



ACID, BASE and SALT

Short Answer Questions (Exercise)

1. Name the three common household substances having:

a. pH value greater than 7 b. pH value less than 7 c. pH value equal to 7

Ans. a). Mint has pH value greater than 7. b). Potatoes has pH value less than 7.

c). Water has pH value equal to 7.

2. Define a base and explain that all alkalis are bases, but all bases are not alkalis.

Ans. A substance which gives OH^- ions in aqueous solution is called base while every base which is soluble in water is called Alkali. It gives OH^- ions in aqueous solutions. Hence all alkalis are bases but all bases are not alkalis. For example; NaOH and KOH are alkalis as well as bases because these are soluble in water and give OH^- ions.

3. Define Bronsted-Lowry base and explain with an example that water is a Bronsted-Lowry base.

Ans. **Bronsted-Lowry Base:** The substance that can accept a proton (H^+) is called Bronsted-Lowry base. For example; $\text{HCl} + \text{H}_2\text{O} \rightleftharpoons \text{H}_3\text{O}^+ + \text{Cl}^-$

Acid Base Conjugate acid Conjugate base

In this reaction water as a base accept a proton (H^+) from HCl so water is Bronsted-Lowry base.

4. How you can justify that Bronsted-Lowry concept of acid and base is applicable to non-aqueous solutions?

Ans. According to Bronsted-Lowry concept an acid is a substance that can donate a proton (H^+). Base is a substance that can accept a proton (H^+). So for the expression of Bronsted-Lowry concept, aqueous solutions aqueous mediums are not necessary. Hence, Bronsted-Lowry concept of acid and base is applicable to non-aqueous solutions.

5. Which kind of bond is formed between Lewis acid and base?

Ans. Coordinate covalent bond is formed between Lewis acid and base. In this type of bond a pair of electrons is donated by a base and accepted by an acid.

6. Why H^+ ion acts as a Lewis acid?

Ans. According to Lewis, acid is a substance that can accept a pair of electrons. So H^+ ion by losing one electron have ability to accept a pair of electrons. Therefore H^+ will acts as a Lewis acid to accept a pair of electrons.

7. Name two acids used in the manufacture of fertilizers.

Ans. i) H_2SO_4 (Sulphuric acid) is used for manufacturing of ammonium sulphate and calcium superphosphate ii) HNO_3 (Nitric acid) is used for manufacturing of ammonium nitrate fertilizer

8. Define pH. What is the pH of pure water?

Ans. pH is the negative logarithm of molar concentration of the hydrogen ions.

$pH = -\log [H^+]$ The pH of pure water is 7.

9. How many times a solution of pH 1 will be stronger than that of a solution having pH 2?

Ans. A solution of pH 1 is 10 times stronger than that of a solution having pH 2. It is because low pH value means strong acid while high pH value means strong base and vice versa.

10. Define the following: i).Normal salt ii).Basic salt

Ans. Normal Salt is salt formed by the total replacement of ionizable H^+ ions of an acid by a positive metal ion is called normal or neutral salt. These salts are neutral to litmus.

For example, $HCl + KOH \longrightarrow KCl + H_2O$

Basic salt is formed by the incomplete neutralization of a polyhydroxy base by an acid. For example, $Al(OH)_3 + HCl \longrightarrow Al(OH)_2Cl + H_2O$

11. Na_2SO_4 is a neutral salt while $NaHSO_4$ is an acidic salt. Justify.

Ans. Na_2SO_4 is formed by complete replacement of H^+ ions from an acid. Therefore it is called neutral salt. E.g $H_2SO_4 + Na_2O \longrightarrow Na_2SO_4 + H_2O$

$NaHSO_4$ is formed by partial replacement of H^+ ion of an acid. Therefore it is called an acidic salt. $H_2SO_4 + NaOH \longrightarrow NaHSO_4 + H_2O$

12. Give a few characteristic properties of salts.

Ans. i) Salts are crystalline ionic compounds. ii) They are neutral compounds.

iii) They contain water of crystallization. For example $CuSO_4 \cdot 5H_2O$, $CaSO_4 \cdot 2H_2O$

iv) They have high melting point and boiling point.

