	INDIAN SCHOOL AL WADI AL KABIR	
Class: XII	**DEPARTMENT OF SCIENCE:2025– 2026** **SUBJECT: CHEMISTRY**	**Date: 28/10/2025**
Worksheet: 08	**CHAPTER 9: CHEMICAL KINETICS**	**Note:** **A4 FILE FORMAT**
CLASS & SEC:	**NAME OF THE STUDENT:**	**ROLL NO.**

I. MULTIPLE CHOICE QUESTIONS (1M)

1. For the reaction X + 2Y →P, the differential form equation of the rate law is:

(a) $\frac{2d[P]}{dt} = \frac{-d[Y]}{dt}$

(b) $\frac{-d[P]}{dt} = \frac{-d[X]}{dt}$

(c) $\frac{+d[X]}{dt} = \frac{-d[P]}{dt}$

(d) $\frac{-2d[Y]}{dt} = \frac{+d[P]}{dt}$

2. In the Arrhenius equation, when log k is plotted against 1/T, a straight line is obtained whose:

(a) slope is $\frac{A}{R}$ and intercept is E_a.

(b) slope is A and intercept is $\frac{-E_a}{R}$.

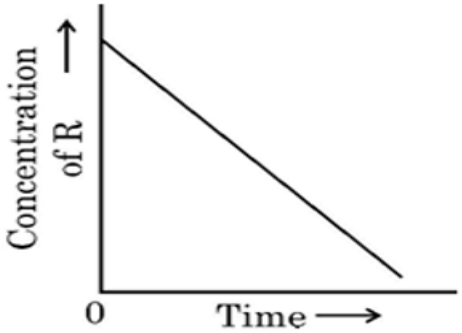
(c) slope is $\frac{-E_a}{RT}$ and intercept is log A.

(d) slope is $\frac{-E_a}{2{\cdot}303\ R}$ and intercept is log A.

3. For the elementary reaction P → Q, the rate of disappearance of 'P' increases by a factor of 8 upon doubling the concentration of 'P', The order of the reaction with respect to 'P' is
(a) 3 (b) 4 (c) 2 (d) 1

4. When a catalyst increases the rate of a chemical reaction, then the rate constant (k):
   (a) remains constant (b) decreases
   (c) increases (d) may increase or decrease depending on the order of the reaction

5. In a given graph of zero-order reaction, the slope and intercept are



   (a) Slope = k, Intercept = $[R]_0$
   (b) Slope = -k, Intercept = $[R]_0$
   (a) Slope = k/2.303, Intercept = $\ln[R]_0$
   (b) Slope = -k/2.303, Intercept = ln A

6. The correct mathematical expression of Arrhenius equation is

   (a) $k = -Ae^{Ea/RT}$ (b) $k = e^{Ea/RT}$

   (c) $k = Ae^{-Ea/RT}$ (d) $k = -Ae^{-Ea/RT}$

7. The role of a catalyst is to change:
   (a) equilibrium constant (b) $\Delta_r G$
   (c) $\Delta_r H$ (d) E_a

8. The half-life for a zero-order reaction equals:

   (a) $\frac{2k}{R}$ (b) $\frac{1}{2}\frac{k}{R^2}$

   (c) $\frac{R^2}{2k}$ (d) $\frac{R}{2k}$

   Where R is the initial concentration.

9. The following experimental rate data were obtained for a reaction carried out 25°C:

   $A_{(g)} + B_{(g)} \rightarrow C_{(g)} + D_{(g)}$

Initial $[A_{(g)}]$/mol dm^{-3}	Initial $[B_{(g)}]$/mol dm^{-3}	Initial rate/mol $dm^{-3}s^{-1}$
3.0×10^{-2}	2.0×10^{-2}	1.89×10^{-4}
3.0×10^{-2}	4.0×10^{-2}	1.89×10^{-4}
6.0×10^{-2}	4.0×10^{-2}	7.56×10^{-4}

What are the orders with respect to A(g) and $B_{(g)}$?

