10. CHEMICAL KINETICS

1. The order of reaction A $\longrightarrow$ product can be given by the expression (s)

[where r = rate of reaction ; $[A]_1$ = concentration at time t_1 ; $[A]_2$ = concentration at time t_2]

(A) $\dfrac{\ln r_2 - \ln r_1}{\ln[A]_2 - \ln[A]_1}$

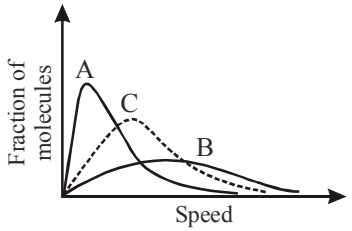
(B) $\dfrac{\ln[A_0]_2 - \ln[A_0]_1}{\ln[t_{1/2}]_2 - \ln[t_{1/2}]_1}$

(C) $\ln\left(\dfrac{-d(A)}{k.dt}\right)/\ln[A]$

(D) $\dfrac{\ln(r/k)}{\ln[A]}$

(1) A, B, C (2) B, C, D (3) A, C, D (4) A, B, D

2. The curve C is for the gas X at 273 K. Choose the **CORRECT** statement(s) :



(A) Curve A may be of a heavier gas but at same temperature

(B) Curve B may be of the same gas but at 373K

(C) Curve A may be of the same gas but at 373K

(D) Curve B may be of the lighter gas but at same temperature

(1) A, B, D (2) A, B, C (3) B, C, D (4) B, D

3. For a reaction of order n, what is the relationship between $t_{3/4}$ and $t_{1/2,}$ where $t_{3/4}$ is the time required for concentration (C) to become 1/4. C_0 and C are the values of the reactant concentration at the start and after time t, respectively.

(1) $t_{3/4} = t_{1/2}\,[2^{n-1} + 1]$ (2) $t_{3/4} = t_{1/2}[2^{n-1} - 1]$

(3) $t_{3/4} = t_{1/2}\,[2^{n+1} - 1]$ (4) $t_{3/4} = t_{1/2}\,[2^{n+1} + 1]$

4. For a complex reaction _____.

(A) order of overall reaction is same as molecularity of the slowest step (provided slowest step having no reaction intermediate)

(B) order of overall reaction is less than the molecularity of the slowest step.

(C) order of overall reaction is greater than molecularity of the slowest step.

(D) molecularity of the slowest step is never zero or non interger.

(1) A, D (2) B, D (3) A, C (4) A, B

5. For a gas reaction A $\rightarrow$ P at T (K) the rate is given by

rate = $k_1\, p_A^2$ atm/hr

rate = $k_2 C_A^{\,2}$ mol/litre/hr

the relation between k_1 and k_2 is

(1) $k_2 = k_1$ (2) $k_2 = k_1\,RT$ (3) $k_2 = k_1/RT$ (4) $k_2 = k_1(RT)^2$

6. Consider the Arrhenius equation given below and mark the correct option. $k = A\, e^{-E_a/RT}$

(A) Rate constant increases exponentially with increasing activation energy and decreasing temperature.

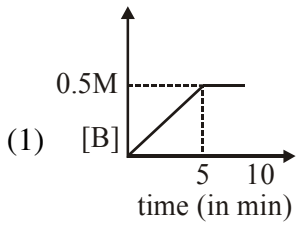
(B) Rate constant decreases exponentially with increasing activation energy and decreasing temperature.

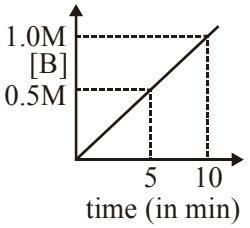
(C) Rate constant increases exponentially with decreasing activation energy and decreasing temperature.

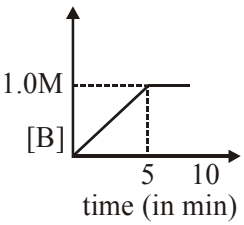
(D) Rate constant increases exponentially with decreasing activation energy and increasing temperature.

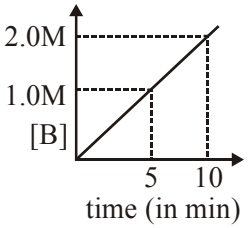
(1) A, B, D (2) B, C (3) B, D (4) A, B

7. Consider a reaction A(g) $\xrightarrow{k=0.1\ M\ min^{-1}}$ 2B(g). If initial concentration of A is 0.5 M then select correct graph.

