

**ASSINGMENT CHEMICAL KINETICS (KV NO-2, CRPF, BHUBANESWAR)**

**CBSE BOARD QUESTION PREPARED BY A K SAMAL, PGT(CHEM.) PH.NO-7381884606 [5 MARKS]**

**2005**

1. Express the relation between the half-life period of a reactant and its initial concentration if the reaction involved is of second order. (1M)
2. A first order reaction takes 69.3 minutes for 50% completion. Set up an equation and calculate the time needed for 80% completion of this reaction.(3)
3. Express the relation between the half-life period of a reactant and its initial concentration for a reaction of  $n^{\text{th}}$  order. (1)
4. The activation energy of a reaction is  $75.2 \text{ kJ mol}^{-1}$  in the absence of a catalyst and  $50.14 \text{ kJ mol}^{-1}$  with a catalyst. How many times will the rate of reaction grow in the presence of the catalyst if the reaction proceeds at  $25^{\circ}\text{C}$ ? ( $R=8.314 \text{ JK}^{-1} \text{ mol}^{-1}$ ) (3)

**2006**

5. For the reaction  $A \rightarrow B$ , the rate of reaction becomes twenty seven times when the concentration of A is increased three times. What is the order of the reaction? (1)
6. The rate of a particular reaction triples when temperature changes from  $50^{\circ}\text{C}$  to  $100^{\circ}\text{C}$ . Calculate the activation energy of the reaction. [ $R = 8.314 \text{ JK}^{-1} \text{ mol}^{-1}$ ] (3)
7. A reaction is 50% complete in 2 hours and 75% complete in 4 hours. What is the order of the reaction? (1)
8. A certain reaction is 50% complete in 20 minutes at 300 K and the same reaction is again 50% complete in 5 minutes at 350 K. Calculate the activation energy. if it is a first order reaction. [ $R = 8.314 \text{ JK}^{-1} \text{ mol}^{-1}$ ;  $\log 4 = 0.602$ ] (3)
9. What is meant by elementary step in a reaction? (1)
10. Define activation energy of a reaction. (1)

**2007**

11. For the reaction  
 $\text{Cl}_2(\text{g}) + 2\text{NO}(\text{g}) \rightarrow 2\text{NOCl}(\text{g})$  the rate law is expressed as  
 $\text{rate} = k[\text{Cl}_2][\text{NO}]^2$

What is the overall order 'of this reaction? (1)

12.

The decomposition of  $\text{NH}_3$  on platinum surface,  $2\text{NH}_3(\text{g}) \xrightarrow{\text{Pt}} \text{N}_2(\text{g}) + 3\text{H}_2(\text{g})$  is a zero order reaction with  $k = 2.5 \times 10^{-4} \text{ Ms}^{-1}$ . What are the rates of production of  $\text{N}_2$  and  $\text{H}_2$  ?

3

13. Express the rate of the following reaction in terms of disappearance of hydrogen in the reaction  $3\text{H}_2 + \text{N}_2 \rightarrow 2\text{NH}_3$

14. The rate constant for a first order reaction is  $60 \text{ s}^{-1}$ . How much time will it take to reduce the concentration of the reactant to 1/10th of its initial value ? 3

15. What is meant by order of a reaction being zero ?

16. The rates of most reactions double when their temperature is raised from 298 K to 308 K. Calculate activation energy of such a reaction. 3

( $R = 8.314 \text{ J mol}^{-1} \text{ K}^{-1}$ ,  $\log 2 = 0.3010$ )

### 2008

17.

Define the term 'order of reaction' for chemical reactions.

18

What is meant by the 'rate constant,  $k$ ' of a reaction ? If the concentration be expressed in  $\text{mol L}^{-1}$  units and time in seconds, what would be the units for  $k$  (i) for a zero order reaction and (ii) for a first order reaction ? 2

19

(a) Derive the general form of the expression for the half-life of a first order reaction.

(b) The decomposition of  $\text{NH}_3$  on platinum surface is a zero order reaction. What are the rates of production of  $\text{N}_2$  and  $\text{H}_2$  if  $k = 2.5 \times 10^{-4} \text{ mol}^{-1} \text{ L s}^{-1}$  ? 2, 3

OR

(a) List the factors on which the rate of a chemical reaction depends.

(b) The half-life for decay of radioactive  $^{14}\text{C}$  is 5730 years. An archaeological artefact containing wood has only 80% of the  $^{14}\text{C}$  activity as found in living trees. Calculate the age of the artefact. 2, 3

20.

A first order decomposition reaction takes 40 minutes for 30% decomposition. Calculate its  $t_{1/2}$  value. 2

### 2009

21. A reaction is of second order with respect to a reactant. How will the rate of reaction [2]

(i) Doubled,

(ii) Reduced to half?

22. A first order reaction has a rate constant of  $0.0051 \text{ min}^{-1}$ . if we begin with  $0.10 \text{ M}$  concentration of the reactant, what concentration of reactant will remain in solution after 3 hours? [3]

### 2010

23.

A reaction is of first order in reactant A and of second order in reactant B. How is the rate of this reaction affected when (i) the concentration of B alone is increased to three times (ii) the concentrations of A as well as B are doubled ? 2

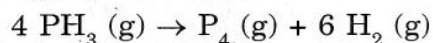
24.

