UNIT

10

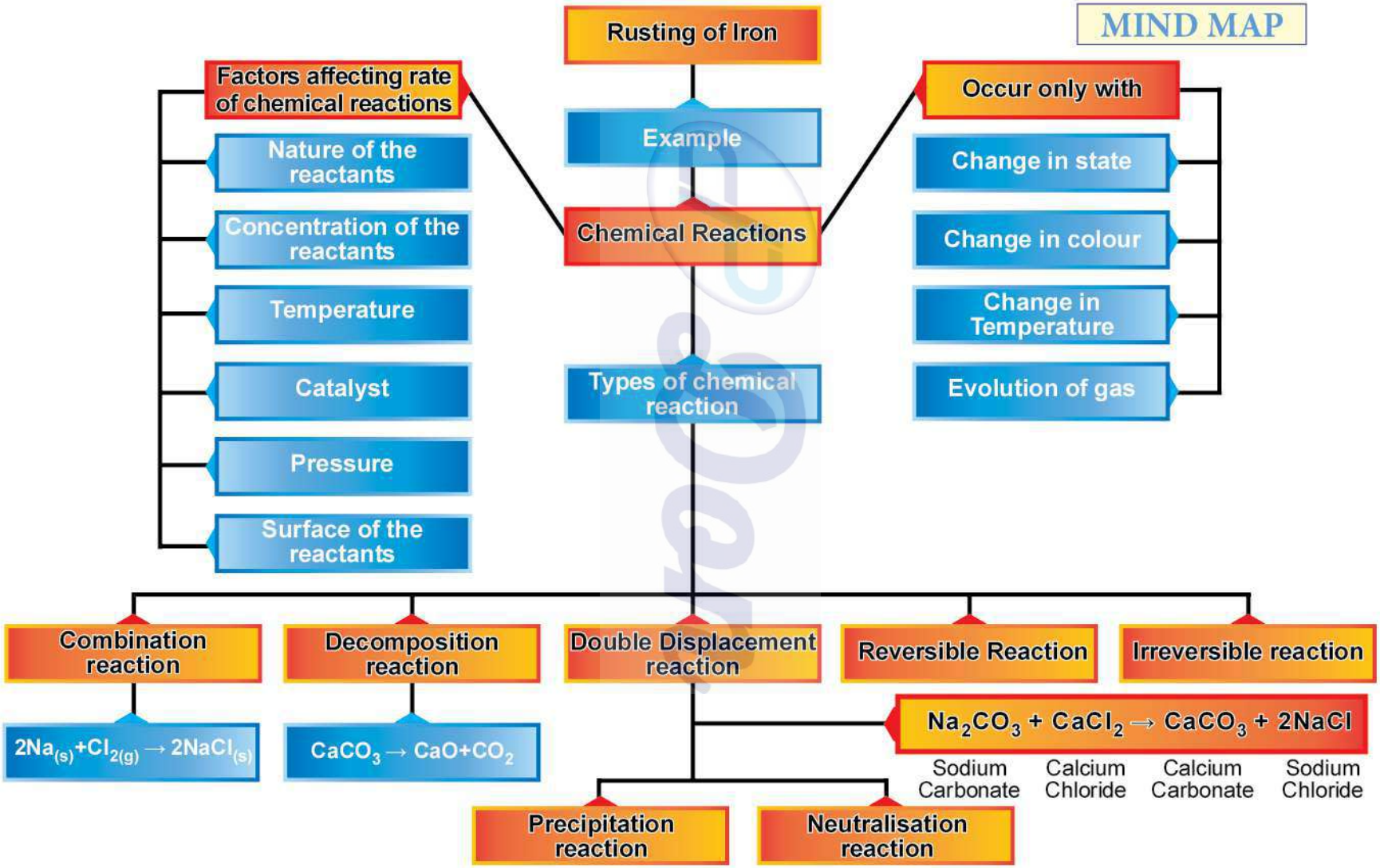
Types of Chemical Reactions

POINTS TO REMEMBER

- A change may happen spontaneously or it may be facilitated by external force (or) energy
- A balanced chemical equation is the simplified representation of a chemical reaction which describes the chemical composition, physical state of the reactants and the products, and the reaction conditions.
- A combination reaction is the reaction in which two or more reactants combine to form a compound.
- In a decomposition reaction, a single compound splits into two or more simpler substances under suitable conditions. Decomposition reaction takes place, by heat, electricity or light.
- More active elements readily displace less active elements from their aqueous solution is called single displacement reactions.
- When two compounds reacts, if their ions are interchanged, then the reaction is called double displacement reaction.
- Chemical reactions are classified into two types based on the direction of the reaction. They are reversible and irreversible reactions.
- When aqueous solutions of two compounds are mixed, if they react to form an insoluble compound and a soluble compound, then it is called as precipitation reaction.
- Acid reacts with the base to form a salt and water, it is called as neutralization reaction.
- Rate of a reaction is the change in the amount or concentration of any one of the reactants or products per unit time.
- Activation energy is the minimum energy with which the reacting particles must collide.
- Physical equilibrium is a s tate of a physical change at which the volume of all the phases remain unchanged. $H_2O(1) \underset{\text{Condensation}}{\overset{\text{Evaporation}}{\rightleftharpoons}} H_2O(g)$
- Some factors influence the rate of chemical reactions. They are nature, concentration, surface area of reactants, temperature, catalyst and pressure.
- Chemical equlibrium is a state of a reversible chemical reaction in which no change takes place in the amount of the reactants and products.
- The pH is the negative logarithm of the hydrogen ion concentration. i.e $pH = -\log 10[H^+]$

