Chapter 12

Chemical Kinetics and Nuclear Chemistry

1. 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) 23.03 minutes (2) 46.06 minutes

   (3) 460.6 minutes (4) 230.3 minutes

2. 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?

   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)

   [AIEEE-2010]

   (1) A only (2) B only

   (3) Both (A) & (B) (4) Neither (A) nor (B)

3. The time for half life period of a certain reaction $A \longrightarrow$ Products is 1 h. When the initial concentration of 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

4. A reactant (A) forms two products :

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

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

   If $E_{a_2} = 2E_{a_1}$, then k_1 and k_2 are related as **[AIEEE-2011]**

   (1) $k_1 = k_2 e^{E_{a_1}/RT}$ (2) $k_1 = 2k_2 e^{E_{a_2}/RT}$

   (3) $k_2 = k_1 e^{E_{a_1}/RT}$ (4) $k_2 = k_1 e^{E_{a_2}/RT}$

5. For a first order reaction, (A) $\rightarrow$ products, the concentration of A changes from 0.1 M to 0.025 M in 40 minutes. The rate of reaction when the concentration of A is 0.01M, is **[AIEEE-2012]**

   (1) 3.47×10^{-4} M/min (2) 3.47×10^{-5} M/min

   (3) 1.73×10^{-4} M/min (4) 1.73×10^{-5} M/min

6. The rate of a reaction doubles when its temperature changes from 300 K to 310 K. Activation energy of such a reaction will be **[JEE (Main)-2013]**

   (R = 8.314 JK^{-1} mol^{-1} and log2 = 0.301)

   (1) 53.6 kJ mol^{-1} (2) 48.6 kJ mol^{-1}

   (3) 58.5 kJ mol^{-1} (4) 60.5 kJ mol^{-1}

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

Initial Concentration (A)	Initial Concentration (B)	Initial rate of formation of C (mol $L^{-1}s^{-1}$)
0.1 M	0.1 M	1.2×10^{-3}
0.1 M	0.2 M	1.2×10^{-3}
0.2 M	0.1 M	2.4×10^{-3}

   The rate law for the formation of C is **[JEE (Main)-2014]**

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

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

8. Higher order (>3) reactions are rare due to **[JEE (Main)-2015]**

   (1) Low probability of simultaneous collision of all the reacting species

   (2) Increase in entropy and activation energy as more molecules are involved

   (3) Shifting of equilibrium towards reactants due to elastic collisions

   (4) Loss of active species on collision

9. Decomposition of H_2O_2 follows a first order reaction. In fifty minutes, the concentration of H_2O_2 decreases from 0.5 to 0.25 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)-2016]**

(1) 6.93×10^{-4} mol min^{-1}

(2) 2.66 L min^{-1} at STP

(3) 1.34×10^{-2} mol min^{-1}

(4) 6.93×10^{-2} mol min^{-1}

10. 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 $mole^{-1}$ K^{-1}) **[JEE (Main)-2017]**

(1) 6 (2) 4

(3) 8 (4) 12

11. 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) 2 (2) 3

(3) 1 (4) 0

12. The following results were obtained during kinetic studies of the reaction ; 2 A + B $\rightarrow$ Products

Experiment	[A] (in mol L^{-1})	[B] (in mol L^{-1})	Initial Rate of reaction (in mol L^{-1} min^{-1})
I	0.10	0.20	6.93×10^{-3}
II	0.10	0.25	6.93×10^{-3}
III	0.20	0.30	1.386×10^{-2}

The time (in minutes) required to consume half of A is **[JEE (Main)-2019]**

(1) 100 (2) 1

(3) 5 (4) 10

13. For the reaction, 2A + B $\rightarrow$ products, when the concentration of A and B both were doubled, the rate of the reaction increased from 0.3 mol $L^{-1}s^{-1}$ to 2.4 mol $L^{-1}s^{-1}$. When the concentration of A alone is doubled, the rate increased from 0.3 mol $L^{-1}s^{-1}$ to 0.6 mol $L^{-1}s^{-1}$. Which one of the following statements is correct? **[JEE (Main)-2019]**

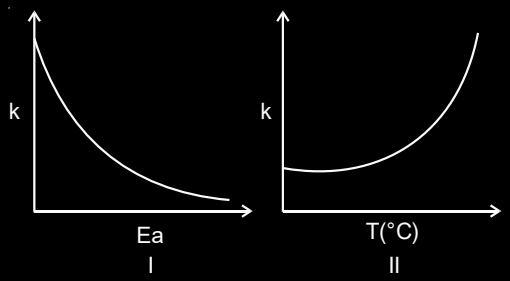
(1) Order of the reaction with respect to A is 2

(2) Order of the reaction with respect to B is 1

(3) Order of the reaction with respect to B is 2

(4) Total order of the reaction is 4

14. 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)-2019]**

(1) I is wrong but II is right

(2) Both I and II are correct

(3) Both I and II are wrong

(4) I is right but II is wrong

15. Which of the following is not an example of heterogeneous catalytic reaction?

[JEE (Main)-2019]

(1) Combustion of coal

(2) Ostwald's process

(3) Hydrogenation of vegetable oils

(4) Haber's process

16. For an elementary chemical reaction, $A_2 \underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}} 2A$, the expression for $\frac{d[A]}{dt}$ is

[JEE (Main)-2019]

(1) $k_1 [A_2] + k_{-1} [A]^2$

(2) $2k_1 [A_2] - 2k_{-1} [A]^2$

(3) $2k_1 [A_2] - k_{-1} [A]^2$

(4) $k_1 [A_2] - k_{-1} [A]^2$

17. If a reaction follows the Arrhenius equation, the plot $\ln k$ vs $\frac{1}{(RT)}$ gives straight line with a gradient (–y) unit. The energy required to activate the reactant is **[JEE (Main)-2019]**

(1) yR unit

(2) y/R unit

(3) –y unit

(4) y unit

18. 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)-2019]**

(1) 12.0 h (2) 7.2 h

(3) 9.0 h (4) 18.0 h

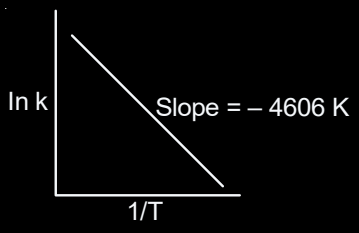
19. Decomposition of X exhibits a rate constant of 0.05 μg/year. How many years are required for the decomposition of 5 μg of X into 2.5 μg?

[JEE (Main)-2019]

(1) 40 (2) 20

(3) 50 (4) 25

20. 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)-2019]

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

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

21. For the reaction $2A + B \rightarrow C$, the values of initial rate at different reactant concentrations are given in the table below. The rate law for the reaction is

[A](mol L^{-1})	[B](mol L^{-1})	Initial Rate (mol L^{-1} s^{-1})
0.05	0.05	0.045
0.10	0.05	0.090
0.20	0.10	0.72

[JEE (Main)-2019]

(1) Rate = $k[A]^2[B]^2$ (2) Rate = $k[A][B]$

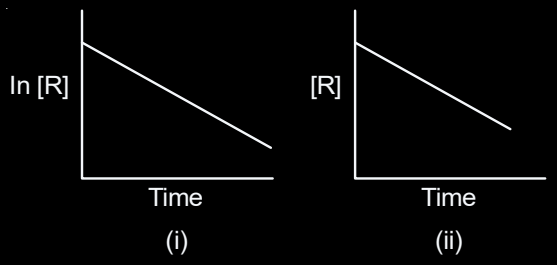
(3) Rate = $k[A]^2[B]$ (4) Rate = $k[A][B]^2$

22. For a reaction scheme $A \xrightarrow{k_1} B \xrightarrow{k_2} C$, if the rate of formation of B is set to be zero then the concentration of B is given by : **[JEE (Main)-2019]**

(1) $k_1k_2[A]$ (2) $(k_1 - k_2)[A]$

(3) $\left(\frac{k_1}{k_2}\right)[A]$ (4) $(k_1 + k_2)[A]$

23. The given plots represent the variation of the concentration of a reactant R with time for two different reactions (i) and (ii). The respective orders of the reactions are



[JEE (Main)-2019]

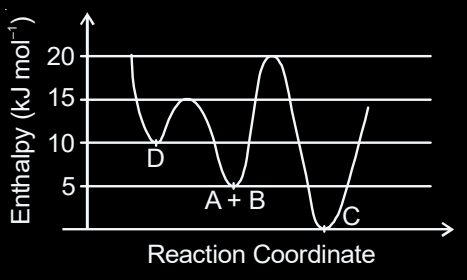
(1) 0, 1 (2) 1, 1

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

24. Consider the given plot of enthalpy of the following reaction between A and B.

$A + B \rightarrow C + D$

Identify the incorrect statement.



[JEE (Main)-2019]

(1) Activation enthalpy to form C is 5 kJ mol^{-1} less than that to form D

(2) D is kinetically stable product

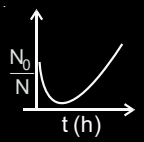
(3) Formation of A and B from C has highest enthalpy of activation

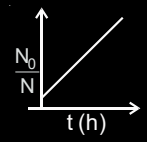
(4) C is the thermodynamically stable product

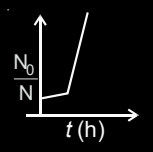
25. A bacterial infection in an internal wound grows as $N'(t) = N_0\exp(t)$, where the time t is in hours. A dose of antibiotic, taken orally, needs 1 hour to reach the wound. Once it reaches there, the bacterial population goes down as $\frac{dN}{dt} = -5N^2$.

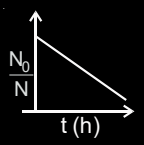
What will be the plot of $\frac{N_0}{N}$ vs. t after 1 hour ?

[JEE (Main)-2019]

(1) 

(2) 

(3) 

(4) 

26. For the reaction of H_2 with I_2, the rate constant is 2.5×10^{-4} dm^3 mol^{-1} s^{-1} at 327°C and 1.0 dm^3 mol^{-1} s^{-1} at 527°C. The activation energy for the reaction, in kJ mol^{-1} is :

($R = 8.314$ J K^{-1} mol^{-1}) **[JEE (Main)-2019]**

(1) 150 (2) 59

(3) 72 (4) 166

27. In the following reaction; $xA \rightarrow yB$

$$\log_{10}\left[-\frac{d[A]}{dt}\right] = \log_{10}\left[\frac{d[B]}{dt}\right] + 0.3010$$

'A' and 'B' respectively can be **[JEE (Main)-2019]**

(1) C_2H_4 and C_4H_8

(2) N_2O_4 and NO_2

(3) n-Butane and Iso-butane

(4) C_2H_2 and C_6H_6

28. NO_2 required for a reaction is produced by the decomposition of N_2O_5 in CCl_4 as per the equation,

$2N_2O_5(g) \rightarrow 4\,NO_2(g) + O_2(g)$.

The initial concentration of N_2O_5 is 3.00 mol L^{-1} and it is 2.75 mol L^{-1} after 30 minutes. The rate of formation of NO_2 is **[JEE (Main)-2019]**

(1) 1.667×10^{-2} mol L^{-1} min^{-1}

(2) 4.167×10^{-3} mol L^{-1} min^{-1}

(3) 8.333×10^{-3} mol L^{-1} min^{-1}

(4) 2.083×10^{-3} mol L^{-1} min^{-1}

29. 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 for the reverse reaction is : **[JEE (Main)-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) $k_b[N_2][H_2O]^2/[H_2]$

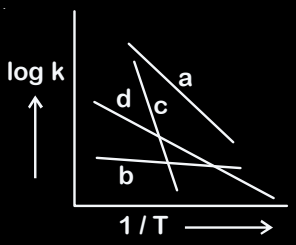
30. The rate of a certain biochemical reaction at physiological temperature (T) occurs 10^6 times faster with enzyme than without. The change in the activation energy upon adding enzyme is

[JEE (Main)-2020]

(1) – 6RT (2) + 6RT

(3) + 6(2.303)RT (4) – 6(2.303)RT

31. 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)-2020]

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

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

32. For following reactions

$A \xrightarrow{700\ K}$ Product

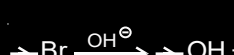
$A \xrightarrow[\text{catalyst}]{500\ K}$ Product

it was found that the E_a is decreased by 30 kJ/ mol in the presence of catalyst. If the rate remains unchanged, the activation energy for catalysed reaction is (Assume pre exponential factor is same) **[JEE (Main)-2020]**

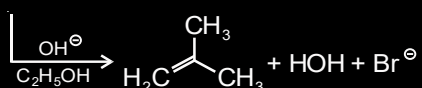
(1) 75 kJ/mol (2) 198 kJ/mol

(3) 105 kJ/mol (4) 135 kJ/mol

33. Consider the reaction sequence given below:



rate = k[t-BuBr] ...(1)



rate = k[t-BuBr][OH⊖] ...(2)

Which of the following statements is true?

