Course: CHM202

Energetics and dynamics of chemical reactions

Assignment – VIII

Q.1 The catalytic decomposition of H_2O_2 is followed by removing equal volume samples at various time intervals and titrating them with $KMnO_4$. The results are

Time (min)	0	5	10	20
Volume of $KMnO_4$ (ml)	46.2	37.1	29.8	19.6

Find the order and determine the half-life time.

Q.2 At 127 °C, the rate of decomposition of a gaseous compound initially at a pressure of 12.6 kPa, was 9.71 Pa s^{-1} when 10% had reacted and7.67 Pa s^{-1} when 20% had reacted. Determine the order of the reaction.

Q.3 The rate constant for the first-order decomposition of a compound A in the reaction $2A \rightarrow P$ is $k = 2.78 \times 10^{-7}\ s^{-1}$ at 25 °C. What is the half-life of A? What will be the pressure, initially 32.1 kPa, at (a) 10 s, (b) 10 min after initiation of the reaction?

Q.4 At 100 °C, the gaseous reaction $A \rightarrow 2B + C$ is observed to be first order. Starting with pure A, it is found that at the end of 10 min the total pressure of the system is 176 mm of Hg and after a long time 270 mm. From these data find (a) the initial pressure of A, (b) the pressure of A at the end of 10 min, (c) the rate constant of the reaction and (d) half-life time.

Q.5 A reaction $2\ A \rightarrow P$ has a third-order rate law with $k = 3.50 \times 10^{-4}\ dm^6\ mol^{-2}\ s^{-1}$. Calculate the time required for the concentration of A to change from 0.077 mol dm^{-3} to 0.021 mol dm^{-3}.

Q.6 Deduce an expression for the time it takes for the concentration of a substance to fall to one-third its initial value in an nth-order reaction.

Q.7 The rate constant for the decomposition of a certain substance is 1.70×10^{-2} dm3 $mol^{-1}\ s^{-1}$ at 24 °C and $2.01 \times 10^{-2}\ dm^3\ mol^{-1}\ s^{-1}$ at 37 °C. Evaluate the Arrhenius parameters of the reaction.

Q.8 The activation energy of one of the reactions in a biochemical process is 87 kJ mol^{-1}. What is the change in rate constant when the temperature falls from 37 °C to 15 °C?