Don

MIND MAP



- pH scale is a scale for measuring the hydrogen ion concentration in a solution.
- Our body works within the pH range of 7.0 to 7.8. Any changes in this value, leads to diseases.
- Our saliva normally ranges between 6.5 to 7.5 when it falls below 5.5, the enamel gets weathered.
- Citrus fruits require slightly alkaline soil, rice requires acidic soil and sugarcane requires natural soil.
- When non-metal oxides emitted by factories and vehicles, is dissolved in rain water, it decreases the PH value of rainwater and causes acid rain.

Formulae

$$pH = -\log_{10}[H^+]$$

$$pOH = -\log_{10}[OH^-]$$

$$pH + pOH = 14$$

$$K_w = [H_3O^+]\,[OH^-] = 1\times10^{-14}\ mol^2dm^{-6}$$

$$K_w = [H^+]\,[OH^-] = 1\times10^{-14}\ mol^2dm^{-6}$$

Textbook Evaluation

I. Choose the most suitable answer from the given four alternatives and write the option code and corresponding answer:

1. $H_{2(g)} + Cl_{2(g)} \rightarrow 2HCl_{(g)}$ is a ★★★

a) Decomposition Reaction
b) Combination Reaction
c) Single Displacement Reaction
d) Double Displacement Reaction

2. Photolysis is a decomposition reaction caused by _____

a) heat
b) electricity
c) light
d) mechanical energy

3. A reaction between carbon and oxygen is represented by $C_{(s)} + O_{2(g)} \rightarrow CO_{2(g)}$ + Heat. In which of the type(s), the above reaction can be classified?

i. Combination Reaction
ii. Combustion Reaction
iii. Decomposition Reaction
iv. Irreversible Reaction

a) i and ii
b) i and iv
c) i, ii and iii
d) i, ii and iv

4. The chemical equation $Na_2SO_{4(aq)} + BaCl_{2(aq)} \rightarrow BaSO_{4(s)} \downarrow + 2NaCl_{(aq)}$ represents which of the following types of reaction? ★★★

a) Neutralisation
b) Combustion
c) Precipitation
d) Single displacement

5. Which of the following statements are correct about a chemical equilibrium?
   i. It is dynamic in nature.
   ii. The rate of the forward and backward reactions are equal at equilibrium.
   iii. Irreversible reactions do not attain chemical equilibrium.
   iv. The concentration of reactants and products may be different.

   a) i, ii and iii b) i, ii and iv
   c) ii, iii and iv d) i, iii and iv

6. A single displacement reaction is represented by $X_{(s)} + 2HCl_{(aq)} \rightarrow XCl_{2(aq)} + H_{2(g)}$. Which of the following(s) could be X?
   i. Zn ii. Ag iii. Cu iv. Mg.
   Choose the best pair.

   a) i and ii b) ii and iii
   c) iii and iv d) i and iv

7. Which of the following is not an "element + element → compound" type reaction?

   a) $C_{(s)} + O_{2(g)} \rightarrow CO_{2(g)}$ b) $2K_{(s)} + Br_{2(l)} \rightarrow 2KBr_{(s)}$
   c) $2CO_{(g)} + O_{2(g)} \rightarrow 2CO_{2(g)}$ d) $4Fe_{(s)} + 3O_{2(g)} \rightarrow 2Fe_2O_{3(s)}$

8. Which of the following represents a precipitation reaction?

   a) $A_{(s)} + B_{(s)} \rightarrow C_{(s)} + D_{(s)}$ b) $A_{(s)} + B_{(aq)} \rightarrow C_{(aq)} + D_{(l)}$
   c) $A_{(aq)} + B_{(aq)} \rightarrow C_{(s)} + D_{(aq)}$ d) $A_{(aq)} + B_{(s)} \rightarrow C_{(aq)} + D_{(l)}$

9. The pH of a solution is 3. Its $[OH^-]$ concentration is ★★★

   a) 1×10^{-3} M b) 3 M c) 1×10^{-11} M d) 11 M

10. Powdered $CaCO_3$ reacts more rapidly than flaky $CaCO_3$ because of _____.

    a) large surface area b) high pressure
    c) high concentration d) high temperature