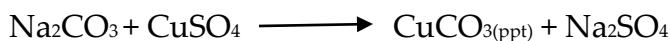
13. How are the soluble salts recovered from water?

Ans. The soluble salts are recovered from water by crystallization and evaporation.

Both processes can be used to recover the soluble salts from water.

14. How are the insoluble salts prepared?

Ans. When solutions of two soluble salts are mixed then exchange of ionic radicals take place to produce two new salts. One of the salts is soluble and other is insoluble. The insoluble salt precipitates out. For example, $\text{AgNO}_3 + \text{NaCl} \longrightarrow \text{AgCl}_{(\text{ppt})} + \text{NaNO}_3$



15. Why is a salt neutral, explain with an example?

Ans. Salt is a neutral compound because it is formed by the neutralization of an acid and a base. For example, $\text{NaOH} + \text{HCl} \longrightarrow \text{NaCl} + \text{H}_2\text{O}$

16. Name an acid used in the preservation of food.

Ans.i) Acetic acid (CH_3COOH) ii) Benzoic acid ($\text{C}_6\text{H}_5\text{COOH}$)

17. Name the acids present in: i. Vinegar ii. Ant sting iii. Citrus fruit iv. Sour milk

Ans. i) Acetic acid is present in vinegar.

ii) Formic acid is present in ant sting.

iii) Citric acid is present in citrus fruit.

iv) Lactic acid is present in sour milk.

18. How can you justify that $\text{Pb}(\text{OH})\text{NO}_3$ is a basic salt?

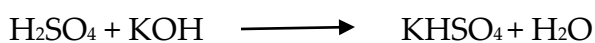
Ans. Basic salts are formed by the incomplete neutralization of polyhydroxy base with acid.



$\text{Pb}(\text{OH})\text{NO}_3$ contains (OH) group so it is basic salt.

19. You are in a need of an acidic salt. How can you prepare it?

Ans. Acidic salt is formed by partial replacement of replaceable H^+ ions by a positive metal ion.



20. Which is used to prepare plaster of Paris?

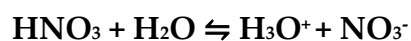
Ans. Calcium sulphate ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$) is used to prepare plaster of Paris. Plaster of Paris is used in cement at the ratio of 5%. It is also used for bandage of bone fracture and making of statues.

Long Answer Questions (Exercise)

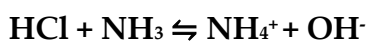
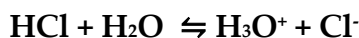
1. Define an acid and base according to Bronsted-Lowry concept and justify with examples water is an amphoteric compound.

Ans. Bronsted-Lowry concept of an acid:-According to Bronsted-Lowry concept, an acid is substance that can donate a proton (H^+) to another substance.

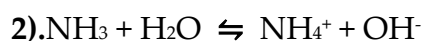
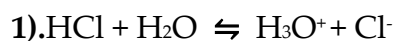
For example; $\text{HCl} + \text{H}_2\text{O} \rightleftharpoons \text{H}_3\text{O}^+ + \text{Cl}^-$



Bronsted-Lowry concept of a base:-According to Bronsted-Lowry concept, a base is a substance that can accept a proton (H^+) from another substance. e.g NH_3 , H_2O



Nature of water according to Bronsted-Lowry concept:-Substance that can behave as an acid, as well as base is called amphoteric compound. For example H_2O



In example 1. Water accept a proton (H^+) from HCl so, it is base.