[JEE (Main)-2020]

(1) Changing the concentration of base will have no effect on reaction (2)

(2) Changing the concentration of base will have no effect on reaction (1)

(3) Changing the base from $OH^{\ominus}$ to $^{\ominus}OR$ will have no effect on reaction (2)

(4) Doubling the concentration of base will double the rate of both the reactions

34. The results given in the below table were obtained during kinetic studies of the following reaction

$2A + B \rightarrow C + D$

Experiment	[A] / mol L^{-1}	[B] / mol L^{-1}	Initial rate / mol L^{-1} min^{-1}
I	0.1	0.1	6.00×10^{-3}
II	0.1	0.2	2.40×10^{-2}
III	0.2	0.1	1.20×10^{-2}
IV	X	0.2	7.20×10^{-2}
V	0.3	Y	2.88×10^{-1}

X and Y in the given table are respectively

[JEE (Main)-2020]

(1) 0.4, 0.3 (2) 0.3, 0.4

(3) 0.4, 0.4 (4) 0.3, 0.3

35. It is true that **[JEE (Main)-2020]**

(1) A zero order reaction is a single step reaction

(2) A zero order reaction is a multistep reaction

(3) A frist order reaction is always a single step reaction

(4) A second order reaction is always a multistep reaction

36. For the reaction $2A+3B+\frac{3}{2}C \rightarrow 3P$, which statement is correct? **[JEE (Main)-2020]**

(1) $\frac{dn_A}{dt} = \frac{3}{2}\frac{dn_B}{dt} = \frac{3}{4}\frac{dn_C}{dt}$

(2) $\frac{dn_A}{dt} = \frac{dn_B}{dt} = \frac{dn_C}{dt}$

(3) $\frac{dn_A}{dt} = \frac{2}{3}\frac{dn_B}{dt} = \frac{4}{3}\frac{dn_C}{dt}$

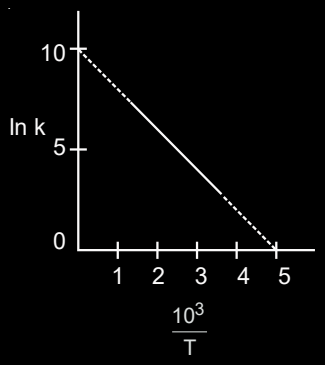
(4) $\frac{dn_A}{dt} = \frac{2}{3}\frac{dn_B}{dt} = \frac{3}{4}\frac{dn_C}{dt}$

37. 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) is : (Use ln 2 = 0.693) **[JEE (Main)-2020]**

(1) 120 (2) 300

(3) 180 (4) 900

38. 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)-2020]

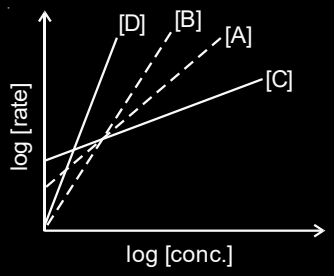
(1) 1/R (2) 2/R

(3) 2R (4) R

39. 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)-2020]**

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

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

40. During the nuclear explosion, one of the products is ^{90}Sr with half life of 6.93 years. If 1 μg of ^{90}Sr was absorbed in the bones of a newly born baby in place of Ca, how much time, in years, is required to reduce it by 90% if it is not lost metabolically _____. **[JEE (Main)-2020]**

41. A sample of milk splits after 60 min. at 300 K and after 40 min. at 400 K when the population of lactobacillus acidophilus in it doubles. The activation energy (in kJ/mol) for this process is closest to _____ . **[JEE (Main)-2020]**

(Given, R = 8.3 J $mol^{-1}K^{-1}$, $\ln\left(\frac{2}{3}\right) = 0.4$, $e^{-3} = 4.0$)

42. If 75% of a first order reaction was completed in 90 minutes, 60% of the same reaction would be completed in approximately (in minutes) _____.

(Take : log 2 = 0.30; log 2.5 = 0.40)

[JEE (Main)-2020]

43. The number of molecules with energy greater than the threshold energy for a reaction increases five fold by a rise of temperature from 27°C to 42°C. Its energy of activation inJ/mol is _____.

(Take In 5 = 1.6094; R = 8.314 J mol^{-1} K^{-1})

[JEE (Main)-2020]

44. The rate of a reaction decreased by 3.555 times when the temperature was changed from 40°C to 30°C. The activation energy (in kJ mol^{-1}) of the reaction is _____. Take; R = 8.314 J mol^{-1} K^{-1} ln 3.555 = 1.268 **[JEE (Main)-2020]**

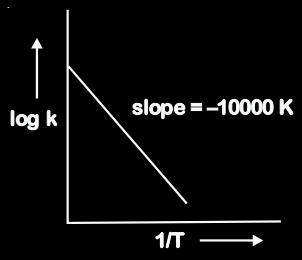
45. Gaseous cyclobutene isomerizes to butadiene in a first order process which has a 'k' value of 3.3 × 10^{-4} s^{-1} at 153°C. The time in minutes it takes for the isomerization to proceed 40% to completion at this temperature is _____. (Rounded off to the nearest integer) **[JEE (Main)-2021]**

46. Sucrose hydrolyses in acid solution into glucose and fructose following first order rate law with a half-life of 3.33 h at 25ºC. 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)

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

[JEE (Main)-2021]

47. For the reaction, aA + bB $\rightarrow$ cC +dD, the plot of log k vs $\frac{1}{T}$ is given below:



The temperature at which the rate constant of the reaction is $10^{-4}s^{-1}$ is _____ K.

(Rounded-off to the nearest integer)

[Given : The rate constant of the reaction is $10^{-5}s^{-1}$ at 500 K.] **[JEE (Main)-2021]**

48. The rate constant of a reaction increases by five times on increase in temperature from 27°C to 52°C. The value of activation energy in kJ mol^{-1} is _____. (Rounded-off to the nearest integer)

[R = 8.314 J K^{-1} mol^{-1}] **[JEE (Main)-2021]**

49. An exothermic reaction X $\rightarrow$ Y has an activation energy 30 kJ mol^{-1}. If energy change ΔE during the reaction is –20 kJ, then the activation energy for the reverse reaction in kJ is _____. (Integer answer) **[JEE (Main)-2021]**

50. 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)

[Use R = 8.31 J K^{-1} mol^{-1}] **[JEE (Main)-2021]**

51. The decomposition of formic acid on gold surface follows first order kinetics. If the rate constant at 300 K is 1.0 × 10^{-3} s^{-1} and the activation energy E_a = 11.488 kJ mol^{-1}, the rate constant at 200 K is _____ × 10^{-5} s^{-1}. (Round off to the Nearest Integer) **[JEE (Main)-2021]**

52. 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)-2021]

53. For a certain first order reaction 32% of the reactant is left after 570 s. The rate constant of this reaction is _____ × 10^{-3} s^{-1}.

(Round off to the Nearest Integer).

[Given $\log_{10}2$ = 0.301, ln10 = 2.303]

[JEE (Main)-2021]

54. The reaction 2A + B_2 $\rightarrow$ 2AB is an elementary reaction. For a certain quantity of reactants. If the volume of the reaction vessel is reduced by a factor of 3, the rate of the reaction increases by a factor of _____. (Round off to the Nearest Integer). **[JEE (Main)-2021]**

55. $2NO(g) + Cl_2(g) \rightleftharpoons 2NOCl(s)$

This reaction was studied at –10°C and the following data was obtained

run	$[NO]_0$	$[Cl_2]_0$	r_0
1	0.10	0.10	0.18
2	0.10	0.20	0.35
3	0.20	0.20	1.40

$[NO]_0$ and $[Cl_2]_0$ are the initial concentrations and r_0 is the initial reaction rate.

The overall order of the reaction is _____.

(Round off to the Nearest Integer).

[JEE (Main)-2021]

56. A first order reaction has a half life of 1 min. The time required for 99.9% completion of the reaction is _____min. (Round off to the Nearest integer).

[Use : ln 2 = 0.69; ln 10 = 2.3]

[JEE (Main)-2021]

57. The inactivation rate of a viral preparation is proportional to the amount of virus. In the first minute after preparation, 10% of the virus is inactivated. The rate constant for viral inactivation is _____ × 10^{-3} min^{-1}. (Nearest integer)

[Use : ln 10 = 2.303; $\log_{10} 3 = 0.477$;

property of logarithm : $\log x^y = y \log x$]

[JEE (Main)-2021]

58. $PCl_5(g) \rightarrow PCl_3(g) + Cl_2(g)$

In the above first order reaction the concentration of PCl_5 reduces from initial concentration 50 mol L^{-1} to 10 mol L^{-1} in 120 minutes at 300 K.The rate constant for the reaction at 300 K is x × 10^{-2} min^{-1}. The value of x is _____.

Given: log5 = 0.6989 **[JEE (Main)-2021]**

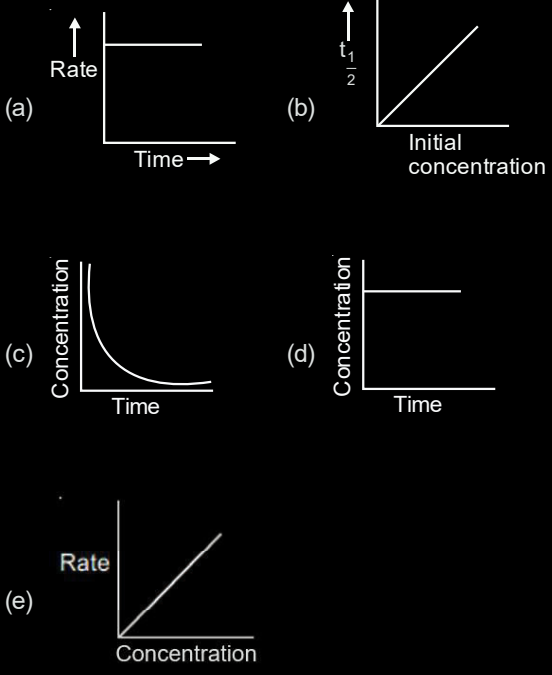
59. $N_2O_{5(g)} \longrightarrow 2NO_{2(g)} + \frac{1}{2}O_{2(g)}$

In the above first order reaction the initial concentration of N_2O_5 is 2.40 × 10^{-2} mol L^{-1} at 318 K. The concentration of N_2O_5 after 1 hour was 1.60 × 10^{-2} mol L^{-1}. The rate constant of the reaction at 318 K is _____ × 10^{-3} min^{-1}. (Nearest integer)

[Given : log 3 = 0.477, log 5 = 0.699]

[JEE (Main)-2021]

60. For the following graphs,



Choose from the options given below, the **correct** one regarding order of reaction is

[JEE (Main)-2021]

(1) (a) and (b) Zero order
(c) and (e) First order

(2) (b) and (d) Zero order
(e) First order

(3) (a) and (b) Zero order
(e) First order

(4) (b) Zero order
(c) and (e) First order

61. For a chemical reaction A ⟶ B, it was found that concentration of B is increased by 0.2 mol L^{-1} in 30 min. The average rate of the reaction is _____ × 10^{-1} mol $L^{-1}h^{-1}$. (in nearest integer)

[JEE (Main)-2021]

62. For a reaction of order n, the unit of the rate constant is :

(1) $mol^{1-n} L^{2n} s^{-1}$ (2) $mol^{1-n} L^{1-n} s^{-1}$

(3) $mol^{1-n} L^{n-1} s^{-1}$ (4) $mol^{1-n} L^{1-n} s$

[JEE (Main)-2021]

63. For the first order reaction $A \rightarrow 2B$, 1 mole of reactant A gives 0.2 moles of B after 100 minutes. The half life of the reaction is _____ min. (Round off to the Nearest Integer).

[Use : In 2 = 0.69, In 10 = 2.3

Properties of logarithms : $\ln x^y = y \ln x$;

$$\ln\left(\frac{x}{y}\right) = \ln x - \ln y]$$

[JEE (Main)-2021]

64. The following data was obtained for chemical reaction given below at 975 K.

$$2NO_{(g)} + 2H_{2(g)} \rightarrow N_{2(g)} + 2H_2O_{(g)}$$

	[NO]	$[H_2]$	Rate
	mol L^{-1}	mol L^{-1}	mol $L^{-1}s^{-1}$
(A)	8×10^{-5}	8×10^{-5}	7×10^{-9}
(B)	24×10^{-5}	8×10^{-5}	2.1×10^{-8}
(C)	24×10^{-5}	32×10^{-5}	8.4×10^{-8}

The order of the reaction with respect to NO is _____. (Integer answer) **[JEE (Main)-2021]**

65. The reaction rate for the reaction

$$[PtCl_4]^{2-} + H_2O \rightleftharpoons [Pt(H_2O)Cl_3]^- + Cl^-$$

was measured as a function of concentrations of different species. It was observed that

$$\frac{-d\left[[PtCl_4]^{2-}\right]}{dt} = 4.8 \times 10^{-5}\left[[PtCl_4]^{2-}\right] - 2.4 \times 10^{-3}\left[[Pt(H_2O)Cl_3]^-\right][Cl^-].$$

where square brackets are used to denote molar concentrations. The equilibrium constant

K_c = _____. (Nearest integer)

[JEE (Main)-2021]

66. The reaction that occurs in a breath analyser, a device used to determine the alcohol level in a person's blood stream is

$$2K_2Cr_2O_7 + 8H_2SO_4 + 3C_2H_6O \rightarrow 2Cr_2(SO_4)_3 + 3C_2H_4O_2 + 2K_2SO_4 + 11H_2O$$

If the rate of appearance of $Cr_2(SO_4)_3$ is 2.67 mol min^{-1} at a particular time, the rate of disappearance of C_2H_6O at the same time is _____ mol min^{-1}. (Nearest integer) **[JEE (Main)-2021]**

67. The first order rate constant for the decomposition of $CaCO_3$ at 700 K is 6.36×10^{-3} s^{-1} and activation energy is 209 kJ mol^{-1}. Its rate constant (in s^{-1}) at 600 K is $x \times 10^{-6}$. The value of x is _____. (Nearest integer)

[Given R = 8.31 J K^{-1} mol^{-1}; log 6.36×10^{-3} = –2.19, $10^{-4.79} = 1.62 \times 10^{-5}$]

[JEE (Main)-2021]

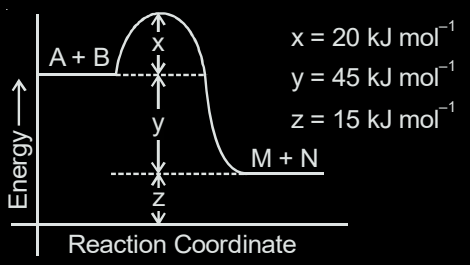
68. For a first order reaction, the ratio of the time for 75% completion of a reaction to the time for 50% completion is _____. (Integer answer)

[JEE (Main)-2021]

69. According to the following figure, the magnitude of the enthalpy change of the reaction

$$A + B \rightarrow M + N \text{ in kJ mol}^{-1}$$

is equal to _____. (Integer answer)



[JEE (Main)-2021]

70. For the reaction $A \rightarrow B$, the rate constant k (in s^{-1}) is given by

$$\log_{10} k = 20.35 - \frac{(2.47 \times 10^3)}{T}$$

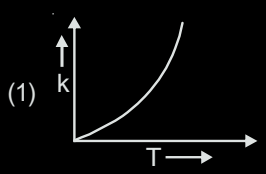
The energy of activation in kJ mol^{-1} is _____. (Nearest integer)

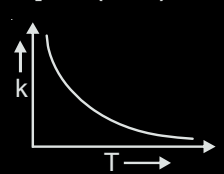
[Given : R = 8.314 JK^{-1} mol^{-1}]

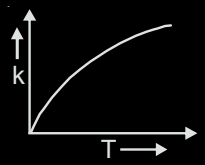
[JEE (Main)-2021]

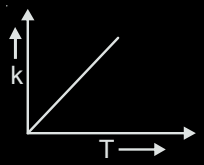
71. Which one of the following given graphs represents the variation of rate constant (k) with temperature (T) for an endothermic reaction?

