CBSE 12th Chemistry Chapter 4 (Chemical Kinetics) Unsolved Important Questions

CBSE 12th Chemistry
Chapter 4 (Chemical Kinetics)
Solved Important Questions

SECTION A

(Each question in this section carry 1 mark)

Q.1. Define the term 'order of reaction' for chemical reactions.

Q.2. Define 'order of a reaction'.

Q.3. 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?

Q.4. What is the effect of adding a catalyst on
(a) Activation energy (E_a), and
(b) Gibbs energy (ΔG) of a reaction?

SECTION B

(Each question in this section carry 2 marks)

Q.5. A first order decomposition reaction takes 40 minutes for 30% decomposition. Calculate its $t_{1/2}$ value.

Q.6. What is meant by the 'rate constant' k' Of a reaction? If the concentration be expressed in 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?

Q.7. A reaction of second order with respect to a reactant. How will the rate of reaction be affected if the concentration of this reactant is:

(i) Doubled,
(ii) Reduced to half?

Q.8. **A reaction of second order with respect to a reactant. How will the rate of reaction be affected if the concentration of this reactant is**

(i) Doubled,
(ii) Reduced to half?

Q.9. **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?**

Q.10. **For a first order reaction, time taken for half of the reaction to complete t_1 and $\frac{3}{4}$ of the reaction to complete is t_2. How are t_1 and t_2 related?**

Q.11. **Distinguish between 'rate expression' and 'rate constant' of a reaction.**

Q.12. **What do you understand by the order of a reaction'? Identify the reaction order from each of the following units of reaction rate constant:**

(i) $L^{-1}mol\,S^{1}$

(ii) $Lmol^{-1}\,S^{-1}$

Q.13. **Write two differences between 'order of reaction' and 'molecularity of reaction'.**

Q.14. **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) $L\,mol^{-1}\,S^{-1}$

Q.15. **The thermal decomposition of HCO_2H is a first order reaction with a rate constant of $2.4 \times 10^{-3}\,s^{-1}$ 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).**

Q.16. **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?**

Q.17. **(a) For a reaction $A + B \longrightarrow P$, the rate law is given by, $r = k[A]^{1/2}[B]^2$ What is the order of this reaction.**
(b) A first order reaction is found to have a rate constant $k = 5.5 \times 10^{-14}S^{-1}$ Find the half-life of the reaction.

Q.18. 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 he slope of the curve?

Q.19. For the first order thermal decomposition reactions, the following data were obtained C2H3Cl(g) C2H4(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)

SECTION C

(Each question in this section carry 3 marks)

Q.20. A first order reaction has a rate constant of $0.0051\ min^{-1}$. If we begin with 0.10 M concentration of the reactant, what concentration of reactant will remain in solution after 3 hours?

Q.21. Nitrogen pentoxide decomposes according to equation:
$2N_2O_5(g) \longrightarrow 4NO_2(g) + O_2(g)$.
This first order reaction was allowed to proceed at 40 ℃ 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 N_2O_5 after 100 minutes?
(c) Calculate the initial rate of reaction

Q.22. For the reaction $2NO_{(g)} + Cl_2(g) \longrightarrow 2\ NOCl_{(g)}$ the following date were collected. Al the measurements were taken at 263K:

Experiment No.	Initial [NO] (M)	Initial [Cl_2] (M)	Initial rate of disappearance of cl2 (M/min)
1	0.15	0.15	0.60
2	0.15	0.13	1.20
3	0.30	0.15	2.40
4	0.25	0.25	?

(a) Write the expression for rate law.

(b) Calculate the value of rate constant and specify its units.

(c) What is the initial rate of

Disappearance of Cl_2 in exp. 4?

Q.23. The following data were obtained during the first thermal decomposition of SO_2Cl_2 at a constant volume:

$$SO_2Cl_2(g)SO \longrightarrow SO_2(g) + Cl_2(g)$$

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)

Q.24. 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 E_a for this reaction and rate constant k if its half life period be 200 minutes. (Given: R = 8.314 $JK^{-1}mol^{-1}$).

Q.25. Following data are obtained for reaction:
$N_2O_5 \rightarrow 2NO_2 + 1/2O_2$

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)

Q.26. **A first reaction has rate constant of $0.0051\ min^{-1}$. If we begin with 0.10 M concentration of the reactant. What concentration of the reactant will be left after 3 hours?**

Q.27. **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 changes with temperature. $[R = 8.314 JK^{-1}mol^{-1}, log4 = 0.6021]$.**

Q.28. **The following data were obtained during the first order thermal decomposition of SO_2Cl_2 at a constant volume:**

$$SO_2Cl_2(g) \longrightarrow SO_2(g) + Cl_2(g)$$

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

Calculate the rate constant. (Given: Log 4 = 0.6021, Log 2 =0.3010)

Q.29. **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)

SECTION D

(Each question in this section carry 5 marks)

Q.30. **(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 concentrations of both A three times?
(iii) How is the rate affected when the concentrations of both A and B are doubled?
(b) A find order reaction takes 40 minutes for 30% decomposition. Calculate $t_{1/2}$ for this reaction. (Given log 1.428 = 0.1548)

Q.31. (a) For a first order reaction, show that time required for 90% completion is twice the time required for the completion of 90% of reaction.

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

$$\log k = \log A - \frac{E_a}{2.303R}\left(\frac{1}{T}\right)$$

Where E_a is the activation energy? When a graph is plotted for log k Vs $\frac{1}{T}$, a straight line with a slope of – 4250 K is obtained. Calculate $'E_a'$ for the reaction. ($R = 8.314\ JK^{-1}mol^{-1}$)

Q.32. 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 is follows pseudo first order reaction, as the concentration of water remains constant.

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

Q.33. (b) 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)

Q.34. (a) Define the following:

(i) Order of reaction

(ii) Activation energy of reaction

(b) $A + 2B \longrightarrow 3C + 2D$. The ratio of disappearance of B is $\times 10^{-2}\ mol/L/S$.

What will be

(i) Rate of the reaction (ii) Rate of change in concentration of A and C?

Q.35. (a) List the factors on which the rate of a chemical reaction depends.

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

Q.36. (a) Explain the following terms:

(i) Rate of a reaction

(ii) Activation energy of a reaction

(b) The decomposition of phosphine, PH3, proceeds according to the following equation:

$$4\,PH_3(g) \longrightarrow P_4(g) + 6\,H_2(g)$$

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

$$Rate = k[PH_3].$$

The half-life of PH_3 is 37.9 s at 120^0C.

(i) How much time is required for $3/4th$ of PH_3 to decompose?

(ii) What fraction of the original sample of PH_3 remains behind after 1 minute?

Q.37. (a) Explain the following terms:

(i) Order of a reaction

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

Q.38. For the hydrolysis of methyl acetate in aqueous solution, the following result are obtained:

t/s	0	10	20
$CH_3COOCH_3 l/\ mol\ L^{-1}$	0.10	0.05	0.025

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

(b) Calculate the average rate of reaction between the time interval 10 to 20 seconds. (Given : $\text{Log } 2 = 0.3010$, $\text{Log } 4 = 0.6021$)

Q.39. (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 in 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 the reaction.