	Order with respect to $A_{(g)}$	Order with respect to $B_{(g)}$
(a)	Zero	Second
(b)	First	Zero
(c)	Second	Zero
(d)	Second	First

10. Given below is the decomposition of hydrogen peroxide in an alkaline medium, which is catalysed by iodide ions:

$$2H_2O_2 \xrightarrow[\text{alkaline medium}]{I^-} 2H_2O + O_2$$

The above reaction takes place in two steps:

$$\text{Step I}: H_2O_2 + I^- \longrightarrow H_2O + IO^- \text{ (slow)}$$

$$\text{Step II}: H_2O_2 + IO^- \longrightarrow H_2O + I^- + O_2$$

Molecularity of Step I and Step II is:

(a) Step I- 2, Step II- 2
(b) Step I- 1, Step II- 2
(c) Step I- 2, Step II- 1
(d) Step I- 3, Step II- 1

ASSERTION REASON TYPE

(a) Both assertion and reason are correct statements, and reason is the correct explanation of the assertion.
(b) Both assertion and reason are correct statements, but reason is not the correct explanation of the assertion.
(c) Assertion is correct, but reason is a wrong statement.
(d) Assertion is wrong, but reason is a correct statement.

11. **Assertion (A):** Order of reaction and molecularity are always the same for complex reactions.
Reason (R): Order is determined experimentally and molecularity is applicable only for elementary reactions.

12. **Assertion (A):** The units of rate constant of a zero order reaction and rate of reaction are the same.
Reason (R): In zero order reaction, the rate of reaction is independent of the concentration of reactants.

13. **Assertion (A):** The enthalpy of reaction remains constant in the presence of a catalyst.
Reason (R): A catalyst participating in the reaction forms different activated complex and lowers

the activation energy, but the difference in energy of reactant and product remains the same.

14. **Assertion (A):** All collisions of reactant molecules lead to product formation.
Reason (R): Only those collisions in which molecules have the correct orientation and sufficient kinetic energy leads to compound formation.

15. **Assertion (A):** Order of a reaction can be zero or fractional.
Reason (R): We cannot determine order from a balanced chemical equation.

II. SHORT ANSWER TYPE (2M)

16. Define molecularity of the reaction. State any one condition in which a bimolecular reaction may be kinetically of first order.

17. A first-order reaction has a rate constant $1.25 \times 10^{-3}\ s^{-1}$. How long will 5g of this reactant take to reduce to 2.5 g? (log 2= 0.301, log 3= 0.4771, log 4= 0.6021)

18. Define the following terms:
(a) Order of a reaction
(b) Activation energy

19. Write any two differences between order of reaction and molecularity of reaction.

20. The rate constant for the first order decomposition of N_2O_5 is given by the following equation:

$$\log k = 23{\cdot}6 - \frac{2\times10^4 K}{T}$$

Calculate E_a for this reaction.
$[R = 8.314\ JK^{-1}mol^{-1}]$

III. SHORT ANSWER TYPE (3M)

21. A chemical reaction

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

in gas phase was carried out in a vessel. The concentration of NO_2 was found to increase by $20 \times 10^{-3}\ molL^{-1}$ in 5 seconds. Calculate
(a) the rate of formation of NO_2
(b) the rate of the reaction
(c) the rate of consumption of N_2O_5

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22. The rate of a reaction doubles when the temperature changes from 27°C to 37°C. Calculate the energy of activation for the reaction.
$(R= 8.314\ JK^{-1}mol^{-1})$
(Given: log 2= 0.3010, log 3= 0.4771, log 4= 0.6021)

23. The following data were obtained during the first order thermal decomposition of C_2H_5Cl at constant

volume:

