

PETIT SEMINAIRE HIGHER SECONDARY SCHOOL – PUDUCHERRY

UNIT – 10 TYPES OF CHEMICAL REACTIONS

STD: X

SELF – EVALUATION

I. Choose the best answer:

- $\text{H}_2(\text{g}) + \text{Cl}_2(\text{g}) \rightarrow 2 \text{HCl}(\text{g})$ is a - **(b) Combination reaction**
- Photolysis is a decomposition reaction caused by - **(c) Light**
- A reaction between carbon and oxygen is represented by $\text{C}(\text{s}) + \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + \text{Heat}$. In which of the type(s), the above reaction can be classified? - **(d) i, ii and iv**
- The chemical equation $\text{Na}_2\text{SO}_4(\text{aq}) + \text{BaCl}_2(\text{aq}) \rightarrow \text{BaSO}_4(\text{s}) \downarrow + 2 \text{NaCl}(\text{aq})$ represents which of the following types of reaction? - **(c) Precipitation**
- Which of the following statements are correct about a chemical equilibrium? - **(a) i, ii and iii**
- A single displacement reaction is represented by $\text{X}(\text{s}) + 2 \text{HCl}(\text{aq}) \rightarrow \text{XCl}_2(\text{aq}) + \text{H}_2(\text{g})$. which of the following(s) could be X. (i) Zn (ii) Ag (iii) Cu (iv) Mg - **(d) i and iv**
- Which of the following is not an “element + element \rightarrow compound” type reaction? - **(c) $2 \text{CO}(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2 \text{CO}_2(\text{g})$**
- Which of the following represents a precipitation reaction? – **(c) $\text{A}(\text{aq}) + \text{B}(\text{aq}) \rightarrow \text{C}(\text{s}) + \text{D}(\text{aq})$**
- The pH of a solution is 3. Its $[\text{OH}^-]$ concentration is - **(c) $1 \times 10^{-11} \text{ M}$**
- Powdered CaCO_3 reacts more rapidly than flaky CaCO_3 because of - **(a) large surface area**

II. Fill in the blanks:

- A reaction between an acid and a base is called **Neutralization reaction**
- When lithium metal is placed in hydrochloric acid, **Hydrogen gas** is evolved.
- The equilibrium attained during the melting of ice is known as **Physical Equilibrium**.
- The pH of a fruit juice is 5.6. If you add slaked lime to this juice, its pH **Increase**.
- The value of ionic product of water at 25°C is **$1 \times 10^{-14} \text{ mol}^2 \text{ dm}^{-6}$**
- The normal pH of human blood is **7.4**
- Electrolysis is type of **Decomposition** reaction.



8. The number of products formed in a synthesis reaction is One or complex product
9. Chemical volcano is an example for Decomposition type of reaction.
10. The ion formed by dissolution of H^+ in water is called Hydronium ion (or) H_3O^+ ion

III. Match the following:

S.No	Reaction	Type
1	$NH_4OH_{(aq)} + CH_3COOH_{(aq)} \rightarrow CH_3COONH_{4(aq)} + H_2O_{(l)}$	Neutralization
2	$Zn_{(s)} + CuSO_{4(aq)} \rightarrow ZnSO_{4(aq)} + Cu_{(s)}$	Single displacement
3	$ZnCO_{3(s)} + Heat \rightarrow ZnO_{(s)} + CO_{2(g)}$	Thermal decomposition
4	$C_2H_{4(g)} + 4O_{2(g)} \rightarrow 2CO_{2(g)} + 2H_2O_{(g)} + Heat$	Combustion

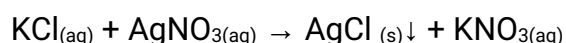
IV. True or False (If false give the correct statement):

1. Silver metal can displace hydrogen gas from nitric acid. - **False**
Correct statement: Silver metal cannot displace hydrogen gas from nitric acid.
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**
Correct statement: At the equilibrium of a reversible reaction, the concentration of the reactants and the products will not be equal.
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**

Correct statement: On dipping a pH paper in a solution, it turns into yellow. Then the solution is acidic.

