CHEMICAL KINETICS

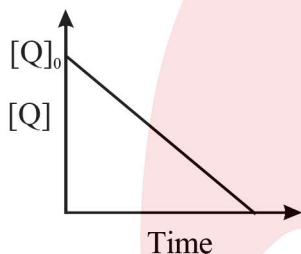**1.** $t_{1/4}$ can be taken as the time taken for the concetration of a reactant to drop to 3/4 of its initial vlaue. If the rate constant for a first order reaction is k, then $t_{1/4}$ can be written as - [ln2 = 0.7, ln3 = 1.11] **[AIEEE-2005]**

(1) 0.29/k   (2) 0.10/k

(3) 0.75/k   (4) 0.69/k

2. A reaction was found to be second order with respect to the concentration of carbon monoxide. If the concentration of carbon monoxide is doubled, with everything else kept the same, the rate of reaction will **[AIEEE-2005]**

(1) triple

(2) increase by a factor of 4

(3) double

(4) remain unchanged

3. Rate of reaction can be expressed by Arhenius equation as $k = Ae^{-E/RT}$. In this equation, E represents **[AIEEE-2005]**

(1) the energy below which colliding molecules will not react

(2) the total energy of the reacting molecule at a temperature, T

(3) The fraction of molecules with energy greater than the activation energy of the reaction

(4) None of these

4. The following mechanism has been proposed for the reaction of NO with Br_2 to form NOBr

$$NO(g) + Br_2(g) \rightleftharpoons NOBr_2(g)$$
$$NOBr_2(g) + NO(g) \rightarrow 2NOBr(g)$$

If the second step is the rate determining step, the order of the reaction with respect to NO(g) is : **[AIEEE 2006]**

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

5. The energies of activation for forward and reverse reactions for $A_2 + B_2 \rightleftharpoons 2AB$ are 180 kJ mol^{-1} and 200 kJ mol^{-1} respectively. The presence of a catalyst lowers the activation energy of both (forward and reverse) reactions by 100 kJ mol^{-1}. The enthalpy change of the reaction $(A_2 + B_2 \rightarrow 2AB)$ in the presence of catalyst will be (in kJ mol^{-1}) - **[AIEEE-2007]**

(1) 300   (2) 120   (3) 280   (4) –20

6. The half life period of a first order chemical reaction is 6.93 minutes. The time required for the completion of 99% of the chemical reaction will be (log 2 = 0.301) :- **[AIEEE-2009]**

(1) 46.06 minutes   (2) 460.6 minutes

(3) 230.3 minutes   (4) 23.03 minutes

7. Consider the reaction:

$$Cl_2(aq) + H_2S(aq) \rightarrow S(s) + 2H^+(aq) + 2Cl^-(aq)$$

The rate equation for this reaction is

rate = $k[Cl_2][H_2S]$

Which of these mechanisms is/are consistent with this rate equation ? **[AIEEE-2010]**

A. $Cl_2 + H_2S \rightarrow H^+ + Cl^- + Cl^+ + HS^-$ (slow)

$Cl^+ + HS^- \rightarrow H^+ + Cl^- + S$(fast)

B. $H_2S \Leftrightarrow H^+ + HS^-$ (fast equilibrium)

$Cl_2 + HS^- \rightarrow 2Cl^- + H^+ + S$(slow)

(1) A only

(2) B only

(3) Both A and B

(4) Neither A nor B

8. The time for half life period of a certain reaction A $\longrightarrow$ Products is 1 hour, when the initial concentration fo the reactant 'A' is 2.0 mol L^{-1}. How much time does it take for its concentration to come from 0.50 to 0.25 mol L^{-1} if it is a zero order reaction ? **[AIEEE-2010]**

(1) 1 h   (2) 4 h

(3) 0.5 h   (4) 0.25 h

9. The concentration of R in the reaction R $\rightarrow$ P was measured as a function of time and the following data is obtained :

[R] (molar)	1.0	0.75	0.40	0.10
t(min.)	0.0	0.05	0.12	0.18

The order of the reaction is. **[JEE 2010]**

10. The rate of a chemical reaction doubles for every 10°C rise of temperature. If the temperature is raised by 50°C, the rate of the reaction increases by about :- **[AIEEE-2011]**