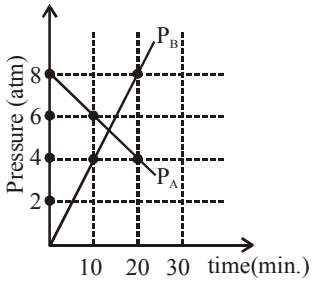
(1)


(2)


(3)


(4)


8. In a chemical reaction A(g) is converted to B(g), following observation is made. Identify the correct statement(s)



(A) Chemical reaction should be $\frac{1}{2}A(g) \rightarrow B(g)$

(B) $t_{1/2}$ of the reaction in independent of initial partial pressure of A.

(C) Reaction must be complex reaction.

(D) Time of completion for the reaction is 40 minutes.

(1) A, B, C (2) B, C, D

(3) A, B, D (4) A, C, D

9. For acid catalysed hydrolyasis of ester rate law obtained is rate = k [ester] $[H^+]$, where k = 0.01 M^{-1} hr^{-1}. What is the half-life if the initial concentrations are 0.02 M for the ester and 0.05 M for the catalyzing acid.

(1) 1429 hours (2) 5000 hours (3) 1386 hours (4) 2 hours

10. For the mechanism

(1) $A + B \underset{E_{a,-1}}{\overset{E_{a,1}}{\rightleftharpoons}} C + D$ (2) $2C \xrightarrow{E_{a,2}} G + H$

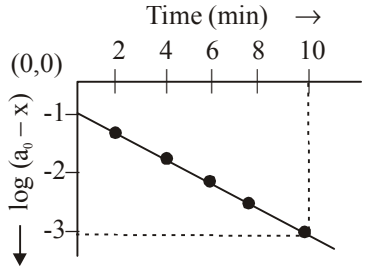
step 2 is rate-determining. Given the activation energies $E_{a.1}$ = 120 kJ/mol, $E_{a,-1}$= 96 kJ/mol, and $E_{a.2}$ = 196 kJ/mol. find E_a for the overall reaction. [2A + 2B ⟶ 2D + G + H]

(1) 154 (2) 244 (3) 354 (4) None of these

11. For the first order decomposition of $SO_2Cl_2(g)$,

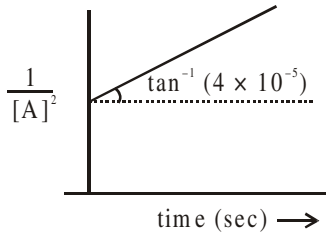
$SO_2Cl_2(g) \rightarrow SO_2(g) + Cl_2(g)$

a graph of log $(a_0 - x)$ vs t is shown in figure. What is the rate constant (sec^{-1})?



(1) 0.2 (2) 4.6×10^{-1} (3) 7.7×10^{-3} (4) 1.15×10^{-2}

12. For a reaction A ⟶ Product



What is the value of k for the given reaction-

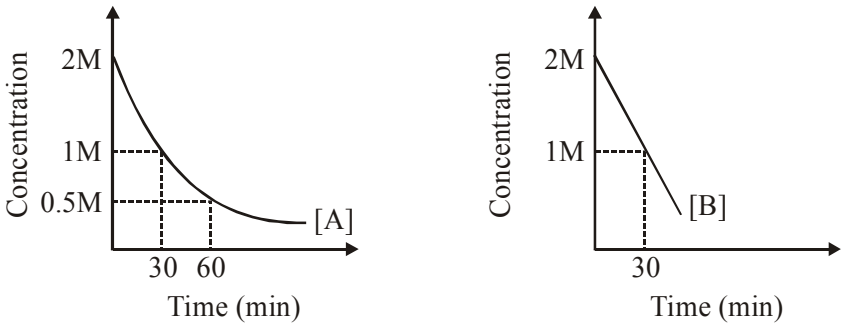
(1) 4×10^{-5} $M^{-1}s^{-1}$ (2) $\frac{4}{3} \times 10^{-5}$ $M^{-2}s^{-1}$

(3) 2×10^{-5} $M^{-1}s^{-1}$ (4) $\frac{2}{3} \times 10^{-5}$ $M^{-2}s^{-1}$

13. For the reactions

(i) $A \xrightarrow{k_I} P$

(ii) $B \xrightarrow{k_{II}} Q$, following observation is made.

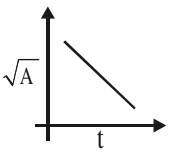


Calculate $\xrightarrow[k_{II}]{k_I}$, where k_I and k_{II} are rate constant for the respective reaction.

