Exercise – I (JEE-Main Pattern)

SECTION–A

- This section contains **TWENTY** questions.
- Each question has **FOUR** options (1), (2), (3) and (4). **ONLY ONE** of these four options is correct.
- For each question, darken the bubble corresponding to the correct option in the ORS.
- For each question, marks will be awarded in one of the following categories :

Full Marks : +4, if only the bubble corresponding to the correct option is darkened.
Zero Marks : 0, if none of the bubbles is darkened.
Negative Marks : –1 in all other cases

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1. In a reaction $N_2(g) + 3H_2(g) \longrightarrow 2NH_3(g)$, the rate of appearance of NH_3 is 2.5×10^{-4} molL^{-1}sec^{-1}. The rate of reaction & rate of disappearance of H_2 will be (In molL^{-1}sec^{-1})

(1) 3.75×10^{-4}, 1.25×10^{-4} (2) 1.25×10^{-4}, 2.5×10^{-4}

(3) 1.25×10^{-4}, 3.75×10^{-4} (4) 5.0×10^{-4}, 3.75×10^{-4}

CCK001

2. If concentration of reactants is increased by 'x', then the rate constant (k) becomes –

(1) $\ln\frac{k}{x}$ (2) $\frac{k}{x}$ (3) k + x (4) k

CCK002

3. $A(g) \longrightarrow B(g) + 3C(g)$

In a closed container at a given temperature, pressure increases from 100 mm Hg to 160 mm Hg in 10 sec. for reaction.

Then the average rate of reaction in first 10 sec. will be -

(1) 2 mm/sec. (2) 4 mm/sec. (3) 6 mm/sec. (4) 3 mm/sec.

CCK003

4. K for a zero order reaction is 2×10^{-2} molL^{-1} sec^{-1}. If the concentration of the reactant after 25 sec is 0.5 M, then concentration after 50 sec. must have been.

(1) 0.5 M (2) 0.25 M (3) 0.125 M (4) 0.0 M

CCK004

5. In a first order reaction the concentration of the reactant is decreased from 1.0 M to 0.25 M in 20 min. The rate constant of the reaction would be –

(1) 10 min^{-1} (2) 6.931 min^{-1} (3) 0.6931 min^{-1} (4) 0.06931 min^{-1}

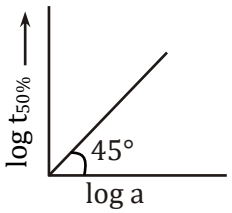
CCK005

6. $SO_2Cl_2 \longrightarrow SO_2 + Cl_2$ is a first order gas reaction with $K = 2.2 \times 10^{-5}$ sec^{-1} at 320° C. The % of SO_2Cl_2 decomposed on heating for 90 minute is : ($10^{0.052} = 1.12$)

(1) 11.26 (2) 1.118 (3) 0.118 (4) 18.11

CCK006

7. What will be the order of reaction and rate constant for a chemical change having log $t_{50\%}$ vs log concentration (a) curves as ?



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

CCK007

8. The rate law for a reaction between the substances A and B is given by, rate = $k[A]^n[B]^m$. On doubling the concentration of A and halving the concentration of B, the ratio of the new rate to the earlier rate of the reaction will be as

(1) $\frac{1}{2^{(m+n)}}$ (2) (m + n) (3) (n – m) (4) 2^{n-m}

CCK008

9. A study of chemical kinetics of the reaction

A + B $\longrightarrow$ products, gave the following data at 25°C :-

Exp. No.	[A]	[B]	Rate
(I)	1.0	0.15	4.2×10^{-6}
(II)	2.0	0.15	8.4×10^{-6}
(III)	1.0	0.20	5.6×10^{-6}

Find out rate law :-

(1) r = K[A] (2) r = K[B] (3) r = K[A] [B] (4) $r = K[A] [B]^2$

CCK009

10. Which of the following statements are correct -

(a) Order of a reaction can be known from experimental results and not from the stoichiometry of reaction

(b) Over all order of a reaction
mA + nB $\rightarrow$ xAB is m + n

(c) Molecularity of a reaction refers to (i) each of the elementary steps in mechanism of a complex reaction or (ii) a single step reaction

(d) Order and molecularity are always different

(1) a, b and c (2) a & b (3) c & d (4) a & c

CCK010

11. Which of the following statements is incorrect ?

(1) A second order reaction must be a bimolecular elementary reaction

(2) A bimolecular elementary reaction must be a second order reaction

(3) Zero order reaction must be a complex reaction

(4) First order reaction may be complex or elementary reaction

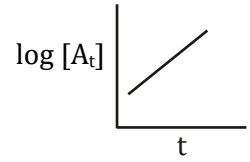
CCK011

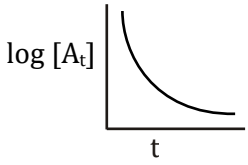
12. A first order reaction takes 69.3 minutes for 50% completion. How much time will be needed for 80% completion (log 5 = 0.7, log 2 = 0.3):-

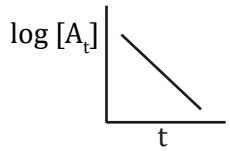
(1) 161. 7 min (2) 170.97 min (3) 150.97 min (4) None

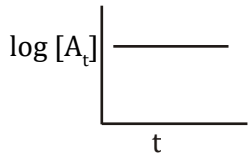
CCK012

13. For the first order reaction A → products which one of the following is the correct plot of log [At] versus time-

(1) 

(2) 

(3) 

(4) 

CCK013

14. For a chemical reaction A ⟶ Products, the rate of disappearance of A is given by :

$$-\frac{dC_A}{dt}=\frac{K_1C_A}{1+K_2C_A}$$

At very high C_A, the reaction is of ..... order with rate constant .....

