Note:-
1. All Questions are compulsory.
2. Numbers on the right indicate full marks.

Section A

Q.1 Select and write the correct answer. (4)

1. The rate equation for the reaction $2a + b \rightarrow c$ is found to be: rate = k [a] [b] the correct statement in relation to this reaction is

   A) unit of k must be s^{-1}

   B) $t_{1/2}$ is a constant

   C) rate of formation of c is twice the rate of disappearance of a

   D) value of k is independent of the initial concentration of a and b

2. Consider the reaction, $2 A + B \rightarrow$ Products When concentration of B alone was doubled, the half-life did not change. When the concentration of A alone was doubled, the rate increased by two times. The unit of rate constant for this reaction is

   A) $L\ mol^{-1}\ s^{-1}$ B) no unit

   C) $mol\ l^{-1}\ s^{-1}$ D) s^{-1}

3. The slope of a graph $ln[A]t$ versus t for a first order reaction is $-2.5 \times 10^{-3} s^{-1}$. The rate constant for the reaction will be

   A) $5.76 \times 10^{-3}\ s^{-1}$ B) $1.086 \times 10^{-3}\ s^{-1}$

   C) $-2.5 \times 10^{-3}\ s^{-1}$ D) $2.5 \times 10^{-3}\ s^{-1}$

4. At certain temperature, the half life period for the thermal decomposition of a gaseous substance depends on the initial partial pressure of the substance as follows
   p(mm hg)   500   250
   $t_{1/2}$(in min)   235   950

   Find the order of reaction
   [Given log (23.5) = 1.37; log (95)= 1.97; log 2 = 0.30]

   A) 1   B) 2

   C) 2.5   D) 3

Q.2 Answer the following. (3)

1. Define Molecularity.

2. Express the rate of reaction in terms of $Br^-_{(aq)}$ as reactant and $Br_{2\ (aq)}$ as product for the reaction: $5\ Br^-_{(aq)} + BrO_3^-{}_{(aq)} + 6\ H^-{}_{(aq)} \rightarrow 3Br_{2\ (aq)} + 3\ H_2O_{(l)}$

3. What is the effect of adding a catalyst on activation energy (E_a) and Gibbs free energy (G)?

Section B
Attempt any Four

Q.3 What is the importance of chemical kinetics? **(2)**

Q.4 For the reaction, $CH_3Br_{(aq)} + OH^-_{(aq)} \rightarrow CH_3OH^-_{(aq)} + Br^-_{(aq)}$, rate law is rate = $k[CH_3Br]$ **(2)**
$[OH^-]$

(a) How does reaction rate changes if $[OH^-]$ is decreased by a factor of 5?
(b) What is change in rate if concentrations of both reactants are doubled?

Q.5 What are the units for rate constants for zero order and second order reactions if time is expressed in seconds and concentration of reactants in mol/L? **(2)**

Q.6 For a chemical reaction represented by $R \rightarrow P$ the rate of reaction is denoted by $\dfrac{\Delta[R]}{\Delta t}$ or $\dfrac{\Delta[P]}{\Delta t}$ **(2)**

why a positive sign (+) is placed before $\dfrac{\Delta[P]}{\Delta t}$ and not before $\dfrac{\Delta[R]}{\Delta t}$?

Q.7 What is the use of integrated rate equation? **(2)**

Q.8 Dinitrogen pentoxide decomposes as follows: **(2)**

$$N_2O_5 \rightarrow 2NO_2 + \frac{1}{2} O_2$$

If $\dfrac{-d[N_2O_5]}{dt} = K_1[N_2O_5], 2\dfrac{d[NO_2]}{dt} = K_2[N_2O_5]$ and $2\dfrac{d[O_2]}{dt} = K_3[N_2O_5]$

Derive a relation between K_1, K_2 and K_3.

Section C
Attempt any Two

Q.9 Derive the integrated rate law for the first order reaction, $A_{(g)} \rightarrow B_{(g)} + C_{(g)}$ in terms of **(3)**
pressure.

Q.10 Comment on the effect of catalyst on each of the following : **(3)**
1. Activation energy   2. Rate of forward reaction   3. Rate of backward reaction.

Q.11 For the reaction, $3I^-_{(aq)} + S_2O_8^{2-}{}_{(aq)} \rightarrow I_3^{3-}{}_{(aq)} + 2\,SO_4^{2-}{}_{(aq)}$ **(3)**

Calculate the rate of formation of I_3^- , the rates of consumption of I^- and $S_2O_8^{2-}$ and the

overall rate of reaction if the rate of formation of SO_4^{2-} is 0.022 moles dm^{-3} sec^{-1}

Section D
Attempt any One

Q.12 What is zeroth order reaction? Derive its integrated rate law. What are the units of rate **(4)**
constant?

Q.13 The gaseous reaction $A_2 \rightarrow 2A$ is first order in A_2. After 12.3 minutes 65,% of A_2 remains **(4)**
undecomposed. How long will it take to decompose 90% of A_2? What is the half life of the
reaction?