Chapter 10 Types of Chemical Reactions

I. Choose the correct Answer:

Question 1

 $\begin{array}{l} H_{2(g)}+Cl_{29(g)}\rightarrow 2HCl_{(g)}\\ (a) \ Decomposition \ Reaction\\ (b) \ Combination \ Reaction\\ (c) \ Single \ Displacement \ Reaction\\ (d) \ Double \ Displacement \ Reaction\\ \ \textbf{Answer:}\\ (a) \ Decomposition \ Reaction \ Reaction \end{array}$

Question 2.

Photolysis is a decomposition reaction caused by _____. (a) heat (b) electricity (c) light (d) mechanical energy **Answer:**. (c) light Hint: $2AgBr(s) \rightarrow Light2Ag(s) + Br2(g)$

Question 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) **Answer:** (d) (i), (ii) and (iv)

Question 4.

The chemical equation Na2SO4(aq)+BaCl2(aq) \rightarrow BaSO4(s)↓+2NaCl(aq) represents which of the following types of reaction? (a) Neutralisation (b) Combustion

(c) Precipitation

(d) Single displacement.

Answer:

(c) Precipitation

Hint: This reaction involves the precipitation of white $BaSO_4$ by mixing of Na_2SO_4 (aq) and $BaCl_2$ (aq). Hence it belongs to precipitation reaction.

Question 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)

Answer:

(a) (i), (ii) and (iii)

Question 6.

A single displacement reaction is represented by $X(s)+2HCl(aq)\rightarrow XCl2(aq)+H2(g)$. 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. Answer: (d) i and iv. Hint: $Zn + 2HCl \rightarrow ZnCl_2 + H_2$ $Mg + 2HCl \rightarrow MgCl_2 + H_2$.

Question 7.

Which of the following is not an "element + element \rightarrow compound" type reaction? (a) $C_{(s)} + O_{2(g)} \rightarrow CO_{2(g)}$ (b) $2K_{(s)} + Br_{2(1)} \rightarrow 2KBr_{(s)}$ (c) $2CO_{(g)} + O_{2(g)} \rightarrow 2CO_{2(g)}$ (d) $4Fe_{(s)} + 3O_{2(g)} \rightarrow 2Fe_2O_{3(s)}$

Answer:

(c) $2CO_{(g)} + O_{2(g)} \rightarrow 2CO_{2(g)}$

Question 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) $A_{(aq)} + B_{(s)} \rightarrow C_{(aq)} + D_{(l)}$ Answer: (c) $A_{(aq)} + B_{(aq)} \rightarrow C_{(s)} + D_{(aq)}$

Question 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. **Answer:** (c) 1×10^{-11} M Hint: pH = 3 It means [H⁺] = 10^{-3} [H⁺] [OH⁻] = 10^{-14} [OH⁻] = 10^{-14} [OH⁻] = 10^{-11}

Question 10.

Powdered CaCO₃ reacts more rapidly than flaky CaCO₃ because of : (a) large surface area (b) high pressure (c) high concentration (d) high temperature **Answer:** (a) large surface area

II. Fill in the blanks:

- 1. A reaction between an acid and a base is called
- 2. When zinc metal is placed in hydrochloric acid, gas is evolved.
- 3. The equilibrium attained during the meiting 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
- 5. The value of ionic product of water at 25 °C is
- 6. The normal pH of human blood is
- 7. Electrolysis is 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
Answer:
1. neutralization

- 2. H₂
- 3. physical equilibrium
- 4. increases to '7'
- $5.1 \times 10^{-14} \text{ mol}^2 \text{ dm}^{-6}$
- 6.7.4
- 7. decomposition
- 8.1
- 9. decomposition
- 10. hydronium ion

III. Match the following:

Question 1.

