Chemical Kinetics

Q.No.1:
The rate constant for a reaction of zero order in A is 0.0030 mol L^{-1} s^{-1}. How long will it take for the initial concentration of A to fall from 0.10 M to 0.075 M?

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Q.No.2:
Define 'rate of a reaction'.

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Q.No.3: The rate constant for the first-order decomposition of H_2O_2 is given by the following equation:

$\log\ k = 14.2 - \frac{1.0\times10^4}{T}\mathrm{K}$

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})

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Q.No.4:
Distinguish between 'rate expression' and 'rate constant' of a reaction.

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Q.No.5:
(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) **(5)**

OR

(a) For a first order reaction, show that time required for 99% 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})

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Q.No.6:
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) L mol^{-1} s^{-1}

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Q.No.7:
For the reaction
$2NO_{(g)} + Cl_{2(g)} \rightarrow 2\ NOCl_{(g)}$
The following data were collected. All the measurements were taken at 263 K:

Experiment No.	**Initial [NO] (M)**	**Initial [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	?

(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?

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Q.No.8: 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 the rate constant.
(Given : log 4 = 0.6021, log 2 = 0.3010) **CBSE Board Paper 2014**

Q.No.9: Explain the following terms :
(i) Rate constant (k)
(ii) Half life period of a reaction ($t_{1/2}$) **CBSE Board Paper 2014**

Q.No.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 interval 30 to 60 seconds.
(Given log 2 = 0.3010, log 4 = 0.6021)

Or

(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)

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Q.No.11: For a reaction :

$$2\,NH_3\left(g\right) \xrightarrow{Pt} N_2\left(g\right) + 3H_2\left(g\right)$$

$$\text{Rate} = k$$

(i) Write the order and molecularity of this reaction.
(ii) Write the unit of k. **CBSE Board Paper 2016**