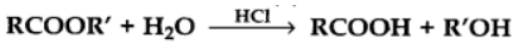
	INDIAN SCHOOL AL WADI AL KABIR	
Class: XII	**DEPARTMENT: SCIENCE (2020-21)** **SUBJECT: CHEMISTRY**	**Date of completion:** **IV week of October 2020**
Worksheet No:09 with answers	**TOPIC: CHEMICAL KINETICS**	**Note:** **A4 FILE FORMAT**
NAME OF THE STUDENT	**CLASS & SEC:**	**ROLL NO.**

I. Multiple Choice Questions:

1. What type of reaction is this?



(a) Second order
(b) Unimolecular
(c) Pseudo-unimolecular
(d) Third order

2. Which among the following is a false statement?
(a) Rate of zero order reaction is independent of initial concentration of reactant.
(b) Half-life of a third order reaction is inversely proportional to square of initial concentration of the reactant.
(c) Molecularity of a reaction may be zero or fraction.
(d) For a first order reaction $t_{1/2} = \frac{0.693}{K}$

3. For the reaction $N_2 + 3H_2 \rightarrow 2NH_3$ if $\frac{\Delta[NH_3]}{\Delta t} = 2 \times 10^{-4}$ mol $L^{-1}s^{-1}$, the value of $\frac{-\Delta[H_2]}{\Delta t}$ would be
(a) 1×10^{-4} mol $L^{-1}s^{-1}$
(b) 3×10^{-4} mol $L^{-1}s^{-1}$
(c) 4×10^{-4} mol $L^{-1}s^{-1}$
(d) 6×10^{-4} mol $L^{-1}s^{-1}$

4. The rate of a certain hypothetical reaction
A + B + C → products
is given by $r = \frac{-d[A]}{dt} = K[A]^{1/2}[B]^{1/3}[C]^{1/4}$. The order of the reaction is
(a) 13/11
(b) 13/14
(c) 12/13
(d) 13/12

5.

In the formation of S02 by contact process;

$2SO_2 + O_2 \rightarrow 2SO_3$, the rate of reaction was measured as $\frac{-d[O_2]}{dt}$ = 2.5 × 10^{-4} mol $L^{-1}s^{-1}$. at

The rate of formation of of S03 will be

(a) -5.0 × 10^{-4} mol $L^{-1}s^{-1}$

(b) -1.25 × 10^{-4} mol $L^{-1}s^{-1}$

(c) 3.75 × 10^{-4} mol $L^{-1}s^{-1}$

(d) 5.00 × 10^{-4} mol $L^{-1}s^{-1}$

6.

For a chemical reaction A→B, it is found that the rate of reaction doubles when the concentration of A is increased four times. The order of reaction is

(a) Two

(b) One

(c) Half

(d) Zero

(WORKING)

ANSWER

$r_1 = k[A]^n$

$r_2 = 2r_1 = k[4A]^n$

$\frac{2r_1}{r_1} = (4)^n$

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

$n = \frac{1}{2}$

7. The half-life of the first order reaction having rate constant K = 1.7 x 10^{-5} s^{-1} is

(a) 12.1 h

(b) 9.7 h

(c) 11.3 h

(d) 1.8 h

8. The decomposition of dimethyl ether is a fractional order reaction. The rate is given by rate =k(pCH_3OCH_3)$^{3/2}$. If the pressure is measured in bar and time in minutes, then what are the units of rate and rate constant?

(a) bar min^{-1}, bar^2 min^{-1}

(b) bar min^{-1}, bar $^{-1/2}$$min^{-1}$

(c) $bar^{1/2}$ min^{-1}, bar^2 min^{-1}

(d) bar min^{-1}, $bar^{1/2}$ min^{-1}

9. A reaction in which reactants (R) are converted into products (P) follows second order kinetics. If concentration of R is increased by four times, what will be the increase in the rate of formation of P?

(a) 9 times

(b) 4 times

(c) 16 times
(d) 8 times

10. The rate of a reaction depends upon
(a) temperature of the reaction
(b) extent of the reaction
(c) the time of completion of reaction
(d) None of these

II. Assertion and Reasoning type questions:

A. If both assertion and reason are true, and the reason is the correct explanation of the assertion.
B. If both assertion and reason are true, and reason is not the correct explanation of the assertion.
C. If assertion is true but reason is false
D. If the assertion and reason both are false
E. If assertion is false but the reason is true.

11. Assertion: Instantaneous rate of reaction is equal to dx / dt.
Reason: It is the rate of reaction at any particular instant of time.
12. Assertion: Molecularity has no meaning for a complex reaction.
Reason: The overall molecularity of a complex reaction is equal to the molecularity of the slowest step.
13. Assertion: If in a zero order reaction, the concentration of the reactant is doubled, the half-life period is also doubled.
Reason: For a zero order reaction, the rate of reaction is independent of initial concentration.
14. Assertion: Half-life period of a reaction of first order is independent of initial concentration.
Reason: Half-life for a first order reaction

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

15. Assertion: The rate of reaction is always negative.
Reason: Minus sign used in expressing the rate shows that concentration of product is decreasing.
16. Assertion: Order of the reaction can be zero or fractional.
Reason: We cannot determine order from balanced chemical equation.