$C_2H_5Cl\ (g) \rightarrow C_2H_4\ (g) + HCl\ (g)$

Experiment	Time (s^{-1})	Total pressure (atm)
1	0	0.4
2	100	0.6

Calculate the rate constant.
(Given: log 2=0.3010, log 3= 0.4771, log 4= 0.6021)

24. A first-order reaction is 50% complete in 40 minutes. Calculate the time required for the completion of 90% of the reaction.
(Given : log 2 = 0.3010, log 10 = 1)

25. Hydrolysis of sucrose takes place by the chemical reaction:

$$C_{12}H_{22}O_{11} + H_2O\ (excess) \xrightarrow{H^+} C_6H_{12}O_6 + C_6H_{12}O_6$$

Based on the above reaction, write:
(a) Rate law equation
(b) Molecularity and order of reaction
(c) What do you call such reactions?

IV. LONG ANSWER TYPE (5M)

26. (a) What do you understand by the rate law and rate constant of a reaction?
(b) Identify the order of a reaction if the units of its rate constant are:
(i) $L^{-1}mol\ s^{-1}$ (ii) $L\ mol^{-1}\ s^{-1}$

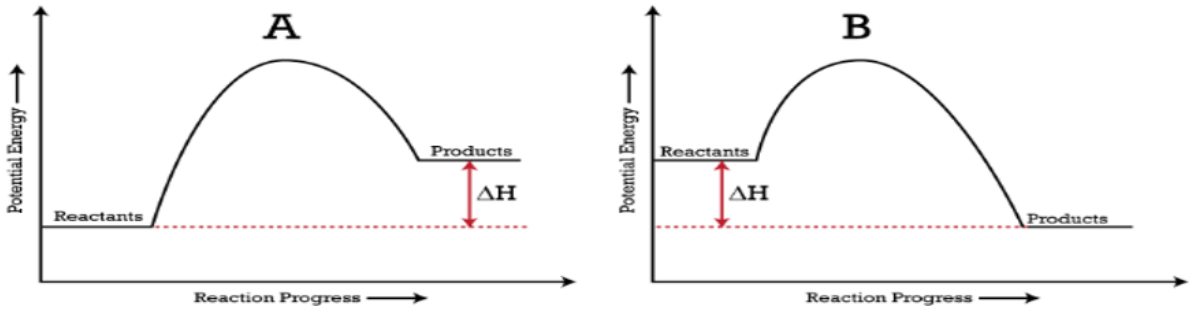
(c) Write the rate law expression for the reaction $2HI \rightarrow H_2 + I_2$, if the order of the reaction is zero.
(d) What is the effect of temperature on the rate of reaction? Write a mathematical expression for the same.

V. PASSAGE BASED QUESTION (4M)

27. Chemical kinetics deals with the rate of chemical reaction, how fast reactants get used up, or how fast products are formed in the reactions. Different chemical reactions have different speeds. The rate of chemical reactions depends on the concentration of reactants, temperature, pressure, especially in gaseous reactions, and the presence of a catalyst. Chemical reactions take place as a result of collisions between reacting molecules. The rate of chemical reactions does not depend on the total number of collisions, but rather on the number of effective collisions. In a redox reaction, if E°cell = +ve, ΔG = -ve, and 'K' equilibrium constant will be high i.e, products formed will be more than reactants.