Ans:

1..	b)	Combination reaction	2.	c)	light
3.	d)	i, ii and iv	4.	c)	Precipitation
5.	a)	i,ii and iii	6.	d)	i and iv
7.	c)	$2CO_{(g)} + O_{2(g)} \rightarrow 2CO_{2(g)}$	8.	c)	$A_{(aq)} + B_{(aq)} \rightarrow C_{(s)} + D_{(aq)}$
9.	c)	1×10^{-11} M	10.	a)	large surface area

II. Fill in the blanks

1. A reaction between an acid and a base is called _____. ★★★
2. When lithium metal is placed in hydrochloric acid, _____ gas is evolved.
3. The equilibrium attained during the melting of ice is known as _____.
4. The pH of a fruit juice is 5.6. If you add slaked lime to this juice, its pH _____ (will increase / will decrease) ★★

5. The value of ionic product of water at 25^0 C is _____.
6. The normal pH of human blood is _____.
7. Electrolysis is a type of _____ reaction.
8. The number of products formed in a synthesis reaction is _____.
9. Chemical volcano is an example for _____ type of reaction. ✶ ✶ ✶
10. The ion formed by dissolution of H^+ in water is called _____.

Ans:

1.	Neutralization	2.	Hydrogen
3.	Physical equilibrium	4.	Increase
5.	1.00×10^{-14} mol^2cm^{-6}	6.	7.4 (7.3 to 7.45)
7.	Decomposition	8.	One
9.	Decomposition reaction	10.	Hydronium ion

III. Match the following

1. Identify the types of reaction

Reaction	Type	Ans
1. $NH_4OH_{(aq)} + CH_3COOH_{(aq)} \longrightarrow CH_3COONH_{4(aq)} + H_2O_{(l)}$	a) Single displacement	(c)
2. $Zn_{(s)} + CuSO_{4(aq)} \longrightarrow ZnSO_{4(aq)} + Cu_{(s)}$	b) Combustion	(a)
3. $ZnCO_{3(s)} \xrightarrow{Heat} ZnO_{(S)} + CO_{2(g)}$	c) Neutralisation	(d)
4. $C_2H_{4(g)} + 4O_{2(g)} \longrightarrow 2CO_{2(g)} + 2H_2O_{(g)} + Heat$	d) Thermal decomposition	(b)

IV. True or False: (If false give the correct statement)

1. **Silver metal can displace hydrogen gas from nitric acid.** **False**
   Sodium metal can displace hydrogen gas from nitric acid. Because silver is least reactive.
2. **The pH of rain water containing dissolved gases like SO_3, CO_2, NO_2 will be less than 7.** **True**
3. **At the equilibrium of a reversible reaction, the concentration of the reactants and the products will be equal.** **False**
   At the equilibrium of a reversible reaction, the concentration of the reactants and the products will be constant.
4. **Periodical removal of one of the products of a reversible reaction increases the yield.** **True**
5. **On dipping a pH paper in a solution, it turns into yellow. Then the solution is basic.** **False**
   On dipping a pH paper in a solution, it turns into yellow. Then the solution is acidic not basic.

V. To interpret what happens in the given situations

1. **Magnesium sulphate solution is added with aluminium in a beaker. What happens?**
   There is no change in that beaker. The reaction does not occur, because aluminium is less reactive than magnesium.

2. **Methane reacts with oxygen. What does happen?**
   It will produce large amount of heat and light steam evaporates with carbon-di-oxide.

3. **Non-metal oxides dissolve in rain water. What happens?**
   Non-metal oxides dissolve in rain water,it decreases the pH of the rain water (i.e) below 7. So it causes rain water

VI. Short answer questions:

1. **When an aqueous solution of potassium chloride is added to an aqueous solution of silver nitrate, a white precipitate is formed. Give the chemical equation of this reaction.**

   $$KCl_{(aq)} + AgNO_{3(aq)} \rightarrow AgCl_{(s)} \downarrow + KNO_{3(aq)}$$

   White precipitate of AgCl is formed in aqueous solution of potassium nitrate.

2. **Why does the reaction rate of a reaction increase on raising the temperature?**
   - The temperature of a reaction increases, the adding heat provides energy to **break more bonds** of the reactant molecules.
   - So more reactants ions increases, produce more products.
   - Thus speed of the reaction increases.

3. **Define combination reaction. Give one example for an exothermic combination reaction.** ★★★
   - A combination reaction is a reaction in which two or more reactants combine to form a compound.
   - It is also called as synthesis reaction (or) composition reaction (a single product).
   - $S_{(s)} + O_{2(g)} \rightarrow SO_{2(g)}$
   - Sulphur reacts with oxygen and produce sulphur di-oxide.
   - Most of combination reactions are exothermic in nature, because they involve the formation of new.

