PLOT 5C, 2ND FLOOR, GANAPATI COMPLEX, SEC-13, OPP. JAIPURIA SCHOOL, VASUNDHARA, GHAZIABAD (U.P)

CHEMICAL KINETICS -4

1. For the reaction Cl_2 (g) + 2NO(g) → 2NOCl (g) the rate law is expressed as rate = $k[Cl_2][NO]^2$. What is the overall order of this reaction?
2. Express the rate of the following reaction in terms of disappearance of hydrogen in the reaction: 3 H_2(g) + N_2(g) → 2NH_3(g).
3. For the reaction A →B, the rate of reaction becomes twenty seven times when the concentration of A is increased three times. What is the order of the reaction?
4. A reaction is 50% complete in 2 hours and 75% complete in 4 hours. What is the order of the reaction?
5. The rate of reaction X→Y becomes 8 times when the concentration of the reactant X is doubled. Write the law of the reaction.
6. What is meant by elementary step in a reaction?
7. Define activation energy of a reaction**?**
8. Express the relation between the half-life period of a reactant and its initial concentration if the reaction involved is of second order.
9. Express the relation between the half-life period of a reactant and its initial concentration for a reaction of n^{th} order.
10. How does the value of the rate constant vary with reactant concentration?
11. A substance with initial concentration 'a' follows zero order kinetics with the rate constant 'k' mol $L^{-1}s^{-1}$. In how much time will the reaction go to completion?
12. When is the rate of reaction equal to specific reaction rate?
13. The reaction A+B →C has zero order. What is the rate equation?
14. In some cases, it is found that a large number of colliding molecules have energy more than threshold value, yet the reaction is slow. Why?
15. Give an example of pseudo first order reaction.
16. The rate law for the decomposition of N_2O_5 is: rate =k[N_2O_5]. What is the significance of 'k' in this equation?
17. The reaction of 2H_2 (g) + O_2 (g) → 2NH_3 (g), is thermodynamically feasible. How is it that a mixture of hydrogen and oxygen kept at room temperature shows no tendency to form water?
18. For the reaction 3H_2 (g) + N_2 (g) → 2NH_3 (g), how is the rate of reaction expressions $-\frac{d(H_2)}{dt}$ and $\frac{d(NH_3)}{dt}$ interrelated?
19. Why is it that instantaneous rate of reaction does not change when a part of the reacting solution is taken out?
20. For a reaction A + H_2O→B.

    rate ∝ [A]

    What is its (i) molecularity (ii) order of reaction?
21. The rate constant of a reaction is 1.5 x $10^7 s^{-1}$ at 50℃ and 4.5 x $10^7 s^{-1}$ at 100℃. Calculate the value of activation energy, E_a for the reaction. [R = 8.314 $JK^{-1}mol^{-1}$].
22. What are photochemical reactions? Explain the mechanism of the photochemical reaction occurring between hydrogen and chlorine gas?
23. What is known as 'activation energy'? How is the activation energy affected by
    a. The use of a catalyst
    b. A rise in temperature?
24. The reaction SO_2Cl_2→SO_2 + Cl_2 is a first order reaction with half- life 3.15 x 10^4s at 320°C. What percentage of SO_2Cl_2 would be decomposed on heating at 320℃ for 90 minutes?

25. What will be the initial rate of reaction if its rate constant is $10^{-3}s^{-1}$ and the concentration of the reactant is 0.2mol L^{-1}? What fraction of the reactant will be converted into the products in 200 seconds?
26. The rate constant for a first order reaction becomes six times when the temperature is raised from 350K to 400K. calculate the activation energy for the reaction. [R = 8.314 $JK^{-1}mol^{-1}$].
27. Why is it that rate of most of the reactions increase, when the temperature is increased? In what unit is the rate of reaction expressed?
28. A first order reaction is 20% complete in 20 minutes. Calculate the time it will take the reaction to complete 80%.
29. a. Draw a schematic graph showing how the rate of reaction changes with change in concentration of reactant.
    b. Rate of reaction is given by the equation :
    Rate = k $[A]^2[B]^1$.
    What are the units of rate and the rate constant for the reaction?
30. Rate constant k of a reaction varies with temperature according to the equation:
    Log k =constant - $\frac{E_a}{2.303R}\frac{1}{T}$, where E_a is the energy of activation for the reaction. When a graph is plotted for log k versus 1/T, a straight line with a slope -6670K is obtained. Calculate energy of activation for this reaction. State the units,(R = 8.314 $JK^{-1}mol^{-1}$).
31. State the role of activated complex in the reaction and state its relation with activation energy.
32. The following experimental data were collected for the reaction:
    $Cl_2(g) + 2NO(g) \rightarrow 2NOCl(g)$

TRIAL	Initial conc. $[Cl_2]$ mol L^{-1}	Initial conc. $[NO_2]$mol L^{-1}	Initial rate mol L^{-1}
1	0.010	0.010	1.20x 10^{-4}
2	0.010	0.030	10.8x 10^{-4}
3	0.020	0.030	21.6 x 10^{-4}