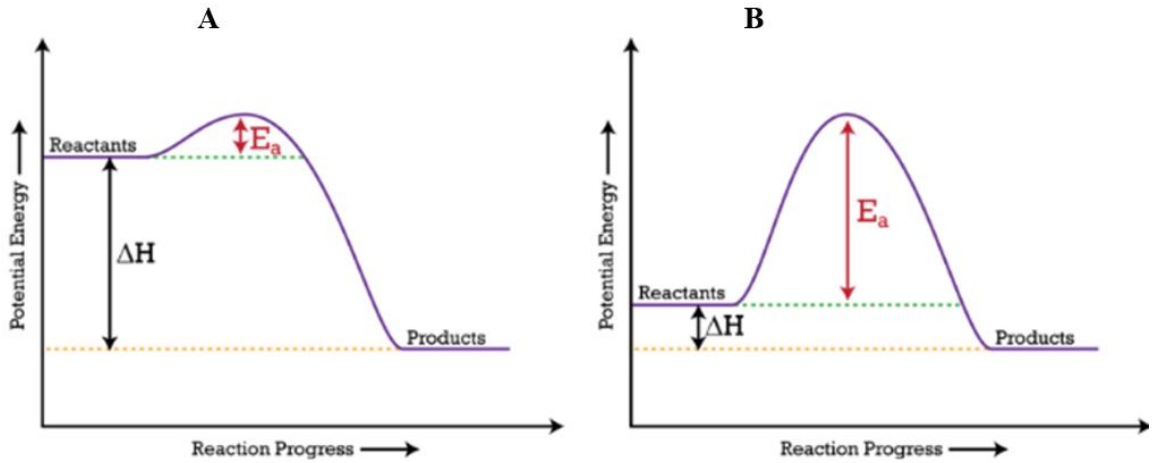
Answer the following questions:
(a) What type of molecules undergo effective collisions?
(b) What does $e^{-Ea/RT}$ represent?

(c) Identify the following as endothermic and exothermic reactions.



OR

(c) Identify the following as slow and fast reactions.



Answer Key

Q. No.	Answer
I.	**MULTIPLE CHOICE QUESTIONS (1M)**
1	(a) $\frac{2d[P]}{dt} = \frac{-d[Y]}{dt}$
2	(d) slope is $\frac{-E_a}{2{\cdot}303\ R}$ and intercept is log A.
3	(a) 3
4	(c) increases
5	(b) Slope = -k, Intercept = $[R]_0$
6	(c) $k = Ae^{-Ea/RT}$
7	(d) E_a
8	(d) $\frac{R}{2k}$
9	(c) Second, zero
10	(a) Step I- 2, Step II- 2

11	(d) Assertion is wrong, but reason is correct statement.
12	(a) Both assertion and reason are correct statements, and reason is the correct explanation of the assertion.
13	(a) Both assertion and reason are correct statements, and reason is the correct explanation of the assertion
14	(d) Assertion is wrong, but reason is correct statement.
15	(b) Both assertion and reason are correct statements, but reason is not the correct explanation of the assertion
II	VERY SHORT ANSWER TYPE QUESTIONS(2M)
16	The number of reacting species (atoms, ions or molecules) taking part in an elementary reaction, which must collide simultaneously in order to bring about a chemical reaction is called molecularity of a reaction. A bimolecular reaction, which involves the collision of two molecules, can be kinetically of first order if one of the reactants is present in a large excess, making the reaction appear dependent on only the concentration of the other reactant.
17	$t = \frac{2.303}{1.25 \times 10^{-3}} \log\left(\frac{5}{2.5}\right)$ t = 554.5 s
18	(a) The order of a reaction is the sum of the exponents to which the concentration terms of the reactants are raised in the rate law expression. It essentially describes how the rate of a chemical reaction change as the concentrations of the reactants change (b) Activation energy is the minimum amount of energy needed to initiate a chemical reaction. It is a barrier that reactants must overcome to transform into products.
19	<table><tr><td></td><td>Order of a reaction</td><td>Molecularity of reaction</td></tr><tr><td>1</td><td>It is the sum of powers raised on the concentration terms in the rate equation.</td><td>It is the number of molecules taking part in the elementary reaction.</td></tr><tr><td>2</td><td>Order is an experimental value derived from the rate expression.</td><td>It is a theoretical concept.</td></tr></table>
20	$\frac{E_a}{2.303RT} = \frac{2 \times 10^4}{T}$ $E_a = 2 \times 10^4 \times 2.303 \times 8.314$ $= 38.3 \times 10^4\ Jmol^{-1}$
III	**SHORT ANSWER TYPE QUESTIONS (3M)**
21	(a) Rate of formation of NO_2 $= \Delta[NO_2]/\Delta t$ $= 20 \times 10^{-3}\ molL^{-1}/5\ s$

