INDIAN SCHOOL AL WADI AL KABIR		
CLASS: XII	**DEPARTMENT: SCIENCE (2024-25)** **SUBJECT: CHEMISTRY**	**DATE: 30/10/2024**
WORKSHEET NO: 8 WITH ANSWERS	**TOPIC CHEMICAL KINETICS**	**NOTE: A4 FILE FORMAT**
CLASS & SEC:	**NAME OF THE STUDENT:**	**ROLL NO.**

MULTIPLE CHOICE QUESTIONS

1. Which of these does not influence the rate of the reaction?

   (a) Nature of reactants
   (b) Concentration of reactants
   (c) Temperature of reaction
   (d) Molecularity of the reaction

2. What is the order of reaction whose rate constant has the same unit as the rate of reaction?
   (a) Zero
   (b) First
   (c) Second
   (d) Half

3. Which of the following is altered by a catalyst?
   (a) Entropy
   (b) Enthalpy
   (c) Internal energy
   (d) Activation energy

4. In the reaction $2A + B \rightarrow A_2B$, if the concentration of A is doubled and that of B is halved, then the rate of the reaction will
   (a) increase two times
   (b) increase four times
   (c) decrease two times
   (d) remain the same

5. The average rate and instantaneous rate of a reaction are equal
   (a) at the start of the reaction.
   (b) at the end of the reaction.
   (c) in between the reaction.
   (d) when two rates have a time interval equal to zero.

6. The rate of a reaction increases sixteen times when the concentration of the reactant increases four times. The order of the reaction is (CBSE 2024)
   (a) 2.5
   (b) 2
   (c) 1.5
   (d) 0.5

7. The rate of reaction A+B→Products, is given by the equation r = [A][B]. If B is taken large excess, the order of the reaction would be
   (a) 2
   (b) 0
   (c) 1
   (d) cannot be predicted (CBSE 2023 SET 1)

8. The half-life of a reaction is doubled when the initial concentration is doubled. The order of the reaction is
   (a) 1
   (b) 2
   (c) 4
   (d) 0 (CBSE 2023 SET 3)

9. For a unimolecular reaction,
   (a) the order and molecularity of the slowest step are the same.
   (b) The reaction's molecularity can be zero, one or two.
   (c) The molecularity can be determined experimentally only.
   (d) More than one reacting species is involved in one step.

10. In a chemical reaction, the activation energy is defined as
   (a) the difference between energies of the reactants and the products.
   (b) the sum of the energies of the reactants and products.
   (c) the difference between the average energy of reactants and products and the energy of the intermediate complex
   (d) the difference between the energy of the intermediate complex and the average energy of the reactants.

ASSERTION REASON TYPE

11. **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. (CBSE 2024)
   (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 wrong statement.
   (d) Assertion is wrong, but reason is correct statement.

12. **Assertion(A)**: Order and molecularity of a reaction are always same.
   Reason(R): Complex reactions involve a sequence of elementary reaction and the slowest step is rate determining.
   (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 wrong statement.
(d) Assertion is wrong, but reason is correct statement.

13. **Assertion(A)**: The order of a reaction can be zero.
Reason(R): In the case of heterogeneous catalysis, the reaction becomes independent of concentration at a high concentration of the reaction.
(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 wrong statement.
(d) Assertion is wrong, but reason is correct statement.

14. **Assertion(A)**: Activation complex for the forward reaction will have lower energy than that for the backward reaction in an exothermic reaction.
Reason(R): Reactants have greater energy than products for an exothermic reaction

(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 wrong statement.
(d) Assertion is wrong, but reason is correct statement

15. **Assertion(A)**: For a certain reaction, a large fraction of molecules has energy more than the threshold energy, still the rate of reaction is very slow.
Reason(R): The colliding molecules should be properly oriented for effective collisions.

(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 wrong statement.
(d) Assertion is wrong, but reason is correct statement.

VERY SHORT ANSWER TYPE (2M)

16. A reaction is first order w.r.t reactant A as well as w.r.t reactant B. Give the rate law. Also give one point of difference between average rate and instantaneous rate. (CBSE 2020)

.

