CHEMISTRY

WORKSHEET-18

STEP

A PROJECT BY PUNJAB GROUP

Worksheet-18

(A. Physical Chemistry)

Reaction Kinetics

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Q.1 The change in concentration of reactants or products per unit time is called rate of reaction. The rate of reaction:

A) Increases as the reaction proceeds

B) Decreases as the reaction proceeds

C) Remains the same as the reaction proceeds

D) May decrease or increase as the reaction proceeds

Q.2 With the increase of 10°C temperature, the rate of reaction doubles. This increase in rate of reaction is due to:

A) Decrease in activation energy of reaction

B) Decrease in the number of collision between molecules of reactants

C) Increase in activation energy of molecules of reactants

D) Increase in number of effective collision

Q.3 The minimum amount of energy required for an effective collision is called activation energy. Which one of the following statements is incorrect about activation energy?

Ea = Activation energy K = Specific rate constant

A) Ea of exothermic reaction in the forward reaction is less than that of backward reaction

B) Ea of endothermic reaction in the forward direction is greater than that of reverse reaction

C) Ea is directly proportional to k

D) Ea is independent of temperature

Q.4 Order of reaction is the number of reacting molecules whose concentration alters as a result of chemical change. For which order of reaction, the unit of rate constant (k) is the same as that of rate of reaction?

A) 1^{st} order reaction C) 2^{nd} order reaction

B) Zero order reaction D) 3^{rd} order reaction

Q.5 Which of the following statements about order of reaction is incorrect?

A) It determines mechanism of reaction

B) It is determined experimentally

C) It is associated with rate equation

D) It is always equal to molecularity

Q.6 **In which of the following order of reaction, the half-life is independent of initial concentration?**

A) Zero order C) 1st order

B) 2nd order D) 3rd order

Q.7 **All of the following factors affect rate of reaction EXCEPT:**

A) Concentration of reactants C) Catalyst

B) Molecularity D) Temperature

Q.8 **The addition of catalyst to a reaction can.**

A) Change the enthalpy

B) Change the entropy

C) Change the nature of products

D) Change the activation energy

Q.9 **The experimental relationship between rate of reaction and concentration of reactant is called:**

A) Rate Law C) Hess's Law

B) Law of mass action D) Le-Chateliar's principle

Q.10 **The specific rate constant is equal to rate of reaction when concentration of reactants are taken as unity. Which of the following factors affects specific rate constant?**

A) Concentration of reactants C) Temperature

B) Pressure D) Surface area

Q.11 **A reaction in which catalyst is used is called catalysis. Which of the following is an example of heterogeneous catalysis?**

A) $2SO_2 + O_2 \overset{V_2O_5}{\rightleftharpoons} 2SO_3$

B) $CH_3COOH + C_2H_5OH \overset{H^+}{\rightleftharpoons} CH_3COOC_2H_5 + H_2O$

C) $SO_2 + O_2 \overset{NO}{\rightleftharpoons} 2SO_3$

D) Both B and C

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Q.12 Half life cycle of an order of reaction is inversely proportional to initial concentration raised to the power one less than order of reaction. For which of the following half-life of an order of reaction is inversely proportional to the initial concentration of reactants?

A) Zero order
C) 2nd order
B) 1st order
D) 3rd order

Q.13 If the reaction $P + Q \longrightarrow R + S$ is described as being of zero order w.r.t to P. It means that:

A) P is a catalyst in this reaction
B) P molecules do not possess sufficient energy to react
C) The rate of reaction is independent of conc. of Q
D) The rate of reaction is independent of conc. of P

Q.14 The hydrolysis of $(CH_3)_3CCl$ by OH^- ion proceed in two steps:

$R = (CH_3)_3C -$

$R - Cl \overset{\text{Slow}}{\rightleftharpoons} R^+ + Cl^-$

$R^+ + OH^- \overset{\text{Fast}}{\rightleftharpoons} R - OH$

Which of the following rate equation is consistent with this mechanism of reaction?

A) rate = $k[RCl]^2$
C) rate = $k[RCl]\ [OH^{-1}]$
B) rate = $k\ [RCl]\ [OH^-]^2$
D) rate = $k\ [RCl]$

Q.15 Which one of the following correctly represents the units of the rate constant k for a first order reaction?