    Construct the rate equation for the reaction.
33. What aspect of a reaction is influenced by presence of catalyst which increases the rate or possibility of the reaction?
34. The rate of reaction $2NO + Cl_2 \rightarrow 2NOCl$ is double when concentration of Cl_2 is doubled and it becomes eight times when concentration of both NO and Cl_2 are doubled. Deduce the order of this reaction.
35. For the decomposition of N_2O_5 at 298 K, the rate law is $\frac{d[N_2O_5]}{dt} = kN_2O_5$. Starting with moles 2.5 moles of $N_2O_5(g)$ in a five litre container, how many moles per litre of N_2O_5 would remain after 75 seconds if rate constant for the reaction is 16.8x $10^{-3}s^{-1}$?
36. For the reaction at 500 K
    $NO_2(g) + CO(g) \rightarrow CO_2(g) + NO(g)$,
    The proposed mechanism is as follows:
    i. $NO_2 + NO_2 \rightarrow NO + NO_3$(slow)
    ii. $NO_3 + CO \rightarrow CO_2 + NO_2$ (fast)
    What is the rate law for the reaction?
37. Nitric oxide reacts with H_2 to give N_2 and water $2NO + 2H_2 \rightarrow N_2 + 2H_2O$
    The rate law for the above reaction is $\frac{-d[NO]}{dt} = k[NO]^2[H_2]$, explain the mechanism of the reaction.
38. The rate constant for the first order decomposition of N_2O_5 at 45^0C is 3.00 x 10^{-2} min^{-1}. If the initial concentration of N_2O_5 is 2.00 x $10^{-2}min^{-1.}$ If the initial concentration of N_2O_5 is 2.00 x $10^{-3}molL^{-1}$, how long will it take for the concentration to drop to 5.00 x 10^{-4} mol L^{-1}?
39. The catalytic decomposition of H_2O_2 was studied by titrating it at different intervals with $KMnO_4$ solution. Calculate the rate constant from the following data assuming the reaction to be of first order.

t(seconds)	0	600	1200
$KMnO_4$(ml)	22.8	13.8	8.2

40. The decomposition of phosphine

$4PH_3(g) \rightarrow P_4 + 6H_2O(g)$ has rate law, rate $=k[PH_3]$. The rate constant is $6.0 \times 10^{-4}\ s^{-1}$ at 300 K and E_a is $3.05 \times 10^5 Jmol^{-1}$. What is the value of rate constant at 310 K? [$R = 8.314\ JK^{-1}mol^{-1}$].

41. The rate constant for the reaction
$CH_3I + C_2H_5ONa \rightarrow CH_3OC_2H_5 + NaI$ at 273 K is 5.60×10^{-5} and at 300 K is $100 \times 10^{-5}\ Lmol^{-1}s^{-1}$ respectively. Calculate the value of activation energy of the reaction.
42. Calculate the activation energy of a reaction whose reaction rate at 310 K gets doubled for 10K rise in temperature.
43. The decomposition of N_2O_5 in CCl_4 solution follows the first order rate law. The concentrations of N_2O_5 measured at different time intervals are given below:

Time in seconds (t)	0	80	160	410	600	1130	1740
$[N_2O_5]$ mol L^{-1}	5.5	5.0	4.8	4.0	3.4	2.4	1.6

Calculate its rate constant at t = 410s and t= 1130 s. what do these results show?

44. For a reaction the energy of activation is zero. What is the value of rate constant at 300 K, if $k = 1.6 \times 10^6\ s^{-1}$ at 280 K? [$R = 8.314\ JK^{-1}mol^{-1}$].
45. For a reaction: $2A + B + C \rightarrow A_2 + B + C$, the rate law has been determined to be: rate $= k[A][B]^2$ if the value of k is $2.0 \times 10^{-6}\ mol^{-2}L^2s^{-1}$ for the reaction, determine the initial rate of the reaction with [A] = 0.2 $molL^{-1}$, [B] = 0.1 mol L^{-1}, [C] = 0.5 mol L^{-1}.
46. What are pseudo unimolecular reactions? Give two examples.
47. Show graphically, how the rate of reaction depends on the concentration of reactant when there is only reactant and the reaction is of first order?
48. What is meant by relative rates of reaction? Write the relative rate expressions for the following chemical reactions:
$4NH_3(g) + 5O_2 \rightarrow 4NO(g) + 6H_2O(g)$
49. The rate constant of a reaction is $0.0439\ min^{-1}$ at 25°C and its activation energy is $70{,}000 Jmol^{-1}$. What is value of rate constant at 40°C? [$R = 8.314\ JK^{-1}mol^{-1}$].
50. The rate constant for a first order reaction is $60s^{-1}$. How much time will it take to reduce the concentration of the reactant to 1/10th of its initial value?
51. The rate of a particular reaction triples when temperature changes from 50°C to 100°C. Calculate the activation energy of the reaction. [log 3 = 0.4771; $R = 8.314\ JK^{-1}mol^{-1}$].
52. A first order reaction takes 69.3 minutes for 50% completion. Set up an equation determining the time needed for 80% completion of this reaction. (Calculation of result is not required).
53. The activation energy of a reaction is $75.2\ kJmol^{-1}$ with a catalyst. How many times will the rate of reaction grow in the presence of the catalyst if the reaction proceeds at 25°C? [$R = 8.314\ JK^{-1}mol^{-1}$].
54. During nuclear explosion, one of the products is ^{90}Sr with half=life of 28.1 years. If 1 µg of ^{90}Sr was absorbed in the bones of a newly born baby instead of calcium, how much of it will remain after 10 years and 60 years if it is not lost metabolically?
55. The rate of a particular reaction doubles when temperature changes from 27°C to 37°C. Calculate the activation energy of such reaction.
56. A reaction is first order in A and second order in B.
    a. Write differential rate equation.
    b. How is the rate affected if the concentration of B is tripled?
    c. How is the rate affected when the concentrations of both A and B are doubled? What is the significance of rate constant in the rate expression?
57. In general it is observed that the rate of a chemical reaction doubles with every 10° rise in temperature. If this generalization holds for a reaction in the temperature range 295 K to 305 K, what would be the value of activation energy for this reaction?