(Assume K_1, K_2 are lesser than 1)

(1) I, K_1/K_2 (2) I, K_1 (3) Zero, K_1/K_2 (4) II, $K_1/(K_1 + K_2)$

CCK014

15. Rate of a reaction can be expressed by Arrhenius equation as,

$K = Ae^{-E_a/RT}$

In this equation, E_a represents :

(1) the energy above which all the colliding molecules will react

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

(3) the total energy of the reacting molecules at a temperature, T

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

CCK015

16. For a gaseous reaction, following data is given:

$A \longrightarrow B$; $K_1 = 10^{15}\, e^{-3000/T}$

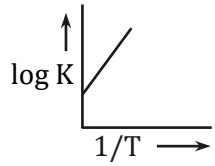
$C \longrightarrow D$; $K_2 = 10^{14} e^{-1000/T}$

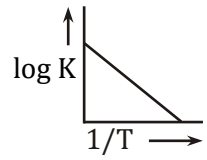
The temperature at which $K_1 = K_2$ is :-

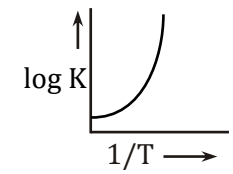
(1) 434.2 K (2) 2000 K (3) 868.43 K (4) None of these

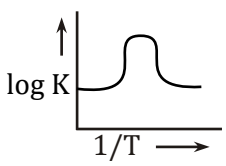
CCK016

17. A graph plotted between log K vs 1/T for calculating activation energy is shown by

(1) 

(2) 

(3) 

(4) 

CCK017

18. 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} (2) 53.6 kJ mol^{-1} (3) 214.4 kJ mol^{-1} (4) 26.8 kJ mol^{-1}

CCK018

19. 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

CCK019

20. Consider the following statements :

(i) increase in concentration of reactant increases the rate of a zero order reaction

(ii) rate constant k is equal to 'A' if $E_a = 0$

(iii) rate constant k is equal to 'A' if $E_a = \infty$

(iv) ln k vs T is a straight line

(v) ln k vs 1/T is a straight line

Correct statement are :

(1) (i) and (iv) (2) (ii) and (v) (3) (iii) and (iv) (4) (ii) and (iii)

CCK020

SECTION-B

- This section will have **TEN questions**. Candidate can choose to attempt any 5 questions out of these 10 questions. In case if candidate attempts more than 5 questions, first 5 attempted questions will be considered for marking.
- The answer to each question is a **NUMERICAL VALUE.**
- For each question, enter the correct numerical value (Answer should be rounded off to the nearest integer).
- Answer to each question will be evaluated according to the following marking scheme:

  Full Marks : +4, if only correct answer is given.
  Zero Marks : 0, if no answer is given.
  Negative Marks : -1 for incorrect answer

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1. For the reaction : 3A (g) $\rightarrow$ 2B(g), the rate of formation of 'B' at 298 K, is represented as $ln\left(\frac{d[B]}{dt}\right) = -0.04 + 2 \times ln[A]$. The order of reaction is-

CCK021

2. 10 gram mixture of two gases A_2(mol.wt. = 20) and B_2 (mol. wt. = 30), which decompose by first order kinetics, was taken in a vessel. The half life of decomposition of A_2 and B_2 are 2 and 3 hours respectively. After 6 hours weight of mixture of A_2 and B_2 is found to be 2 gram. Find the weight of A_2 in the initial mixture-

CCK022

3. The half-life of decomposition of gaseous CH_3CHO at initial pressure of 365 mm and 170 mm of Hg were 420 sec and 880 sec respectively. The order of the reaction is :-

CCK023

4. At 27°C, for the reaction, $N_2O_{4(g)} \rightarrow 2NO_{2(g)}$, rate of reaction is 6×10^{-3} atm min^{-1}. If rate of same reaction in terms of mol L^{-1} min^{-1} is $y \times 10^{-4}$ mol L^{-1} min^{-1}, then calculate value of 5y

CCK024

5. In a reaction $A_2B_3(g) \rightarrow A_2(g) + \frac{3}{2}B_2(g)$, the pressure increases from 60 torr to 75 torr in 2.5 minutes. The rate of disappearance of A_2B_3 in torr/min is:-

CCK025

6. $A(g) \rightarrow 2B(g)$ initially 2 moles of A are taken in 5 litre vessel. After 20 min, $[A]_t = \frac{[B]_t}{2}$. Find half life time of A in the first order reaction

CCK026

7. 99% of first order was completed in 64 minutes. When 99.9% of the reaction will complete

CCK027

8. A drop of solution (volume 0.10 ml) contains 6×10^{-6} mole of $H^{\oplus}$. If the rate constant of disappearance of $H^{\oplus}$ is 1×10^{7} mole $litre^{-1}$ sec^{-1}, If time for complete disappearance for $H^{\oplus}$ is $x \times 10^{-10}$ sec, then x will be

CCK028

9. A certain substance A is mixed with an equimolar quantity of substance B. At the end of an hour A is 75% reacted. Calculate the time in minute when A is 10% unreacted.