(1) 32 times   (2) 64 times

(3) 10 times   (4) 24 times

11. A reactant (1) forms two products : **[AIEEE-2011]**

A $\xrightarrow{k_1}$ B, Activation Energy Ea_1

A $\xrightarrow{k_2}$ C, Activation Energy Ea_2

If $Ea_2 = 2 Ea_1$, then k_1 and k_2 are related as :-

(1) $k_1 = 2k_2 e^{Ea_2/RT}$ (2) $k_1 = k_2 e^{Ea_1/RT}$

(3) $k_2 = k_1 e^{Ea_2/RT}$ (4) $k_1 = [A] k_2 e^{Ea_1/RT}$

12. For the first order reaction   **[JEE 2011]**
$$2N_2O_5(g) \longrightarrow 4NO_2(g) + O_2(g)$$
(1) the concentration of the reactant decreases exponentially with time
(2) the half-life of the reaction decreases with increasing temperature.
(3) the half-life of the reaction depends on the initial concentration of the reactant.
(4) the reaction proceeds to 99.6% completion in eight half-life duration.

13. An organic compound undergoes first-order decomposition . The time taken for its decomposition to 1/8 and 1/10 of its initial concentration are $t_{1/8}$ and $t_{1/10}$ respectively. What is the value of

$\dfrac{[t_{1/8}]}{t_{1/10}} \times 10$? (take $\log_{10}2 = 0.3$)   **[JEE 2012]**

14. In the reaction :
$$P + Q \longrightarrow R + S$$

the time taken for 75% reaction of P is twice the time taken for 50% reaction of P. The concentration of Q varies with reaction time as shown in the figure. The overall order of the reaction is - **[JEE 2013]**
(1) 2   (2) 3
(3) 0   (4) 1

15. For the non-stoichiometric reaction $2A + B \rightarrow C + D$, the following kinetic data were obtained in three separate experiments, all at 298 K.

                                [JEE-MAIN 2014]

Initial Concentration (A)	Initial Concentration (B)	Initial rate of formation of C (mol L⁻S⁻)
0.1M	0.1M	1.2×10^{-3}
0.1M	0.2M	1.2×10^{-3}
0.2M	0.1M	2.4×10^{-3}

(1) $\dfrac{dc}{dt} = k[A][B]^2$ (2) $\dfrac{dc}{dt} = k[A]$

(3) $\dfrac{dc}{dt} = k[A][B]$ (4) $\dfrac{dc}{dt} = k[A]^2[B]$

16. For the elementary reaction $\mathbf{M} \rightarrow \mathbf{N}$, the rate of disappearance of $\mathbf{M}$ increases by a factor of 8 upon doubling the concentration of $\mathbf{M}$. The order of the reaction with respect to $\mathbf{M}$ is   **[JEE 2014]**
(1) 4   (2) 3
(3) 2   (4) 1

17. Higher order (>3) reactions are rare due to :-

                     [JEE-MAIN-(Offline)2015]

(1) shifting of equilibrium towards reactants due to elastic collision
(2) loss of active species on collision
(3) low probability of simultaneous collision of all the reacting species
(4) increase in entropy and activation energy as more molecules are involved.

18. The reaction : $2N_2O_5(g) \rightarrow 4NO_2(g) + O_2(g)$, follows first order kinetics. The pressure of a vessel containing only N_2O_5 was found to increase from 50 mm Hg to 87.5 mm Hg in 30 min. The pressure exerted by the gases after 60 min. will be (Assume temperature remains constant)

                     [JEE-MAIN-(Online)2015]

(1) 106.25 nm Hg   (2) 116.25 nm Hg
(3) 125 mm Hg   (4) 150 mm Hg

19. For the equilibrium, $A(g) \rightleftharpoons B(g)$, ΔH is -40 kJ/mol. If the ratio of the activation energies of the forward

(E_f) and reverse (E_b) reactions is $\dfrac{2}{3}$ then :-
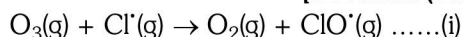
                     [JEE-MAIN-(Online)2015]

