"CULTIVATING EXCELLENCE IN EVERY STUDENT"

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Class:-XII (Sci.) **Name of Student……**
Subject:- Chemistry

10 YEAR QUSTIONS
Chapter-4
Chemical kinetics

1. (a) A reaction is second order in A and first order in B.
(i) Write the differential rate equation.
(ii) How is the rate affected on increasing the concentration of A three times ?
(iii) 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)

2. Nitrogen pentoxide decomposes according to equation : $2N_2O_5(g) \longrightarrow 4\ NO_2(g) + O_2(g)$. This first order reaction was allowed to proceed at 40 °C and the data below were collected :

$[N_2O_5]$ (M)	Time (min)
0.400	0.00
0.289	20.0
0.209	40.0
0.151	60.0
0.109	80.0

(a) Calculate the rate constant. Include units with your answer.
(b) What will be the concentration of N_2O_5 after 100 minutes ?
(c) Calculate the initial rate of 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)

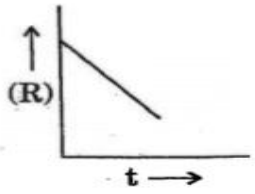
4. **What do you understand by the rate law and rate constant of a reaction ? Identify the order of a reaction if the units of its rate constant are : (i) L^{-1} mol s^{-1} (ii) L mol^{-1} s^{-1}**

5. **The thermal decomposition of HCO_2H is a first order reaction with a rate constant of $2{\cdot}4 \times 10^{-3}$ s^{-1} at a certain temperature. Calculate how long will it take for three-fourths of initial quantity of HCO_2H to decompose. (log 0·25 = – 0·6021)**

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

7. The reaction, $N_2(g) + O_2(g) \rightleftharpoons 2\,NO(g)$ contributes to air pollution whenever a fuel is burnt in air at a high temperature. At 1500 K, equilibrium constant K for it is $1{\cdot}0 \times 10^{-5}$. Suppose in a case $[N_2] = 0{\cdot}80$ mol L^{-1} and $[O_2] = 0{\cdot}20$ mol L^{-1} before any reaction occurs. Calculate the equilibrium concentrations of the reactants and the product after the mixture has been heated to 1500 K.

8. **For a chemical reaction R → P, the variation in the concentration (R) vs. time (t) plot is given as :**



(i) Predict the order of the reaction.
(ii) What is the slope of the curve ?

9. The following data · were obtained· during the first order thermal decomposition of SO_2Cl_2 at a constant volume; $SO_2Cl_2(g) \longrightarrow SO_2(g) + Cl_2(g)$

Experiment	Time/s^{-1}	Total pressure/atm
1	0	0·4
2	100	0·7

Calculate the rate constant. (Given: log 4 = 0·6021, log 2 = 0·3010)

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

t/s	0	30	60
$[CH_3COOCH_3]$/mol L^{-1}	0.60	0.30	0.15

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

(ii) Calculate the average rate of reaction between the time intervals 30 to 60 seconds. (Given log 2 = 0.3010, log 4 = 0.6021)

11. (a) For a reaction A + B → P, the rate is given by Rate = k[A] $[B]^2$

(i) How is the rate of reaction affected if the concentration of B is doubled?

(ii) What is the overall order of reaction if A is present in large excess?

(b) A first order reaction takes 30 minutes for 50% completion. Calculate the time required for 90% completion of this reaction. (log 2 = 0.3010)

12. The' rate' Constant of a first 'order reaction increases from 2 $x10^{-2}$ to 4 $x\ 10^{-2}$ when the temperature changes from 300 K to 310 K Calculate the energy of activation (Ea);(log 2 = 0·301, log 3 = 0·4 771, log 4 = 0·6021)

13. Define rate of reaction. Write two factors that affect the rate of reaction.

14. The rate constant for the first order decomposition of H_2O_2 is given by the following equation: $\log k = 14.2 - \frac{1.0 \times 10^4}{T} K$

Calculate Ea for this reaction and rate constant k if its half-life period be 200 minutes. (Given: R = 8.314 J K^{-1} mol^{-1})

15. For a reaction : $2NH_3(g) \xrightarrow[\text{Rate} = k]{Pt} N_2(g) + 3H_2(g)$

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

(ii) Write the unit of k.

16. For a reaction : $H_2 + Cl_2 \xrightarrow{h\nu} 2HCl$, Rate = k

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

(ii) Write the unit of k.

17. Show that the time required for completion of $\frac{3}{4}$th of reaction of first order is twice that of half-life ($t_{½}$) of the reaction.