[JEE (Main)-2021]

(1) 

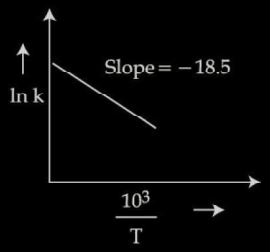
(2) 

(3) 

(4) 

72. The rate constants for decomposition of acetaldehyde have been measured over the temperature range 700 – 1000 K. The data has been analysed by plotting $\ln k$ vs $\frac{10^3}{T}$ graph. The value of activation energy for the reaction is _____ kJ mol^{-1}. (Nearest integer)

(Given : R = 8.31 J K^{-1} mol^{-1})



[JEE (Main)-2022]

73. For a first order reaction, the time required for completion of 90% reaction is 'x' times the half life of the reaction. The value of 'x' is (Given: ln 10 = 2.303 and log 2 = 0.3010) **[JEE (Main)-2022]**

(1) 1.12 (2) 2.43

(3) 3.32 (4) 33.31

74. For a given chemical reaction

$\gamma_1A + \gamma_2B \rightarrow \gamma_3C + \gamma_4D$

Concentration of C changes from 10 mmol dm^{-3} to 20 mmol dm^{-3} in 10 seconds. Rate of appearance of D is 1.5 times the rate of disappearance of B which is twice the rate of disappearance A. The rate of appearance of D has been experimentally determined to be 9 mmol dm^{-3} s^{-1}. Therefore, the rate of reaction is _____ mmol dm^{-3} s^{-1}.

(Nearest Integer)

[JEE (Main)-2022]

75. At 345 K, the half life for the decomposition of a sample of a gaseous compound initially at 55.5 kPa was 340 s. When the pressure was 27.8 kPa, the half life was found to be 170 s. The order of the reaction is _____. [integer answer]

[JEE (Main)-2022]

76. A flask is filled with equal moles of A and B. The half lives of A and B are 100 s and 50 s respectively and are independent of the initial concentration. The time required for the concentration of A to be four times that of B is _____s.

(Given : ln 2 = 0.693) **[JEE (Main)-2022]**

77. Catalyst A reduces the activation energy for a reaction by 10 kJ mol^{-1} at 300 K. The ratio of rate constants, $\frac{K', \text{Catalysed}}{K, \text{Uncatalysed}}$ is e^x. The value of x is _____.[nearest integer]

[Assume that the pre-exponential factor is same in both the cases Given R = 8.31 J K^{-1} mol^{-1}]

[JEE (Main)-2022]

78. The rate constant for a first order reaction is given by the following equation :

$$\ln k = 33.24 - \frac{2.0 \times 10^4\ K}{T}$$

The activation energy for the reaction is given by _____ kJ mol^{-1}. (In nearest integer)

(Given : R = 8.3 J K^{-1} mol^{-1}) **[JEE (Main)-2022]**

79. It has been found that for a chemical reaction with rise in temperature by 9 K the rate constant gets doubled. Assuming a reaction to be occurring at 300 K, the value of activation energy is found to be _____kJ mol^{-1}. [nearest integer]

(Given ln10 = 2.3, R = 8.3 J K^{-1} mol^{-1}, log 2 = 0.30)

[JEE (Main)-2022]

80. For a first order reaction $A \rightarrow B$, the rate constant, k = 5.5 × 10^{-14} s^{-1}. The time required for 67% completion of reaction is x × 10^{-1} times the half life of reaction. The value of x is _____ (Nearest integer)

[JEE (Main)-2022]

81. A radioactive element has a half life of 200 days. The percentage of original activity remaining after 83 days is _____. (Nearest integer)

(Given : antilog 0.125 = 1.333,

antilog 0.693 = 4.93) **[JEE (Main)-2022]**

82. The activation energy of one of the reactions in a biochemical process is 532611 J mol^{-1}. When the temperature falls from 310 K to 300 K, the change in rate constant observed is $k_{300} = x \times 10^{-3}\ k_{310}$. The value of x is _____.

[Given: ln10 = 2.3, R = 8.3 $JK^{-1}\ mol^{-1}$]

[JEE (Main)-2022]

83. The equation

$k = (6.5 \times 10^{12} s^{-1}) e^{-26000K/T}$ is followed for the decomposition of compound A. The activation energy for the reaction is _____ kJ mol^{-1}. [nearest integer]

(Given : R = 8.314 J $K^{-1}\ mol^{-1}$]

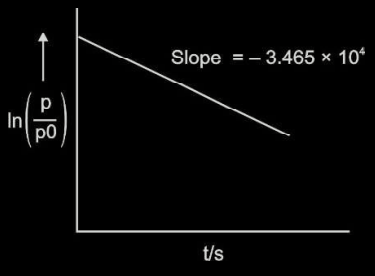
[JEE (Main)-2022]

84. The half-life for the decomposition of gaseous compound A is 240 s when the gaseous pressure was 500 torr initially. When the pressure was 250 torr, the half-life was found to be 4.0 min. The order of the reaction is _____. (Nearest integer)

[JEE (Main)-2022]

85. For the decomposition of azomethane,

$CH_3N_2CH_3(g) \rightarrow CH_3CH_3(g) + N_2(g)$, a first order reaction, the variation in partial pressure with time at 600 K is given as



The half life of the reaction is _____ × 10^{-5}s. [Nearest integer]

[JEE (Main)-2022]

86. For a reaction A → 2B + C the half lives are 100 s and 50 s when the concentration of reactant A is 0.5 and 1.0 mol L^{-1} respectively. The order of the reaction is _____. (Nearest integer)

[JEE (Main)-2022]

87. At 30ºC, the half life for the decomposition of AB_2 is 200 s and is independent of the initial concentration of AB_2. The time required for 80% of the AB_2 to decompose is

(Given : log 2 = 0.30, log 3 = 0.48)

[JEE (Main)-2022]

(1) 200 s (2) 323 s

(3) 467 s (4) 532 s

88. $2NO + 2H_2 \rightarrow N_2 + 2H_2O$

The above reaction has been studied at 800°C. The related date are given in the table below

Reaction serial number	Initial Pressure of H_2/kPa	Initial Pressure of NO/kPa	Initial rate $\left(\frac{-dp}{dt}\right)$ /(kPa/s)
1	65.6	40.0	0.135
2	65.6	20.1	0.033
3	38.6	65.6	0.214
4	19.2	65.6	0.106

The order of the reaction with respect to NO is ___.

[JEE (Main)-2022]

89. [A] → [B]

Reactant Product

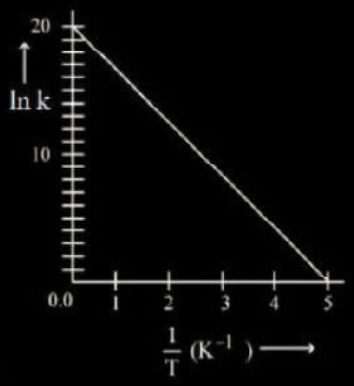
If formation of compound [B] follows the first order of kinetics and after 70 minutes the concentration of [A] was found to be half of its initial concentration. Then the rate constant of the reaction is x × 10^{-6} s^{-1}. The value of x is _____. (Nearest Integer)

[JEE (Main)-2022]

90. For the given first order reaction A → B, the half-life of the reaction is 0.3010 min. The ratio of the initial concentration of reactant to the concentration of reactant at time 2.0 min will be equal to _____. (Nearest integer) **[JEE (Main)-2022]**

91. For a reaction, given below is the graph of ln k vs $\frac{1}{T}$. The activation energy for the reaction is equal to____ cal mol^{-1}. (Nearest integer)

(Given: R = 2 cal K^{-1} mol^{-1})



[JEE (Main)-2022]

92. The reaction between X and Y is first order with respect to X and zero order with respect to Y.

Experiment	[X] / mol L^{-1}	[Y] / mol L^{-1}	Initial rate / mol L^{-1} min^{-1}
I	0.1	0.1	2×10^{-3}
II	L	0.2	4×10^{-3}
III	0.4	0.4	$M\times10^{-3}$
IV	0.1	0.2	2×10^{-3}

Examine the data of table and calculate ratio of numerical values of M and L. (Nearest integer)

[JEE (Main)-2022]

93. Assuming 1μg of trace radioactive element X with a half life of 30 years is absorbed by a growing tree. The amount of X remaining in the tree after 100 years is _____ × 10^{-1} μg.

[Given : ln 10 = 2.303; log 2 = 0.30]

[JEE (Main)-2022]

94. For kinetic study of the reaction of iodide ion with H_2O_2 at room temperature :

(A) Always use freshly prepared starch solution.

(B) Always keep the concentration of sodium thiosulphate solution less than that of KI solution.

(C) Record the time immediately after the appearance of blue colour.

(D) Record the time immediately before the appearance of blue colour.

(E) Always keep the concentration of sodium thiosulphate solution more than that of KI solution.

Choose the **correct** answer from the options given below :

[JEE (Main)-2022]

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

(3) (D), (E) only (4) (A), (B), (E) only

❑ ❑ ❑

Chapter 12

Chemical Kinetics and Nuclear Chemistry

1. Answer (2)

$$t_{1/2} = \frac{\ln 2}{k}$$

$$\Rightarrow \quad k = \frac{2.303 \times 0.301}{6.93}$$

$$\text{Also,} \quad t = \frac{2.303}{k} \log\left(\frac{a}{a - 0.99a}\right)$$

$$\Rightarrow \qquad t = \frac{2.303}{2.303 \times 0.301} \times 6.93 \log\left(\frac{1}{0.01}\right)$$

= 46.05 minutes

2. Answer (1)

Rate depends only on slow step

3. Answer (4)

$$K = \frac{a}{2t_{\frac{1}{2}}} = \frac{2}{2\times 1} = 1$$

$$t = \frac{C_0 - C_t}{K} = \frac{0.5 - 0.25}{1} = 0.25\,h$$

4. Answer (1)

$$k_1 = k_2 e^{E_{a_1}/RT}.$$

$$k_1 = Ae^{-E_{a_1}/RT}, k_2 = Ae^{-E_{a_2}/RT}$$

$$\ln k_1 - \ln k_2 = \frac{-E_{a_1}}{RT} + \frac{2E_{a_1}}{RT}$$

$$\frac{k_1}{k_2} = e^{E_{a_1}/RT}$$

$$k_1 = k_2\, e^{E_{a_1}/RT}$$

5. Answer (1)

6. Answer (1)

$$\log\frac{k_2}{k_1} = \frac{E_a}{2.303R}\left[\frac{1}{T_1} - \frac{1}{T_2}\right]$$

$$\log 2 = \frac{E_a}{2.303\times 8.314}\left[\frac{1}{300} - \frac{1}{310}\right]$$

$$E_a = \frac{0.301\times 2.303\times 8.314\times 300\times 310}{10}$$

$$\simeq 53600\,J\,mol^{-1} \text{ or } 53.6\,kJ\,mol^{-1}$$

7. Answer (4)

$$2A + B \longrightarrow C + D$$

$$\text{Rate of Reaction} = \frac{-1}{2}\frac{d[A]}{dt} = -\frac{d[B]}{dt}$$

$$= \frac{d[C]}{dt} = \frac{d[D]}{dt}$$

Let rate of Reaction = $k[A]^x[B]^y$

Or, $\frac{d[C]}{dt} = k[A]^x[B]^y$

Now from table,

$1.2 \times 10^{-3} = k\,[0.1]^x[0.1]^y$ ...(i)

$1.2 \times 10^{-3} = k\,[0.1]^x[0.2]^y$ ...(ii)

$2.4 \times 10^{-3} = k\,[0.2]^x[0.1]^y$ ...(iii)

Dividing equation (i) by (ii)

$$\Rightarrow \qquad \frac{1.2\times 10^{-3}}{1.2\times 10^{-3}} = \frac{k[0.1]^x[0.1]^y}{k[0.1]^x[0.2]^y}$$

$$\Rightarrow \qquad 1 = \left[\frac{1}{2}\right]^y$$

$$\Rightarrow \qquad \boxed{y = 0}$$

Now Dividing equation (i) by (iii)

$$\Rightarrow \qquad \frac{1.2\times 10^{-3}}{2.4\times 10^{-3}} = \frac{k[0.1]^x[0.1]^y}{k[0.2]^x[0.1]^y}$$

$\Rightarrow \quad \left[\frac{1}{2}\right]^1 = \left[\frac{1}{2}\right]^x$

$\Rightarrow \quad \boxed{x = 1}$

Hence $\frac{d[C]}{dt} = k[A]^1[B]^0$.

8. Answer (1)

Higher order greater than 3 for reaction is rare because there is low probability of simultaneous collision of all the reacting species.

9. Answer (1)

Rate = $K[H_2O_2] = \frac{0.693}{25} \times 0.05$

Rate of formation of $H_2O_2 = \frac{1}{2} \times \frac{0.693}{25} \times 0.05$

$= 6.93 \times 10^{-4}$ mol min^{-1}

10. Answer (2)

$k_1 = Ae^{-E_{a_1}/RT}$

$k_2 = Ae^{-E_{a_2}/RT}$

$\frac{k_2}{k_1} = e^{\frac{1}{RT}(E_{a_1} - E_{a_2})}$

$\ln \frac{k_2}{k_1} = \frac{E_{a_1} - E_{a_2}}{RT}$

$= \frac{10 \times 10^3}{8.314 \times 300} \approx 4$

11. Answer (1)

Assume the order of reaction with respect to acetaldehyde is x.

Condition-1 :

Rate = $k[CH_3CHO]^x$

$1 = k[363 \times 0.95]^x$

$1 = k[344.85]^x$ ...(i)

Condition-2 :

$0.5 = k[363 \times 0.67]^x$

$0.5 = k[243.21]^x$ ...(ii)

Divide equation (i) by (ii),

$\frac{1}{0.5} = \left(\frac{344.85}{243.21}\right)^x \quad \Rightarrow \quad 2 = (1.414)^x$

$\Rightarrow$ x = 2

12. Answer (3)

From experiment I and II, it is observed that order of reaction w.r.t. 3 is zero.

From experiment II and III,

$\frac{1.386 \times 10^{-2}}{6.93 \times 10^{-3}} = \left(\frac{0.2}{0.1}\right)^{\alpha}$

$\therefore \quad \alpha = 1$

Rate = $K[A]^1$

$6.93 \times 10^{-3} = K(0.1)$

$K = 6.93 \times 10^{-2}$

For $2A + B \rightarrow$ products

$2\,Kt = \ln \frac{[A]_0}{[A]}$

$t_{1/2} = \frac{0.693}{2K}$

$= \frac{0.693}{6.93 \times 10^{-2} \times 2} = 5$

13. Answer (3)

$r = K[A]^x\,[B]^y$

$\frac{r_2}{r_1} = 2^x.2^y = 8 \Rightarrow x + y = 3$

$\frac{r_3}{r_1} = 2^x = 2 \Rightarrow x = 1$

$\therefore \quad y = 2$

14. Answer (2)

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

So, as E_a increases, K decreases.

and as T increases, K increases.