(Given: order of reaction is zero for both A & B.)

CCK029

10. For a zero order chemical reaction,

$$2NH_3(g) \longrightarrow N_2(g) + 3H_2(g)$$

rate of reaction = 0.1 atm/sec. Initially only NH_3 is present & its pressure = 3 atm. Calculate total pressure in atm at t = 10 sec.

CCK030

Exercise – II (JEE-Main PYQs)

1. 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.

CCK033

2. 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 mm Hg (2) 116.25 mm Hg (3) 125 mm Hg (4) 150 mm Hg

CCK034

3. 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 $\frac{2}{3}$ 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 = 70kJ/mol; E_b = 30 kJ/mol

CCK035

4. 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-MAIN-2017]**

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

CCK036

5. 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-MAIN-2018]**

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

CCK037

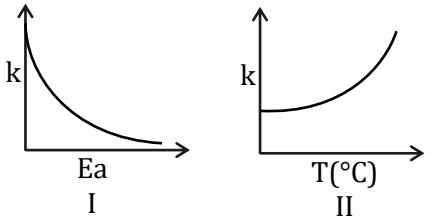
6. For a first order reaction, $A \rightarrow P$, $t_{1/2}$ (half life) is 10 days. The time required for $\frac{1}{4}^{th}$ conversion of A (in days) is :- **[JEE-MAIN (online)-2018]**

($\ln 2 = 0.693$, $\ln 3 = 1.1$)

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

CCK038

7. Consider the given plots for a reaction obeying Arrhenius equation (0°C < T < 300°C) : (k and E_a are rate constant and activation energy, respectively)



Choose the correct option : **[JEE-MAIN (online)-2019]**

(1) Both I and II are wrong (2) I is wrong but II is right

(3) Both I and II are correct (4) I is right but II is wrong

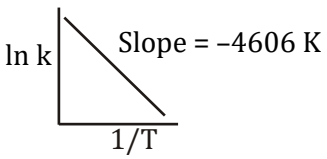
CCK039

8. The reaction $2X \rightarrow B$ is a zeroth order reaction. If the initial concentration of X is 0.2 M, the half-life is 6 h. When the initial concentration of X is 0.5 M, the time required to reach its final concentration of 0.2 M will be :- **[JEE-MAIN(online)-2019]**

(1) 18.0 h (2) 7.2 h (3) 9.0 h (4) 12.0 h

CCK040

9. For a reaction, consider the plot of ln k versus 1/T given in the figure. If the rate constant of this reaction at 400 K is 10^{-5} s^{-1}, then the rate constant at 500 K is : **[JEE-MAIN (online)-2019]**



(1) 2×10^{-4} s^{-1} (2) 10^{-4} s^{-1} (3) 10^{-6} s^{-1} (4) 4×10^{-4} s^{-1}

CCK041

10. Decomposition of X exhibits a rate constant of 0.05 μg/year. How many years are required for the decomposition of 5 μg of X into 2.5 μg ? **[JEE-MAIN (online)-2019]**

(1) 50 (2) 25 (3) 20 (4) 40

CCK042

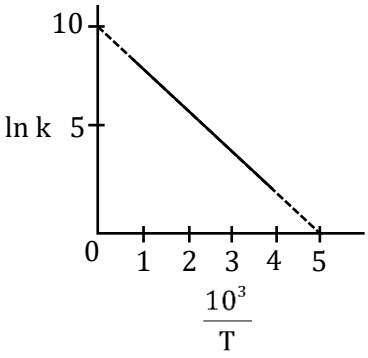
11. A flask contains a mixture of compounds A and B. Both compounds decompose by first-order kinetics. The half-lives for A and B are 300 s and 180 s, respectively. If the concentrations of A and B are equal initially, the time required for the concentration of A to be four times that of B(in s) : (Use ln 2 = 0.693) **[JEE-MAIN (online)-2020]**

(1) 180 (2) 120 (3) 300 (4) 900

CCK043

12. The rate constant (k) of a reaction is measured at different temperatures (T), and the data are plotted in the given figure. The activation energy of the reaction in kJ mol^{-1} is : (R is gas constant)

[JEE-MAIN (online)-2020]



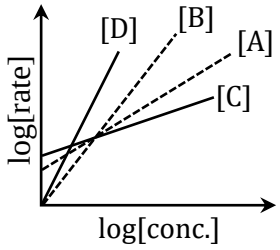
(1) 2R (2) R (3) 1/R (4) 2/R

CCK044

13. Consider the following reactions :

$A \rightarrow P1$; $B \rightarrow P2$; $C \rightarrow P3$; $D \rightarrow P4$

The order of the above reactions are a, b, c, and d, respectively. The following graph is obtained when log [rate] vs. log[conc] are plotted :



Among the following, the correct sequence for the order of the reactions is:

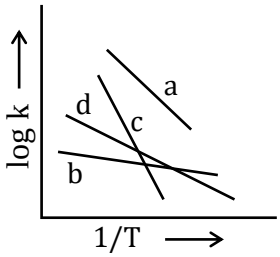
[JEE-MAIN (online)-2020]

(1) a > b > c > d (2) c > a > b > d (3) d > b > a > c (4) d > a > b > c

CCK045

14. Consider the following plots of rate constant versus $\frac{1}{T}$ for four different reactions. Which of the following orders is correct for the activation energies of these reactions?