III. Passage Based Questions:

Read the passage given below carefully and answer to the questions that follow:

Chemical kinetics is the study of reaction rates in a chemical reaction. The reaction rate for a reactant or product in a particular reaction tells you how fast a reaction takes place. Catalysis is the increase in rate of a chemical reaction by means of a substance called a catalyst. The order of reaction with respect to a certain reactant is defined, in chemical kinetics, as the power to which its concentration term in the rate

equation is raised. The rate-determining step is a chemistry term for the slowest step in a chemical reaction. An intermediate in a chemical reaction is a molecular entity with a lifetime appreciably longer than a molecular vibration that is formed from the reactants and reacts further to give the products of a chemical reaction. A reaction mechanism is the step by step sequence of elementary reactions by which overall chemical change occurs. The rate law or rate equation for a chemical reaction is an equation which links the reaction rate with concentrations or pressures of reactants and constant parameters.
A reaction step of a chemical reaction is defined as an elementary reaction, constituting one of the stages of a reaction in which a reaction intermediate is converted into the next reaction intermediate in the sequence between reactants and products.

Decomposition of Hydrogen peroxide

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

Mechanism:

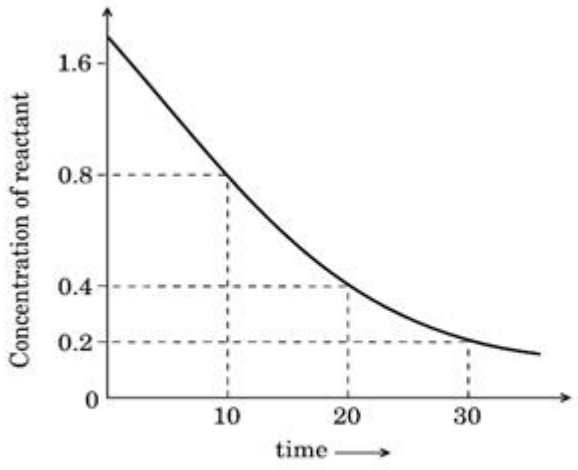
(1) $H_2O_2 + I^- \rightarrow H_2O + IO^-$ (slow)
(2) $H_2O_2 + IO^- \rightarrow H_2O + I^- + O_2$ (fast)

17. Which is the rate determining step?
18. Which acts as the intermediate?
19. Write the rate equation.
20 What is the overall order of the reaction?

IV. Answer the following questions: (Previous Years' Board Based)

21. (2)

Analyse the given graph, drawn between concentration of reactant vs. time.



(a) Predict the order of reaction.

(b) Theoretically, can the concentration of the reactant reduce to zero after infinite time ? Explain.

22. Calculate the time taken of the first order reaction whose concentration of the reactant decomposed by 90% and the rate constant is 60 s^{-1} . (2)

23. (2)

Write units of rate constants for zero order and for the second order reactions if the concentration is expressed in mol L^{-1} and time in second.

24. (2)

For a reaction, $C_2H_4\,(g) + H_2\,(g) \rightarrow C_2H_6\,(g)$, rate = $5{\cdot}5 \times 10^{-14}\,[C_2H_4]$.

(a) Write the unit of rate constant.

(b) Calculate its half-life ($t_{1/2}$).

25. (3)

A first order reaction takes 10 minutes for 25% decomposition. Calculate $t_{1/2}$ for the reaction.

(Given : log 2 = 0·3010, log 3 = 0·4771, log 4 = 0·6021)

26. (3)

For a reaction

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

the proposed mechanism is as given below :

(1) $H_2O_2 + I^- \rightarrow H_2O + IO^-$ (slow)

(2) $H_2O_2 + IO^- \rightarrow H_2O + I^- + O_2$ (fast)

(i) Write rate law for the reaction.

(ii) Write the overall order of reaction.

(iii) Out of steps (1) and (2), which one is rate determining step ?

27. (3)

The decomposition of NH_3 on platinum surface is zero order reaction. If rate constant (k) is 4×10^{-3} Ms^{-1}, how long will it take to reduce the initial concentration of NH_3 from 0.1 M to 0.064 M.

V. Solved Textbook Questions:

28. The conversion of molecules X to Y follows second order kinetics. If concentration of X is increased to three times, how will it affect the rate of formation of Y?

29. A reaction is second order with respect to a reactant. How is the rate of the reaction affection if the concentration of the reactant is (i) double (ii) reduced to half?

30.

In a reaction between A and B, the initial rate of reaction (r_0) was measured for different initial concentrations of A and B as given below:

A/ mol L^{-1}	0.20	0.20	0.40
B/ mol L^{-1}	0.30	0.10	0.05
r_0/ mol L^{-1} s^{-1}	5.07×10^{-5}	5.07×10^{-5}	1.43×10^{-4}

What is the order of the reaction with respect to A and B?