(1) $E_f = 60$ kJ/mol; $E_b = 100$ kJ/mol
(2) $E_f = 30$ kJ/mol; $E_b = 70$ kJ/mol
(3) $E_f = 80$ kJ/mol; $E_b = 120$ kJ/mol
(4) $E_f = 70$ kJ/mol; $E_b = 30$ kJ/mol

20. Decomposition of H_2O_2 follows a first order reaction. In fifty minutes the concentration of H_2O_2 decreases from 0.5 to 0.125 M in one such decomposition. When the concentration of H_2O_2 reaches 0.05 M, the rate of formation of O_2 will be :-
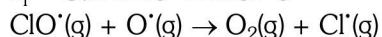
                     [JEE-MAIN-(Offline)2016]

(1) 1.34×10^{-2} mol min⁻¹
(2) 6.93×10^{-2} mol min⁻¹
(3) 6.93×10^{-4} mol min⁻¹
(4) 2.66 L min⁻¹ at STP

21. The reaction of ozone with oxygen atoms in the presence of chlorine atoms can occur by a two step process shown below :
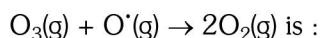
[JEE-MAIN-(Online)2016]

$O_3(g) + Cl^{\bullet}(g) \rightarrow O_2(g) + ClO^{\bullet}(g)$ ......(i)
$k_i = 5.2 \times 10^9$ L mol^{-1}s^{-1}
$ClO^{\bullet}(g) + O^{\bullet}(g) \rightarrow O_2(g) + Cl^{\bullet}(g)$
$k_{ii} = 2.6 \times 10^{10}$ L mol^{-1}s^{-1}.....(ii)
The closest rate constant for the overall reaction $O_3(g) + O^{\bullet}(g) \rightarrow 2O_2(g)$ is :
(1) 3.1×10^{10} L mol^{-1}s^{-1}
(2) 2.6×10^{10} L mol^{-1}s^{-1}
(3) 5.2×10^9 L mol^{-1}s^{-1}
(4) 1.4×10^{20} L mol^{-1}s^{-1}

22. the rate law for the reaction below is given by the expression k[A][B]

$$A + B \rightarrow Product$$

If the concentration of B is increased from 0.1 to 0.3 mole, keeping the value of A at 0.1 mole, the rate constant will be : **[JEE-MAIN-(Online)2016]**
(1) 3k   (2) 9k   (3) k   (4) k/3

23. According to the Arrhenius equation,

[JEE 2016]

(1) A high activation energy usually implies a fast reaction
(2) Rate constant increase with increase in temperature. This is due to a greater number of collisions whose energy exceeds the activation energy
(3) Higher the magnitude of activation energy, stronger is the temperature dependence of the rate constant
(4) The pre-exponential factor is a measure of the rate at which collisions occur, irrespective of their energy.

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})   **[JEE-MAINS-2017]**
(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}) : **[MAINS-2017(online)]**
(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 :

[MAINS-2017(online)]

(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 : **[JEE-MAINS-2018(offline)]**
(1) 3   (2) 1   (3) 0   (4) 2

28 For a first order reaction, A $\rightarrow$ P, $t_{1/2}$ (half life) is 10 days. The time required for $\dfrac{1}{4}^{th}$ conversion of A (in days) is :- (ln 2 = 0.693, ln 3 = 1.1)

[MAINS-2018(online)]

(1) 5   (2) 4.1   (3) 3.2   (4) 2.5

29. N_2O_5 decomposes to NO_2 and O_2 and follows first order kinetics. After 50 minutes, the pressure inside the vessel increases from 50 mmHg to 87.5 mmHg. The pressure of the gaseous mixture after 100 minute at constant temperature will be:

[MAINS-2018(online)]

(1) 116.25 mmHg   (2) 175.0 mmHg
(3) 106.25 mmHg   (4) 136.25 mmHg

PREVIOUS YEARS QUESTIONS				ANSWER KEY					Exercise-II
Que.	1	2	3	4	5	6	7	8	9	10
Ans.	1	2	1	3	4	1	1	4	0	1
Que.	11	12	13	14	15	16	17	18	19	20
Ans.	2	1,2,4	9	4	2	2	3	1	3	3
Que.	21	22	23	24	25	26	27	28	29	
Ans.	3	3	2,3,4	4	1	2	4	2	3	