[JEE-MAIN (online)-2020]



(1) $E_b > E_d > E_c > E_a$ (2) $E_a > E_c > E_d > E_b$

(3) $E_c > E_a > E_d > E_b$ (4) $E_b > E_a > E_d > E_c$

CCK046

15. For the reaction,

$2H_2(g) + 2NO(g) \rightarrow N_2(g) + 2H_2O(g)$

the observed rate expression is, rate = $k_f[NO]^2[H_2]$. The rate expression of the reverse reaction is :

[JEE-MAIN (online)-2020]

(1) $k_b[N_2][H_2O]^2/[NO]$ (2) $k_b[N_2][H_2O]$

(3) $k_b[N_2][H_2O]^2$ (4) $k_b[N_2][H_2O]^2/[H_2]$

CCK047

16. A and B decompose via first order kinetics with half-lives 54.0 min and 18.0 min respectively. Starting from an equimolar non-reactive mixture of A and B, the time taken for the concentration of A to become 16 times that of B is _____ min. (Round off to the Nearest Integer).

[JEE-MAIN (online)-2021]

CCK048

17. Sucrose hydrolyses in acid solution into glucose and fructose following first order rate law with a half-life of 3.33 h at 25 °C. After 9 h, the fraction of sucrose remaining is *f*. The value of $\log_{10}\left(\frac{1}{f}\right)$ is _____ × 10^{-2}. (Rounded off to the nearest integer) **[JEE-MAIN (online)-2021]**

[Assume : ln 10 = 2.303, ln 2 = 0.693]

CCK049

18. If the activation energy of a reaction is 80.9 kJ mol^{-1}, the fraction of molecules at 700 K, having enough energy to react to form products is e^{-x}. The value of *x* is _____.

(Rounded off to the nearest integer) **[JEE-MAIN (online)-2021]**

[Use R = 8.31 J K^{-1} mol^{-1}]

CCK050

19. For a chemical reaction A + B → Product, the order is 1 with respect to A and B.

Rate mol L^{-1} s^{-1}	[A] mol L^{-1}	[B] mol L^{-1}
0.10	20	0.5
0.40	*x*	0.5
0.80	40	*y*

What is the value of *x* and *y*? **[JEE (Main)-2023]**

(1) 80 and 2 (2) 40 and 4 (3) 160 and 4 (4) 80 and 4

CCK146

20. $t_{87.5}$ is the time required for the reaction to undergo 87.5% completion and t_{50} is the time required for the reaction to undergo 50% completion. The relation between $t_{87.5}$ and t_{50} for a first order reaction is $t_{87.5} = x \times t_{50}$

The value of x is_____ (Nearest integer) **[JEE (Main)-2023]**

CCK147

Exercise - III (JEE Advanced Pattern)

SECTION–I

- This section contains **FIVE** questions.
- Each question has FOUR options (A), (B), (C) and (D). ONLY ONE of these four options is correct.
- For each question, darken the bubble corresponding to the correct option in the ORS.
- For each question, marks will be awarded in one of the following categories:

Full Marks : +3, if only the bubble corresponding to the correct option is darkened.
Zero Marks : 0, if none of the bubbles is darkened.
Negative Marks : –1, in all other cases

1. A reaction takes place in three steps with individual rate constant and activation energy as follows-

	Rate constant	Activation energy
Step 1	k_1	E_{a_1} = 180 kJ/mol
Step 2	k_2	E_{a_2} = 80 kJ/mol
Step 3	k_3	E_{a_3} = 50 kJ/mol

If overall rate constant, (k) = $\left(\frac{k_1 k_2}{k_3}\right)^{2/3}$, then

overall activation energy of the reaction will be:

(A) 140 kJ/mol (B) 150 kJ/mol (C) 130 kJ/mol (D) 120 kJ/mol

CCK051

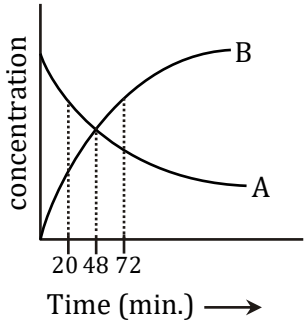
2. In a reaction involving one single reactant, the fraction of the reactant consumed may be defined as f = $\left(1-\frac{C}{C_0}\right)$ where C_0 and C are the concentrations of the reactant at the start and after time, t.