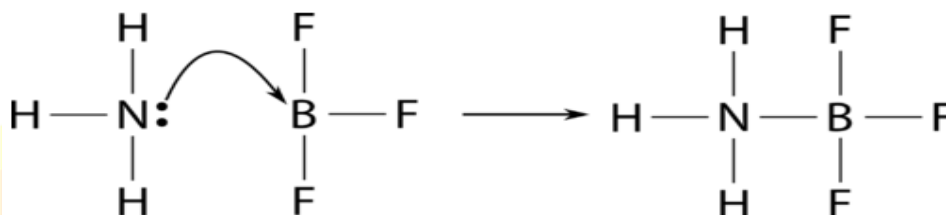
In example 2. Water donates proton(H^+) to NH_3 so, it is an acid.

2. Explain the Lewis concept of acids and bases.

Ans. Acid is a substance which can accept a pair of electrons. e.g H^+ , BF_3 , AlCl_3

Base is a substance which can donate a pair of electrons. e.g NH_3 , R-NH_2 , R-OH

A reaction between ammonia and boron trifluoride takes place by forming a coordinate covalent bond by donating and accepting a pair of electrons respectively.



In this example NH_3 donate a pair of electrons to BF_3 . So NH_3 acts as a Lewis-base and BF_3 acts as a Lewis-acid.

The product of any Lewis acid-base is a single species, called an adduct. So a neutralization reaction according to Lewis concept is donation and acceptance of an electron pair to form a coordinate covalent bond is an adduct.

A substance which has an unshared pair of electrons can acts as a Lewis base while a substance which has an empty orbital that can accommodate a pair of electrons acts as Lewis acid.

3. What is auto ionization of water? How is it used to establish the pH of water?

Ans.The process in which a compound or molecule ionize into its ions by itself is called auto ionization or self-ionization.



The equilibrium expression of this reaction is written as:

$$K_c = [\text{H}^+] [\text{OH}^-] / [\text{H}_2\text{O}]$$

$$\text{OR } K_c[\text{H}_2\text{O}] = [\text{H}^+] [\text{OH}^-]$$

A new equilibrium constant known as ionic product constant of water K_w is used instead of product of equilibrium constant and H_2O . Therefore $K_w = [\text{H}^+] [\text{OH}^-] = 1.0 \times 10^{-14}$ at 25°C

As we know one molecule of water produces one H^+ ion and one OH^- ion on dissociation. So

$$[\text{H}^+] = [\text{OH}^-]$$

$$\text{OR } [\text{H}^+]^2 = 1.0 \times 10^{-14}$$

$$[\text{H}^+] = \sqrt{1.0 \times 10^{-14}}$$

Therefore $[H^+] = 1.0 \times 10^{-7} M$ at $25^\circ C$

pH is the negative logarithm of molar concentration of hydrogen ion that is why;

So $pH = -\log [H^+]$

OR $pH = -\log [1 \times 10^{-7}]$

OR $pH = 7$

Similarly $pOH = -\log [OH^-]$

OR $pOH = -\log [1 \times 10^{-7}]$

OR $p-OH = 7$

p-H values normally varies from 0- 14 therefore $p-H + pOH = 14$

	Strongly acidic			Slightly acidic			Neutral			Slightly basic			Strongly basic		
p-H	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
p-OH	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

4. Define a salt and give characteristics properties of salts.

Ans. Salt is ionic compound generally formed by the neutralization of an acid with base.

e.g $NaOH + HCl \longrightarrow NaCl + H_2O$

Characteristics properties of salts:

i) Salts are crystalline ionic compounds. ii) They have high melting and boiling point.

iii) Most of the salts contain water of crystallization which is responsible for the shape of the crystals. Number of molecules of water is specific for each salt and they are written with the chemical formula of a salt.

For example, Copper sulphate $CuSO_4 \cdot 5H_2O$, Calcium sulphate $CaSO_4 \cdot 2H_2O$

iv) They are neutral compounds. Although, they do not compose of equal number of positive and negative ions, but have equal number of positive and negative charges.