4. **Differentiate reversible and irreversible reactions.** ★★★

S.No	Reversible	Irreversible
1.	It **can be reversed** under suitable conditions.	It **cannot be reversed.**
2.	**Both forward and backward** reactions take place simultaneously.	It is unidirectional. It proceeds **only in forward direction.**
3.	It **attains** equilibrium.	Equilibrium is **not attained.**
4.	The reactants **cannot be converted** completely into products.	The reactants **can be completely converted** into products.
5.	It is relatively **slow.**	It is **fast.**

VII. Answer in detail

1. What is thermolysis reaction? ★★

- In a decomposition reaction, a single compound splits into two or more simpler substances by the help of heat. It is called **'Thermolysis'.**
- For example, It is a class of compound to element/element decomposition. i.e. a compound (HgO) is decomposed into two elements (Hg and Oxygen).

$$2HgO_{(s)} \xrightarrow{heat} 2Hg_{(l)} + O_{2(g)}$$

- In thermal decomposition reaction, heat is supplied to break the bonds.
- Such reactions, in which heat is absorbed, are called **'Endothermic reactions'**
- When calcium carbonate is heated, it breaks down into calcium oxide and carbon dioxide.
- It is a type of compound to compound/compound decomposition.

$$CaCO_{3(s)} \xrightarrow{heat} CaO_{(s)} + CO_{2(g)}$$

2. Explain the types of double displacement reactions with examples. ★★★

- When two compounds react, if their ions are interchanged, then the reaction is called double displacement reaction.
- There are major classes of double displacement reactions. They are:
- Precipitation Reactions
- Neutralization Reactions

Precipitation Reactions:

- When aqueous solutions of two compounds are mixed, if they react to form an insoluble compound and a soluble compound, then it is called precipitation reaction.

Aqueous Solution + **Aqueous Solution** → **Insoluble compound** + **Soluble compound**

- When the clear aqueous solutions of potassium iodide and lead (II) nitrate are mixed, a double displacement reaction takes place between them.

$$Pb(NO_3)_{2(aq)} + 2KI_{(aq)} \rightarrow PbI_{2(aq)} \downarrow + 2KNO_{3(aq)}$$

- PbI_2 form a yellow precipitate

Neutralization Reactions:

- It is a type of displacement reaction in which the acid reacts with the base to form a salt and water.
- It is called 'neutralization reaction' as both acid and base neutralize each other.

Acid + Base → Salt + Water

- Reaction of sodium hydroxide with hydrochloric acid is a typical neutralization reaction.
- Here, sodium displaces hydrogen from hydrochloric acid forming sodium chloride, a neutral soluble salt.

$$NaOH_{(aq)} + HCl_{(aq)} \rightarrow NaCl_{(aq)} + H_2O_{(l)}$$

3. Explain the factors influencing the rate of a reaction

Important factors that affect trate of a reaction are

- Nature of the reactants
- Concentration of the reactants
- Temperature
- Catalyst
- Pressure
- Surface area of the reactants

Nature of the reactants:

- The reaction of sodium with hydrochloric acid is faster than that with acetic acid.
- Because Hydrochloric acid is a stronger acid than acetic acid and thus more reactive.
- $2Na_{(s)} + 2HCl_{(aq)} \rightarrow 2NaCl_{(aq)} + H_{2(g)} \rightarrow$ (fast)
- $2Na_{(s)} + 2CH_3COOH_{(aq)} \rightarrow 2CH_3COONa_{(aq)} + H_{2(g)} \rightarrow$ (slow)

Concentration of the reactants:

- The amount of the substance present in a certain volume of the solution is called 'concentration'.
- More the concentration, more particles per volume exist in it and faster the reaction.
- Granulated zinc reacts faster with 2M hydrochloric acid than 1M hydrochloric acid.

Temperature:

- Most of the reactions go faster at higher temperature.
- Because adding heat to the reactants provides energy to break more bonds and thus speed up the reaction.
- **E.g:** Calcium carbonate reacts slowly with hydrochloric acid at room temperature and faster when temperature increases..

Pressure:

- Increasing the pressure of reactant gases increases the reaction rate.
- Because, increasing pressure the reacting particles come closer and collide frequently.

Catalyst:

- A catalyst is a substance which increases the reaction rate without being consumed in the reaction.
- **E.g:** On heating potassium chlorate, it decomposes into potassium chloride and oxygen gas, but at a slower rate.
- If manganese dioxide is added, it increases the reaction rate.

Surface area of the reactants:

- When solid reactants are involved in a reaction, their powdered form reacts more readily.
- Because, powdering of the reactants increases the surface area and more energy is available on collision of the reactant particles.
- Thus, the reaction rate is increased.
- **E.g:** Powdered calcium carbonate reacts more readily with hydrochloric acid than marble chips.