For a first order reaction

(A) $\frac{df}{dt}=k(1-f)$ (B) $-\frac{df}{dt}=kf$ (C) $-\frac{df}{dt}=k(1-f)$ (D) $\frac{df}{dt}=kf$

CCK052

3. For a first order reaction, $nA \longrightarrow B$ whose concentration vs time curve is as shown in the figure. If half life for the reaction is 24 minutes. Find out the value of n.



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

CCK053

4. Consider the reaction :

$A \longrightarrow B + C$

Initial concentration of A is 1 M. 20 minutes time is required for completion of 80 % reaction.

If $\frac{d[B]}{dt} = k[A]$, then half life ($t_{1/2}$) is (Use : ln 5 = 1.6, ln2 = 0.7)

(A) 55.44 min. (B) 50 min (C) 8.75 min (D) 12.5 min

CCK054

5. The reaction A(g) + 2B(g) → C(g) is an elementary reaction. In an experiment involving this reaction, the initial partial pressures of A and B are P_A = 0.40 atm and P_B = 1.0 atm respectively. When pressure of C becomes 0.3 atm in the reaction the rate of the reaction relative to the initial rate is :

(A) $\frac{1}{12}$ (B) $\frac{1}{50}$ (C) $\frac{1}{25}$ (D) none of these

CCK055

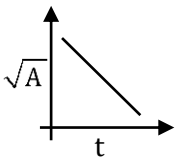
SECTION-II

- This section contains **FIVE** questions.
- Each question has **FOUR** options for correct answer(s). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct option(s).
- For each question, choose the correct option(s) to answer the question.
- Answer to each question will be evaluated according to the following marking scheme:

Full Marks	:	+4, if only (all) the correct option(s) is (are) chosen.
Partial Marks	:	+3, if all the four options are correct but ONLY three options are chosen.
Partial Marks	:	+2, if three or more options are correct but ONLY two options are chosen, both of which are correct options.
Partial Marks	:	+1, if two or more options are correct but ONLY one option is chosen and it is a correct option.
Zero Marks	:	0, if none of the options is chosen (i.e. the question is unanswered).
Negative Marks	:	–2 in all other cases.

6. For the reaction A → 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 integrated 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 $t_{\frac{3}{4}} = \frac{\sqrt{[A]_0}}{k}$

CCK056

7. 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.

CCK057

8. 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.

CCK058

9. For the gas 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) $R^{\bullet} + X2 \xrightarrow{k_4} R - X + X^{\bullet}$

Based on this, select the correct option (s)

(A) Effective rate constant for the formation of RX is $k_3k_4 \frac{k_1}{k_2}$

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

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

(D) $\frac{d[RX]}{dt} \propto [X_2]^{1/2}$

CCK059

10. 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

(A) Half life of reaction is 10 sec

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

(C) Total pressure at t = 50 sec will be 126 mm of Hg

(D) Reaction must be a complex reaction

CCK060

SECTION–III

- This section contains **TWO** question.
- **Each question has matching lists.** The codes for the lists have choices (A), (B), (C) and (D) out of which **ONLY ONE is correct**
- For each question, marks will be awarded in one of the following categories :

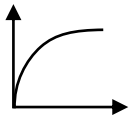
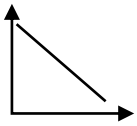
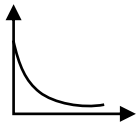
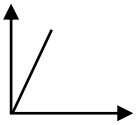
Full Marks : +3, if only the bubble corresponding to the correct option is darkened.

Zero Marks : 0, if none of the bubbles is darkened.

Negative Marks : –1 in all other cases

11. For the reaction of type $A(g) \longrightarrow 2B(g)$

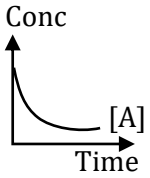
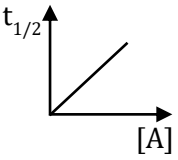
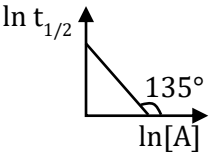
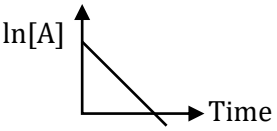
Column-I contains four entries and **column-II** contains four entries. Entry of column-I are to be matched with **ONLY ONE ENTRY** of column-II

Column I		Column II	
(A)	$\frac{d[B]}{dt}$ vs $\frac{-dt[A]}{dt}$ for first order	(P)	
(B)	[A] vs t for first order	(Q)	
(C)	[B] vs t for first order	(R)	
(D)	[A] vs t for zero order	(S)	

(A) A – Q; B - P; C - R; D – S
(B) A - Q; B - R; C - P; D - S
(C) A - S; B - R; C - P; D – Q
(D) A – R; B - P; C - S; D – Q

CCK061

12. For the reaction A + B → product, Given : $[A]_0 = [B]_0$

List-I (Observed Rate Law) is -		List-II (Graph)	
(P)	r = k[A]	(1)	
(Q)	$r = k[A]^{1/2}[B]^{1/2}$	(2)	
(R)	r = k[A] [B]	(3)	
(S)	$r = k[A]^0 [B]^0$	(4)	

(A) P – 4; Q - 1; R – 3; S – 2
(B) P – 2; Q - 3; R - 1; S - 4
(C) P – 1; Q - 2; R - 3; S – 4
(D) P – 4; Q - 3; R - 2; S – 1

CCK062

SECTION–IV

- This section contains **a** paragraph.
- Based on each paragraph, there are **TWO** questions.
- Each question has **FOUR** options (A), (B), (C) and (D) **ONLY ONE** of these four options is correct.
- For each question, darken the bubble corresponding to the correct option in the ORS.
- For each question, marks will be awarded in one of the following categories:

Full Marks : +3, if only the bubble corresponding to the correct answer is darkened.