15. Answer (1)

$C + O_2 \longrightarrow CO_2$ No catalyst

Ostwald process :

$4NH_3 + 5O_2 \xrightarrow{Pt/Rh} 4NO + 6H_2O$

Haber's process

$N_2 + 3H_2 \xrightarrow{Fe} 2NH_3$

16. Answer (2)

$$A_2 \underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}} 2A$$

$$-\frac{1}{2}\frac{d[A]}{dt} = k_{-1}[A]^2 - k_1[A_2]$$

$$\frac{d[A]}{dt} = -2k_{-1}[A]^2 + 2k_1[A_2]$$

$$\Rightarrow \frac{d[A]}{dt} = 2k_1[A_2] - 2k_{-1}[A]^2$$

17. Answer (4)

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

$$\ln k = \ln A - \frac{E_a}{RT}$$

For $\ln k$ versus $\frac{1}{RT}$, slope = –y

$-y = -E_a$

$\Rightarrow E_a = y$

18. Answer (4)

For the reaction $2X \rightarrow B$, follow zeroth order

Rate equation is

$2Kt = [A]_0 - [A]$

For the half-life

$$2Kt = \frac{[A]_0}{2}$$

$$K = \frac{0.2}{2 \times 2 \times 6}$$

$$K = \frac{1}{120}\ M\ hr^{-1}$$

$\therefore$ time required to reach from 0.5 M to 0.2 M

$2Kt = [A]_0 - [A]$

$t = (0.5 - 0.2) \times 60$

$= 18$ hour

19. Answer (3)

Rate constant of decomposition of X = 0.05 μg/year
From unit of rate constant, it is clear that the decomposition follows zero order kinetics.

For zero order kinetics,

$[X] = [X]_0 - kt$

$$\Rightarrow t = \frac{5 - 2.5}{0.05}$$

$$= \frac{2.5}{0.05} = 50 \text{ years}$$

20. Answer (4)

$$\ln K = \ln A - \frac{E_a}{RT}$$

$$\text{Slope} = \frac{E_a}{R} = 4606\ K$$

$$\ln\left(\frac{K_2}{K_1}\right) = \frac{E_a}{R}\left(\frac{T_2 - T_1}{T_1T_2}\right)$$

$$= \frac{4606(100)}{400 \times 500}$$

$= 2.303$

$$\Rightarrow \log\left(\frac{K_2}{K_1}\right) = 1$$

$$\frac{K_2}{K_1} = 10$$

$\Rightarrow K_2 = 10K_1$

$= 10^{-5} \times 10$

$= 10^{-4}\ s^{-1}$

21. Answer (4)

$2A + B \longrightarrow P$

Rate $= k[A]^x [B]^y$

Exp-1, $0.045 = k[0.05]^x [0.05]^y$ …(i)

Exp-2, $0.090 = k[0.1]^x [0.05]^y$ …(ii)

Exp-3, $0.72 = k[0.2]^x [0.1]^y$…(iii)

Divide equation (i) by equation (ii)

$$\frac{0.045}{0.090} = \left(\frac{1}{2}\right)^x \Rightarrow x = 1$$

Divide equation (i) by equation (iii)

$$\frac{0.045}{0.72} = \left(\frac{0.05}{0.1}\right)^y \left(\frac{0.05}{0.2}\right)^1$$

$$\left(\frac{1}{2}\right)^2 = \left(\frac{1}{2}\right)^y \Rightarrow y = 2$$

Rate law $= k[A]^1 [B]^2$.

22. Answer (3)

$$A \xrightarrow{k_1} B \xrightarrow{k_2} C$$

$$\frac{d[B]}{dt} = k_1[A] - k_2[B] = 0$$

$$[B] = \frac{k_1[A]}{k_2}$$

23. Answer (3)

Graph-(i) : In[Reactant] vs time is linear
Hence, 1st order

Graph-(ii) : [Reactant] vs time is linear
Hence, zero order

24. Answer (1)

Activation enthalpy to form C is 5 kJ more than that to form D.

25. Answer (2)

When drug is administered bacterial growth is given by $\frac{dN}{dt} = -5N^2$

$\Rightarrow \frac{N_0}{N_t} = 1 + 5t\,N_0$. Thus $\frac{N_0}{N_t}$ increases linearly with t.

26. Answer (4)

$$\log \frac{K_2}{K_1} = \frac{E_a}{2.303R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$

$$\log \frac{1}{2.5\times10^{-4}} = \frac{E_a}{8.314\times2.303}\left(\frac{1}{600} - \frac{1}{800}\right)$$

$$3.6 = \frac{E_a}{8.314\times2.303}\times\frac{200}{600\times800}$$

E_a = 165.4 kJ/mol
$\approx$ 166 kJ/mol

27. Answer (1)

$xA \rightarrow yB$

$$\therefore \quad \frac{-dA}{xdt} = \frac{1}{y}\frac{dB}{dt}$$

$$\frac{-dA}{dt} = \frac{dB}{dt}\times\frac{x}{y}$$

$$\log\left[\frac{-dA}{dt}\right] = \log\left[\frac{dB}{dt}\right] + \log\left(\frac{x}{y}\right)$$

$$\frac{x}{y} = 2$$

The reaction is of type $2A \rightarrow B$.

28. Answer (1)

$2N_2O_5 \rightarrow 4NO_2 + O_2$

$$\text{rate} = \frac{-1}{2}\frac{d[N_2O_5]}{dt} = \frac{1}{4}\frac{d[NO_2]}{dt} = \frac{d[O_2]}{dt}$$

Since, instant of finding rate of formation of NO_2 is not mentioned, hence

$$\therefore \quad \frac{-\Delta[N_2O_5]}{\Delta t} = -\frac{(2.75-3)}{30} = \frac{0.25}{30}\,M\,min^{-1}$$

$$\therefore \quad \frac{\Delta[NO_2]}{\Delta t} = 2\times\frac{-\Delta[N_2O_5]}{\Delta t}$$

$$= 2\times\frac{0.25}{30}$$

$$= 1.67\times10^{-2}\ M\ min^{-1}$$

29. Answer (4)

$$k_{eq} = \frac{k_f}{k_b} = \frac{[N_2][H_2O]^2}{[H_2]^2[NO]^2}$$

Rearranging

$$k_f[NO]^2[H_2] = \frac{k_b[N_2][H_2O]^2}{[H_2]}$$

on comparing R_f and R_b at equilibrium,

$$R_b = k_b\frac{[N_2][H_2O]^2}{[H_2]}$$

30. Answer (4)

The rate constant of a reaction is given by

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

The rate constant in presence of catalyst is given by

$$k' = Ae^{-E_a'/RT}$$

$$\frac{k'}{k} = e^{-(E_a'-E_a)/RT}$$

$$10^6 = e^{-(E_a'-E_a)/RT}$$

$$\ln 10^6 = -\frac{(E_a'-E_a)}{RT}$$

$$E_a' - E_a = -6(2.303)RT$$

31. Answer (2)

$$\log k = \log A - \frac{E_a}{2.303\,RT}$$

$$\text{Slope} = -\frac{E_a}{2.303\,R}$$

So correct order of activation energies $\Rightarrow E_c > E_a > E_d > E_b$

32. Answer (1)

Rate of reaction at 700 K in the absence of catalyst = Rate of reaction at 500 K in the presence of catalyst

$$(E_a) - (E_a)_c = 30 \text{ kJ/mole}$$

$\because$ Rate is same

$\therefore$ Rate constant will also be same

(Assuming same value of pre exponential factor)

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

$$\Rightarrow \quad \frac{-E_a}{R \times 700} = \frac{-(E_a)_c}{R \times 500}$$

$$\Rightarrow \quad -5E_a = -7(E_a)_c = -7(E_a - 30)$$

$$\Rightarrow \quad 2E_a = 210 \quad \Rightarrow \quad E_a = 105 \text{ kJ/mol}$$

$\therefore$ Activation energy in the presence of catalyst = 105 – 30 = 75 kJ/mol

33. Answer (2)

For reaction 1

rate = K [t-BuBr] ...(1)

for reaction 2

rate = K[t-BuBr][OH^-] ...(2)

Reaction 1 is independent of concentration of OH^- where as reaction 2 is dependent on concentration of OH^-

Hence changing the concentration of base will have no effect on reaction 1

34. Answer (2)

Rate = $k[A]^a [B]^b$

$6 \times 10^{-3} = k(0.1)^a (0.1)^b$ ...(1)

$2.4 \times 10^{-3} = k(0.1)^a (0.2)^b$ ...(2)

$1.2 \times 10^{-3} = k(0.2)^a (0.1)^b$ ...(3)

Solving eq (1), (2) and (3), we get

a = 1, b = 2

$6 \times 10^{-3} = k(0.1)^1 (0.1)^2$ from (1)

k = 6

$7.2 \times 10^{-2} = 6(x)^1 (0.2)^2 \Rightarrow x = 0.3$

$2.88 \times 10^{-2} = 6(0.3)^1 (y)^2 \Rightarrow y = 0.4$

35. Answer (2)

Zero order reaction has complex mechanism. Zero order reaction is a multistep reaction.

36. Answer (3)

$$2A + 3B + \frac{3}{2}C \longrightarrow 3P$$

$$\text{rate} = \frac{1}{2}\frac{dn_A}{dt} = \frac{1}{3}\frac{dn_B}{dt} = \frac{1}{3/2}\frac{dn_C}{dt}$$

$$\frac{dn_A}{dt} = \frac{2}{3}\frac{dn_B}{dt} = \frac{4}{3}\frac{dn_C}{dt}$$

37. Answer (4)

$\because \quad A = A_0 e^{-kt}$ $\qquad k = \dfrac{\ln 2}{t_{1/2}}$

$$\therefore \quad \frac{4B = A_0 e^{-\frac{\ln 2}{300} \times t}}{B = B_0 e^{-\frac{\ln 2}{180} \times t}}$$ [given $A_0 = B_0$, $A = 4B$]

$$4 = e^{\ln 2\left(\frac{1}{180} - \frac{1}{300}\right)t}$$

t = 900 sec.

38. Answer (3)

$$K = Ae^{-\frac{E_a}{RT}}$$

$$\ln K = \ln A - \frac{E_a}{RT}$$

$$\ln K = \ln A - \frac{E_a 10^3}{10^3 RT}$$

$$-\frac{E_a}{10^3 R} = -\frac{10}{5}$$

$$\Rightarrow \quad \frac{E_a}{R} = 2 \times 10^3$$

$\Rightarrow \quad E_a = 2R$ kJ/mol.

39. Answer (1)

Rate = $k[A]^n$

$\log[\text{Rate}] = \log k + n \log [A]$

slope = n [n is order of the reaction]

$\therefore$ Correct sequence for the order of the reaction is

d > b > a > c

40. Answer (23.03)

$$\text{Decay constant } (\lambda) = \frac{\ell n 2}{(\text{half life})} = \frac{0.693}{6.93}$$

$$= 0.1 \text{ yr}^{-1}$$

$$\text{Now } \lambda\ (t_{90\%}) = \ln\left(\frac{100}{10}\right)$$

$t_{90\%} = 10 \ln 10$

$= 10 \times 2.303$

$= 23.03$ yr

41. Answer (3.98)

Using Arrehenius equation

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

Assuming A (pre - exponential factor remains same)

$$\Rightarrow \ln\left(\frac{k_{400}}{k_{300}}\right) = \frac{E_a}{R}\left(\frac{1}{300} - \frac{1}{400}\right)$$

$$\Rightarrow \ln\left(\frac{1}{40} \times \frac{60}{1}\right) = \frac{Ea}{R} \times \frac{100}{300 \times 400}$$

$$\Rightarrow \ln\frac{3}{2} = \frac{Ea}{1200R} = 0.4$$

$\therefore$ Ea = 0.4 × 1200 × 8.3 = 3984 J/mol

Ea = 3.984 kJ/mol

= 3.98 kJ/mol

42. Answer (60)

Time for completion of 75% of a I[st] order reaction = 90 min.

$$\therefore \text{ Half life, } t_{\frac{1}{2}} = \frac{1}{2} \times t_{\frac{3}{4}}$$

$$= \frac{90}{2} = 45 \text{ min}$$

$$\text{Rate constant, } K = \frac{0.693}{45} \text{min}^{-1}$$

Time for completion of 60% of the reaction,

$$t_{60\%} = \frac{2.303}{K} \log \frac{10}{4}$$

$$= \frac{2.303 \times 45}{0.693}[1 - 0.6] \simeq 60$$

43. Answer (84297.48)

$\because$ $k = Ae^{-E_a/RT}$

Assuming A and E_a to be temperature independent.

$$\ln\frac{k_2}{k_1} = \frac{E_a}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$

$$\Rightarrow \ln 5 = \frac{E_a}{R}\left(\frac{1}{300} - \frac{1}{315}\right)$$

$$\Rightarrow E_a = \frac{1.6094 \times 8.314 \times 300 \times 315}{15}$$

= 84297.48 J/mol

44. Answer (100.00)

$$k = Ae^{-\frac{E_a}{RT}}$$

Assuming A and E_a to be independent of temperature

$$\ln\frac{k_2}{k_1} = \frac{E_a}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$

$$\ln 3.555 = \frac{E_a}{8.314}\left(\frac{1}{303} - \frac{1}{313}\right)$$

$$\Rightarrow E_a = \frac{1.268 \times 8.314 \times 303 \times 313}{10}$$

= 99980.7 = 99.98 kJ/mol

45. Answer (26)

For a 1[st] order reaction

$$kt = \ln\frac{a_0}{a_t}$$

$$t_{40\%} = \frac{1}{3.3 \times 10^{-4}} \ln\frac{a_0}{0.6a_0}$$

$$= \frac{10^4}{3.3} \ln\frac{10}{6} \text{ sec}$$

$$= \frac{10^4 \times 0.51}{3.3 \times 60} \text{ min} = 25.8 \text{ min}$$

≈ 26

46. Answer (81)

	Sucrose	+ H_2O $\xrightarrow{H^+}$	Glucose	+ Fructose
t = 0	a		0	0
t = 9 hr	a – x		x	x

$$k = \frac{0.693}{3.33} hr^{-1}$$

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

$$\frac{0.693 \times 9}{3.33 \times 2.303} = \log_{10}\left(\frac{1}{f}\right)$$

$$\log_{10}\left(\frac{1}{f}\right) = 81$$

47. Answer (526)

$$k = Ae^{-E^a/RT}$$

$$\log k = \log A - \frac{E^a}{2.303R} \times \frac{1}{T}$$

From given graph : slope = –10000 = $\frac{-E^a}{2.303R}$

$$\because \log \frac{k_2}{k_1} = \frac{E^a}{2.303R}\left[\frac{1}{T_1} - \frac{1}{T_2}\right]$$

$$\log \frac{10^{-4}}{10^{-5}} = 10000\left[\frac{1}{500} - \frac{1}{T_2}\right]$$

$$\Rightarrow 1 = 20 - \frac{10000}{T_2}$$

$$\Rightarrow T_2 = \frac{10000}{19} = 526.3 \approx 526 \text{ K}$$

48. Answer (52)

$$\log \frac{K_2}{K_1} = \frac{E_a}{2.303\,R}\left[\frac{1}{T_1} - \frac{1}{T_2}\right]$$

$$\log 5 = \frac{E_a}{2.303 \times 8.314}\left[\frac{1}{300} - \frac{1}{325}\right]$$

$$E_a = \frac{0.7 \times 2.303 \times 8.314 \times 300 \times 325}{25} \text{ J mol}^{-1}$$

$$= 52271 \text{ J} = 52.271 \text{ kJ mol}^{-1} \simeq 52$$

49. Answer (50)

$X \rightarrow Y$

$\Delta E = (Ea)_f - (Ea)_b$

$-20 = 30 - (Ea)_b$

$\Rightarrow (Ea)_b = 50$ kJ

50. Answer (14)

Energy of activation, $E_a = 80.9$ kJ mol^{-1}

Temperature of reaction, T = 700 K

Fraction of molecules having enough energy to react $= e^{-E_a/RT} = e^{-x}$

$$\therefore \quad x = \frac{E_a}{RT} = \frac{80900}{8.31 \times 700} = 13.9 \simeq 14$$