A) s^{-1}
C) mol $dm^{-3}s$
B) $mol.dm^{-3}s^{-1}$
D) $mol^{-1}dm^3s$

Q.16 If rate of reaction decay of a radioactive isotope decreases from 200 counts per minutes to 25 counts per minute after 24 hours. What is half life?

A) 3 hours
C) 4 hours
B) 6 hours
D) 8 hours

Q.17 Consider the general reaction $nA \longrightarrow$ Product. The rate of equation for a reaction is given by rate of reaction = $k\ [A]^n$. If the value of n = 2. Then the unit of k for the 2nd order of reaction is:

A) mol $dm^{-3}s^{-1}$
C) $mol^{-1}dm^3s^{-1}$
B) $mol^{-2}dm^6s^{-1}$
D) $mol^{-1}s^{-1}$

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Q.18 **For the gaseous reaction $2X + Y \rightarrow X$.**

$$\text{rate} = k[X]^2[Y]^0$$

If the pressure in the reaction vessel is doubled but temperature remains constant. By what factor does the rate of reaction increases?

A) 2 C) 3

B) 8 D) 4

Q.19 **A radioactive element has two isotopes, "G" and "H", with half lives of 5 min and 15 min respectively. An experiment starts with 4 times as many atoms of "G" as of "H". Radioactive decay is a first order reaction. How long will it be before the number of atoms of "G" left equal the number of atoms of "H" left?**

A) 5 min C) 15 min

B) 10 min D) 20 min

Q.20 **The half-life of any order of reaction is inversely proportional to the initial concentration. (a) raised to the power one less than the order of reaction:**

$$\left(t_{1/2}\right)_n \propto \frac{1}{a^{n-1}}$$

Which of the following mathematical expression is true for the half-life period of zero order reaction?

A) $\left(t_{1/2}\right)_0 \propto a^o$ C) $\left(t_{1/2}\right)_3 \propto \frac{1}{a^3}$

B) $\left(t_{1/2}\right)_2 \propto \frac{1}{a^1}$ D) $\left(t_{1/2}\right)_1 \propto \frac{1}{a^2}$

Q.21 **All of the following are characteristic features of catalyst EXCEPT:**

A) It speeds up a chemical reaction

B) It is used in smaller amount

C) It can initiate a chemical reaction

D) Enthalpy change of a catalyzed and uncatalyzed reaction is not same

Q.22 **In some of the reactions, a product formed acts as a catalyst, this phenomenon is called:**

A) Autocatalysis C) Negative catalysis

B) Enzyme Catalysis D) Poisoning of a catalyst

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Q.23 Identify the incorrect statement about enzyme catalysis:

A) It is highly specific in action

B) Its activity is increased by the presence of activator

C) It shows maximum rate of reaction at minimum temperature

D) Its catalytic activity is inhibited by a poison

Q.24 A solution A of concentration 0.10 mol dm^{-3} undergoes first order reaction at an initial rate of 5.0 x 10^{-4} mol dm^{-3} s^{-1}. The value of rate constant for this reaction is:

A) 2 x 10^{-3} s^{-1} C) 4 x 10^{-3} s^{-1}

B) 3 x 10^{-3} s^{-1} D) 5x 10^{-3} s^{-1}

Q.25 Which of the following is an example of first order reaction?

A) $2N_2O_{5(g)} \longrightarrow 2N_2O_{4(g)} + O_{2(g)}$

B) $2FeCl_{3(aq)} + 6KI_{(aq)} \longrightarrow 2FeI_{2(aq)} + 6KCl_{(aq)}$

C) $NO_{(g)} + O_{3(g)} \longrightarrow NO_{2(g)} + O_{2(g)}$

D) $CHCl_{3(\ell)} + Cl_{2(g)} \longrightarrow CCl_{4(\ell)} + HCl_{(g)}$

Q.26 The reaction which takes place among the molecules when they have:

A) Activation energy

B) Properly oriented

C) Activation energy and proper orientation

D) Concentrated

Q.27 All of the following statements are correct for rate of reaction and specific rate constant EXCEPT:

Opt.	Rate of reaction	Specific rate constant
A)	Change in concentration of reactant or product per unit time is called rate of reaction	It is equal to rate of reaction when molar concentration of reactants are taken as unity
B)	Rate = $\frac{\Delta C}{\Delta t}$	k = proportionality constant
C)	Its unit is mol dm^{-3} s^{-2}	Its unit does not depend on order of reaction
D)	Its value changes with the passage of time	Its value remains constant under given conditions

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Q.28 Mark the incorrect statement about molecularity and order of reaction:

Opt.	Molecularity	Order of reaction
A)	It is number of molecules involved in the balanced equation	It is sum of exponents of molar concentration of reactants as given in the rate equation
B)	It is theoretical value	It is experimental value
C)	Molecularity is ≥ 3	Order of reaction can be 1, 2 or 3
D)	It can have zero value	It cannot have small integral, half integral and zero value

Q.29 Choose the type of catalysis in the following reaction:

$$2SO_{2(g)} + O_{2(g)} \overset{NO_{(g)}}{\rightleftharpoons} 2SO_{3(g)}$$

A) Homogeneous catalysis C) Biological catalysis

B) Heterogeneous catalysis D) Gas catalysis

Q.30 Which of the following physical methods is used to determine rate of reaction when rate of reaction depends on the rate of change in the concentration of reacting ions or ions are formed during the reaction?

A) Electrical conductivity method

B) Dilatometeric method

C) Refractrometric method

D) Optical rotation method

ANSWER KEY (Worksheet-18)					
1	B	11	A	21	D
2	D	12	C	22	A
3	C	13	D	23	C
4	B	14	D	24	D
5	D	15	A	25	A
6	C	16	D	26	C
7	B	17	C	27	C
8	D	18	D	28	D
9	A	19	C	29	A
10	C	20	A	30	A

ANSWERS EXPLAINED

Q.1 (B) The frequency with which the molecules collide depends upon their concentrations of reactants. The more crowded the molecules are, the more likely they are to collide and react with one another. So as the reaction proceeds collision frequency of the molecules decreases, and thus the rate of reaction decreases.

Q.2 (D) **It can be explained by Collision Theory such as:** For a reaction to take place, the colliding particles must have energy equal to or greater than E_a. since there are more particles with energy greater than E_a with the increase of 10°C, the frequency of effective collisions with sufficient energy also increases. Hence, the rate of reaction doubles (Arrhenius equation $k = Ae^{-Ea/RT}$ proves it) with the increase of 10°C temperature.

Q.3 (C) In fact, Ea is inversely proportional to K.

- **Smaller is Ea value, greater is K value, faster is the rate of reaction.**

Q.4 (B) For general reaction nA $\longrightarrow$ Product $\therefore$ rate of reaction = $k\,[A]^n$. For zero order reaction [A] = 1, n = 0.

Rate of reaction = k $\therefore$ k = rate of reaction = $moldm^3s^{-1}$

Conclusion: For zero order reaction unit of k = rate of reaction= $moldm^3s^{-1}$

Q.5 (D) Order of reaction may or may **not equal** to **molecularity.**

Q.6 (C) $\left(t_{1/2}\right)_n \propto \frac{1}{a^{n-1}}$

$\Rightarrow$ **For 1st order reaction n = 1**

- $\left(t_{1/2}\right)1 \propto \frac{1}{a^{1-1}} \Rightarrow \left(t_{1/2}\right) \propto \frac{1}{a^o} \Rightarrow$

independent of initial concentration

Q.7 (B) Molecularity is associated with balanced equation but it has no concern with rate of reaction.

Q.8 (D) Addition of catalyst decreases Ea by changing mechanism of reaction.

Q.9 (A) The experimental relationship between rate of reaction and concentration of reactant is **called rate law.**

Q.10 (C) The only factor which affects the value of specific rate constant is **temperature.**

Q.11 (A) In **heterogeneous** catalysis reactant and catalyst are **not** in the **same phase** as shown in the reaction.

$$2SO_{2(g)} + O_{2(g)} \overset{V_2SO_{5(s)}}{\rightleftharpoons} 2SO_{3(g)}$$

Q.12 (C) $\left(t_{1/2}\right)_2 \propto \frac{1}{a^{2-1}} \Rightarrow \left(t_{1/2}\right)_2 \propto \frac{1}{a^1}$

$\therefore$ **Half-life of second order reaction is inversely proportional to initial concentration for second order reaction.**

Q.13 (D) **Zero order** with respect to a reactant **means** that the rate of reaction is **independent** of the concentration of the reactant **i.e.** a change in concentration of **P** has **no effect** on the rate of the reaction.