Zero Marks : 0 in all other cases.

Paragraph for Question Nos. 13 & 14

A reaction is said to be first order if it's rate is proportional to the concentration of reactant. Let us consider a reaction

	A(g) ⟶	B(g) +	C(g)
At t = 0	a	0	0
At time t	a – x	x	s x

The rate of reaction is given by the expression $\frac{dx}{dt} = k(a - x)$ and integrated rate equation for a given reaction is represented as $k = \frac{1}{t}\ln\left(\frac{a}{a-x}\right)$ where a = initial concentration and (a – x) = concentration of A after time t.

13. Thermal decomposition of compound X is a first order reaction. If 75% of X is decomposed in 100 min. How long will it take for 90% of the compound to decompose?

Given : log 2 = 0.30

(A) 190 min (B) 176.66 min (C) 166.66 min (D) 156.66 min

CCK063

14. Consider a reaction $A(g) \longrightarrow 3B(g) + 2C(g)$ with rate constant 1.386×10^{-2} min^{-1}. Starting with 2 moles of A in 12.5 litre a closed vessel initially, if reaction is allowed to takes place at constant pressure & at 298K then find the concentration of B after 100 min.

(A) 0.04 M (B) 0.36 M (C) 0.09 M (D) None of these

CCK064

SECTION–V

- This section contains **SIX** questions.
- The answer to each question is a **NUMERICAL VALUE.**
- For each question, enter the correct numerical value (in decimal notation, truncated/rounded-off to the second decimal place; e.g. 6.25, 7.00, –0.33, –.30, 30.27, –127.30, if answer is 11.36777..... then both 11.36 and 11.37 will be correct).
- Answer to each question will be evaluated according to the following marking scheme:

  Full Marks : +3, if ONLY the correct numerical value is entered as answer.

  Zero Marks : 0, in all other cases.

---

15. The decomposition of a compound A in solution follow first order kinetics. If 10% w/v solution of A is 10% decomposed in 10 minutes at 10°C, then 20% w/v solution of A is ..... % decomposed in 20 minutes at 10°C.

CCK065

16. Conversion of A into B and C follows first order kinetics. A, B and C all are optically active, initially A is present in 500 ml solution and 100 minutes after the start of reaction, the resulting solution becomes optically inactive. If angle of rotation of A is +50 degree per molar, B is –20 degree per molar and C is +10 degree per molar, then find the time for completion of $\left(\frac{875}{9}\right)$ % of the chemical reaction in minutes.

$A(aq.) \rightarrow B(aq.) + C(aq.)$

CCK066

17. For the reaction,

$A \rightarrow P$

If ratio of $t_{7/8} : t_{1/4}$ is 7 : 2 what is order of reaction.

$t_{7/8}$ = time in which 7/8 part of reactant is reacted

$t_{1/4}$ = time in which 1/4 part of reactant is reacted

CCK067

18. If $t_{1/2}$ of a second order reaction is 1.0 hr. After what time in hr, the amount of reactant will be 25% of the initial amount?

CCK068

19. From the following data, calculate value of rate constant for decomposition of H_2O_2 in $M^{-1}sec^{-1}$

Time (in minutes)	0	10
Volume (in c.c. of $KMnO_4$)	22.8	11.4

CCK069

20. Consider two reactions at 27ºC

(I). A ⟶ B ; (First order kinetics)

(II). X ⟶ Y ; (Zero order kinetics)

If both A & X each having initial concentration 0.1M & same half life period. Then find simplest ratio of rate constants for I & II reactions. [ln2 = 0.7]

CCK070

Exercise - IV (JEE Advanced PYQs)

1. For the first order reaction.

$2N_2O_5(g) \longrightarrow 4NO_2(g) + O_2(g)$ **[JEE (Advanced) 2011]**

(A) the concentration of the reactant decreases exponentially with time

(B) the half-life of the reaction decreases with increasing temperature.

(C) the half-life of the reaction depends on the initial concentration of the reactant.

(D) the reaction proceeds to 99.6% completion in eight half-life duration.

