reaction. So, the reaction behaves as first order reaction. Such reactions are called **pseudo first order reactions**.

Inversion of cane sugar is another pseudo first order reaction.

