

CHEMICAL KINETICS – PAST PAPER QUESTIONS (2013- 2022)
YEAR 2022

1. Answer the following questions :

(i) Identify the order of reaction from the following unit for its rate constant: $\text{Lmol}^{-1}\text{s}^{-1}$

(ii) The conversion of molecules A to B follow second order kinetics. If concentration of A is increased to three times, how will it affect the rate of formation of B?

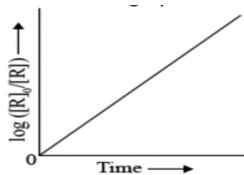
(iii) Write the expression of integrated rate equation for zero order reaction.

2. Observe the graph shown in figure and answer the following questions :

(i) What is the order of the reaction?

(ii) What is the slope of the curve?

(iii) Write the relationship between k and $t_{1/2}$ (half-life period)



YEAR 2020

1. In a chemical reaction $X \rightarrow Y$, it is found that the rate of reaction doubles when the concentration of X is increased four times. The order of the reaction with respect to X is

- (a) 1 (b) 0 (c) 2 (d) $1/2$

2. A first order reaction is 25% complete in 40 minutes. Calculate the value of rate constant. In what time will the reaction be 80% completed? Define order of reaction. Write the condition under which a bimolecular reaction follows first order kinetics.

3. (i) A first order reaction is 50% complete in 30 minutes at 300 K and in 10 minutes at 320 K. Calculate activation energy (E_a) for the reaction.

($R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$)

(ii) Write the two conditions for collisions to be effective collisions.

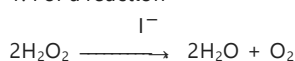
(iii) How order of reaction and molecularity differ towards a complex reaction?

[Given: $\log 2 = 0.3010$, $\log 3 = 0.4771$, $\log 4 = 0.6021$, $\log 5 = 0.6991$]

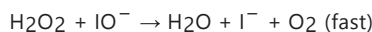
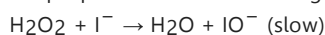
4. Write the slope value obtained in the plot of $\log [R_0]/[R]$ Vs. time for a first order reaction.

YEAR 2019

1. For a reaction



the proposed mechanism is as given below:



(i) Write rate law for the reaction.

(ii) Write the overall order of reaction.

(iii) Out of steps (1) and (2), which one is rate determining step?

2. The Decomposition of NH_3 on the platinum surface is zero order reaction. If rate constant (k) is $4 \times 10^{-3} \text{ Ms}^{-1}$, how long it will take to reduce the initial concentration of NH_3 from 0.1 M to 0.064 M.

For the reaction

YEAR 2018

1. $2\text{N}_2\text{O}_5 (\text{g}) \rightarrow 4\text{NO}_2 (\text{g}) + \text{O}_2 (\text{g})$, the rate of formation of $\text{NO}_2 (\text{g})$ is $2.8 \times 10^{-3} \text{ M s}^{-1}$. Calculate the rate of disappearance of $\text{N}_2\text{O}_5 (\text{g})$.

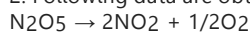
2. A first order reaction is 50% completed in 40 minutes at 300 K and in 20 minutes at 320 K. Calculate the activation energy of the reaction.

(Given : $\log 2 = 0.3010$, $\log 4 = 0.6021$, $R = 8.314 \text{ JK}^{-1} \text{ mol}^{-1}$)

YEAR 2017

1. For a reaction $R \rightarrow P$, half-life ($t_{1/2}$) is observed to be independent of the initial concentration of reactants. What is the order of reaction?

2. Following data are obtained for reaction :



t/s	0	300	600
$[\text{N}_2\text{O}_5]/\text{mol L}^{-1}$	1.6×10^{-2}	0.8×10^{-2}	0.4×10^{-2}

(i) Show that it follows first order reaction.

(ii) Calculate the half-life. (Given $\log 2 = 0.3010$, $\log 4 = 0.6021$)

3. What is the effect of catalyst on:

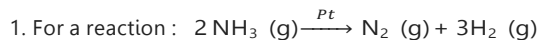
(i) Gibbs energy (ΔG) and

(ii) activation energy of a reaction?

3. A first order reaction takes 20 minutes for 25% decomposition. Calculate the time when 75% of the reaction will be completed.

(Given : $\log 2 = 0.3010$, $\log 3 = 0.4771$, $\log 4 = 0.6021$)

YEAR 2016



Rate = k

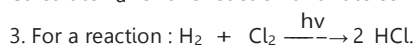
(i) Write the order and molecularity of this reaction

(ii) Write the unit of k .

2. The rate constant for the first-order decomposition of H_2O_2 is given by the following equation:

$$\log k = 14.2 - \frac{1.0 \times 10^4 K}{T}$$

Calculate E_a for this reaction and rate constant k if its half-life period be 200 minutes. (Given: $R = 8.314 \text{ JK}^{-1} \text{ mol}^{-1}$)



Rate = k

(i) Write the order and molecularity of this reaction.

(ii) Write the unit of k .