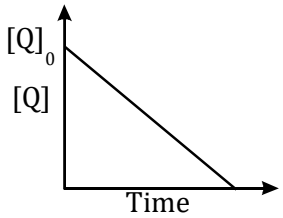
CCK071

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

CCK072

3. 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 (Advanced) 2013]**

(A) 2 (B) 3 (C) 0 (D) 1

CCK073

4. For the elementary reaction M → N, the rate of disappearance of M increases by a factor of 8 upon doubling the concentration of M. The order of the reaction with respect to M is

[JEE (Advanced) 2014]

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

CCK074

5. In dilute aqueous H_2SO_4, the complex diaquodioxalatoferrate (II) is oxidized by $MnO_4^{\ominus}$. For this reaction, the ratio of the rate of change of $[H^{\oplus}]$ to the rate of change of $[MnO_4^{\ominus}]$ is

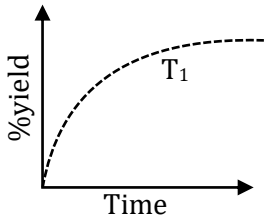
[JEE (Advanced) 2015]

CCK075

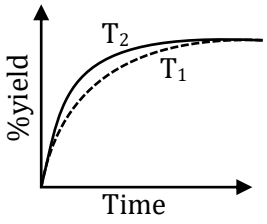
6. The % yield of ammonia as a function of time in the reaction

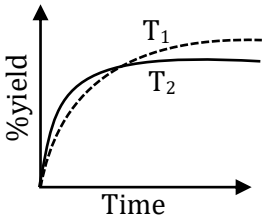
$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g), \Delta H < 0$

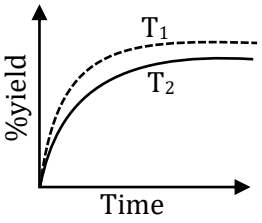
at (P, T_1) is given below -

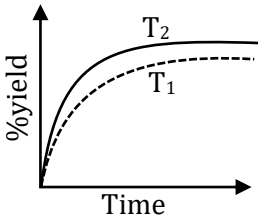


If this reaction is conducted at (P, T_2), with $T_2 > T_1$, the % yield of ammonia as a function of time is represented by - **[JEE (Advanced) 2015]**

(A) 

(B) 

(C) 

(D) 

CCK076

7. According to the Arrhenius equation, **[JEE (Advanced) 2016]**

(A) A high activation energy usually implies a fast reaction

(B) Rate constant increase with increase in temperature. This is due to a greater number of collisions whose energy exceeds the activation energy

(C) Higher the magnitude of activation energy, stronger is the temperature dependence of the rate constant

(D) The pre-exponential factor is a measure of the rate at which collisions occur, irrespective of their energy.

CCK077

8. In a bimolecular reaction, the steric factor P was experimentally determined to be 4.5. The correct option(s) among the following is(are) : **[JEE (Advanced) 2017]**

(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

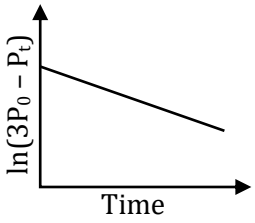
(C) Since P = 4.5, the reaction will not proceed unless an effective catalyst is used.

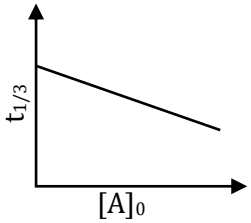
(D) Experimentally determined value of frequency factor is higher than that predicted by Arrhenius equation.

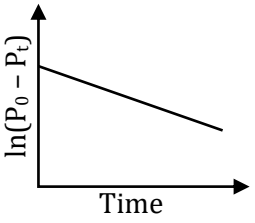
CCK078

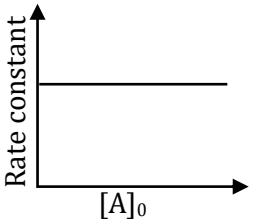
9. For a first order reaction $A(g) \rightarrow 2B(g) + C(g)$ at constant volume and 300 K, the total pressure at the beginning (t = 0) and at time t are P_0 and P_t, respectively. Initially, only A is present with concentration $[A]_0$, and $t_{1/3}$ is the time required for the partial pressure of A to reach $1/3^{rd}$ of its initial value. The correct option(s) is (are) :-

(Assume that all these gases behave as ideal gases) **[JEE (Advanced) 2018]**

(A) 

(B) 

(C) 

(D) 

CCK079

10. Consider the kinetic data given in the following table for the reaction A + B + C → Product.

Experiment No.	[A] (mol dm^{-3})	[B] (mol dm^{-3})	[C] (mol dm^{-3})	Rate of reaction (mol dm^{-3} s^{-1})
1	0.2	0.1	0.1	6.0×10^{-5}
2	0.2	0.2	0.1	6.0×10^{-5}
3	0.2	0.1	0.2	1.2×10^{-4}
4	0.3	0.1	0.1	9.0×10^{-5}

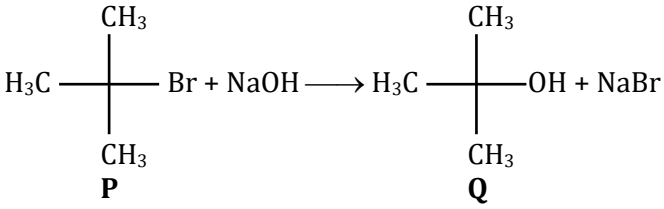
The rate of the reaction for [A] = 0.15 mol dm^{-3}, [B] = 0.25 mol dm^{-3} and [C] = 0.15 mol dm^{-3} is found to be $Y \times 10^{-5}$ mol dm^{-3} s^{-1}. The value of Y is –––––. **[JEE (Advanced) 2019]**