4. How does pH play an important role in everyday life? ★★

- Our body works within the pH range of 7.0 to 7.8.
- Different body fluids have different pH values.
- For example, pH of blood is ranging from 7.35 to 7.45.
- Any increase or decrease in this value leads to diseases.
- The ideal pH for blood is 7.4.

pH in our digestive system:

- HCl present in our stomach helps in digestion.
- During indigestion our stomach produces more acid and this causes pain and irritation.
- pH of the stomach fluid is approximately 2.0.

pH changes as the cause of tooth decay:

- pH of the saliva normally ranges between 6.5 to 7.5.
- White enamel coating (calcium phosphate) is a hard substance in our body.
- When the pH value falls below 5.5, it weathers.
- The basic toothpaste neutralises the excess acid and prevents tooth decay.

pH of soil:

- Citrus fruits require slightly alkaline soil, rice requires acidic soil and sugarcane requires neutral soil.

pH of rain water:

- The pH of rain water is approximately 7.
- If the atmospheric air is polluted with oxides of non-metals, they get dissolved in the rain water and make its pH less than 7.
- As its pH value is less than 7, then it is called acid rain.
- When this rain water reaches river water, the survival of aquatic life becomes difficult.

5. What is a chemical equilibrium? What are its characteristics? ★★★

- Chemical equilibrium is a state of a reversable chemical reaction in which no change in the amount of the reactants and products takes place.
- At equilibrium

  Rate of forward reaction = Rate of backward reaction

Characteristics of equilibrium:

- In a chemical equilibrium, the rate of forward and backward reactions are equal.
- The observable properties such as pressure, concentration, colour, density, viscosity, etc., of the system remain unchanged with time.
- The chemical equilibrium is a dynamic equilibrium, because both the forward and backward reactions continue to occur even though it appears static externally.
- In physical equilibrium, the volume of all the phases remain constant.

VIII. Solve the following problems

1. Lemon juice has a pH 2, what is the concentration of H^+ ions? ★★

Concentration of hydrogen ion $H^+ = 10^{-pH}$ M

Concentration of hydrogen ion in lemon juice $= 10^{-2}$ M

$= 0.01$ M

Concentration of lemon juice is **0.01 M**

2. Calculate the pH of 1.0×10^{-4} molar solution of HNO_3.

HNO_3 dissociates in water as

$HNO_{3(aq)} \rightarrow H^+ + NO_3^-$

Each Nitric acid gives one H^+ ions in water. So 1.0×10^{-4} molar solution of HNO_3 gives 1.0×10^{-4} moles of ions in water.

Therefore $[H^+] = 1.0 \times 10^{-4}$

Formula used:

$pH = -\log_{10}[H^+]$

$pH = -\log_{10}[H^+]$

$= -\log_{10} 1.0 \times 10^{-4}$

$= -(-4)\log_{10} 1.0 \times 10^{-4}$

$= 4 \log_{10} 10^{10} = 4 \times 1$

pH = 4

pH of 1.0×10^{-4} molar solution of HNO_3 is **4**

3. What is the pH of 1.0×10^{-5} molar solution of KOH?

KOH is a strong base and dissolve in water and gives

$KOH \rightarrow K^+ + OH^-$

Each KOH molecules gives one OH^- ion. So 1.0×10^{-5} molar solution of KOH gives 1.0×10^{-5} OH^- ions.

$[OH^-] = 1.0 \times 10^{-5}$

Formula used:

$pOH = -\log_{10}[OH^-]$

$pOH = -\log_{10}[OH^-]$

$= -\log_{10} 1.0 \times 10^{-5}$

$= -(-5)\log_{10} 10$

$pOH = 5 \times 1$

$pOH = 5$

$pH + pOH = 14$

$pH = 14 - pOH$

$= 14 - 5$

pH = 9

The pH of 1.0×10^{-5} molar solution of KOH is **9.**

4. The hydroxide ion concentration of a solution is 1×10^{-11}M. What is the pH of the solution? ★ ★ ★

$[OH^-] = 1 \times 10^{-11}$

Formula used:

$pOH = -\log_{10}[OH^-]$

$pOH = 11$

$pOH = -\log_{10}[OH^-]$

$= -\log_{10} 1 \times 10^{-11}$

$= -(-11)\log_{10} 1 \times 10$

$= 11 \log_{10} 10 = 11 \times 1$

$pOH = 11$

$pH = 14 - pOH$

$pH = 14 - 11$

pH = 3

pH of the hydroxide ion concentration of a solution of 1×10^{-11} M is **3**

IX. Higher Order Thinking Skill (HOTS)

1. A solid compound 'A' decomposes on heating into 'B' and a gas 'C'. On passing the gas 'C' through water, it becomes acidic. Identify A, B and C.