V. Short answers 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.



Aqueous solution of KCl reacts with silver nitrate solution to give a white



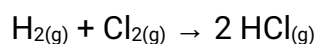
precipitate (curd like) and potassium nitrate.

2. Why does the reaction rate of a reaction increase on raising the 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.

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 otherwise called 'synthesis reaction' or 'composition reaction'.

Ex: Hydrogen gas combines with chlorine gas to form hydrogen chloride gas.



4. Differentiate reversible and irreversible reactions

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. Ans

1. What are called thermolysis reactions?

- In this type of reaction, the reactant is decomposed by applying heat.
- For Ex: On heating mercury (II) oxide is decomposed into mercury metal and oxygen gas.
- As the molecule is dissociated by the absorption of heat, it is otherwise called "Thermolysis".



- It is a class of compound to element / element decomposition. i.e a compound (HgO) is decomposed into two elements (Hg and Oxygen).



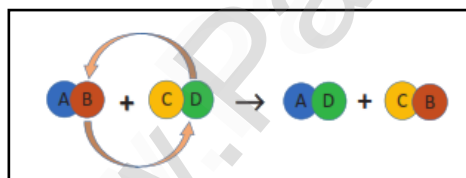
- Similarly, when calcium carbonate is heated, it breaks down into a calcium oxide and carbon dioxide. It is a type of compound to compound / compound decomposition.



- In thermal decomposition reaction, heat is supplied to break the bonds. Such reactions, in which heat is absorbed, are called "Endothermic reactions".

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

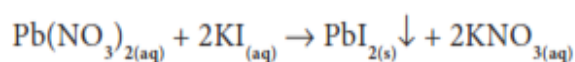
- When two compounds react with each other, if their ions are interchanged, then the reaction is called double displacement reaction.
- The ion of one compound is replaced by the ion of the another compound. Ions of identical charges are only interchanged.
- A cation can be replaced by other cation. This reaction is also called metathesis reaction.



- In double displacement reaction to take place, one of the products must be a precipitate (or) water. They are classified into two types. (i) Precipitate reaction and (ii) Neutralization reaction.

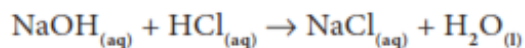
Precipitate Reaction:

- When the clear aqueous solutions of potassium iodide and lead II nitrate are mixed, a double displacement reaction takes place between them. Potassium and lead displace to one other and form a yellow precipitate of lead II iodide.



Neutralization reaction:

- Sodium hydroxide with hydrochloric acid is a typical neutralization reaction. Here sodium replaces hydrogen from hydrochloric acid forming sodium chloride and water.

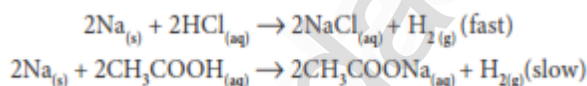


3. Explain the factors influencing the rate of a reaction.

The following important factors that affect rate of the reaction. They are (i) Nature of reactant, (ii) Concentration of the reactant, (iii) Temperature, (iv) Catalyst, (v) pressure, (vi) Surface area of the reactants.

Nature of reactant:

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.

**Concentration of the reactants:**

Changing the amount of the reactants also increases the reaction rate. 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 hence 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. Calcium carbonate reacts slowly with hydrochloric acid at room temperature. When the reaction mixture is heated the reaction rate increases.

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 frequency.

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. (Here, MnO_2 as a catalyst).

Surface area of the reactants:

When solid reactants are involve in a reaction, their powdered form reacts more readily. For example, 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.