(1) 2.303 (2) 1 (3) 0.36 (4) 0.693

14. For the reaction $A \rightarrow B$, the rate law expression is $-\frac{d[A]}{dt} = k\,[A]^{1/2}$. If initial concentration of [A] is $[A]_0$, then

(A) The integerated rate expression is $k = \frac{2}{t}(A_0^{1/2} - A^{1/2})$

(B) The graph of $\sqrt{A}$ vs t will be 

(C) The half life period, $t_{1/2} = \frac{K}{2[A]_0^{1/2}}$

(D) The time taken for 75% completion of reaction $t_{3/4} = \frac{\sqrt{[A]_0}}{k}$

(1) A, B, D (2) B, C, D (3) A, B, C (4) A, C, D

15. Select **incorrect** statement(s):

(A) Unit of pre-exponential factor (A) for second order reaction is mol L^{-1} s^{-1}.

(B) A zero order reaction must be a complex reaction.

(C) Molecularity is defined only for RDS in a complex reaction.

(D) Rate constant (k) remain unaffected on changing temperature.

(1) A, C, D (2) A, B, C (3) B, C, D (4) A, B, D

16. Which of the following is/are **correct** statement?

(A) Stoichiometry of a reaction tells about the order of the elementary reactions.

(B) For a zero order reaction, rate and the rate constant are identical.

(C) A zero order reaction is controlled by factors other than concentration of reactants.

(D) A zero order reaction is always elementary reaction.

(1) A, B, D (2) A, C, D (3) A, B, C (4) B, C, D

17. For the gase phase reaction : $R - H + X_2 \rightarrow R - X + HX$, following mechanism has been proposed

(i) $X_2 \underset{k_2}{\overset{k_1}{\rightleftharpoons}} 2X^{\bullet}$

(ii) $X^{\bullet} + R - H \xrightarrow{k_3} R^{\bullet} + H - X$ (slowest)

(iii) $R^{\bullet} + X_2 \xrightarrow{k_4} R - X + X^{\bullet}$

Based on this select the correct option (s)

(A) Effective rate constant for the formation of RX is $k_3 k_4 \sqrt{\frac{k_1}{k_2}}$

(B) $\frac{d[RX]}{dt} \propto [X_2]$

(C) Overall order of the reaction is 3/2

(D) $\frac{d[RX]}{dt} \propto [RH]^1$

(1) A, B (2) B, C (3) C, D (4) A, D

18. For a first order reaction : $A(g) \rightarrow 2B(g)$

Time(in second)	0	20	40	∞
Total pressure of system (in mm.of Hg)	64	112	124	128

(1) Half life of reaction is 10 sec

(2) Value of rate constant for reaction is $6.93 \times 10^{-3} sec^{-1}$

(3) Total pressure at t = 50 sec will be 252 mm of Hg

(4) Reaction must be a complex reaction

19. Which of the following is **INCORRECT** for first order reaction ?

(1) On introducing catalyst, both rate constant and rate of reaction increases.

(2) On increasing temperature both rate constant & rate of reaction increases.

(3) On decreasing volume both rate constant & rate of gaseous reaction increases.

(4) On increasing concentration of gaseous reactant at constant volume & constant temperature both total pressure and rate of the reaction increases.

Rate = K $[X]^1$ $[Y]^0$ $[Z]^2$.

Choose the correct statements

(A) If [z] >> [x] and 75% of X undergoes reaction in 20 sec, then 50% of X will react in 10 sec.

(B) Rate of reaction decreases by reducing the concentration of Y to half of the original value

(C) The half life of Z increases by increasing its concentration if [x] >> [z]

(D) On increasing the concentration of X,Y & Z double, rate of reaction becomes 8 times

(1) A, B (2) B, D (3) A, D (4) A, C

21. For the reaction A + 3B $\rightarrow$ C, select the correct statement(s) :-

(A) $\frac{d[C]}{dt} = \frac{-d[A]}{dt}$ (B) $\frac{3d[C]}{dt} = -\frac{d[B]}{dt}$

(C) Rate law must be r = k $[A][B]^3$

(D) Units for rate of reaction are independent of order of reaction

(1) A, B, D (2) A, C, D (3) B, C, D (4) A, B, C

22. Choose the incorrect statement -

(1) Activation energy of reaction always decreases on decreasing temperature

(2) Order of reaction may change with change in temperature

(3) When slowest step is the first step in a mechanism, then the rate law of overall reaction is the same as the rate law for this step

(4) Rate of photochemical reaction is directly proportional to intensity of absorbed photons.