Identify the types of reaction:

Reaction		Туре	
A	$NH_4OH_{(aq)} + CH_3COOH_{(aq)}$ $\rightarrow CH_3COONH_{4(aq)} + H_2O_{(l)}$	(i)	Single Displacement
В	$Zn_{(s)} + CuSO_{4(aq)} \rightarrow$ $ZnSO_{4(aq)} + Cu_{(s)}$	(ii)	Combustion
C	$ZnCO_{3(s)} + \xrightarrow{Heat}$ $ZnO_{(s)} + CO_{2(g)}$	(iii)	Neutralisation
D	$\begin{vmatrix} C_2 H_{4(g)} + 4O_{2(g)} \rightarrow \\ 2CO_{2(g)} + 2H_2O_{(g)} + Heat \end{vmatrix}$	(iv)	Thermal decomposition

Answer:

- A. (iii)
- B. (i)
- C. (iv)
- D. (ii)

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

1. Silver metal can replace hydrogen gas from nitric acid.

- The pH of rain water containing dissolved gases like SO₃, CO₂, NO₂ will be less than
 7.
- 3. At the equilibrium of a reversible reaction, the concentration of the reactants and the products will be equal.
- 4. Periodical removal of one of the products of a reversible reaction increases the yield.
- 5. On dipping a pH paper in a solution, it turns into yellow. Then the solution is basic.

Answer:

- 1. False Silver cannot displace H₂ from HNO₃ acid, since it is placed below hydrogen in the activity series.
- 2. True
- 3. False At equilibrium the concentration of the reactants and products do not change it remains constant, but the concentration of the reactants and the products will not be equal.
- 4. True
- 5. False The solution is neutral if the solution is basic it will be green in colour.

V. Short Answer Questions:

Question 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. **Answer**:

$$\begin{array}{c} \mathrm{KCl}_{(\mathrm{aq})} + \mathrm{AgNO}_{3(\mathrm{aq})} \longrightarrow \mathrm{AgCl}_{(\mathrm{s})} \downarrow + \mathrm{KNO}_{3(\mathrm{aq})} \\ & \text{Silver chloride} \end{array}$$

Curdy white precipitate

Question 2.

Why does the reaction rate of a reaction increase in raising the temperature? **Answer**:

On increasing temperature heat is supplied to the reactant. This energy breaks more bonds and thus speed up the chemical reaction. Foods kept at room temperature spoils faster than that kept in the refrigerator.

Question 3.

Define combination reaction. Give one example for an exothermic combination reaction. **Answer**:

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

Eg: $C_{(s)} + O_{2(g)} \rightarrow CO_{2(g)} + heat$

Question 4.

Differentiate reversible and irreversible reactions. **Answer**:

Reversible reaction	Irreversible reaction	
It can be reversed under suitable conditions.	It cannot be reversed.	
Both forward and backward reactions take place simultaneously.	It is unidirectional. It proceeds only in forward direction.	
It attains equilibrium.	Equilibrium is not attained.	
The reactants cannot be converted completely into products.	The reactants can be completely converted into products.	
It is relatively slow.	It is fast.	

VI. Answer in detail:

Question 1.

What are called thermolysis reactions?

Answer:

Thermal decomposition reactions are called 'thermolysis' reaction. In this type of reaction, the reactant is decomposed by applying heat. There are two types of thermolysis reactions. They are:

(i) Compound to element / element decomposition:

A compound is decomposed into two elements.

Eg:

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

(ii) Compound to compound / compound decomposition:

A compound is decomposed into two compounds.

Eg:

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

Question 2.

Explain the types of double displacement reactions with examples.

Answer:

There are two major classes of double displacement reactions. They are,

(i) 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.

 $Pb(NO3)2(aq)+2KI(aq)\rightarrow PbI2(s)\downarrow+2KNO3(aq)$

(ii) Neutralisation Reactions: Another type of displacement reaction in which the acid reacts with the base to form a salt and water. It is called 'neutralisation reaction' as both acid and base neutralize each other.

 $NaOH(aq)+HCl(aq)\rightarrow NaCl(aq)+H2O(l).$

Question 3.

Explain the factors influencing the rate of a reaction.

Answer:

Important factors that affect rate of a reaction are:

- 1. Nature of the reactants
- 2. Concentration of the reactants
- 3. Temperature
- 4. Catalyst
- 5. Pressure
- 6. Surface area of the reactants

1. 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. So, the nature of the reactants influence the reaction rate. $2Na_{(s)} + 2HCl_{(aq)} \rightarrow 2NaCl_{(aq)} + H_{2(g)}$ (fast) $2Na_{(s)} + 2CH_3COOH_{(aq)} \rightarrow 2CH_3COONa_{(aq)} + H_{2(g)}$ (slow)

2. Concentration of the reactants : Changing the amount of the reactants also increases the reaction rate. More the concentration, more particles per volume exist in it and hence faster the reaction. Granulated zinc reacts faster with 2M hydrochloric acid than 1M hydrochloric acid.