51. Answer (10)

$$\log \frac{k_2}{k_1} = \frac{E_a}{2.303R}\left[\frac{1}{T_1} - \frac{1}{T_2}\right]$$

k_1 (at 200 K) = ?

k_2 (at 300 K) = 1×10^{-3} s^{-1}

$$\log \frac{1 \times 10^{-3}}{k_1} = \frac{11.488 \times 10^3}{2.303 \times 8.314}\left[\frac{1}{600}\right] = 1$$

$$\frac{1 \times 10^{-3}}{k_1} = 10$$

$k_1 = 10 \times 10^{-5}$ s^{-1}

52. Answer (108)

Initially : $[A_0] = [B_0] = a$

After time 't' min : [A] = 16 [B]

$[A] = [A_0]\ e^{-k_A t}$

$[B] = [B_0]\ e^{-k_B t}$

$\Rightarrow a.e^{-k_A t} = 16ae^{-k_B t}$

$\Rightarrow e^{-(k_A - k_B)t} = 16$

$\Rightarrow (k_B - k_A)t = \ln 16$

$$\Rightarrow \ln 2\left(\frac{1}{18} - \frac{1}{54}\right)t = 4 \ln 2$$

$$\Rightarrow t = \frac{54 \times 18 \times 4}{36} = 108 \text{ min}$$

53. Answer (2)

$A \longrightarrow$ Products

Rate constant of a first order is given as

$$k = \frac{2.303}{t}\log\frac{[A]_0}{[A]_t}$$

$$= \frac{2.303}{570}\log\frac{100}{32}$$

$= 2 \times 10^{-3}\ s^{-1}$

54. Answer (27)

$2A + B_2 \longrightarrow 2B$

$$\text{rate} \propto [A]^2\ [B_2] \propto (P_A)^2\left(P_{B_2}\right)$$

Now, if volume is reduced by a factor of 3, then P is increased by a factor of 3.

$$\therefore \left(V \propto \frac{1}{P}\right)$$

$$\text{rate}' \propto \left(3P_A\right)^2\left(3P_{B_2}\right)$$

$$\propto 27P_A^2.P_{B_2}$$

Rate increases by 27 times the previous rate.

55. Answer (03)

Rate (r) = $k[NO]^x\ [Cl_2]^y$

From run (2) and (3)

$$\frac{(r_0)_3}{(r_0)_2} = \frac{(0.20)^x(0.20)^y}{(0.10)^x(0.20)^y}$$

$$\Rightarrow \quad 2^x = \frac{1.40}{0.35} = 2^2$$

$\therefore \quad x = 2$

From run (1) and (2)

$$\frac{(r_0)_2}{(r_0)_1} = \frac{(0.10)^x(0.20)^y}{(0.10)^x(0.10)^y}$$

$$\frac{0.35}{0.18} = 2^y$$

$\Rightarrow \quad y \approx 1$

$\therefore \quad r = k[NO]^2\ [Cl_2]^1$

$\therefore$ Overall order of reaction = 2 + 1 = 3

56. Answer (10)

The given reaction to be first order, then

$$\ln(1000) = \frac{\ln 2}{t_{1/2}}t$$

$$t = \frac{1\ln(1000)}{\ln 2}$$

= 10 min

57. Answer (106)

Rate = k [Amount of virus]

$$k = \frac{1}{1\,\text{min}}\ln\frac{1}{0.9} \quad (\because \text{ 10\% of virus is inactivated})$$

$= 2.303\ (1 - 0.954)$

$= 0.1059$

$= 105.9 \times 10^{-3}$

$\approx 106 \times 10^{-3}\ \text{min}^{-1}$ (nearest integer)

58. Answer (1)

$a_0 = 50\ \text{mol}\ L^{-1}$

$a_t = 10\ \text{mol}\ L^{-1}$

$$K = \frac{1}{120} \times 2.303\log\frac{50}{10}$$

$= 0.01341$

$= 1.34 \times 10^{-2}\ \text{min}^{-1}$

$x = 1.34 \approx 1$ (nearest integer)

59. Answer (7)

For the first order reaction

$$Kt = \ln\frac{[R]_0}{[R]}$$

$$K \times 60 = \ln\frac{(2.4 \times 10^{-2})}{(1.6 \times 10^{-2})}$$

$= 2.303 \times (\log 3 - \log 2)$

$= 2.303 \times (0.477 - 0.301)$

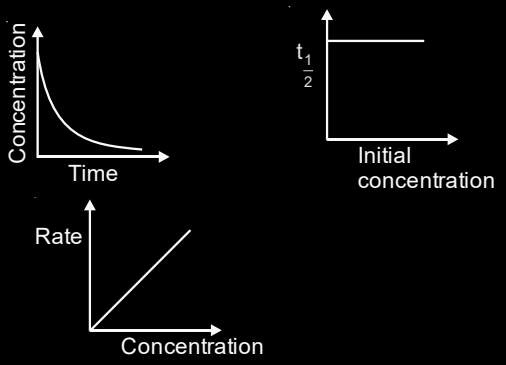
$K = 6.7 \times 10^{-3}\ \text{min}^{-1}$

For 1st order reaction

Rate = k [Reactant]

$[A] = [A]_0 e^{-kt}$

$t_{\frac{1}{2}} = \frac{0.693}{k}$

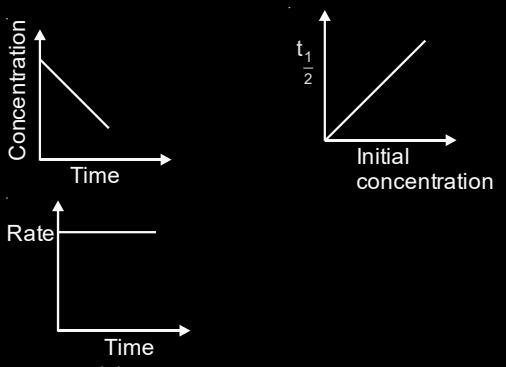


For zero order reaction

Rate = k

$[A] = [A]_0 - kt$

$t_{\frac{1}{2}} = \frac{[A]_0}{2k}$



61. Answer (4)

$A \rightarrow B$

$$\text{Average rate} = \frac{\text{Increase in concentration of B}}{\text{Time}}$$

$$= \frac{0.2\ \text{mol L}^{-1}}{0.5\ \text{hr}}$$

$$= 0.4 = 4 \times 10^{-1}\ \text{mol L}^{-1}\text{h}^{-1}$$

62. Answer (3)

Rate = $k[A]^n$

$$\frac{(\text{mol/L})^1}{\text{s}} = k\ (\text{mol/L})^n$$

$$k = (\text{mol/L})^{1-n}\ \text{s}^{-1}$$

$$= \text{mol}^{1-n}\ \text{L}^{n-1}\ \text{s}^{-1}$$

63. Answer (658)

	A	$\rightarrow$	2B
t = 0	1		0
t = 100 min	1 – x		2x

$2x = 0.2 \Rightarrow x = 0.1$

$$k = \frac{1}{t}\ln\frac{[A]_0}{[A]}$$

$$k = \frac{\ln 2}{t_{\frac{1}{2}}}$$

$$\frac{\ln 2}{t_{\frac{1}{2}}} = \frac{1}{100}\ln\frac{1}{0.9}$$

$$t_{\frac{1}{2}} = \frac{\ln 2 \times 100}{\ln 10 - \ln 9} \approx (600 - 700)\ \text{min}^*$$

(depending on value of log 3)

64. Answer (1)

$2NO_{(g)} + 2H_{2(g)} \rightarrow N_{2(g)} + 2H_2O_{(g)}$

Rate = $k[NO]^x [H_2]^y$

$7 \times 10^{-9} = k(8 \times 10^{-5})^x (8 \times 10^{-5})^y$ ...(i)

$2.1 \times 10^{-8} = k(24 \times 10^{-5})^x (8 \times 10^{-5})^y$ ...(ii)

Now dividing (ii) by (i)

$$\frac{2.1\times10^{-8}}{7\times10^{-9}} = \left(\frac{24\times10^{-5}}{8\times10^{-5}}\right)^x$$

$3 = 3^x$

$\Rightarrow x = 1$

Similarly,

$$\frac{8.4\times10^{-8}}{2.1\times10^{-8}} = \left(\frac{32\times10^{-5}}{8\times10^{-5}}\right)^y$$

$\Rightarrow y = 1$

Order of reaction w.r.t. NO is 1.

65. Answer (0)

$$[PtCl_4]^{2-} + H_2O \underset{K_b}{\overset{K_f}{\rightleftharpoons}} [Pt(H_2O)Cl_3]^- + Cl^-$$

$$\frac{-d[[PtCl_4]^{2-}]}{dt} = K_f\left[[PtCl_4]^{2-}\right] - K_b\left[[Pt(H_2O)Cl_3]^-\right][Cl^-]$$

$$K_C = \frac{K_f}{K_b} = \frac{4.8\times10^{-5}}{2.4\times10^{-3}} = 2\times10^{-2}$$

66. Answer (4)

$2K_2Cr_2O_7 + 8H_2SO_4 + 3C_2H_6O$

$\rightarrow 2Cr_2(SO_4)_3 + 3C_2H_4O_2 + 2K_2SO_4 + 11H_2O$

$$\text{Rate} = -\frac{1}{3}\frac{d[C_2H_6O]}{dt} = \frac{1}{2}\frac{d[Cr_2(SO_4)_3]}{dt}$$

$$\frac{d[Cr_2(SO_4)_3]}{dt} = 2.67 \text{ mol min}^{-1}$$

$$-\frac{d[C_2H_6O]}{dt} = \frac{3}{2}\frac{d[Cr_2(SO_4)_3]}{dt}$$

$$= \frac{3}{2}\times 2.67 = 4 \text{ mol min}^{-1}$$

67. Answer (16)

$k_1 = 6.36 \times 10^{-3}\ s^{-1}$ $T_1 = 700$ k

$E_a = 209$ kJ/mol

$k_2 = x \times 10^{-6}\ s^{-1}$ $T_2 = 600$ k

$$\ln\frac{k_2}{k_1} = \frac{E_a}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$

$$\log\left(\frac{x\times 10^{-6}}{6.36\times 10^{-3}}\right) = \frac{209\times 10^3}{8.31\times 2.303}\left(\frac{1}{700} - \frac{1}{600}\right)$$

$$\log(x\times 10^{-6}) = -4.79$$

$$x\times 10^{-6} = 1.62\times 10^{-5}$$

$$x = 16.2 \simeq 16 \text{ (Nearest integer)}$$

68. Answer (2)

For first order reaction

$t_{75\%} = 2 \times t_{50\%}$

$\because$ $kt = \ln\frac{A_0}{A}$ (for first order reaction)

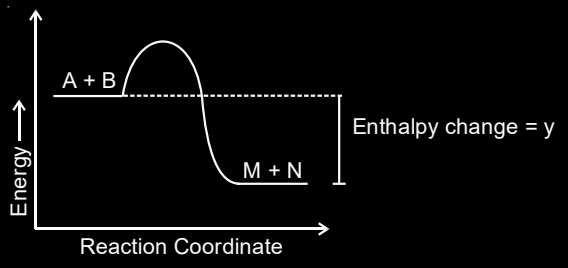
At $t_{50\%} \Rightarrow A = \frac{A_0}{2}$

$\therefore$ $kt_{50\%} = \ln 2$

At $t_{75\%} \Rightarrow A = \frac{A_0}{4}$

$\therefore$ $kt_{75\%} = \ln 4$

69. Answer (45)



y = 45 kJ/mol

70. Answer (47)

$$\log_{10} K = 20.35 - \frac{(2.47\times 10^3)}{T} \quad \text{...(i)}$$

$$\log K = \log A - \frac{E_a}{2.303\ RT} \quad \text{...(ii)}$$

Comparing (i) and (ii),

$$\frac{E_a}{2.303\ RT} = \frac{2.47\times 10^3}{T}$$

$E_a = 2.47 \times 10^3 \times 2.303 \times 8.314$

$= 47293.44$ J mol^{-1}

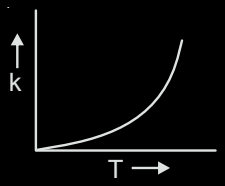
$= 47.2934$ kJ mol^{-1}

71. Answer (1)

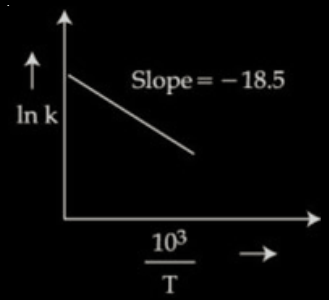
According to Arrhenius equation

$K = A\ e^{-E_a/RT}$

The graph will varies as



72. Answer (154)



$$\ln k = \ln A - \frac{E_a}{RT}$$

$$\therefore \text{ Slope of the graph} = -\frac{E_a}{R\times 10^3} = -18.5$$

$$\therefore \quad E_a = 18.5\times 8.31\times 1000 \simeq 154 \text{ kJ mol}^{-1}$$