- On passing 'C' through water it becomes acidic.
- Therefore the gas 'C' must be a non-metal oxide (CO_2).
- So a solid compound must be a calcium carbonate.
- It decomposes into calcium oxide and carbon dioxide. (C)

$$\underset{A}{CaCO_{3(g)}} \rightarrow \underset{B}{CaO_{(S)}} + \underset{C}{CO_{2(g)}}$$

- A → $CaCO_3$
- B → CaO
- C → CO_2

2. Can a nickel spatula be used to stir copper sulphate solution? Justify your answer.

- No, because Nickel is more reactive than Copper.
- So Nickel easily reacts and displaces copper from copper sulphate solution.
- $Ni_{(s)} + Cu_{(aq)} \rightarrow Ni_{(aq)} + Cu_{(S)}$

Additional Questions

I. Choose the most suitable answer from the given four alternatives and write the option code and corresponding answer:

1. $4NaCl + 2Mg \rightarrow$

a) $MgCl_2 + 4Na$ b) does not occur c) $NaMgCl_2$ d) $Na(MgCl)_2$

2. Metal + Acid → Salt + _____.

a) Oxygen b) Water c) Hydrogen d) Carbon

3. Copper is more reactive than _____. ✶

a) silver b) gold
c) platinum d) all of these.

4. If the concentration of reactants increases, the rate of reaction will

a) increase b) decrease
c) remains same d) initially decreases then increases

5. In a solution $[OH^-]$ is 1×10^{-8} then the solution is

a) Basic b) Acidic
c) Neutral d) None of these

6. A substance which alters the rate of reaction without undergoing any change in its mass and composition is known as ✶

a) Reactants b) Products
c) Rate of reaction d) Catalyst

7. **The pH is the _____ of the hydrogen ion concentration.**
   a) logarithm b) positive logarithm
   c) negative logarithm d) division of logarithm

8. **The acid, helps in digestion of food in stomach is**
   a) H_2SO_4 b) HNO_3 c) HCl d) H_3PO_4

9. **pH value for Antacids**
   a) 4 – 5 b) 6 – 8 c) 10 d) 11

10. **When Potassium Iodide reacts with lead nitrate, we get _____ as a yellow precipitation.** ✶
    a) Lead iodide b) Potassium Nitrate
    c) Potassium Iodide d) Lead Nitrate

Ans:

1.	b)	does not occur	2.	c)	Hydrogen
3.	d)	all of these	4.	a)	increase
5.	b)	Acidic	6.	d)	Catalyst
7.	C)	Negative logarithm	8.	c)	HCl
9.	c)	10	10.	a)	Lead Iodide

II. Fill in the blanks

1. **_____ of iron causes rusting .**
2. **If a bond is breaking in a chemical reaction , it _____ energy.(absorb/releases)**
3. **The condition for a chemical reaction is mentioned _____ the arrow mark.**
4. **The colour of silver bromide is _____.**
5. **Precipitation reaction is a type of _____ reaction.** ✶
6. **Rate = $-\frac{d[A]}{dt} = +\frac{d[B]}{dt}$ Here [ ] represents _____.**
7. **When temperature increases, the speed of reaction _____.**
8. **The pH value of coffee is _____.**
9. **When we add water in acid, its pH value _____.** ✶
10. **pH of a substance is 9. When we add acid in it, its pH value _____.**

Ans:

1.	Oxidation	2.	Absorbs
3.	Above	4.	Light yellow
5.	double displacement	6.	Concentration
7.	Increases	8.	5.6
9.	Increases	10.	will decrease

III. Match the following

1. Identify the types of reaction. ★

1) Compound + Element → Compound	-	a) Speed induced by catalyst	(c)
2) $2AgBr \rightarrow 2Ag + Br_2$	-	b) Do not react	(d)
3) $CaCl_2 + Fe \rightarrow$	-	c) Combination	(b)
4) $2\,KClO_3 \xrightarrow{MnO_2} 2KCl + 3O_2$	-	d) Photolysis	(a)

2. Substances and its colour in pH paper

1) Stomach acid	-	a) Dark blue	(d)
2) Drain cleaner	-	b) Pale blue	(a)
3) Egg white	-	c) Red	(b)
4) Freshmilk	-	d) Dark red	(c)

3.

1) Digestion juice	-	a) Fast process	(b)
2) Soft drinks	-	b) Acidic in nature	(e)
3) Digestion process	-	c) Slow process	(a)
4) Rusting of iron	-	d) Alkaline in nature	(c)
5) Milk of magnesia	-	e) Carbonic acid	(d)

IV. True or False: (If false give the correct statement)

1. **Oxidation of Iron causes rusting.** — **True**

2. **Chemical formula for marble is $Ca(OH)_2$** — **False**
   Chemical formula for marble is $CaCO_3$

3. **In a double displacement reaction, one cation replaces anion from another molecule.** ★ — **False**
   In a double displacement reaction the ion of one compound will be displaced by ion of another compound.

4. **On recharging the mobile, chemical energy is stored in the form of electric energy.** — **False**
   On recharging the mobile, electric energy is stored in the form of chemical energy.