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

19. For the first order thermal decomposition reaction, the following data were obtained : $C_2H_5Cl(g) \rightarrow C_2H_4(g) + HCl(g)$

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)

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

21. Following data are obtained for the reaction : $N_2O_5 \rightarrow 2NO_2 + ½O_2$

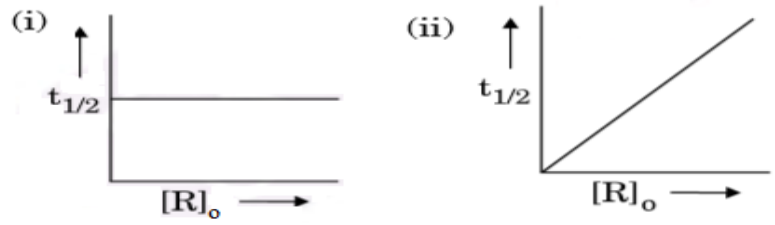
t/s	0	300	600
$[N_2O_5]$/mol L^{-1}	1.6×10^{-2}	0.8×10^{-2}	0.4×10^{-2}

(a) Show that it follows first order reaction.

(b) Calculate the half-life.

(Given log 2 = 0.3010 log 4 = 0.6021)

22. (a) A first order reaction is 75% completed in 40 minutes. Calculate its t1/2. (b) Predict the order of the reaction in the given plots :



Where [R]o is the initial concentration of reactant. (Given: log 2 = 0·3010, log 4 = 0·6021)

23. The following data were obtained for the reaction : $2\ NO + O_2 \rightarrow 2\ NO_2$

Experiment	[NO] / M	$[O_2]$ / M	Initial rate of formation of NO_2 / M min^{-1}
1	0·3	0·2	$7·2 \times 10^{-2}$
2	0·1	0·1	$6·0 \times 10^{-3}$
3	0·3	0·4	$2·88 \times 10^{-1}$
4	0·4	0·1	$2·40 \times 10^{-2}$

(a) Find the order of reaction with respect to NO and O_2.

(b) Write the rate law and overall order of reaction. (c) Calculate the rate constant (k).

24. A reaction is first order in A and second order in B

(i) Write the differential rate equation.

(ii) How is the rate affected on increasing the concentration of B three times?

(iii) How is the rate affected when the concentration of both A and B are doubled?

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

26. For a reaction $2H_2O_2 \xrightarrow[\text{alkaline medium}]{I^-} 2H_2O + O_2$

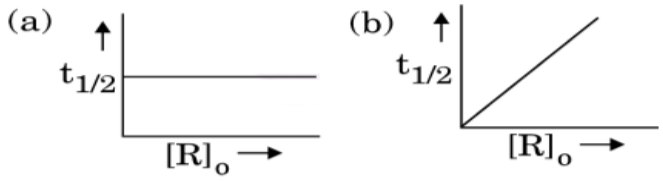
The proposed mechanism is as given below:

(1) $H_2O_2 + I^- \rightarrow H_2O + IO^-$ (slow) (2) $H_2O_2 + IO^- \rightarrow H_2O + I^- + O_2$ (fast)

(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?

27. Define order of reaction. Predict the order of reaction in the given graphs :



Where [R]o is the initial concentration of reactant and t1/2 is half-life.

28. The following data were obtained for the reaction : A + 2B → C

Experiment	[A]/M	[B]/M	Initial rate of formation of C /M min^{-1}
1	0·2	0·3	$4·2 \times 10^{-2}$
2	0·1	0·1	$6·0 \times 10^{-3}$
3	0·4	0·3	$1·68 \times 10^{-1}$
4	0·1	0·4	$2·40 \times 10^{-2}$

(a) Find the order of reaction with respect to A and B.

(b) Write the rate law and overall order of reaction. (c) Calculate the rate constant (k).

29. (a) Define order of reaction. How does order of a reaction differ from molecularity for a complex reaction? (b) A first order reaction is 50% complete in 25 minutes. Calculate the time for 80% completion of the reaction.

30. (a) The decomposition of a hydrocarbon has value of rate constant as $2·5 \times 10^4$ s^{-1} at 27^0C. At what temperature would rate constant be $7·5 \times 10^4$ s^{-1} if energy of activation is $19·147 \times 10^3$ J mol^{-1}?
(b) Write a condition under which a bimolecular reaction is kinetically first order. Give an example of such a reaction. (Given: log 2 = 0·3010, log 3 = 0·4771, log 5 = 0·6990)

31. The rate of reaction quadruples when temperature changes from 293 K to 313 K. Calculate Ea assuming that it does not change with time. [R = 8·314 JK^{-1} mol^{-1}]

32. (a) Draw the plot of ln k vs 1/T for a chemical reaction. What does the intercept represent? What is the relation between slope and Ea? (b) A first order reaction takes 30 minutes for 20% decomposition. Calculate $t_{1/2}$. [Log 2 = 0.3010]

33. The reaction between A and B is first order with respect to A and zero order with respect to B. For this reaction, fill in the blanks in the following table.

Experiment	[A] mol/L	[B] mol/L	Initial Rate Mol/L/min
I	0·1	0·1	$2·0 \times 10^{-2}$
II	–	0·2	$4·0 \times 10^{-2}$
III	0·4	0·4	–
IV	–	0·2	$2·0 \times 10^{-2}$

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