Q.14 (D) Since rate of reaction is always determined from the **slow step,** and in the given reaction only **one molecule RCl** takes part. It **means** that rate of

reaction **depends** on concentration of **RCl only.**

Q.15 (A) For general reaction nA $\longrightarrow$ Product A rate of reaction = k $[A]^1$. For 1st order reaction

n = 1, rate of reaction = kA

$$\therefore k = \frac{\text{rate of reaction}}{[A]}$$

$$= \frac{\text{moldm}^{-3}\text{s}^{-1}}{\text{moldm}^{-3}} = \text{s}^{-1}$$

$\therefore$ unit of k for first order reaction = s^{-1}

Q.16 (D) $200 \xrightarrow{t_{1/2}} 100 \xrightarrow{t_{1/2}} 50 \xrightarrow{t_{1/2}} 25$

Hence, $3 \times t_{1/2} = 24$

$t_{1/2} = 8$ hrs

Conclusion the half-life of decay of a radioactive isotope = 8 hrs

Q.17 (C) For general reaction nA $\longrightarrow$ Product $\therefore$ rate of reaction = k $[A]^n$. For 2nd order reaction

n = 2, k = $dm^3mol^{-1}s^{-1}$.

Q.18 (D) When the pressure is doubled **(e.g. by having the volume), [X] and [Y] are doubled.** Since the reaction is second order with respect to **X,** therefore, the rate increases by **4 times.**

Q.19 (C) Let the number of atoms in G and H be 4X and X respectively.

Solution:

$$G: 4X \xrightarrow{5\text{min}} 2X \xrightarrow{5\text{min}} X \xrightarrow{5\text{min}} \frac{1}{2}X$$

$$H: \text{X} \xrightarrow{15\text{min}} \frac{1}{2}X$$

Q.20 (A) Mathematical expression for the half-life period of zero order reaction is $\left(t_{1/2}\right)_0 \propto a$.

Q.21 (D) In fact, enthalpy change of a catalyzed and uncatalyzed reaction is same.

Q.22 (A) In some of the reactions, a product formed acts as a catalyst, this phenomenon is **called autocatalysis. e.g. the reaction of oxalic acid with acidified $KMnO_4$ is slow at the beginning, but after sometimes, $MnSO_4$ produced in the reaction makes it faster, so the product $MnSO_4$ act as a autocatalysis.**

Q.23 (C) It shows maximum rates of reaction at an **optimum** temperature.

Q.24 (D) Solution:

Given data:

Initial rate of reaction = 5×10^{-4} mol dm^{-3} s^{-1}

Concentration of A substance = 0.10 mol dm^{-3}

Initial rate = k[A] =

$$k = \frac{\text{Rate of reaction}}{A} = \frac{5 \times 10^{-4}}{0.10}$$

$$= 5 \times 10^{-3}\ \text{s}^{-1}$$

Q.25 (A) $2N_2O_{5(g)} \longrightarrow 2N_2O_{4(g)} + O_{2(g)}$ **is an example of first order reaction.**

Q.26 (C) The reaction takes place among the molecules of reactants when they have required activation energy and proper orientation.

Q.27 (C) It is incorrect statement. In fact, the correct statement is given in the tabular form:

C)	**Its unit is mol^1 dm^{-3} s^{-1}**	**Its unit depends on order of reaction**

Q.28 (D) It is incorrect statement. In fact, the correct statement is given in the tabular form:

Opt.	Molecularity	Order of reaction
D)	**It cannot have zero value**	**It cannot have integral fractional and zero value**

Q.29 (A) A type of reaction in which reactants and catalyst are in the same phase is called homogenous catalysis. The reaction below is an example of homogenous catalysis.

$$2SO_{2(g)} + O_{2(g)} \overset{NO_{(g)}}{\rightleftharpoons} 2SO_{3(g)}$$

Q.30 (A) **Electrical conductivity is a** physical method which is used to determine rate of reaction when rate of reaction depends on the rate of change in the concentration of reacting ions or ions are formed during the reaction.

STEP

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