73. Answer (3)

$A \rightarrow$ Products

For a first order reaction,

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

Time for 90% conversion,

$$t_{90\%} = \frac{1}{k}\ln\frac{100}{10} = \frac{\ln 10}{k} = \frac{2.303}{k}$$

$$t_{90\%} = \frac{2.303}{0.693}t_{1/2} = 3.32\,t_{1/2}$$

74. Answer (1)

$$\text{Rate} = \frac{1}{r_1}\left(\frac{-d[A]}{dt}\right) = \frac{1}{r_2}\left(\frac{-d[B]}{dt}\right) = \frac{1}{r_3}\left(\frac{-d[C]}{dt}\right) = \frac{1}{r_4}\left(\frac{d[D]}{dt}\right)$$

$$\frac{d[D]}{dt} = \frac{r_4}{r_2}\left(\frac{-d[B]}{dt}\right)$$

$$\frac{r_4}{r_2} = \frac{3}{2}$$

$$\frac{-d[B]}{dt} = \frac{r_2}{r_1}\left(\frac{-d[A]}{dt}\right) \Rightarrow \frac{r_2}{r_1} = 2$$

$r_2 = 2r_1$

$r_4 = 1.5r_2 = 3r_1$

$\frac{d[C]}{dt}$ = 1 m.mol dm^{-3} sec^{-1}

$\frac{d[D]}{dt}$ = 9 m.mol dm^{-3} sec^{-1}

$$\frac{d[D]}{dt} = \frac{r_4}{r_3}\cdot\frac{d[C]}{dt} \Rightarrow \frac{r_4}{r_3} = 9$$

$r_4 = 9r_3 = 3r_1$

$\Rightarrow r_1 = 3r_3$

$3r_3A + 6r_3B \rightarrow r_3C + 9r_3D$

$\therefore$ rate of reaction = $\frac{1}{9}\times 9$ m.mol dm^{-3} sec^{-1}

= 1 m.mol dm^{-3} sec^{-1}

75. Answer (0)

$$t_{1/2} \propto \frac{1}{[P_0]^{n-1}}$$

$$\frac{(t_{1/2})_1}{(t_{1/2})_2} = \frac{[P_0]_2^{n-1}}{[P_0]_1^{n-1}}$$

$$\frac{340}{170} = \left(\frac{27.8}{55.5}\right)^{n-1}$$

$$2 = \left(\frac{1}{2}\right)^{n-1}$$

$2 = (2)^{1-n}$

$1 - n = 1$

$n = 0$

76. Answer (200)

	A	+	B
at initially	1 mole		1 mole
after 100 s	$\frac{1}{2}$		$\frac{1}{4}$
after 200 s	$\frac{1}{4}$		$\frac{1}{16}$

Ans. 200 seconds

77. Answer (4)

$$\ln\frac{K'}{K} = \frac{Ea - Ea'}{RT}$$

$$= \frac{10\times 10^3}{8.314\times 300}$$

$$\ln\frac{K'}{K} = \frac{100}{8.314\times 3}$$

$$\frac{K'}{K} = e^4$$

$x = 4$

78. Answer (166)

$$\ln k = 33.24 - \frac{2\times10^4}{T}$$

$$\therefore \quad \frac{E_a}{R} = 2\times10^4$$

$E_a = 2 \times 10^4 \times 8.3$

$= 166$ kJ/mol

79. Answer (59)

$T_1 = 300$ K

(Rate constant)

$K_2 = 2K_1$, on increase temperature by 9K

$T_2 = 309$ K

Ea = ?

$$\log\frac{K_2}{K_1} = \frac{Ea}{2.3R}\left[\frac{T_2 - T_1}{T_2 \cdot T_1}\right]$$

$$\log 2 = \frac{Ea}{2.3\times8.3}\left[\frac{9}{309\times300}\right]$$

$$Ea = \frac{0.3\times309\times300\times2.3\times8.3}{9}$$

$$= 58988.1 \text{ J/mole}$$

$$\simeq 59 \text{ kJ/mole}$$

80. Answer (16)

$$\because \quad kt = \ln\frac{A_0}{A}$$

$$\frac{\ln 2}{t_{\frac{1}{2}}} t_{67\%} = \ln\frac{A_0}{0.33A_0}$$

$$\frac{\log 2}{t_{\frac{1}{2}}} t_{67\%} = \log\frac{1}{0.33}$$

$t_{67\%} = 1.566\ t_{1/2}$

x = 15.66

Nearest integer = 16

81. Answer (75)

$$\lambda = \frac{2.303}{t}\log\frac{A_0}{A}$$

$$\frac{0.693}{200} = \frac{2.303}{83}\log\frac{A_0}{A}$$

$$\frac{A}{A_0} = 0.75$$

Hence, percentage of original activity remaining after 83 days is 75%

82. Answer (1)

$$\log\left(\frac{K_{310}}{K_{300}}\right) = \frac{532611}{8.3}\left(\frac{1}{300} - \frac{1}{310}\right)$$

$$\frac{K_{310}}{K_{300}} = 10^3 \ \Rightarrow\ K_{300} = 1\times10^{-3}\times K_{310}$$

83. Answer (216)

$$k = A\, e^{\frac{-E_a}{RT}}$$

$$\frac{E_a}{RT} = \frac{26000}{T}$$

$E_a = 26000 \times 8.314$

$= 216164$ J

$= 216$ kJ

84. Answer (1)

$(t_{1/2})_A = 240$ s when P = 500 torr

$(t_{1/2})_A = 4$ min $= 4 \times 60 = 240$ sec when P = 250 torr

If means half-life is independent of concentration of reactant present.

$\therefore$ Order of reaction = 1

85. Answer (2)

For first order reaction,

$\ln A = \ln A_0$ –– kt

Hence Slope = –k

$-k = -3.465 \times 10^4$

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

$$3.465 \times 10^4 = \frac{0.693}{t_{1/2}}$$

$t_{1/2} = 2 \times 10^{-5}$ s

86. Answer (2)

$$t_{½} \propto \frac{1}{(a_0)^{n-1}}$$

$t_{1/2} = 100$ sec $\quad a_0 = 0{\cdot}5$

$t_{1/2} = 50$ sec $\quad a_0 = 1$

$$\frac{100}{50} = \left(\frac{1}{0{\cdot}5}\right)^{n-1}$$

$(2) = (2)^{n-1}$

$n - 1 = 1$

$n = 2$

87. Answer (3)

Since, half life is independent of the initial concentration of AB_2. Hence, reaction is "First Order".

$$k = \frac{2.303 \log 2}{t_{1/2}}$$

$$\frac{2.303 \log 2}{t_{1/2}} = \frac{2.303}{t} \log \frac{100}{(100 - 80)}$$

$$\frac{2.303 \times 0.3}{200} = \frac{2.303}{t} \log 5$$

$t = 467$ s

88. Answer (2)

Let the rate of reaction (r) is as

$r = K[NO]^n[H_2]^m$

From 1st data

$0.135 = K[40]^n \cdot (65.6)^m$ …(1)

From 2nd data

$0.033 = K(20.1)^n \cdot (65.6)^m$…(2)

On dividing equation (1) by equation (2)

$$\frac{0.135}{0.033} = \left(\frac{40}{20.1}\right)^n$$

$4 = (2)^n$

$\therefore$ $n = 2$

$\therefore$ Order of reaction w.r.t. NO is 2.

89. Answer (165)

A $\longrightarrow$ B

Reactant Product

$$k = \frac{0.693}{70 \times 60} = 165 \times 10^{-6}\,s^{-1}$$

$\therefore$ $x = 165$

90. Answer (100)

$$t_{1/2} = \frac{0.693}{K}$$ $\quad t_{1/2}$ given = 0.3010

$$K = \frac{0.693}{0.3010}$$

$K = 2.30$

$$K = \frac{2.303}{t} \log \frac{(A_0)}{(A_t)}$$

$A_0 \rightarrow$ initial concentration of reactant

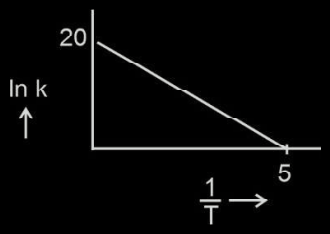
$A_t \rightarrow$ concentration of reactant at time t

$$2.303 = \frac{2.303}{2} \log \frac{(A_0)}{(A_t)}$$

$$2 = \log \frac{(A_0)}{(A_t)}$$

$$100 = \frac{A_0}{A_t}$$

91. Answer (8)



$$\text{Slope} = \frac{-20}{5}$$

$$\ln k = \ln A - \frac{E_a}{RT}$$

$$\therefore \frac{E_a}{R} = \frac{20}{5} \Rightarrow E = \frac{20\,R}{5} = 8 \text{ cal mol}^{-1}$$

92. Answer (40)

Rate $\propto$ $[X]^1[Y]^0$

Rate = k[X]

From Exp I and II,

$$\frac{4\times10^{-3}}{2\times10^{-3}} = \left(\frac{L}{0.1}\right)^1\left(\frac{0.2}{0.1}\right)^0$$

$2 = (10\,L)^1$.

Hence L = 0.2 mol/L

From Exp III and IV,

$$\frac{M\times10^{-3}}{2\times10^{-3}} = \left(\frac{0.4}{0.1}\right)\left(\frac{0.4}{0.2}\right)^0$$

$$\frac{M}{2} = 4$$

M = 8

$$\frac{M}{L} = \frac{8}{0.2} = 40$$

93. Answer (1)

$$kt = \ln\frac{1}{1-X}$$

$$\frac{0.693}{30}(100) = \ln\frac{1}{1-X}$$

$$2.303 = 2.303 \log\frac{1}{1-X} \Rightarrow \frac{1}{1-X} = 10$$

$$\Rightarrow 1 = 10 - 10X$$

$$\Rightarrow X = \frac{9}{10}$$

$$= 0.9\ \mu g$$

Amount of X remaining $= 1 - X$

$= 1 - 0.9 = 0.1\ \mu g$

$= 1 \times 10^{-1}\ \mu g$

94. Answer (1)

To minimize contamination, use freshly prepared starch solution to determine end point. As KI is used in excess to consume all the H_2O_2 the concentration of sodium thiosulphate solution is less than KI solution. After appearance of blue colour record the time immediately.

❑ ❑ ❑

Chapter 13

Surface Chemistry

1. Which of the following statements is incorrect regarding physissorptions? **[AIEEE-2009]**
   (1) More easily liquefiable gases are adsorbed readily
   (2) Under high pressure it results into multi molecular layer on adsorbent surface
   (3) Enthalpy of adsorption ($\Delta H_{adsorption}$) is low and positive
   (4) It occurs because of van der Waal's forces

2. According to Freundlich adsorption isotherm, which of the following is correct? **[AIEEE-2012]**
   (1) $\frac{x}{m} \propto p^1$
   (2) $\frac{x}{m} \propto p^{1/n}$
   (3) $\frac{x}{m} \propto p^0$
   (4) All the above are correct for different ranges of pressure

3. The coagulating power of electrolytes having ions Na^+, Al^{3+} and Ba^{2+} for arsenic sulphide sol increases in the order **[JEE (Main)-2013]**
   (1) $Al^{3+} < Ba^{2+} < Na^+$ (2) $Na^+ < Ba^{2+} < Al^{3+}$
   (3) $Ba^{2+} < Na^+ < Al^{3+}$ (4) $Al^{3+} < Na^+ < Ba^{2+}$

4. 3 g of activated charcoal was added to 50 mL of acetic acid solution (0.06N) in a flask. After an hour it was filtered and the strength of the filtrate was found to be 0.042 N. The amount of acetic acid adsorbed (per gram of charcoal) is **[JEE (Main)-2015]**
   (1) 18 mg
   (2) 36 mg
   (3) 42 mg
   (4) 54 mg

5. For a linear plot of $\log\left(\frac{x}{m}\right)$ 'versus log p in a Freundlich adsorption isotherm, which of the following statements is correct? (k and n are constants) **[JEE (Main)-2016]**
   (1) $\frac{1}{n}$ appears as the intercept
   (2) Only $\frac{1}{n}$ appears as the slope
   (3) $\log\left(\frac{1}{n}\right)$ appears as the intercept
   (4) Both k and $\frac{1}{n}$ appear in the slope term

6. The Tyndall effect is observed only when following conditions are satisfied **[JEE (Main)-2017]**
   (a) The diameter of the dispersed particles is much smaller than the wavelength of the light used.
   (b) The diameter of the dispersed particle is not much smaller than the wavelength of the light used
   (c) The refractive indices of the dispersed phase and dispersion medium are almost similar in magnitude
   (d) The refractive indices of the dispersed phase and dispersion medium differ greatly in magnitude
   (1) (a) and (c) (2) (b) and (c)
   (3) (a) and (d) (4) (b) and (d)

7. Adsorption of a gas follows Freundlich adsorption isotherm. In the given plot, x is the mass of the gas adsorbed on mass m of the adsorbent at pressure p. $\frac{x}{m}$ is proportional to

[JEE (Main)-2019]

(1) p^2 (2) p

(3) $p^{1/4}$ (4) $p^{1/2}$

8. For coagulation of arsenious sulphide sol, which one of the following salt solution will be most effective? **[JEE (Main)-2019]**

(1) Na_3PO_4 (2) $AlCl_3$

(3) NaCl (4) $BaCl_2$

9. Haemoglobin and gold sol are examples of

[JEE (Main)-2019]

(1) Negatively charged sols

(2) Positively charged sols

(3) Positively and negatively charged

(4) Negatively and positively charged sols, respectively

10. An example of solid sol is **[JEE (Main)-2019]**

(1) Butter (2) Hair cream

(3) Paint (4) Gem stones

11. Among the colloids cheese (C), milk (M) and smoke (S), the correct combination of the dispersed phase and dispersion medium, respectively is **[JEE (Main)-2019]**

(1) C : solid in liquid; M : liquid in liquid; S : gas in solid

(2) C : liquid in solid; M : liquid in solid; S : solid in gas

(3) C : liquid in solid; M : liquid in liquid; S : solid in gas

(4) C : solid in liquid; M : solid in liquid; S : solid in gas

12. Given

Gas	H_2	CH_4	CO_2	SO_2
Critical Temperature/K	33	190	304	630

On the basis of data given above, predict which of the following gases shows least adsorption on a definite amount of charcoal? **[JEE (Main)-2019]**

(1) SO_2 (2) CO_2

(3) CH_4 (4) H_2

13. Among the following, the false statement is

[JEE (Main)-2019]

(1) Tyndall effect can be used to distinguish between a colloidal solution and a true solution.

(2) Latex is a colloidal solution of rubber particles which are positively charged

(3) Lyophilic sol can be coagulated by adding an electrolyte.

(4) It is possible to cause artificial rain by throwing electrified sand carrying charge opposite to the one on clouds from an aeroplane.