The rate constant for a reaction of zero order in A is  $0.0030 \text{ mol L}^{-1} \text{ s}^{-1}$ . How long will it take for the initial concentration of A to fall from  $0.10 \text{ M}$  to  $0.075 \text{ M}$  ? 2

**2011**

**25.**

- (a) Explain the following terms :
- Rate of a reaction
  - Activation energy of a reaction
- (b) The decomposition of phosphine,  $\text{PH}_3$ , proceeds according to the following equation :



It is found that the reaction follows the following rate equation :

$$\text{Rate} = k [\text{PH}_3].$$

The half-life of  $\text{PH}_3$  is 37.9 s at 120° C.

- How much time is required for  $3/4^{\text{th}}$  of  $\text{PH}_3$  to decompose ?
- What fraction of the original sample of  $\text{PH}_3$  remains behind after 1 minute ?

5

**OR**

- (a) Explain the following terms :
- Order of a reaction
  - Molecularity of a reaction
- (b) The rate of a reaction increases four times when the temperature changes from 300 K to 320 K. Calculate the energy of activation of the reaction, assuming that it does not change with temperature. ( $R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$ )

5

**26. The slope of a line in the graph of  $\log_{10} K$  verses  $(1/T)$  for a reaction is  $-5642\text{k}$ . Calculate the activation energy for this reaction.**

**2012**

**27.** A reaction is second order with respect to a reactant. How is the rate of reaction affected if the concentration of the reactant is (i) doubled (ii) reduced to half?

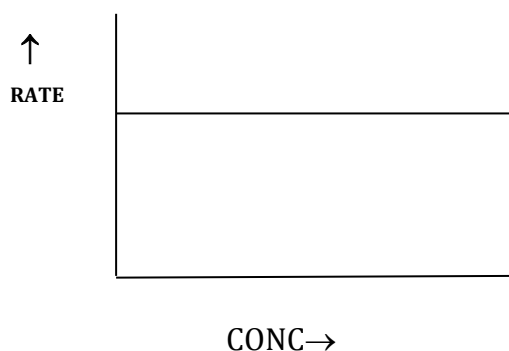
**2013**

**28.** Rate constant  $K$  for first order reaction has been found to be  $2.54 \times 10^{-3} \text{ sec}^{-1}$ . Calculate its three-fourth life.

**OR**

A first order gas reaction  $\text{A}_2(\text{g})\text{B}_2(\text{g}) \rightarrow 2\text{A}(\text{g}) + 2\text{B}(\text{g})$  at the temperature 400°C has the rate Constant  $K = 2.0 \times 10^{-4} \text{ sec}^{-1}$ . What percentage of  $\text{A}_2\text{B}_2$  is decomposed on heating for 900seconds?

**29.** For a chemical reaction variation in rate with conc. is shown below:

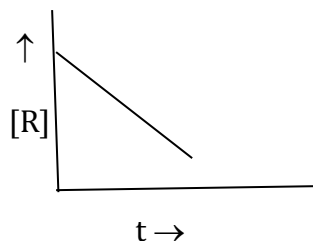


What is the order of the reaction?

What the units are of rate constant  $K$  for the reaction?

**2014**

30. For a chemical reaction  $R \rightarrow P$ , the variation in concentration  $[R]$  Vs time( $t$ ) plot is given as



(i) Predict the order of reaction.

(ii) What is the slope of curve?

31. The following data were obtained during the first order thermal decomposition of  $SO_2Cl_2$

at a constant volume:  $SO_2Cl_{2(g)} \rightarrow SO_{2(g)} + Cl_{2(g)}$

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

Calculate rate constant. (Given:  $\log 4 = 0.6021, \log 2 = 0.3010$ )

**2015**

32. For the hydrolysis of methyl acetate in aqueous solution, the following results were obtained:

t/s	0	20	40
$[CH_3COOCH_3]/molL^{-1}$	0.40	0.20	0.10

(a) Show that it follows pseudo first order reaction, as concentration of water remain constant.

(b) Calculate the average rate of reaction between the time intervals 20 to 40 seconds.

OR

(a) Define following terms:

(i) Collision frequency

(ii) Rate constant (k)

(b) The rate constant for the first order increases from  $4 \times 10^{-4}$  to  $24 \times 10^{-2}$  when the temperature changes from 300 K to 350 K. Calculate the energy of activation ( $E_a$ ) of the reaction assuming that it does not change with temperature.

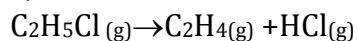
**2016**

33. Show that the time required for completion of  $\frac{3}{4}$  th of reaction of first order is twice that of half-life ( $t_{1/2}$ ) of reaction.

OR

Derive integrated rate equation for rate constant of a zero order reaction.

34. For the first order thermal decomposition reaction, the following data were obtained:



Experiment	Time/sec	Total pressure/atm
1	0	0.30
2	300	0.50

Calculate rate constant.

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

2017

35. What is the effect of adding a catalyst on [1]

(a) Activation energy ( $E_a$ ), and

(b) Gibbs energy ( $\Delta G$ ) of a reaction?

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

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

2018

37. For the reaction:  $2\text{N}_2\text{O}_{5(g)} \rightarrow 4\text{NO}_{2(g)} + \text{O}_{2(g)}$ ,

the rate of formation of  $\text{NO}_{2(g)}$  is  $2.8 \times 10^{-3} \text{M s}^{-1}$ . Calculate the rate of disappearance of  $\text{N}_2\text{O}_{5(g)}$ . [2]

38. A first order reaction 50% completed in 40 minutes at 300K and 20 minutes at 320K. Calculate the activation energy of reaction. [Given:  $\log 2 = 0.3010$ ,  $\log 4 = 0.6021$ ,  $R = 8.314 \text{J K}^{-1} \text{mol}^{-1}$ ] [3]