4. For the first order thermal decomposition reaction, the following data were obtained: $\text{C}_2\text{H}_5\text{Cl}(\text{g}) \rightarrow \text{C}_2\text{H}_4(\text{g}) + \text{HCl}(\text{g})$

Time/sec **Total pressure/ atm**

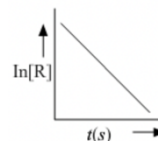
0 0.30

300 0.50

Calculate the rate constant. (Given: $\log 2 = 0.301$, $\log 3 = 0.4771$, $\log 4 = 0.6021$)

YEAR 2015

- Define rate of reaction? Write two factors that affect the rate of reaction.
- The rate constant of a first-order reaction increases from 2×10^{-2} to 4×10^{-2} , when the temperature changes from 300 K to 310 K. Calculate the energy of activation (E_a). (log 2 = 0.301, log 3 = 0.4771, log 4 = 0.6021)
- (b) A first order reaction takes 10 minutes for 25% decomposition. Calculate $t_{1/2}$ for the reaction. (Given : log 2 = 0.3010, log 3 = 0.4771, log 4 = 0.6021)
- For a chemical reaction $R \rightarrow P$, the variation in the concentration, $\ln [R]$ vs. time (s) plot is given as



- Predict the order of the reaction.
- What is the slope of the curve?
- Write the unit of rate constant for this reaction.

- Show that the time required for 99% completion is double of the time required for the completion of 90% reaction.
- For the hydrolysis of methyl acetate in aqueous solution, the following results were obtained :

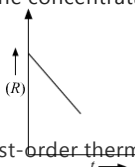
t/s	0	30	60
$[\text{CH}_3\text{COOCH}_3] / \text{mol L}^{-1}$	0.60	0.30	0.15

Show that it follows pseudo first order reaction, as the concentration of water remains constant.

- Calculate the average rate of reaction between the time interval 30 to 60 seconds. (Given log 2 = 0.3010, log 4 = 0.6021)
- For a reaction $A + B \rightarrow P$, the rate is given by $\text{Rate} = k[A][B]^2$
 - How is the rate of reaction affected if the concentration of B is doubled ?
 - What is the overall order of reaction if A is present in large excess ?
- A first order reaction takes 30 minutes for 50% completion. Calculate the time required for 90% completion of this reaction. (log 2 = 0.3010)

YEAR 2014

- For a chemical reaction $R \rightarrow P$, the variation in the concentration R vs. time t plot is given as



- Predict the order of the reaction.
- What is the slope of the curve?

- The following data were obtained during the first-order thermal decomposition of SO_2Cl_2 at a constant volume:
 $\text{SO}_2\text{Cl}_2 (\text{g}) \rightarrow \text{SO}_2 (\text{g}) + \text{Cl}_2 (\text{g})$

Experiment	Time/ s^{-1}	Total pressure/atm
1	0	0.4
2	100	0.7

Calculate the rate constant. (Given: log 4 = 0.6021 and log 2 = 0.3010)

- Define the following terms:

- Pseudo first-order reaction
- Half-life period of reaction ($t_{1/2}$).
- Rate constant (k)

- Write two differences between 'order of reaction' and 'molecularity of reaction'.

- (i) For a reaction $A + B \rightarrow P$, the rate law is given by, $r = k[A]^{1/2}[B]^2$. What is the order of this reaction?
 (ii) A first order reaction is found to have a rate constant $k = 5.5 \times 10^{-14} \text{ s}^{-1}$. Find the half life of the reaction
- The rate of a reaction becomes four times when the temperature changes from 293 K to 313 K. Calculate the energy of activation (E_a) of the reaction assuming that it does not change with temperature. ($R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$, log 4 = 0.6021)

YEAR 2013

- (a) A reaction is second order in A and first order in B.

- Write the differential rate equation.
 - How is the rate affected on increasing the concentration of A three times?
 - How is the rate affected when the concentrations of both A and B are doubled?
- (b) A first order reaction takes 40 minutes for 30% decomposition. Calculate $t_{1/2}$ for this reaction. (Given log 1.428 = 0.1548)

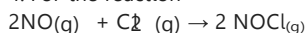
- For a first order reaction, show that time required for $3/4^{\text{th}}$ completion of the initial concentration of the reactant is twice the time required for the half life.

- (a) Rate constant ' k ' of a reaction varies with temperature ' T ' according to the equation:

$$\log k = \log A - \frac{E_a}{2.303R} \left(\frac{1}{T} \right) \quad \text{Where } E_a \text{ is the activation energy. When a graph is plotted for } \log k \text{ Vs. } \frac{1}{T}, \text{ a straight line with a slope of } -4250 \text{ K is obtained.}$$

Calculate ' E_a ' for the reaction. ($R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$)

- For the reaction



The following data were collected. All the measurements were taken at 263 K:

Experiment No.	Initial $[\text{NO}]$ (M)	Initial $[\text{Cl}_2]$ (M)	Initial rate of disappearance of Cl_2 (M/min)
1	0.15	0.15	0.60
2	0.15	0.30	1.20
3	0.30	0.15	2.40
4	0.25	0.25	?

- Write the expression for rate law.
- Calculate the value of rate constant and specify its units.
- What is the initial rate of disappearance of Cl_2 in exp. 4?