17. Show that in case of a first order reaction, the time taken for completion of 99% reaction is twice the time taken for 90% completion of reaction (log 10=1)

18. The following data were obtained for the reaction:
$2NO_2(g) + F_2(g) \rightarrow 2NO_2F(g)$

Experiment no	$[NO_2]$/M	$[F_2]$/M	Initial rate $Mmin^{-1}$
1	0.2	0.05	6×10^{-3}
2	0.4	0.05	1.2×10^{-2}
3	0.8	0.1	4.8×10^{-2}

Determine the overall order of the reaction. (CBSE 2023)

19. Rate constant 'k' of a reaction varies with temperature 'T' according to the equation:

$$\log k = \log A - \frac{E_a}{2.303R}\left(\frac{1}{T}\right)$$

Where E_a is the activation energy. When a graph is plotted for log k vs 1/T, a straight line with a slope of -4250 K is obtained. Calculate Ea for the reaction ($R=8.314\ JK^{-1}mol^{-1}$)

20. A chemical reaction

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

In gas phase was carried out in a closed vessel. The concentration of NO_2 was found to increase by 5×10^{-3} in 10 seconds. Calculate:

(a) the rate of formation of NO_2

(b) the rate of consumption of N_2O_5 (CBSE 2023 Set 1)

SHORT ANSWER TYPE (3M)

21. For a reaction

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

the proposed mechanism is as given below:

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

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

(i) Write the rate law for the reaction

(ii) Write the overall order of the reaction.

(iii) Out of steps (i) and (ii), which one is rate determining determining step? (CBSE 2019)

22. The rate of a reaction doubles when temperature increases from 27°C to 37°C. Calculate 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. For the first order thermal decomposition, following data were obtained.

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

Time /sec	Total pressure/atm
0	0.3
300	0.5

Calculate the rate constant.

(Given log 2= 0.3010, log3=0.4771, log4=0.6021) (CBSE 2015)

24. A first order reaction is 50% completed in 40 min at 300 K and in 20 min at 320 K. Calculate the activation energy of the reaction.

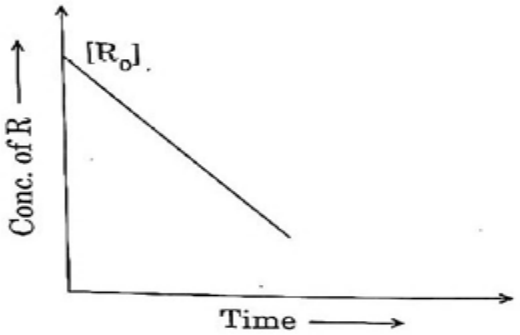
(Given log 2=0.3010, log 4=0.6021, $R=8.314\ JK^{-1}mol^{-1}$) (CBSE 2018)

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

(CBSE 2022)

LONG ANSWER TYPE (5M)

26. **A.** A student plotted a graph between concentration of R and time for a reaction R→P. On the basis of this graph, answer the following questions.



(a) Predict the order of the reaction.
(b) What does the slope of the line indicate?
(c) What are the units of rate constant?

B. A first order reaction takes 25 minutes for 25% decomposition. Calculate $t_{1/2}$.
[Given log 2=0.3010, log 3=0.4771, log 4=0.6021]

27. (a) The rate constant for a first order reaction is $60s^{-1}$. How much time will it take to reduce the intial concentration of the recatant to its $1/16^{th}$ value?
(b) Write two factors that affect the rate of the reaction.
(c) Write two conditions for effective collisions.

PASSAGE BASED QUESTION (4M)

28. Observe the given data showing volume of CO_2 obtained by reaction of $CaCO_3$ and dilute HCl after every minute. Answer the questions that follow.
Table showing volume of CO_2 at one minute interval by reaction of $CaCO_3$ with dilute HCl.

Time/min	Volume of CO_2/cm^3
0	0
1	24
2	34
3	38
4	40
5	40
6	40

(a) Why does $CaCO_3$ powder reacts faster than marble chips?
(b) What happens to rate of reaction if concentrated HCl is used?
(c) Why does the rate of reaction double for 10° increasae in tempearture?