5. **Addition of reactants, increase the forward reaction.** ★ — **True**

6. **Unit of concentration of acid is pH value.** — **False**
   Unit of concentration of acid is mole.

7. **Rice plants needs acidic soil.** — **True**

8. **pOH of a substance is four. Then it is acidic in nature.** — **False**
   pOH of a substance is four. Then it is basic in nature.

V. Assertion and reason type questions

Answer the following questions using the data given below.

a) A and R are corrrect, R explains the A
b) A is wrong, R is correct.
c) A is correct, R is wrong.
d) A and R are correct, R does not explains A.

1. **Assertion:** The physical state of the substances in a chemical reaction are denoted in superscript of the formula.
   Reason: Balanced equation should give full information about the reaction.
   Ans: b) A is wrong, R is correct.
2. **Assertion:** Hydrogen displace copper from its compounds.
   Reason: Hydrogen is more reactive than copper .
   Ans: a) A and R are correct, R explains the A
3. **Assertion:** Reversible reaction reaches chemical equilibrium level. ★
   Reason: In a reversible reaction, the forward reaction is always faster than the backward reaction.
   Ans: c) A is correct, R is wrong
4. **Assertion :** To increase the speed of reaction, the metal may be powdered.
   Reason: By increasing surface area, the speed of a reaction can be increased.
   Ans: a) A and R are correct, R explains the A

VI. Short answer questions:

1. What happen during a chemical reaction? ★

- In a chemical reaction, the atoms of the reacting molecules (or) atoms are **rearranged** to form new molecules.
- Old chemical bonds between atoms are **broken** and new chemical bonds are **formed**.
- Bond breaking absorbs energy whereas bond formation releases energy.

2. What is photolysis? Write an equation for photolysis? ★★

- Some of the reactants (i.e silver Bromide, etc) breaking down, when it expose to light is called photolysis.
- Eg. $2AgCl_{(S)} \xrightarrow{\text{sun light}} 2Ag_{(S)} + Cl_{2(g)}$
- It is also called as **photo decomposition reaction.**

3. All combustion reactions are oxidations but all oxidations are not combustion. Why?

- The process of combustion need fuel and oxygen.
- Addition of oxygen with a substance (fuel) is called oxidation which gives heat and light (i.e. combustion).
- But additionof oxygen with all substances does not give heat and light, however it is called oxidation but not combustion. (Eg: rusting of Iron)

4. $2H_2O_{2(aq)} \rightarrow 2H_2 + 2O_{2(g)}$ But H_2O_2 is poured in wound, the backward reaction does not take place. Why?

When we poured H_2O_2 on wounds, it decomposes into H_2 and O_2, but oxygen gas moves away from wound, the backward reaction does not take place.

5. Write the equation for rate of a chemical reaction. Mention all symbols used in the equation. ✶✶

- The rate of chemical equation is given by

$$\text{Rate} = -\frac{d[A]}{dt} = +\frac{d[B]}{dt}$$

Where

[A] → Concentration of A

[B] → Concentration of B

- The negative sign indicates the decrease in the concentration of A with time.
- The positive sign indicates the increase in the concentration of B with time.
- [ ] Represents concentration.
- 'd' represents the infinitesimal change in the concentration.

6. Conductivity of electricity in water is a reversible reaction. This reversible reaction attains equilibrium very quickly why?

- When electricity passes through water it produces Hydronium ion (H_3O^+) and Hydroxyl ion (OH^-).
- Hydronium ion is strong and acidic in nature and hydroxyl ion is strong and basic in nature.
- So these react quickly again to form water.
- So, this irreversible reaction attains equilibrium very quickly.

VII. Answer in detail

1. What is combination reaction? Write its types, Write an equation for each type of combination reactions.

- A combination reaction is a reaction in which two or more reactants combine to form a compound.

Element + Element → Compound

- In this type of combination reaction, two elements react with one another to form a compound.
- Metal reacts with non-metallic elements.

$$2Na_{(s)} + Cl_{2(g)} \rightarrow 2NaCl_{(s)}$$

- Two non-metals react with each other.

$$S_{(s)} + O_{2(g)} \rightarrow SO_{2(g)}$$

Compound + Element → Compound

- A compound reacts with an element to form a new compound.

$$PCl_{3(l)} + Cl_{2(g)} \rightarrow PCl_{5(s)}$$

Compound + Compound → Compound

- It is a reaction between two compounds to form a new compound.

$$SiO_{2(s)} + CaO_{(s)} \rightarrow CaSiO_{3(s)}$$

VIII. Solve the following problems

1. The hydroxyl ion concentration of a solution is 1×10^{-8} M. a) what is the pOH value of the solution? b) Is the given solution acidic (or) basic?