CCK080

11. The decomposition reaction $2N_2O_5(g) \xrightarrow{\Delta} 2N_2O_4(g) + O_2(g)$ is started in a closed cylinder under isothermal isochoric condition at an initial pressure of 1 atm. After $Y \times 10^3$ s, the pressure inside the cylinder is found to be 1.45 atm. If the rate constant of the reaction is 5×10^{-4} s^{-1}, assuming ideal gas behaviour, the value of Y is . **[JEE (Advanced) 2019]**

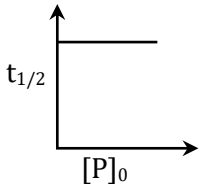
CCK081

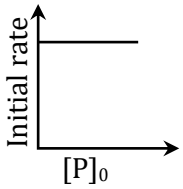
12. Which of the following plots is(are) correct for the given reaction (first order S_N^1 reaction)?

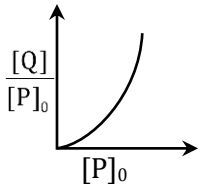


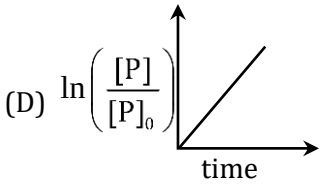
P **Q**

($[P]_0$ is the initial concentration of P) **[JEE (Advanced) 2020]**

(A) 

(B) 

(C) 

(D) 

CCK082

13. For the following reaction

$2X + Y \xrightarrow{k} P$

the rate of reaction is $\frac{d[P]}{dt} = k[X]$. Two moles of X are mixed with one mole of Y to make 1.0 L of solution. At 50 s, 0.5 mole of Y is left in the reaction mixture. The correct statement(s) about the reaction is(are). (Use : ln 2 = 0.693) **[JEE (Advanced) 2021]**

(A) The rate constant, k, of the reaction is $13.86 \times 10^{-4}\ s^{-1}$.

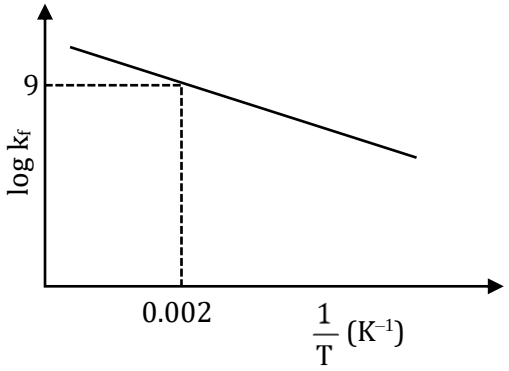
(B) Half-life of X is 50s.

(C) At 50 s, $-\frac{d[X]}{dt} = 13.86 \times 10^{-3}\ mol\ L^{-1}\ s^{-1}$.

(D) At 100 s, $-\frac{d[Y]}{dt} = 3.46 \times 10^{-3}\ mol\ L^{-1}\ s^{-1}$.

CCK083

14. The plot of log k_f versus $\frac{1}{T}$ for a reversible reaction A (g) $\rightleftharpoons$ P (g) is shown.



Pre-exponential factors for the forward and backward reactions are $10^{15}\ s^{-1}$ and $10^{11}\ s^{-1}$, respectively. If the value of log K for the reaction at 500 K is 6, the value of $|\log k_b|$ at 250 K is _____.

[K = equilibrium constant of the reaction

k_f = rate constant of forward reaction

k_b = rate constant of backward reaction] **[JEE (Advanced) 2023]**

CCK148

ANSWER KEY

Exercise – I (JEE-Main Pattern)

Section-A	Q.	1	2	3	4	5	6	7	8	9	10
	A.	3	4	1	4	4	1	1	4	3	4
	Q.	11	12	13	14	15	16	17	18	19	20
	A.	1	1	3	3	2	3	2	1	2	2
Section-B	Q.	1	2	3	4	5	6	7	8	9	10
	A.	2	4	2	12	4	20	96	60	72	5

Exercise – II (JEE-Main PYQs)

Question	1	2	3	4	5	6	7	8	9	10
Answer	3	1	3	4	4	2	4	1	2	1
Question	11	12	13	14	15	16	17	18	19	20
Answer	4	1	3	3	4	108	81	14	1	3

Exercise - III (JEE-Advanced Pattern)

Section-I	Q.	1	2	3	4	5	
	A.	A	A	C	C	C	
Section-II	Q.	6	7	8	9	10	
	A.	A,B,D	A,C,D	A,B,C	C,D	A,C	
Section-III	Q.	11	12				
	A.	C	A				
Section-IV	Q.	13	14				
	A.	C	C				
Section-V	Q.	15	16	17	18	19	20
	A.	19.00	200.00	0.00	3.00	0.06-0.07	14.00

Exercise – IV (JEE Advanced PYQs)

Question	1	2	3	4	5	6	7	8	9	10
Answer	A,B,D	9	D	B	8	B	B,C,D	B,D	A,D	6.75
Question	11	12	13	14						
Answer	2.30	A	B,C,D	5						