CHEMICAL KINETICS-2

1. Which of the following statements is correct regarding order of reaction?
   1) First order reaction is always bimolecular
   2) Order of reaction is always a finite number.
   3) Order is determined theoretically from stoichiometric equation.
   4) Order is determined by experimental results
2. If the rate of reaction is independent of concentration of reactants, the order of reaction is
   1) 0 2) 1 3) 2 4) 3
3. For the reaction, the rate expression is, rate = K $[H_2]\,[Br_2]^{1/2}$ which statement is true about this reaction
   1) The reaction is of second order
   2) Order of the reaction is 3/2
   3) The unit of K is sec^{-1}
   4) Order of the reaction is ½
4. In SN^1 reaction of t-butyl iodide the molecularity for the elementary step $\left(CH_3\right)_3 C\ I_{(aq)} \rightarrow (CH_3)C^+_{(aq)} + I^-_{(aq)}$ is
   1) Zero 2) 1 3) 2 4) fractional
5. The units of rate constant for the reaction obeying rate expression, r = $k[A][B]^{2/3}$ is
   1) $mole^{-2/3}\ lit^{2/3}\ time^{-1}$ 2) $mole^{2/3}\ lit^{-2/3}\ time^{-1}$
   3) $mole^{-5/3}\ lit^{5/3}\ time^{-1}$ 4) $mole^{2/3}\ lit^{2/3} time^{-1}$

Hint: order=1+2/3= 5/3 ∴ units of rate constant= $mole^{1-5/3}\ lit^{5/3-1}\ time^{-1}$

6. In the following sequence of reactions $A \xrightarrow{K_1} B \xrightarrow{k_2} C \xrightarrow{k_3} D$ if $K_1<K_2<K_3$, then the rate determining step is
   1) A → B 2) B → C 3) C→ D 4) A → C

Hint: slowest step of reaction is the rate determining step.

7. Taking the reaction x+2y →products to be of second order, which of the following is / are the rate law expression/s for the reaction
   I) $\frac{dx}{dt} = K[x][y]$ II) $\frac{dx}{dt} = K[x]^2$ III) $\frac{dx}{dt} = K[x][y]^2$ IV) $\frac{dx}{dt} = K\frac{[x]}{[y]^2}$
   Then the correct answers can be
   1) I only 2) I and III only 3) I and II only 4) I and IV only
8. For a reaction pA+ qB→ products, the rate law expression is r = k $[A]^l\,[B]^m$ then
   1) (p+q) = (l+ m)
   2) (p + q) > (l + m)
   3) (p + q) may or may not be equal to (l + m)
   4) (p + q) (l + m)
9. The half life for a given reaction was doubled as the initial concentration of the reactant was doubled. The order of the reaction is
   1) Zero 2) 1st 3) 2nd 4) 3rd

Hint: for zero order $t_{1/2} \propto$ initial concentration

10. The hydrolysis of Ethyl acetate in alkaline solution is
    1) 1st order 2) 2nd order 3) 3rd order 4) zero order

11. The half-life of a first order reaction is
    1) independent of the initial concentration of the reactant
    2) directly proportional to the initial concentration of the reactant
    3) inversely proportional to the initial concentration of the reactant
    4) directly proportional to the square of the initial concentration of the reactant.

12. Acid hydrolysis of ester is a
    1) Second order reaction with molecularity 2
    2) First order reaction with molecularity 2
    3) Second order reaction with molecularity 1
    4) First order reaction with molecularity 2

13. The following data were obtained for the reaction $2NO_{(g)} + Br_{2(g)} \rightarrow 2NOBr_{(g)}$

Expt	Initial conc. [NO]	[Br_2]	Initial rate mol/lit/sec
I	0.10	0.10	$1.3X10^{-6}$
II	0.20	0.10	$5.2X10^{-6}$
III	0.20	0.30	$1.56X10^{-5}$

The order of reaction is
1) 1   2) 2   3) 3   4) 0

Solution:

$r = k[NO]^n[Br_2]^m$ – (1)

$4r = k[2NO]^n[Br_2]^m$ – (2)

$12r = k[2NO]^n[3Br_2]^m$ – (3)

$\frac{2}{1} \Rightarrow n = 2$, $\frac{3}{1} \Rightarrow 12 = 2^n.3^m$ ∴ order = 1 + 2 = 3

$12 = 2^2.3^m$

$3 = 3^m$

$m = 1$

14. The rate constant of a first order reaction is 0.0693. What is the time (in minutes) required for reducing an initial concentration of 20M to2.5M?
1) 40   2) 30   3) 20   4) 10

Solution: $k = \frac{2.303}{t}\log\frac{a}{a-x}$, 0.0693=2.303/t log20/2.5→ t=2.303Xlog8/0.0693=30

15. **Type - I** / **Type - II**

Type - I	Type - II
I) $SO_2Cl_2 \rightarrow SO_2 + Cl_2$	a) pseudo unimolecular reaction
II) $2NO_2 \rightarrow 2N_2 + O_2$	b) first order reaction
III) $2NO + O_2 \rightarrow 2NO_2$	c) second order reaction
IV) $CH_3COOC_2H_5 + H_2O \xrightarrow{H^+} CH_3COOH + C_2H_5OH$	d) third order