14. Adsorption of a gas follows Freundlich adsorption isotherm. x is the mass of the gas adsorbed on mass m of the adsorbent. The plot of $\log \frac{x}{m}$ versus log p is shown in the given graph. $\frac{x}{m}$ is proportional to

[JEE (Main)-2019]

(1) $p^{3/2}$ (2) p^3

(3) $p^{2/3}$ (4) p^2

15. The aerosol is a kind of colloid in which

[JEE (Main)-2019]

(1) Solid is dispersed in gas

(2) Gas is dispersed in solid

(3) Liquid is dispersed in water

(4) Gas is dispersed in liquid

16. 10 mL of 1 mM surfactant solution forms a monolayer covering 0.24 cm^2 on a polar substrate. If the polar head is approximated as a cube, what is its edge length? **[JEE (Main)-2019]**

(1) 2.0 pm (2) 2.0 nm

(3) 0.1 nm (4) 1.0 pm

17. The principle of column chromatography is **[JEE (Main)-2019]**

(1) Differential adsorption of the substances on the solid phase.

(2) Gravitational force.

(3) Differential absorption of the substances on the solid phase.

(4) Capillary action.

18. A gas undergoes physical adsorption on a surface and follows the given Freundlich adsorption isotherm equation

$$\frac{x}{m} = kp^{0.5}$$

Adsorption of the gas increases with **[JEE (Main)-2019]**

(1) Increase in p and decrease in T

(2) Decrease in p and decrease in T

(3) Increase in p and increase in T

(4) Decrease in p and increase in T

19. The correct option among the following is : **[JEE (Main)-2019]**

(1) Colloidal medicines are more effective because they have small surface area.

(2) Colloidal particles in lyophobic sols can be precipitated by electrophoresis.

(3) Brownian motion in colloidal solution is faster if the viscosity of the solution is very high.

(4) Addition of alum to water makes it unfit for drinking.

20. Peptization is a : **[JEE (Main)-2019]**

(1) Process of converting a colloidal solution into precipitate

(2) Process of converting precipitate into colloidal solution

(3) Process of converting soluble particles to form colloidal solution

(4) Process of bringing colloidal molecule into solution

21. Among the following, the INCORRECT statement about colloids is **[JEE (Main)-2019]**

(1) They can scatter light.

(2) The range of diameters of colloidal particles is between 1 and 1000 nm.

(3) The osmotic pressure of a colloidal solution is of higher order than the true solution at the same concentration.

(4) They are larger than small molecules and have high molar mass.

22. A chromatography column, packed with silica gel as stationary phase, was used to separate a mixture of compounds consisting of (A) benzanilide (B) aniline and (C) acetophenone. When the column is eluted with a mixture of solvents, hexane : ethyl acetate (20 : 80), the sequence of obtained compounds is **[JEE (Main)-2020]**

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

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

23. As per Hardy-Schulze formulation, the flocculation values of the following for ferric hydroxide sol are in the order **[JEE (Main)-2020]**

(1) $AlCl_3 > K_3[Fe(CN)_6] > K_2CrO_4 > KBr = KNO_3$

(2) $K_3[Fe(CN)_6] < K_2CrO_4 < KBr = KNO_3 = AlCl_3$

(3) $K_3[Fe(CN)_6] > AlCl_3 > K_2CrO_4 > KBr > KNO_3$

(4) $K_3[Fe(CN)_6] < K_2CrO_4 < AlCl_3 < KBr < KNO_3$

24. For the following Assertion and Reason, the correct option is

Assertion : For hydrogenation reactions, the catalytic activity increases from Group 5 to Group 11 metals with maximum activity shown by Group 7-9 elements.

Reason : The reactants are most strongly adsorbed on group 7-9 elements.

[JEE (Main)-2020]

(1) Both assertion and reason are true and the reason is the correct explanation for the assertion.

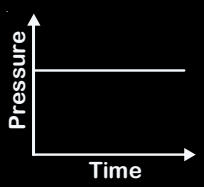
(2) Both assertion and reason are false.

(3) The assertion is true, but the reason is false.

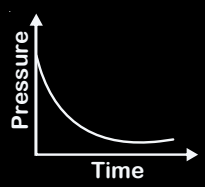
(4) Both assertion and reason are true but the reason is not the correct explanation for the assertion.

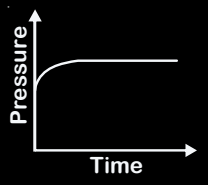
25. A mixture of gases O_2, H_2 and CO are taken in a closed vessel containing charcoal. The graph that represents the correct behaviour of pressure with time is **[JEE (Main)-2020]**

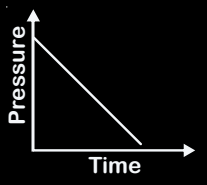
(1)



(2)



(3) 

(4) 

26. Which of the following is used for the preparation of colloids? **[JEE (Main)-2020]**

(1) Van Arkel Method (2) Bredig's Arc Method

(3) Mond Process (4) Ostwald Process

27. Amongst the following statements regarding adsorption, those that are valid are

(a) ΔH becomes less negative as adsorption proceeds

(b) On a given adsorbent, ammonia is adsorbed more than nitrogen gas

(c) On adsorption, the residual force acting along the surface of the adsorbent increases

(d) With increase in temperature, the equilibrium concentration of adsorbate increases

[JEE (Main)-2020]

(1) (c) and (d) (2) (a) and (b)

(3) (d) and (a) (4) (b) and (c)

28. Tyndall effect is observed when **[JEE (Main)-2020]**

(1) The diameter of dispersed particles is much larger than the wavelength of light used

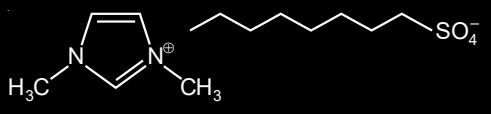
(2) The diameter of dispersed particles is similar to the wavelength of light used

(3) The diameter of dispersed particles is much smaller than the wavelength of light used

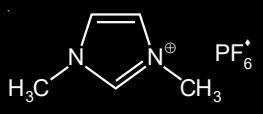
(4) The refractive index of dispersed phase is greater than that of the dispersion medium

29. An ionic micelle is formed on the addition of **[JEE (Main)-2020]**

(1) Excess water to liquid



(2) Excess water to liquid



(3) Sodium stearate to pure toluene

(4) Liquid diethyl ether to aqueous NaCl solution

30. Match the following **[JEE (Main)-2020]**

(i) Foam	(a) smoke
(ii) Gel	(b) cell fluid
(iii) Aerosol	(c) jellies
(iv) Emulsion	(d) rubber
	(e) froth
	(f) Milk

(1) (i)-(b), (ii)-(c), (iii)-(e), (iv)-(d)

(2) (i)-(d), (ii)-(b), (iii)-(e), (iv)-(f)

(3) (i)-(d), (ii)-(b), (iii)-(a), (iv)-(e)

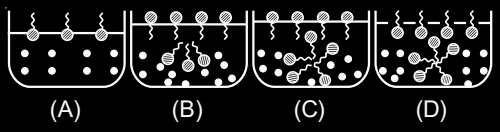
(4) (i)-(e), (ii)-(c), (iii)-(a), (iv)-(f)

31. A sample of red ink (a colloidal suspension) is prepared by mixing eosin dye, egg white, HCHO and water. The component which ensures stability of the ink sample is **[JEE (Main)-2020]**

(1) HCHO (2) Water

(3) Eosin dye (4) Egg white

32. Identify the correct molecular picture showing what happens at the critical micellar concentration (CMC) of an aqueous solution of a surfactant (◍ polar head; 〰 non-polar tail; • water).

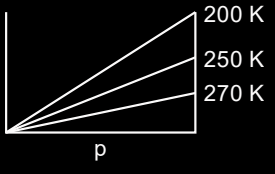


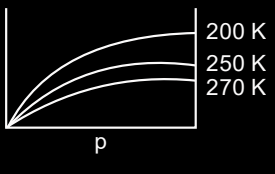
[JEE (Main)-2020]

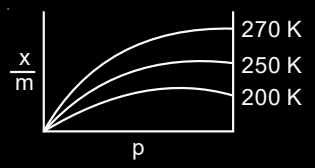
(1) (C) (2) (A)

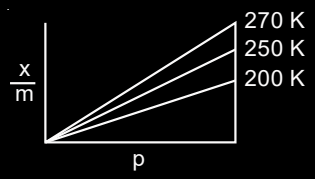
(3) (D) (4) (B)

33. Adsorption of a gas follows Freundlich adsorption isotherm. If x is the mass of the gas adsorbed on mass m of the adsorbent, the correct plot of $\frac{x}{m}$ versus p is **[JEE (Main)-2020]**

(1) 

(2) 

(3) 

(4) 

34. Kraft temperature is the temperature

[JEE (Main)-2020]

(1) below which the aqueous solution of detergents starts freezing.

(2) above which the formation of micelles takes place.

(3) below which the formation of micelles takes place.

(4) above which the aqueous solution of detergents starts boiling.

35. The flocculation value of HCl for arsenic sulphide sol. is 30 m mol L^{-1}. If H_2SO_4 is used for the flocculation of arsenic sulphide, the amount, in grams, of H_2SO_4 in 250 ml required for the above purpose is _____.

(molecular mass of H_2SO_4 = 98 g/mol)

[JEE (Main)-2020]

36. The mass of gas adsorbed, x, per unit mass of absorbate, m, was measured at various pressures, p. A graph between $\log\frac{x}{m}$ and log p gives a straight line with slope equal to 2 and the intercept equal to 0.4771. The value of $\frac{x}{m}$ at a pressure of 4 atm is:

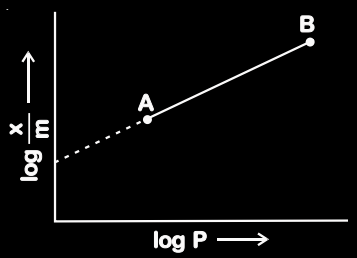
(Given log 3 = 0.4771) **[JEE (Main)-2020]**

37. For Freundlich adsorption isotherm, a plot of log (x/m) (y-axis) and log p (x-axis) gives a straight line. The intercept and slope for the line is 0.4771 and 2, respectively. The mass of gas, adsorbed per gram of adsorbent if the initial pressure is 0.04 atm, is _____ × 10^{-4} g. (log 3 = 0.4771)

[JEE (Main)-2020]

38. In Freundlich adsorption isotherm, slope of AB line is:

[JEE (Main)-2021]



(1) n with (n, 0.1 to 0.5)

(2) $\frac{1}{n}$ with $\left(\frac{1}{n} = 0 \text{ to } 1\right)$

(3) log n with (n > 1)

(4) $\log\frac{1}{n}$ with (n < 1)

39. Most suitable salt which can be used for efficient clotting of blood will be **[JEE (Main)-2021]**

(1) $FeCl_3$ (2) $FeSO_4$

(3) $NaHCO_3$ (4) $Mg(HCO_3)_2$

40. In Freundlich adsorption isotherm at moderate pressure, the extent of adsorption $\left(\frac{x}{m}\right)$ is directly proportional to P^x. The value of x is:

(1) Zero (2) 1

(3) ∞ (4) $\frac{1}{n}$

[JEE (Main)-2021]

41. Which one of the following statements is FALSE for hydrophilic sols ?

(1) Their viscosity is of the order of that of H_2O

(2) They do not require electrolytes for stability

(3) These sols are reversible in nature

(4) The sols cannot be easily coagulated

[JEE (Main)-2021]

42. 3.12 g of oxygen is adsorbed on 1.2 g of platinum metal. The volume of oxygen adsorbed per gram of the adsorbent at 1 atm and 300 K in L is _____.

[R = 0.0821 L atm K^{-1} mol^{-1}]

[JEE (Main)-2021]

43. The nature of charge on resulting colloidal particles when $FeCl_3$ is added to excess of hot water is:

(1) Sometimes positive and sometimes negative

(2) Negative

(3) Neutral

(4) Positive

[JEE (Main)-2021]

44. The **INCORRECT** statements below regarding colloidal solutions is

(1) The flocculating power of Al^{3+} is more than that of Na^+.

(2) A colloidal solution shows Brownian motion of colloidal particles.

(3) An ordinary filter paper can stop the flow of colloidal particles.

(4) A colloidal solution shows colligative properties.

[JEE (Main)-2021]

45. A colloidal system consisting of a gas dispersed in a solid is called a/an

(1) Aerosol (2) Foam

(3) Solid sol (4) Gel

[JEE (Main)-2021]

46. $C_{12}H_{22}O_{11} + H_2O \xrightarrow{\text{Enzyme A}} \underset{\text{Glucose}}{C_6H_{12}O_6} + \underset{\text{Fructose}}{C_6H_{12}O_6}$

$\underset{\text{Glucose}}{C_6H_{12}O_6} \xrightarrow{\text{Enzyme B}} 2C_2H_5OH + 2CO_2$

In the above reactions, the enzyme A and enzyme B respectively are

(1) Amylase and Invertase

(2) Invertase and Zymase

(3) Zymase and Invertase

(4) Invertase and Amylase

[JEE (Main)-2021]

47. For the coagulation of a negative sol, the species below, that has the highest flocculating power is

(1) Ba^{2+} (2) PO_4^{3-}

(3) SO_4^{2-} (4) Na^+

[JEE (Main)-2021]

48. The charges on the colloidal CdS sol and TiO_2 sol are, respectively

(1) Positive and positive

(2) Positive and negative

(3) Negative and positive

(4) Negative and negative

[JEE (Main)-2021]

49. The conditions given below are in the context of observing Tyndall effect in colloidal solutions:

(A) The diameter of the colloidal particles is comparable to the wavelength of light used.

(B) The diameter of the colloidal particles is much smaller than the wavelength of light used.

(C) The diameter of the colloidal particles is much larger than the wavelength of light used.

(D) The refractive indices of the dispersed phase and the dispersion medium are comparable.

(E) The dispersed phase has a very different refractive index from the dispersion medium.