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

- Living organisms can survive only in a narrow range of pH change. Different body fluids have different pH values.
- 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.
- Our stomach produces hydrochloric acid. It helps in the digestion of food without harming the stomach. During indigestion the stomach produces too much acid and this causes pain and irritation. pH of the stomach fluid is approximately 2.0.
- pH of the saliva normally ranges between 6.5 to 7.5.
- When the pH of the mouth saliva falls below 5.5, the enamel



gets weathered. Tooth pastes, which are generally basic, are used for cleaning the teeth that can neutralize the excess acid and prevent tooth decay.

- The pH of rain water is approximately 7, which means that it is neutral and also represents its high purity. If the atmospheric air is polluted with oxide gases of sulphur and nitrogen, they get dissolved in the rain water and make its pH less than 7. Thus, if the pH of rain water is less than 7, then it is called acid rain. When acid rain flows into the rivers it lowers the pH of the river water also.
- In agriculture, the pH of soil is very important. It depends upon the nature and the range of different soil, different crops are cultivated.

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

It is state of a reversible chemical reaction in which no change in the amount of the reactants and products take place. At equilibrium,

Rate of Forward reaction = Rate of Backward reaction.

Characteristics of equilibrium

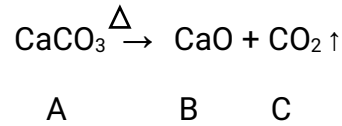
- ◆ In a chemical equilibrium, the rates of the forward and backward reactions are equal.
- ◆ The observable properties such as pressure, concentration, colour, density, viscosity etc., of the system remain unchanged with time.
- ◆ The chemical equilibrium is a dynamic equilibrium, because both the forward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

VII. HOTS 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. A solid compound 'A' is Calcium carbonate decomposes on heating into Calcium oxide (B) and a gas carbon dioxide (C). On passing this carbon

dioxide (C) through water, it becomes acidic because the formation of Carbonic acid.

(i) When calcium carbonate is heated, it breaks down into calcium oxide and carbon dioxide.



(ii) When carbon dioxide added with water it becomes carbonic acid.



Compound	Molecular formula	Name
A	CaCO ₃	Calcium Carbonate
B	CaO	Calcium Oxide
C	CO ₂	Carbon dioxide

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

No, Nickel spatula cannot be used to stir copper sulphate solution.

Reason: Nickel is more reactive than copper.

On stirring copper sulphate solution with Nickel, it will displace copper from its solution and copper will be deposited on the nickel spatula.



VIII. Problems:

<p>1. $p^H = 2$; H^+ = ?</p> $p^H = -\log_{10} [H^+]$ $-p^H = \log_{10} [H^+]$ $[H^+] = 10^{-p^H}$ $[H^+] = 10^{-2}$ <p>\therefore Concentration of H^+ ions is 1.0×10^{-2} mole litre⁻¹</p>	<p>2. $[H^+] = 1.0 \times 10^{-4} M$, $p^H = ?$</p> $p^H = -\log_{10} [H^+]$ $= -\log_{10} [1 \times 10^{-4}]$ $= -\log_{10} [10^{-4}]$ $= -[-4 \log_{10} 10]$ $p^H = 4 \quad [\because \log_{10} 10 = 1]$
<p>3. $[OH^-] = 1.0 \times 10^{-5} M$, $p^H = ?$</p> $p^{OH} = -\log_{10} [OH^-]$ $= -\log_{10} [1.0 \times 10^{-5}]$ $= -\log_{10} [10^{-5}]$ $= -[-5 \log_{10} 10]$ $p^{OH} = 5$ $p^H + p^{OH} = 14$ $p^H = 14 - p^{OH}$ $p^H = 14 - 5$ $p^H = 9$	<p>4. $[OH^-] = 1 \times 10^{-11} M$, $p^H = ?$</p> $p^{OH} = -\log_{10} [OH^-]$ $= -\log_{10} [1 \times 10^{-11}]$ $= -\log_{10} [10^{-11}]$ $= -[-11 \times \log_{10} 10]$ $p^{OH} = 11$ $p^H + p^{OH} = 14$ $p^H = 14 - p^{OH}$ $p^H = 14 - 11$ $p^H = 3$