23. Which statement(s) is/are false ?

(A) Every reaction has an order if mechanism is not provided.

(B) All rate constant have same dimension.

(C) Every chemical species that appears in the rate law of reaction must be reactant or product in that reaction.

(D) Rate constant is never negative.

(1) A, B, C (2) B, C, D (3) A, C, D (4) A, B, D

24. Two reactions R_1 and R_2 have identical pre-exponential factors. Activation energy of R_1 exceeds that of R_2 by 10 kJ mol^{-1}. If k_1 and k_2 are rate constants for reactions R_1 and R_2 respectively at 300 K, then $\ln(k_2/k_1)$ is equal to :

(R = 8.314 J $mol^{-1}K^{-1}$)

(1) 8 (2) 12 (3) 6 (4) 4

25. The rate of a reaction quadruples when the temperature changes from 300 to 310 K. The activation energy of this reaction is (Assume activation energy and pre-exponential factor are independent of temperature ; ln 2 = 0.693, R = 8.314 J $mol^{-1}K^{-1}$) :

(1) 107.2 kJ $mol^{-1}K^{-1}$ (2) 53.6 kJ $mol^{-1}K^{-1}$

(3) 214.4 kJ $mol^{-1}K^{-1}$ (4) 26.8 kJ $mol^{-1}K^{-1}$

26. The rate of a reaction A doubles on increasing the temperature from 300 to 310 K. By how much, the temperature of reaction B should be increased from 300 K so that rate doubles if activation energy of the reaction B is twice to that of reaction A :

(1) 2.45 K (2) 4.92 K (3) 9.84 K (4) 19.67 K

27. At 518° C, the rate of decomposition of a sample of gaseous acetaldehyde, initially at a pressure of 363 Torr, was 1.00 Torr s^{-1} when 5% had reacted and 0.5 Torr s^{-1} when 33% had reacted. The order of the reaction is :

(1) 3 (2) 1 (3) 0 (4) 2

28. Which of the following statement(s) is (are) correct

(A) A plot of log K_p versus 1/T is linear

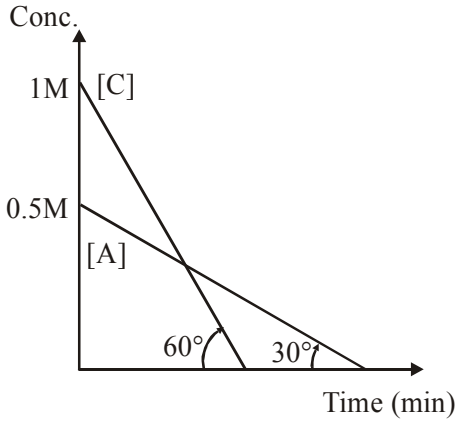
(B) A plot of log [X] versus time is linear for a first order reaction, $X \longrightarrow P$

(C) A plot of log P versus 1/T is linear at constant volume.

(D) A plot of P versus 1/V is linear at constant temperature.

(1) A, B, C, D (2) B, C, D (3) A, C, D (4) A, B, D

29. For the two reaction I : A → B; II : C → D following graph is obtained.



Which of the following is true :

(1) If [B] = [A] then at that time [D] = 0.75 M

(2) If [C] = [A] then at that time [B] > [D]

(3) $(t_{100\%})_{\text{reaction I}} = (t_{100\%})_{\text{reaction II}}$

(4) [A] = [C] at t = $\frac{\sqrt{3}}{2}$ min.

30.

option(s) among the following is(are):

(A) The value of frequency factor predicted by Arrhenius equation is higher than that determined experimentally

(B) The activation energy of the reaction is unaffected by the value of the steric factor

(C) Since P = 4.5, the reaction will not proceed unless an effective catalyst is used.

(D) Experimentally determined value of frequency factor is higher than that predicted by Arrhenius equation.

(1) A, B (2) B, D (3) A, C, D (4) B, C

ANSWER KEY															
Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	**3**	**1**	**1**	**1**	**2**	**3**	**3**	**4**	**3**	**2**	**3**	**3**	**4**	**1**	**1**
Que.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Ans.	**3**	**3**	**1**	**3**	**3**	**1**	**1**	**1**	**4**	**1**	**2**	**4**	**4**	**1**	**2**