Choose the most appropriate conditions from the options given below. **[JEE (Main)-2021]**

(1) (A) and (D) only (2) (C) and (D) only

(3) (B) and (E) only (4) (A) and (E only

50. 100 ml of 0.0018% (w/v) solution of Cl^- ion was the minimum concentration of Cl^- required to precipitate a negative sol in one h. The coagulating value of Cl^- ion is x, then the value of 2x is _____. (Nearest integer) **[JEE (Main)-2021]**

51. When silver nitrate solution is added to potassium iodide solution then the sol produced is :

[JEE (Main)-2021]

(1) AgI/Ag^+ (2) $AgNO_3/NO_3^-$

(3) KI/NO_3^- (4) AgI/I^-

52. Sodium stearate $CH_3(CH_2)_{16}COO^-Na^+$ is an anionic surfactant which forms micelles in oil. Choose the **correct** statement for it from the following

[JEE (Main)-2021]

(1) It forms non-spherical micelles with $CH_3(CH_2)_{16}$ – group pointing towards the centre

(2) It forms spherical micelles with $CH_3(CH_2)_{16}$ – group pointing outwards on the surface of sphere

(3) It forms non-spherical micelles with $-COO^{\ominus}$ group pointing outwards on the surface

(4) It forms spherical micelles with $CH_3(CH_2)_{16}$ – group pointing towards the centre of sphere

53. Match List-I with List-II :

List-I Example of Colloids	List-II Classification
(a) Cheese	(i) Dispersion of liquid in liquid
(b) Pumice stone	(ii) Dispersion of liquid in gas
(c) Hair cream	(iii) Dispersion of gas in solid
(d) Cloud	(iv) Dispersion of liquid in solid

Choose the most appropriate answer from the options given below : **[JEE (Main)-2021]**

(1) (a) - (iv), (b) - (iii), (c) - (i), (d) - (ii)

(2) (a) - (iv), (b) - (i), (c) - (iii), (d) - (ii)

(3) (a) - (iii), (b) - (iv), (c) - (i), (d) - (ii)

(4) (a) - (iv), (b) - (iii), (c) - (ii), (d) - (i)

54. CO_2 gas adsorbs on charcoal following Freundlich adsorption isotherm. For a given amount of charcoal, the mass of CO_2 adsorbed becomes 64 times when the pressure of CO_2 is doubled. the value of n in the Freundlich isotherm equation is _____ $\times 10^{-2}$. (Round off to the Nearest integer)

[JEE (Main)-2021]

55. Given below are two statements : one is labelled as **Assertion A** and the other is labelled as **Reason R**.

Assertion A : $SO_2(g)$ is adsorbed to a larger extent than $H_2(g)$ on activated charcoal.

Reason R : $SO_2(g)$ has a higher critical temperature than $H_2(g)$.

In the light of the above statements, choose the most appropriate answer from the options given below. **[JEE (Main)-2021]**

(1) **A** is correct but **R** is not correct

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

(3) **A** is not correct but **R** is correct

(4) Both **A** and **R** are correct and **R** is the correct explanation of **A**

56. Which one of the following is correct for the adsorption of a gas at a given temperature on a solid surface? **[JEE (Main)-2021]**

(1) $\Delta H < 0, \Delta S < 0$ (2) $\Delta H > 0, \Delta S < 0$

(3) $\Delta H > 0, \Delta S > 0$ (4) $\Delta H < 0, \Delta S > 0$

57. The sol given below with negatively charged colloidal particles is : **[JEE (Main)-2021]**

(1) KI added to $AgNO_3$ solution

(2) $AgNO_3$ added to KI solution

(3) $Al_2O_3 \cdot xH_2O$ in water

(4) $FeCl_3$ added to hot water

58. Tyndall effect is more effectively shown by : **[JEE (Main)-2021]**

(1) Lyophobic colloid (2) Lyophilic colloid

(3) True solution (4) Suspension

59. Lyophilic sols are more stable than lyophobic sols because, **[JEE (Main)-2021]**

(1) The colloidal particles are solvated

(2) The colloidal particles have positive charge

(3) The colloidal particles have no charge

(4) There is a strong electrostatic repulsion between the negatively charged colloidal particles

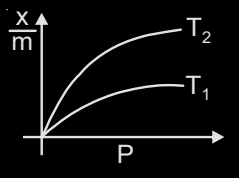
60. Select the graph that correctly describes the adsorption isotherms at two temperatures T_1 and T_2 ($T_1 > T_2$) for a gas :

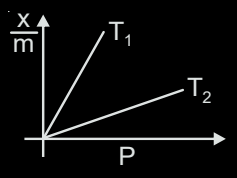
(x – mass of the gas adsorbed

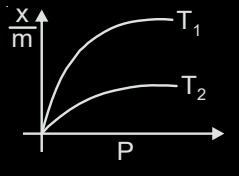
m – mass of adsorbent

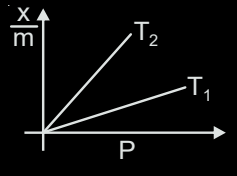
P – pressure)

[JEE (Main)-2021]

(1) 

(2) 

(3) 

(4) 

61. CH_4 is adsorbed on 1 g charcoal at 0ºC following the Freundlich adsorption isotherm. 10.0 mL of CH_4 is adsorbed at 100 mm of Hg, whereas 15.0 mL is adsorbed at 200 mm of Hg. The volume of CH_4 adsorbed at 300 mm of Hg is 10^x mL. The value of x is _____ × 10^{-2}. (Nearest integer)

[Use $\log_{10}2 = 0.3010$, $\log_{10}3 = 0.4771$]

[JEE (Main)-2021]

62. Match List-I with List-II.

List-I (Colloid Preparation Method)	**List-II (Chemical Reaction)**
(a) Hydrolysis	(i) $2AuCl_3 + 3HCHO + 3H_2O \rightarrow 2Au(sol) + 3HCOOH + 6HCl$
(b) Reduction	(ii) $As_2O_3 + 3H_2S \rightarrow As_2S_3(sol) + 3H_2O$
(c) Oxidation	(iii) $SO_2 + 2H_2S \rightarrow 3S(sol) + 2H_2O$
(d) Double Decomposition	(iv) $FeCl_3 + 3H_2O \rightarrow Fe(OH)_3(sol) + 3HCl$

Choose the **most appropriate** answer from the options given below **[JEE (Main)-2021]**

(1) (a)-(iv), (b)-(ii), (c)-(iii), (d)-(i)

(2) (a)-(i), (b)-(ii), (c)-(iv), (d)-(iii)

(3) (a)-(i), (b)-(iii), (c)-(ii), (d)-(iv)

(4) (a)-(iv), (b)-(i), (c)-(iii), (d)-(ii)

63. Given below are two statements:

Statement I : Emulsion of oil in water are unstable and sometimes they separate into two layers on standing.

Statement II : For stabilisation of an emulsion, excess of electrolyte is added.

In the light of the above statements, choose the most appropriate answer from the options given below:

[JEE (Main)-2022]

(1) Both **Statement I** and **Statement II** are correct

(2) Both **Statement I** and **Statement II** are incorrect.

(3) **Statement I** is correct but **Statement II** is incorrect.

(4) **Statement I** is incorrect but **Statement II** is correct.

64. When 200 mL of 0.2 M acetic acid is shaken with 0.6 g of wood charcoal, the final concentration of acetic acid after adsorption is 0.1 M. The mass of acetic acid adsorbed per gram of carbon is _____g. **[JEE (Main)-2022]**

65. **Incorrect** statement for Tyndall effect is :

[JEE (Main)-2022]

(1) The refractive indices of the dispersed phase and the dispersion medium differ greatly in magnitude.

(2) The diameter of the dispersed particles is much smaller than the wavelength of the light used.

(3) During projection of movies in the cinemas hall, Tyndall effect is noticed.

(4) It is used to distinguish a true solution from a colloidal solution.

66. Using very little soap while washing clothes, does not serve the purpose of cleaning of clothes, because:

[JEE (Main)-2022]

(1) soap particles remain floating in water as ions.

(2) the hydrophobic part of soap is not able to take away grease.

(3) the micelles are not formed due to concentration of soap, below its CMC value.

(4) colloidal structure of soap in water is completely distributed.

67. Match List I with List II.

	List I		**List II**
A	Zymase	I	Stomach
B	Diastase	II	Yeast
C	Urease	III	Malt
D	Pepsin	IV	Soyabean

Choose the correct answer from the options given below **[JEE (Main)-2022]**

(1) A-II, B-III, C-I, D-IV

(2) A-II, B-III, C-IV, D-I

(3) A-III, B-II, C-IV, D-I

(4) A-III, B-II, C-I, D-IV

68. 2.0 g of H_2 gas is adsorbed on 2.5 g of platinum powder at 300 K and 1 bar pressure. The volume of the gas adsorbed per gram of the adsorbent is _____ mL.

(Given : R = 0.083 L bar K^{-1} mol^{-1})

[JEE (Main)-2022]

69. Match List I with List II

	List I Enzyme		List II Conversion of
A	Invertase	I	Starch into maltose
B	Zymase	II	Maltose into glucose
C	Diastase	III	Glucose into ethanol
D	Maltase	IV	Cane sugar into glucose

Choose the most appropriate answer from the options given below

[JEE (Main)-2022]

(1) A-III, B-IV, C-II, D-I (2) A-III, B-II, C-I, D-IV

(3) A-IV, B-III, C-I, D-II (4) A-IV, B-II, C-III, D-I

70. Match **List-I** with **List-II**

	List-I		List-II
(A)	Lyophilic colloid	(I)	Liquid-liquid colloid
(B)	Emulsion	(II)	Protective colloid
(C)	Positively charged colloid	(III)	$FeCl_3$ + NaOH
(D)	Negatively charged colloid	(IV)	$FeCl_3$ + hot water

Choose the **correct** answer from the options given below :

[JEE (Main)-2022]

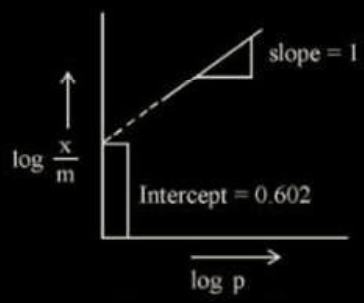
(1) (A)-(II), (B)-(I), (C)-(IV), (D)-(III)

(2) (A)-(III), (B)-(I), (C)-(IV), (D)-(II)

(3) (A)-(II), (B)-(I), (C)-(III), (D)-(IV)

(4) (A)-(III), (B)-(II), (C)-(I), (D)-(IV)

71.



If the initial pressure of a gas 0.03 atm, the mass of the gas absorbed per gram of the adsorbent is ____ × 10^{-2}g.

[JEE (Main)-2022]

72. The Zeta potential is related to which property of colloids?

[JEE (Main)-2022]

(1) Colour

(2) Tyndall effect

(3) Charge on the surface of colloidal particles

(4) Brownian movement

73. Match List-I with List-II :

	List-I		List-II
(A)	Negatively charged sol	(I)	$Fe_2O_3 \cdot xH_2O$
(B)	Macromolecular colloid	(II)	CdS sol
(C)	Positively charged sol	(III)	Starch
(D)	Cheese	(IV)	a gel

Choose the **correct** answer from the options given below:

[JEE (Main)-2022]

(1) (A) – (II), (B) – (III), (C) – (IV), (D) – (I)

(2) (A) – (II), (B) – (I), (C) – (III), (D) – (IV)

(3) (A) – (II), (B) – (III), (C) – (I), (D) – (IV)

(4) (A) – (I), (B) – (III), (C) – (II), (D) – (IV)

74. Which of the following is a **correct** statement?

[JEE (Main)-2022]

(1) Brownian motion destabilises sols.

(2) Any amount of dispersed phase can be added to emulsion without destabilising it.

(3) Mixing two oppositely charged sols in equal amount neutralises charges and stabilises colloids.

(4) Presence of equal and similar charges on colloidal particles provides stability to the colloidal solution.

75. A 42.12% (w, v) solution of NaCl causes precipitation of a certain sol in 10 hours. The coagulating value of NaCl for the sol is

[Given : Molar mass : Na = 23.0 g mol^{-1}; Cl = 35.5 g mol^{-1}]

[JEE (Main)-2022]

(1) 36 mmol L^{-1} (2) 36 mol L^{-1}

(3) 1440 mol L^{-1} (4) 1440 mmol L^{-1}

76. For micelle formation, which of the following statements are correct?

A. Micelle formation is an exothermic process.

B. Micelle formation is an endothermic process.

C. The entropy change is positive

D. The entropy change is negative

[JEE (Main)-2022]

(1) A and D only (2) A and C only

(3) B and C only (4) B and D only

77. Given below are two statements: one is labelled as **Assertion A** and other is labelled as **Reason R**.

Assertion A : Finest gold is red in colour, as the size of the particles increases, it appears purple then blue and finally gold.

Reason R : The colour of the colloidal solution depends on the wavelength of light scattered by the dispersed particles.

In the light of the above statements, choose the ***most appropriate*** answer from the options given below.

[JEE (Main)-2022]

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

(2) Both **A** and **R** are true but **R** is NOT the correct explanation of **A**

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

(4) **A** is false but **R** is true

78. Given below are two statements. One is labelled as **Assertion A** and the other is labelled as **Reason R.**

Assertion A: Activated charcoal adsorbs SO_2 more efficiently than CH_4.

Reason R: Gases with lower critical temperatures are readily adsorbed by activated charcoal.

In the light of the above statements, choose the ***correct*** answer from the options given below.

[JEE (Main)-2022]

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

(2) Both **A** and **R** are correct but **R** is NOT the correct explanation of **A**.

(3) **A** is correct but **R** is not correct.

(4) **A** is not correct but **R** is correct.

79. Given below are two statements : one is labelled as **Assertion (A)** and the other is labelled as **Reason (R) :**

Assertion (A) : Dissolved substances can be removed from a colloidal solution by diffusion through a parchment paper.

Reason (R) : Particles in a true solution cannot pass through parchment paper but the colloidal particles can pass through the parchment paper.

In the light of the above statements, choose the correct answer from the options given below

[JEE (Main)-2022]

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

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

(3) (A) is correct but (R) is not correct

(4) (A) is not correct but (R) is correct

80. Which of the following enhances the lathering property of soap? **[JEE (Main)-2022]**

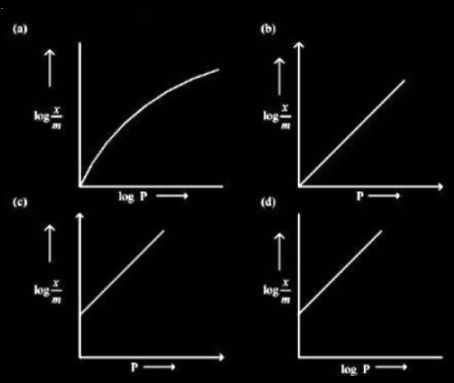
(1) Sodium stearate

(2) Sodium carbonate

(3) Sodium rosinate

(4) Trisodium phosphate

81. Among the following the number of curves not in accordance with Freundlich adsorption isotherm is____.



[JEE (Main)-2022]

82. 100 mL of 5% (w/v) solution of NaCl in water was prepared in 250 mL beaker. Albumin from the egg was poured into NaCl solution and stirred well. This resulted in a/an :

[JEE (Main)-2022]

(1) Lyophilic sol

(2) Lyophobic sol

(3) Emulsion

(4) Precipitate

❑ ❑ ❑