The correct matching is
1) I - a, II - b, III - c, IV - d   2) I - b, II - a, III - d, IV - c
3) I - d, II - c, III - b, IV - a   4) I - b, II - c, III - d, IV – a

16. **Type - I** **Type - II**

I) first order reaction — a) $\alpha \frac{1}{a^{n-1}}$

II) Zero order reaction — b) Radio active decay

III) Trimolecular reaction — c) Photochemical reactions

IV) Half life period of 'n' th order — d) $2CO + O_2 \rightarrow 2CO_2$

1) I - a, II - b, III - c, IV - d
2) I - b, II - c, III - d, IV - a
3) I - c, II - d, III - b, IV - a
4) I - d, II - c, III - b, IV - a

17. The rate of a reaction between A and B increases by a factor of 1000 times when the concentration of A is changed from 0.1 mole litre^{-1} to 1 mole litre $^{-1}$. The order of the reaction with respect of A is

1) 2 2) 1 3) 3 4) 4

Solution:

$r = k[A]^n [B]^m \quad -(1)$

$1000r = k[10A]^n [B]^m \quad -(2)$

$\frac{2}{1} \Rightarrow n = 3$

18. After how many seconds will the concentration of the reactant in a first order reaction be halved, if the rate constant is 1.155x10^{-3} sec^{-1}

1) 600 2) 100 3) 60 4) 10

Hint; $t_{1/2} = \frac{0.693}{k}$

19. The rate of a certain reaction at different times is as follows

Time	0	10	20	30
Rate	3.2×10^{-2}	3.18×10^{-2}	3.22×10^{-2}	3.19×10^{-2}

The order of the reaction is

1) 1 2) zero 3) 2 4) Can not be predicted.

Hint: For zero order rate remains constant with time.

20. The half life of a reaction is 46 minutes when the initial concentration of the reactant is 0.4 moles/lit and 92 minutes when the initial concentration is 0.2 moles/lit. The order of the reaction is

1) Zero 2) 0.5 3) 2 4) 1

Hint; from given data $t_{1/2} \propto \frac{1}{a}$ .so the reaction is the second order

21. In a first order reaction, 50 minutes time is taken for the completion of 93.75% of a reaction. Half life of the reaction is

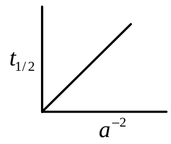
1) 25 min 2) 12.5 min 3) 20 min 4) 10 min

Hint; $t_{93.75\%}$=4 $t_{1/2}$, $t_{1/2}$=50/4=12,5min

22. Which order reaction obeys the expression $t_{1/2} = \frac{1}{k.a}$ in chemical kinetics?

1) 0 2) 1 3) 2 4)

23. The following plot of, $t_{1/2}$ Vs concentration



Corresponds to

1) Second order 2) Third order 3) First order 4) Zero order

Hint; For Third order $t_{1/2} \propto \frac{1}{a^2} (or) t_{1/2} \propto a^{-2}$

24. If initial concentration is reduced to 1/4th in a zero order reaction, the time taken for half the reaction to complete

1) Remains same 2) becomes 4 times 3) becomes one-fourth 4) doubles

25. For a first order reaction $t_{75\%}$ is 1386 seconds therefore, the specific rate constant in Sec^{-1} is.

1) 10^{-3} 2) 10^{-2} 3) 10^{-9} 4) 10^{-5}

Hint: $t_{75\%} = 2t_{50\%} and t_{50\%} = \frac{0.693}{k}$

26. A first order reaction was commenced with 0.2 M solution of the reactants. If the molarity of the solution falls to 0.02M after 100 minutes the rate constant of the reaction is

1) 2×10^{-2} min^{-1} 2) 2.3×10^{-2} min^{-1} 3) 4.6×10^{-2} min^{-1} 4) 2.3×10^{-1} min^{-1}

Hint; $k = \frac{2.303}{t} \log \frac{a}{a-x}$

27. For a reaction 2A+3B→Products, the rate law expression is given by rate=K $(A)^1$ $(B)^2$. The order of the reaction with respect to A,B and over all order of reaction are

1) 2, 1, 3 2) 1, 2, 3 3) 0, 1, 2 4) 2, 1, 0

28. In a first order reaction when $\log\left[\frac{a}{(a-x)}\right]$ is plotted against time the graph obtained is

1) a straight line whose slope is $\frac{2.303}{k}$

2) a straight line whose slope is $\frac{k}{2.303}$

3) a straight line whose slope is $-\frac{k}{2.303}$

4) a straight line whose slope is $-\frac{2.303}{k}$

Hint: $k = \frac{2.303}{t} \log \frac{a}{a-x}, \log \frac{a}{a-x} = \frac{kt}{2.303}, y = mx$ where m=k/2.303

Assertion - Reason type

1) Both (A) and (R) are true and (R) is the correct explanation of (A)

2) Both (A) and (R) are true and (R) is not the correct explanation of A

3) (A) is true but (R) is false

4) Both (A) and (R) are false

29. Assertion (A): For zero order reaction the rate of reaction does not decrease with time
Reason (R): For zero order reaction amount of substance reacted is proportional to time

30. Assertion (A): The order of reaction is equal to molecularity of simple reactions.
Reason (R): Molecularity of the reaction can not be fractional.