a) $[OH^-] = 1 \times 10^{-8}$

$pOH = -\log_{10}[OH^-]$

$pOH = -\log_{10}(1 \times 10^{-8})$

$= -(-8) \log_{10} 1 \times 10 = 8 \log_{10} 10 = 8 \times 1$

pH = 8

Formula used:

$pOH = -\log_{10}[OH^-]$

$pOH = 8$

b) $pOH = 8$

$pH = 14 - pOH$

$= 14 - 8$

pH = 6

The given solution is acidic as its pH value is less than **7.**

2. Calculate the pH of 1×10^{-5} molar solution of Li(OH)

LiOH is a strong base and it gives

$Li(OH) \rightarrow Li^+ + OH^-$

One Lithium hydroxide give one OH^- ion in water so 1×10^{-5} molar solution gives 1×10^{-5} OH^- ions in water therefore

$[OH^-] = 1 \times 10^{-5}$

$pOH = -\log_{10}[OH^-]$

$pOH = -\log_{10}(1 \times 10^{-5})$

$= -(-5) \log_{10} 1 \times 10$

$= 5 \log_{10} 10 = 5 \times 1$

$pOH = 5$

$pH = 14 - pOH$

$= 14 - 5$

pH = 9

Formula used:

$pOH = -\log_{10}[OH^-]$

$pOH = 5$

pH value of 1×10^{-5} molar solution of LiOH is **9**

3. Calculate the P^H value of 1×10^{-3} molar solution of H_3PO_4 ✶

H_3PO_4 is dissociate in water and give $H_3PO_4 + H_2O \rightarrow H_3PO_4^- + H_3O^+$

$[H_3O^+]$ may be simply written as $[H^+]$

One H_3PO_4 (phosphoric acid) gives one $[H^+]$ ion in water. So 1×10^{-3} molar solution of H_3PO_4 gives 1×10^{-3} H^+ of ions in water.

$[H^+] = 1 \times 10^{-3}$ M

$pH = -\log_{10}[H^+]$

Formula used:

$pH = -\log_{10}[H^+]$

$$pH = -\log_{10} 1 \times 10^{-3}$$
$$= -(-3) \log_{10} 1 \times 10$$
$$= 3 \log_{10} 10 = 3 \times 1$$
$$pH = 3$$

pH value of 1×10^{-3} molar solution of H_3PO_4 is 3

IX. Higher Order Thinking Skill (HOTS)

1. Why should we keep soft drinks in refrigerator?

- Soft drinks contain dissolved CO_2 as carbonic acid.
- When temperature increases to room temperature, the CO_2 undissolved back to the gas phase.
- So when kept in a refrigerator, temperature decreases, more CO_2 is dissolved and forms carbonic acid which helps in digestion.

2. Why should we store silver bromide in dark colour bottles?

- It is because silver bromide decomposes into silver and bromine gas in the presesnce of sun light.

$$2AgBr_{(S)} \xrightarrow{\text{sunlight}} 2Ag_{(S)} + Br_{2(g)}$$

3. Why should chemical equation be balanced?

- The equation should be balanced because matter can neither be created nor be destroyed.
- The total mass of reactants should be equal to the total mass of products.

Unit Test - 10

Types of Chemical Reactions

Time : 1 hr | Marks : 30

I. Choose the most suitable answer and write the code with the corresponding answer. 5 × 1 = 5

1. $H_{2(g)} + Cl_{2(g)} \rightarrow 2HCl_{(g)}$ is a
   a) Decomposition Reaction b) Combination Reaction
   c) Single Displacement Reaction d) Double Displacement Reaction

2. The pH of a solution is 3. Its $[OH^-]$ concentration is
   a) 1×10^{-3} M b) 3 M c) 1×10^{-11} M d) 11 M

3. Powdered $CaCO_3$ reacts more rapidly than flaky $CaCO_3$ because of _____.
   a) Large surface area b) High pressure
   c) High concentration d) high temperature

4. A substance which alters the rate of reaction without undergoing any change in mass and composition is known as
   a) Reactants b) Products c) Rate of reaction d) Catalyst

5. The acid, helps in digestion of food in stomach is
   a) H_2SO_4 b) HNO_3 c) HCl d) H_3PO_4

II. Answer the following questions in one or two lines. 5 × 2 = 10

1. What happen during a chemical reaction?
2. What is photolysis? Write an equation for photolysis.
3. All combustion reactions are oxidations but all oxidations are not combustion reaction. Why?
4. What are the factors influencing the rate of a reaction?
5. Conductivity of electricity in water is a reversible reaction. This reversible reaction attains equilibrium very quickly why?

III. Answer the following questions in brief. 2 × 4 = 8

1. Explain the factors influencing the rate of a reaction.
2. Why should we store silver bromide in dark colour bottles?

IV. Answer the following questions in detail. 1 × 7 = 7

1. i) What is a chemical equilibrium? What are its characteristics?
   ii) Why should we keep soft drinks in refrigerator?