ANSWERS/HINTS

S. No	Answers
1	(d) Molecularity of the reaction
2	(a) Zero
3	(d) Activation energy
4	(a) increase two times
5	(d) when two rates have a time interval equal to zero
6	(b) 2
7	(c) 1
8	(d) 0
9	(a) the order and molecularity of the slowest step are the same
10	(d) the difference between the energy of the intermediate complex and the average energy of the reactants.
11	(a) Both assertion and reason are correct statements, and reason is the correct explanation of the assertion.
12	(d) Assertion is wrong, but reason is correct statement.
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	(a) Both assertion and reason are correct statements, and reason is the correct explanation of the assertion.
16	Rate =k[A][B] The rate of a reaction at a specified or particular point of time is instantaneous rate. It occurs within a short span of time. Average rate is the rate of change of concentration of substances for a definite interval of time. It occurs during a large span of time
17	$t_{99\%} = 2.303/k \log 100/1$ -(1) $t_{90\%} = 2.303/k \log 100/10$ -(2) Divide (2) by (1) $t_{99\%} = 2\ t_{90\%}$
18	Rate = $k[NO_2]^x[F_2]^y$ x = 1 y = 1 Overall order = 2
19	Slope = $-E_a/2.303R$ Slope = - 4250 K Therefore E_a = 81375.3 $Jmol^{-1}$
20	(a) Rate of formation of NO_2 = 1/4 × increase in conc of NO_2/time

	$= 1/4 \times 5\times10^{-3}/10 = 1.25 \times 10^{-4}$ molL^{-1}s^{-1}. (b) Rate of consumption of N_2O_5 Rate of the reaction $= 1.25 \times 10^{-4}$ molL^{-1}s^{-1} $= -1/2\ \Delta[N_2O_5]/\Delta t$ Therefore $\Delta[N_2O_5]/\Delta t = -2.5 \times 10^{-4}$ molL^{-1}s^{-1}
21	i) As step (1) is slow, it is the rate-determining step as it dictates the overall pace of the reaction, hence its Rate = $k[H_2O_2][I^-]$ ii) According to the rate law expressed in (i), Order = 2 iii) Step 1 is rate-determining, as it dictates the overall pace of the reaction.
22	Here, we are given that When $T_1 = 27^\circ C = 300\ \text{K},\ k_1 = k(\text{say})$. When $T_2 = 37^\circ C = 310\ \text{K}, k_2 = 2k$ Substituting these values in the equation : $\log \frac{k_2}{k_1} = \frac{E_a}{2.303R}\left(\frac{T_2 - T_1}{T_1T_2}\right)$, 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 $E_a = 53598.6\ \text{J mol}^{-1} = 53.6\ \text{kJ mol}^{-1}$
23	k = 2.303/log $p_i/2p_i-p_t$ = 2.303/300 log 0.3/0.6-0.5 = 2.303/300 log3 = 0.0036 s^{-1}
24	k_1 = 0.693/40 k_2 = 0.693/20 log k_2/k_1 = Ea/2.303 R(T_2-T_1/T_1T_2) Ea= 27.66 kjmol^{-1}
25	k=.0173 t=2.303/k log $[R]_0$ / [R] = 2.303/0.0173 log 100/10 = 133.3 min

26

A.(a) zero order

(b) Slope =-k

(c) Unit is $molL^{-1}s^{-1}$

B.

Apply the relation :

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

$25\,\%$ decomposition means $[R] = 0.75[R]_0$ and $t = 25$ minutes Substituting the values in the equation above,, we have

$$k = \frac{2.303}{25}\log\frac{[R]_0}{0.75[R]_0}$$

$$= \frac{2.303}{25}\log\frac{4}{3}$$

$$= \frac{2.303}{25}[\log 4 - \log 3]$$

$$= \frac{2.303}{25}[0.6021 - 0.4771]$$

$$= \frac{2.303}{25} \times 0.1250 = 0.011515 \ \ \text{minutes}^{-1}$$

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

$$= \frac{0.693}{0.011515 \ \ \text{minutes}^{-1}}$$

=60.18 min

27	(a) It is known that, $t = \frac{2.303}{k} \log \frac{[R]_0}{[R]}$ $= \frac{2.303}{60\ s^{-1}} \log \frac{1}{\frac{1}{16}}$ $= \frac{2.303}{60\ s^{-1}} \log 16$ $= 4.6 \times 10^{-2}\ s\ (\text{approximately})$ (b) Temperature, Concentration of the reactants (c) The molecules must collide with a sufficient amount of energy known as the activation energy so that the chemical bonds will not break. The molecules should also collide with proper orientation.
28	(a) The powdered form has more surface area which inturn results in increased rate of reaction. (b) The rate of reaction will increase because rate of reaction increases with concentration. (c) Increasing the temperature increases reaction rates because of the disproportionately large increase in the number of high energy collisions (almost double). It is only these collisions (possessing at least the activation energy for the reaction) which result in a reaction.

Prepared by:
Ms Jasmin Joseph