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TARGET: Class 12th CBSE Boards 2024-25

Chemistry (Chemical Kinetics)

BATCH: 12th

DURATION: 1 hr 20 min

MAX. MARKS: 30

Please read the instructions carefully. You are allotted 5 minutes specifically for this purpose

INSTRUCTIONS

Section A – From question 1 to 3 are MCQs and 4 are assertion and reason based of 1 mark each.

Section B – Question no. 5-7 are Very Short Answer Type Questions, carrying 2 marks each.

Answer to each question should not exceed 40 words.

Section C contains Q.8-9 are Short Answer Type Questions, carrying 3 marks each.

Answer to each question should not exceed 60 words

Section D – Questions no 10 are case based questions with three sub questions and are of 4 marks each.

Section-E - Question no. 11-12 are long answer type questions, carrying 5 marks each.

Answer to each question should not exceed 120 words

There is no overall choice in the question paper. However, an internal choice has been provided in few questions. Only one of the choices in such questions have to be attempted.

Section A

1. For the reaction, $A + 2B \rightarrow AB_2$, the order w.r.t. reactant A is 2 and w.r.t. reactant B is zero. What will be change in rate of reaction if the concentration of A is doubled and B is halved?

(A) increases four times

(B) decreases four times

(C) increases two times

(D) no change

Ans. Option (A) is correct.

2. For a zero order reaction, the slope in the plot of [R] vs. time is

(A) $\frac{-k}{2.303}$

(B) -k

(C) $\frac{+k}{2.303}$

(D) +k

Ans. Option (B) is correct.

3. A first order reaction is 50% completed in 1.26×10^{14} s. How much time would it take for 100% completion?

(A) 1.26×10^{15} s

(B) 2.52×10^{14} s

(C) 2.52×10^{28} s

(D) Infinite

Ans. Option (D) is correct.

4. Assertion (A): Hydrolysis of an ester follows first order kinetics.

Reason (R): Concentration of water remains nearly constant during the course of the reaction.

Ans. Both A and R are correct and R is correct explanation of A

Section B

5. The activation energy for the reaction,
 $2\text{HI}(\text{g}) \rightarrow \text{H}_2(\text{g}) + \text{I}_2(\text{g})$ is $209.5 \text{ kJ mol}^{-1}$ at 581K. Calculate the fraction of molecules of reactants having energy equal to or greater than activation energy.
6. What is the effect of adding a catalyst on
(i) Activation energy (E_a), and
(ii) Gibb's energy (ΔG) of a reaction?

Ans. (i) Decreases (ii) No effect

7. The C-14 content of an ancient piece of wood was found to have three tenths of that in living trees. How old is that piece of wood? ($\log 3 = 0.4771$, $\log 7 = 0.8540$, Half-life of C-14 = 5730 years)

Section C

8. The following data were obtained for the reaction:



Experiment	[A]/M	[B]/M	Initial rate of formation of C/M min^{-1}
1	0.2	0.3	4.2×10^{-2}
2	0.1	0.1	6.0×10^{-3}
3	0.4	0.3	1.68×10^{-1}
4	0.1	0.4	2.40×10^{-2}

- (a) Find the order of reaction with respect to A and B.
(b) Write the rate law and overall order of reaction.
(c) Calculate the rate constant (k).
9. Two reactions of the same order have equal pre-exponential factors but their activation energies differ by 24.9 kJ mol^{-1} . Calculate the ratio between the rate constants of these reactions at 27°C . (Gas constant $R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$)

Section D

10. Read the passage given below and answer the following questions: (1 × 4 = 4)
Read the passage given below and answer the following questions: The rate of the reaction is proportional to the concentration of the reactant. Hydrogenation of ethene results in the formation of ethane. The rate constant, k for the reaction was found to be $2.5 \times 10^{-15} \text{ s}^{-1}$. The concentration of the reactant reduces to one-third of the initial concentration in 5 minutes.
The following questions are multiple choice questions. Choose the most appropriate answer:

A. Find the order of reaction:

(A) Zero order

(B) First order

(C) Second order

(D) Fractional order

Ans. Option (B) is correct.

B. The rate law equation is:

(A) Rate = $k [C_2H_6]$

(B) Rate = $k [C_2H_4]^2$

(C) Rate = $k [C_2H_4]$

(D) Rate = $k [C_2H_4]^2$

Ans. Option (C) is correct.

C. The half-life for the reaction is:

(A) 2.772×10^{-24} s

(B) 2.772×10^{-12} s

(C) 1.386×10^{-24} s

(D) 1.386×10^{-12} s

Ans. Option (A) is correct

D. The rate constant of the reaction after 5 minutes is:

(A) 0.4290 min^{-1}

(B) 0.1297 min^{-1}

(C) 0.2197 min^{-1}

(D) 0.6591 min^{-1}

Ans. Option (D) is correct

OR

The slope of the curve in the reaction is:

(A) k

(B) $-k$

(C) $2k$

(D) $-2k$

Section E

11. (a) A first order reaction is 50% completed in 30 minutes at 300 K and in 10 minutes at 320 K.

Calculate activation energy (E_a) for the reaction. ($R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$)

(b) Write the two conditions for collisions to be effective collisions.

(c) How order of reaction and molecularity differ towards a complex reaction?

[Given: $\log 2 = 0.3010$, $\log 3 = 0.4771$, $\log 4 = 0.6021$, $\log 5 = 0.6991$]

Ans. (a) $43.85 \text{ kJ mol}^{-1}$

(b) Two conditions for collisions to be effective collision are:

(i) The reactant molecules must have attained sufficient energy to break chemical bonds

(ii) The reactant molecules must have the proper orientation.

(c) The number of the reacting species that collide simultaneously in a chemical reaction is called as molecularity of a reaction. The sum of the coefficients of the reacting species is the order of reaction. For complex reactions, molecularity has no significance while the order of reaction is applicable.

12. (a) A first order reaction is 25% complete in 40 minutes. Calculate the value of rate constant. In what time will the reaction be 80% completed?

(b) Define order of reaction. Write the condition under which a bimolecular reaction follows first order kinetics.

