

TUTORIAL CHEMICAL KINETICS

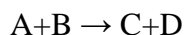
1. If the reaction is zeroth (0th) order with respect to [X], which of the following quantities when plotted vs. t should be a straight line: $\ln[X]$, $1/[X]$, $[X]$, or $[X]^2$?
2. The decomposition of HI is a classical second order reaction.
 $2\text{HI} \rightarrow \text{H}_2 + \text{I}_2(\text{s})$ In an experiment starting at 8:00 am, the partial pressure of HI decreases from 30.0 Pa to 15.0 Pa at 8:45 am (at a constant temperature). What shall the time be for the partial pressure of HI to reduce to 3.75 Pa?
3. The decomposition of A is first order, and [A] is monitored. The following data are recorded:

t / min	0	1	2	3
$[\text{A}]/[\text{M}]$	0.100	0.0905	0.0819	0.670

Calculate k . Calculate the half-life.

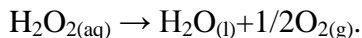
Calculate [A] when $t = 5$ min. Calculate t when $[\text{A}] = 0.0100$

4. The dimerization reaction of butadiene is second order process: $2\text{C}_4\text{H}_{6(\text{g})} \rightarrow \text{C}_8\text{H}_{12(\text{g})}$. The rate constant at some temperature is 0.100 /min with an initial concentration of butadiene ([B]) of 1 M. Calculate the concentration of butadiene at 1, 2, 5, 10, 20, 30, and 70 minutes.
5. Radioactive decay always follows first order kinetics. Carbon-11 is a radioactive isotope of carbon, and its half-life is 20.3 min. What is the decay constant?
6. In a first order reaction, $\text{A} \rightarrow \text{B}$. The half-life is 10 days. Determine its rate constant k ? How much time required for this reaction to be at least 50% and 60% complete?
7. Given the data below, find the rate law for the following reaction at 300 K and the corresponding rate constant.



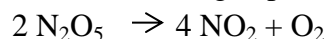
Trial	$[\text{A}]_{\text{initial}} (\text{M})$	$[\text{B}]_{\text{initial}} (\text{M})$	$r_{\text{initial}} (\text{M}/\text{sec})$
1	1	1	2
2	1	2	8.1
3	2	2	15.9

8. A reaction involving reactant A has a rate constant of $1.4 \times 10^{-4} \text{ s}^{-1}$. If 1.0 M of reactant reacts for 25 minutes, how much is left?
9. Hydrogen peroxide decomposes in a dilute sodium hydroxide solution at 20°C in a first order



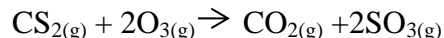
The rate = $k[\text{H}_2\text{O}_2]$ with $k = 1.06 \times 10^{-3} \text{ min}^{-1}$. What is the fraction remaining after 100.0 min? What is the concentration of H_2O_2 after 100.0 min if the initial concentration of H_2O_2 is 0.020 mol/L?

10. The gas phase decomposition of dinitrogen pentoxide at 335 K



is first order in N_2O_5 . During one experiment it was found that an initial concentration of 0.249 M dropped to 0.0496 M in 230 s. What is the value of the rate constant, k , in s^{-1} ?

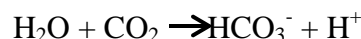
11. The reaction between CS_2 and ozone was studied using a large excess of CS_2 .



The pressure of ozone as a function of time is given in the following table. Is the reaction first order or second order with respect to ozone?

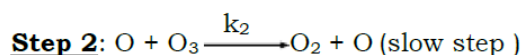
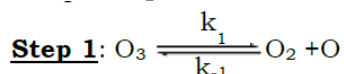
Time (s)	Ozone pressure (torr)
0	1.76
30	1.04
60	0.79
120	0.52
180	0.37
240	0.29

12. According to the information provided on some milk cartons, homogenized milk will keep for 1/3 day at 80°F, for 1/2 day at 70°F, for 1 day at 60°F, for 2 days at 50°F, for 10 days at 40°F, and for 24 days at 32°F. Calculate the activation energy for the process that spoils milk.
13. The enzyme carbonic anhydrase catalyzes both the forward and the reverse reactions for the hydration of CO_2 according to:



Carbonic anhydrase has a single active site and its molecular mass is 30,000 g/mol. If 8.0 μg of carbonic anhydrase catalyzes the hydration of 0.146 g of CO_2 in 30 seconds at 37°C, what is the turn over number of the enzyme?

14. At $T = 400 \text{ K}$, the rate of decomposition of a gaseous compound initially at a pressure of $p_0 = 12.6 \text{ kPa}$, was $v_1 = 9.71 \text{ Pa s}^{-1}$ when 10.0 percent had reacted (extent of reaction $\xi_1 = 0.100$) and $v_2 = 7.67 \text{ Pa s}^{-1}$ when 20.0 percent had reacted ($\xi_2 = 0.200$). Find the order of the reaction.
15. The decomposition of ozone is depicted below:



What is steady state approximation? Find the expression of rate of decomposition of O_3 (using steady state approximation)