3. 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. Calcium carbonate reacts slowly with hydrochloric acid at room temperature. When the reaction mixture is heated the reaction rate increases.

4. Pressure : If the reactants are gases, increasing their pressure increases the reaction rate. This is because, on increasing the pressure the reacting particles come closer and collide frequently.

5. Catalyst : A catalyst is a substance which increases the reaction rate without being consumed in the reaction. In certain reactions, adding a substance as catalyst speeds up the reaction. For example, 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.

6. Surface area of the reactants : Powdered calcium carbonate reacts more readily with hydrochloric acid than marble chips. 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.

Question 4.

How does pH play an important role in everyday life? **Answer**:

- The pH of blood is almost 7.4. Any increase or decrease in this value leads to diseases
- Citrus fruits require slightly alkaline soil, while rice requires acidic soil and sugarcane requires neutral soil.
- If the pH of rainwater becomes less than 7, it becomes acid rain which is harmful in day-to-day life.
- pH changes cause tooth decay.
- During indigestion, the stomach produces too much acid and this causes pain and irritation.

Question 5.

What is chemical equilibrium? What are its characteristics?

Answer:

Chemical equilibrium is a state of a reversible chemical reaction where the, Rate of forward reaction = Rate of backward reaction.

No change in the amount of the reactants and products takes place.

Characteristics of equilibrium:

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

VII. HOT Questions:

Question 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.

Answer:

A – CaCO₃, solid compound

'A' decomposes on heating into 'B' and a gas 'C'.

$$CaCO_{3(s)} \xrightarrow{\Delta} CaO_{(s)} + CO_{2(g)}^{\uparrow}$$

Calcium carbonate (B) (C) On passing the gas CO₂ through water, it becomes acidic. $H_2O_{(l)} + CO_{2(g)} \longrightarrow H_2CO_{3(aq)}$

Carbonic acid

Acidic

A – CaCO₃, Calcium carbonate B – CaO, Calcium oxide

C – CO₂, Carbondioxide gas

Question 2.

Can a nickel spatula be used to stir copper sulphate solution? Justify your Answer. **Answer**:

No, nickel spatula cannot be used to stir the copper sulphate solution. Actually, on the basis of activity series, nickel is more reactive than copper, so nickel will displace copper from its solution and copper will be deposited on nickel spatula.

VIII. Solve the following problems:

Question 1.

Lemon juice has a pH 2, what is the concentration of H⁺ ions? Answer: $pH = -log [H^+]$ $[H^+] = antilog of [-pH]$ = antilog [-2] $[H^+] = 10^{-2} M$ [OR] $PH = -log [H^+]$ $[H^+] = 10^{-pH}$

 $[H^+] = 10^{-pH}$ $[H^+] = 10^{-2}M$

Question 2.

Calculate the pH of 1.0×10^{-4} molar solution of HNO₃. **Answer**: pH = $-\log [H^+]$ HNO3 \rightarrow H⁺ + NO₃⁻ pH = $-\log [1 \times 10^{-4}]$ = $-(-4)\log_{10} 10 = 4$ pH = 4

Question 3.

What is the pH of 1.0 x 10⁻⁵ molar solution of KOH? **Answer**: KOH \rightarrow K⁺ + OH⁻ pOH = -log[OH⁻] = -log [1 × 10⁻⁵] pOH = 5 pH + pOH = 14 $\therefore pH \text{ of } KOH = 14 - 5 = 9$ pH = 9

Question 4.

Laundry detergent has a pH 8.5, What is the concentration of H⁺ ions? Answer: pH = 8.5 $pH = -\log [H^+]$ $[H^+] = 10^{-pH}$ $[H^+] = 10^{-8.5}$ $[H^+] = 3.16 \times 10^{-9} M$

Question 5.

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

 $\begin{array}{l} [OH^{-}] = 1 \times 10^{-11} \, \text{M} \\ pOH = -\log[OH^{-}] \\ = -\log[1 \times 10^{-11}] \\ = -\log_{10}1 - \log_{10}10^{-11} \\ = -(-11) \, \log_{10}10 = 11 \\ pOH = 11 \\ pH + pOH = 14 \\ pH = 14 - 11 \\ pH = 3 \end{array}$