	$= 4 \times 10^{-3}$ molL^{-1}s^{-1} (b) Rate of the reaction $= -\frac{1}{2}\frac{\Delta[N_2O_5]}{\Delta t} = \frac{1}{4}\frac{\Delta[NO_2]}{\Delta t} = \frac{\Delta[O_2]}{\Delta t}$ $= \frac{1}{4} \times 4 \times 10^{-3}$ $= 1 \times 10^{-3}$ molL^{-1}s^{-1} (c) Rate of consumption of N_2O_5 $= -\frac{\Delta[N_2O_5]}{\Delta t} = \frac{1}{2}\frac{\Delta[NO_2]}{\Delta t}$ $= \frac{1}{2} \times 4 \times 10^{-3}$ $= 2 \times 10^{-3}$ molL^{-1}s^{-1}
22	$T_1 = 27^\circ C = 300$ K, $k_1 = k$(say). When $T_2 = 37^\circ C = 310$ K, $k_2 = 2k$ Substituting these values in the equation : $\log \frac{k_2}{k_1} = \frac{E_a}{2.303R}\left(\frac{T_2 - T_1}{T_1 T_2}\right)$, we get, $\log \frac{2k}{k} = \frac{E_a}{2.303 \times 8.314} \times \frac{10}{300 \times 310\left(\text{J mol}^{-1}\right)}$ or $\log 2 = \frac{E_a}{2.303 \times 8.314} \times \frac{10}{300 \times 310\left(\text{J mol}^{-1}\right)}$ This on solving gives $E_a = 53598.6$ J mol^{-1} $= 53.6$ kJ mol^{-1}

23	$C_2H_5Cl\ (g) \rightarrow C_2H_4\ (g) + HCl\ (g)$ p_i 0 0 p_i-x x x At 0 sec, $p_t = p_i + 0 + 0$ $0.4 = p_i$ At 100 sec, $p_t = p_i - x + x + x$ $0.6 = p_i + x$ $x = 0.6 - 0.4$ $= 0.2$ $k = \frac{2.303}{100} \log \frac{p_i}{p_i - x}$ $= \frac{2.303}{100} \log \frac{0.4}{0.2}$ $= 6.9 \times 10^{-3}\ s^{-1}$
24	$k = \frac{0.693}{t_{1/2}}$ $= 0.0173\ min^{-1}$ $t = \frac{2.303}{0.0173} \log \frac{100}{10}$ $= 133.1\ min$
25	(a) Rate = $k[C_{12}H_{22}O_{11}]$ (b) Molecularity = 2 Order = 1 (c) Pseudo first-order reaction
IV	**LONG ANSWER TYPE QUESTION**
26	(a) Rate law is the expression in which the reaction rate is given in terms of the molar concentration of reactants with each term raised to some power, which may or may not be the same as the stoichiometric coefficient of the reacting species in a balanced

chemical equation.

The rate constant, often denoted as 'k', is a proportionality constant in chemical kinetics that relates the rate of a chemical reaction to the concentrations of reactants.