31. Assertion (A): Hydrolysis of cane sugar is a first order reaction
Reason (R): Water is present in large excess during hydrolysis

32. **Assertion (A):** The molecularity of a reaction is a whole number other than zero, but generally less than 3
Reason (R): The order of a reaction is always whole number

33. **Assertion (A):** Molecularity of a reaction cannot be more than three
Reason (R): Probability of simultaneous collision between more than three particles is very less

34. Assertion (A): Half life period is always inversely proportional to rate constant
Reason (R): Half life period is always independent of initial concentration.

35. Assertion (A): For a first order reaction $t_{1/2}$ is independent of the initial concentration of reactants.
Reason (R): For a first order reaction $t_{87.5\%}$ is thrice the $t_{50\%}$

36. In a first order reaction, 20% reaction is completed in 24 minutes. The percentage of reactant remaining after 48 minutes is
1) 60 2) 64 3) 81 4) 80

Solution; In First order reaction time required for completion of given % is same.
In 24min 20% completes. So 80 left. In another 24min 20% of 80=20X80/100=16 react.
∴ 80-16=64%left after 48 min.

37. A first order reaction is half-completed in 45 minutes. How long does it need for 99.9% of the reaction to be completed?
1) 20 hours 2) 10 hours 3) 7 ½ hours 4) 5 hours

Solution; For 1st order $t_{99.9\%}=10\ t_{1/2}$=10X45=450min=7.5hours.

38 The concentration of the reactant A in the reaction AB at different times are given below:

Concentration (M)	Time (seconds)
0.069	0
0.052	17
0.035	34
0.018	51

The rate constant of the reaction according to the correct order of reaction is
1) 0.001 $M^{-2}s^{-1}$ 2) 0.001 $M^{-2}s^{-1}$ 3) 0.001 s^{-1} 4) 0.001 Ms^{-1}

Hint; As the change in concentration at regular time intervals is same, it is zero order.
Unit of k for zero order is $M\ S^{-1}$

39. 99% of a first order reaction was completed in 32 min. When will 99.9% of the reaction complete?
1) 50 min 2) 46 min 3) 49 min 4) 48 min

Hint; $t_{99.9\%} : t_{99\%}$ =3:2

40. For a first order reaction with half-life of 150 seconds, the time taken for the concentration of the reactant to fall from M/10 to M/100 will be approximately

1) 1500 s 2) 500 s 3) 900 s 4) 600 s

Hint; $k = \frac{2.303}{t}\log\frac{a}{a-x}$, k=0.693/$t_{1/2}$

41. A reaction which is of first order w.r.t reactant A, has a rate constant is 6 min^{-1}. If we start with [A] = 0.5 mol.L^{-1}, when would [A] reach the value of 0.05 mol.L^{-1}.

1) 0.384 min 2) 15 min 3) 20 min 4) 3.84 min

Hint; $k = \frac{2.303}{t}\log\frac{a}{a-x}$,

42. For a first order reaction A →B, the reaction rate at reactant concentration of 0.01 M is found to be 2.0 x10 $^{-5}$ mol L^{-1} s^{-1}. The half life period of the reaction is

1) 220s 2) 30 s 3) 374 s 4) 347 s

Hint; rate=k[A], $t_{1/2}$=0.693/ k

43. In the case of a first order reaction, the ratio of the time required for 99.9% completion of the reaction to its half life is nearly

1) 1 2) 10 3) 20 4) 8

44. Out of 300g substance [decomposes as per 1st order], how much will remain after 18 hr? ($t_{0.5}$ = 3 hr)

1) 4.6 gm 2) 5.6 gm 3) 9.2 gm 4) 6.4 gm

Solution; no, half lives n=18/3=6, amount left=initial amount $(1/2)^n$

Amount left=300$(1/2)^6$=300/64=4.6gm

45. 75% of a first order process is completed in 30 min. The time required for 93.75% completion of same process (in hr)?

1) 1 2) 120 3) 2 4) 0.25

Hint; $t_{75\%}$ $t_{93.75\%}$ =1:2

KEY

1) 4 2) 1 3) 2 4) 2 5) 1 6) 1 7) 3 8) 3 9) 1 10) 2

11) 1 12) 2 13) 3 14)2 15) 4 16) 2 17) 3 18) 1 19)2 20)3

21)2 22)3 23)2 24)3 25)1 26)2 27)2 28)2 29)1 30)2

31)1 32)3 33)1 34)3 35)2 36)2 37)3 38)4 39) 4 40)2

41) 1 42)4 43)2 44)1 45)1