ANSWERS - MCQ			
1	c	6	c
2	c	7	c
3	b	8	b
4	d	9	c
5	d	10	a

ANSWERS – ASSERTION AND REASONING			
11	B	14	A
12	B	15	D
13	B	16	B

17	The slow step	1
18	IO^-	1
19	Rate = $k[H_2O_2][I^-]$	1
20	Second order kinetics	1
21	(a) 1st order (b) No, due to exponential relation / the curve never touches the x-axis.	2
22	$k = \frac{2.303}{t} \log\left[\frac{R_0}{R}\right]$ $t = \frac{2.303}{60\ s^{-1}} \log 10$ **t = 0.0383sec**	2
23	Zero order : mol $L^{-1}s^{-1}$ Second order : L $mol^{-1}s^{-1}$	2

24.	Since its a first order reaction, a) Unit of rate constant is s^{-1} / $time^{-1}$ b) $t_{1/2} = \frac{0.693}{k}$ $= \frac{0.693}{5.5 \times 10^{-14}}$ $= 1.26 \times 10^{13}$ s (or any other unit of time)	2
25	$k = \frac{2.303}{t} \log \frac{[R_0]}{[R]}$ $k = \frac{2.303}{10\ \text{min}} \log \frac{100}{75}$ $k = \frac{2.303 \times 0.125}{10\ \text{min}}$ $k = 0.02879\ \text{min}^{-1}$ $t_{1/2} = \frac{0.693}{k} = \frac{0.693}{0.02879\ min^{-1}}$ $t_{1/2} = 24.07\text{min}$	3
26	i) Rate = k $[H_2O_2]$ $[I^-]$ ii) order = 2 iii) Step 1	3
27	$t = \frac{[R]0 - [R]t}{k}$ $= \frac{[0.1 - 0.064]}{4X\ 10^{-3}}$ = 9 s	3

28	The reaction X → Y follows second order kinetics. Therefore, the rate equation for this reaction will be: Rate = $k[X]^2$ Let [X] = a mol L^{-1}, then can be written as: $Rate_1 = k.(a)^2$ $= ka^2$ If the concentration of X is increased to three times, then [X] = $3a$ mol L^{-1} Now, the rate equation will be: Rate = $k(3a)^2$ $= 9(ka^2)$ Hence, the rate of formation will increase by 9 times.
29.	Consider, The concentration of reactant $[A] = a$ and its order is 2 So, rate of reaction is $K[A]^2$.....[1] Rate $= Ka^2$ i) If the concentration is doubled i.e $[A] = 2a$ Write the values in equation (1) Rate of reaction $R = K[2a]^2 = K4a^2$ Initial rate $= Ka^2$ Final rate $R_1 = K4a^2$ so, $R_1 = 4R$ hence, the rate of reaction increased 4 times ii) If the concentration of the reactant is reduced to half so, the concentration of reactant $[A] = [\frac{1}{2}]a$ Final rate $R_2 = K((\frac{1}{2})a)^2 = (\frac{1}{4})Ka^2$ we know $R = Ka^2$ $R_1 = (\frac{1}{4})R$ Hence rate of reaction reduce to $(\frac{1}{4})$.

30

Let the order of the reaction with respect to A be x and with respect to B be y.

Therefore,

$$r_0 = k[A]^x [B]^y$$

$$5.07\times10^{-5} = k[0.20]^x[0.30]^y \quad \text{(i)}$$

$$5.07\times10^{-5} = k[0.20]^x[0.10]^y \quad \text{(ii)}$$

$$1.43\times10^{-4} = k[0.40]^x[0.05]^y \quad \text{(iii)}$$

Dividing equation (i) by (ii), we obtain

$$\frac{5.07\times10^{-5}}{5.07\times10^{-5}} = \frac{k[0.20]^x[0.30]^y}{k[0.20]^x[0.10]^y}$$

$$\Rightarrow 1 = \frac{[0.30]^y}{[0.10]^y}$$

$$\Rightarrow \left(\frac{0.30}{0.10}\right)^0 = \left(\frac{0.30}{0.10}\right)^y$$

$$\Rightarrow y = 0$$

Dividing equation (iii) by (ii), we obtain

$$\frac{1.43\times10^{-4}}{5.07\times10^{-5}} = \frac{k[0.40]^x[0.05]^y}{k[0.20]^x[0.30]^y}$$

$$\Rightarrow \frac{1.43\times10^{-4}}{5.07\times10^{-5}} = \frac{[0.40]^x}{[0.20]^x} \quad \left[\text{Since } y = 0, [0.05]^y = [0.30]^y = 1\right]$$

$$\Rightarrow 2.821 = 2^x$$

$$\Rightarrow \log 2.821 = x \log 2 \quad \text{(Taking log on both sides)}$$

$$\Rightarrow x = \frac{\log 2.821}{\log 2} = 1.496 = 1.5 \text{ (approximately)}$$

Hence, the order of the reaction with respect to A is 1.5 and with respect to B is zero.

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