(b) (i) Zero order (ii) Second order

(c) Rate = $k[HI]^0$
Rate = k

(d) For a chemical reaction with a rise in temperature by 10°, the rate constant is nearly doubled.

$$k = A\ e^{-Ea/RT}$$

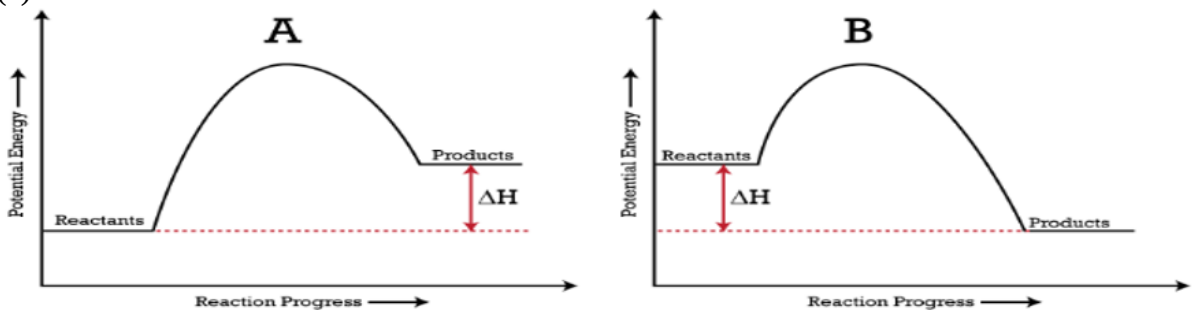
where *A* is the Arrhenius factor or the frequency factor. It is also called the pre-exponential factor. It is a constant specific to a particular reaction. *R* is the gas constant and *E*a is activation energy measured in J mol^{-1}.

V **PASSAGE BASED QUESTION (4M)**

27 (a) The collisions in which molecules collide with sufficient kinetic energy (called threshold energy*) and proper orientation, so as to facilitate breaking of bonds between reacting species and formation of new bonds to form products are called as effective collisions.

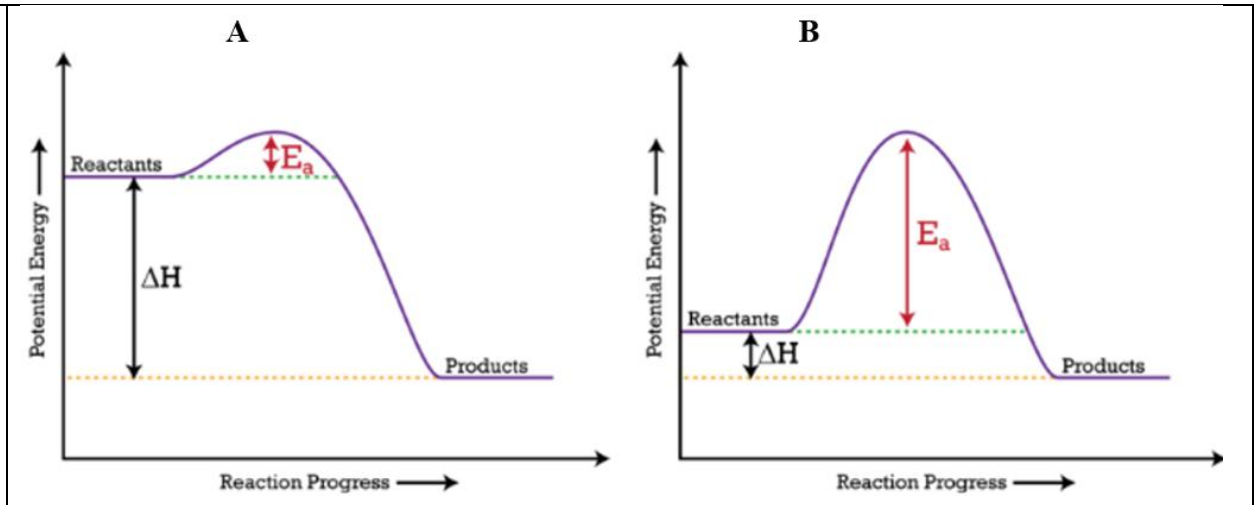
(b) $e^{-Ea/RT}$ represents the fraction of molecules with energies equal to or greater than *E*a.

(c)



A – Endothermic reaction **B**- Exothermic reaction

OR



A- Fast reaction **B-** Slow reaction

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