5. Explain with examples that how soluble salts are prepared?

Ans. Preparation of soluble salts:- Soluble salts are often prepared in water. Therefore, they are recovered by evaporation or crystallization.

i) By the reaction of an acid and a metal:- This is direct displacement method in which

hydrogen ion of an acid is replaced by a reactive metal. Such as calcium, magnesium, zinc and iron. e.g. $HCl + Mg \longrightarrow MgCl_2 + H_2$

ii) By the reaction of an acid and a base:- It is a neutralization reaction in which acid and base react to produce a salt and water. For example; $HCl + NaOH \longrightarrow NaCl + H_2O$

iii) By the reaction of an acid and metallic oxide:- Mostly the insoluble metallic oxides react with dilute acids to form salt and water.

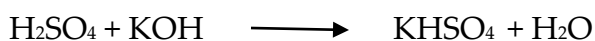
For example, $H_2SO_4 + CuO \longrightarrow CuSO_4 + H_2O$

iv) By the reaction of an acid and carbonate:- Dilute acids react with metallic carbonates to produce salts, water and carbon dioxide gas.

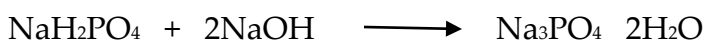
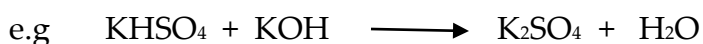
For example; $2HNO_3 + Na_2CO_3 \longrightarrow 2NaNO_3 + H_2O + CO_2$

6. Give the characteristics of acidic salts.

Ans. i). Acidic salts are formed by partial replacement of a replaceable H⁺ ion of an acid by a positive metal ion.



ii). Acidic salts turn blue litmus paper red. iii). Acidic salts react with bases to form normal salts.



7. Give four uses of calcium oxide.

Ans. i) CaO is used as drying agent for gases and alcohol and in steel making.

ii) CaO is used in water treatment and other chemicals like slaked lime, bleaching powder, calcium carbide.

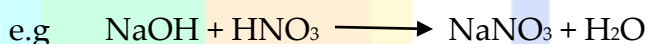
iii) CaO is used for purification of sugar.

iv) A mixture of CaO and NaOH called soda lime is used to remove CO₂ and water vapours from atmosphere.

8. You are having a strong acid (HNO₃) and strong base (NaOH) on mixing

i) What type of salt you will have?

Ans. On mixing a strong acid (HNO₃) and strong base (NaOH) a neutral salt is formed.



ii) What type of this reaction will be?

Ans. This reaction will be neutralization process.

iii) Will it be soluble or insoluble?

Ans. It will be soluble.

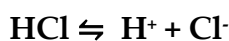
iv) If it is soluble, how it will be recovered?

Ans. This salt can be recovered by crystallization or evaporation.

9. Explain why: Give necessary equations.

i) HCl forms only one series of salt

Ans. Because it has only one ionizable proton (H⁺).



ii) H₂SO₄ forms two series of salts

Ans. Because it has two ionizable (H⁺) ions. $\text{H}_2\text{SO}_4 \rightleftharpoons 2\text{H}^+ + \text{SO}_4^{2-}$



iii) H₃PO₄ forms three series of salts

Ans. Because it has three ionizable (H⁺) ions. $\text{H}_3\text{PO}_4 \rightleftharpoons 3\text{H}^+ + \text{PO}_4^{3-}$

10. Classify the following salts are soluble or insoluble salts.

Ans.

Name	Solubility
i. Sodium Chloride	Soluble
ii. Silver Nitrate	Soluble
iii. Lead Chloride	Insoluble
iv. Copper Sulphate	Soluble
v. Barium sulphate	Insoluble
vi. Ammonium Chloride	Soluble
vii. Sodium Carbonate	Soluble
viii. Calcium Carbonate	Insoluble
ix. Ferric Chloride	Soluble
Magnesium Sulphate.	Insoluble

11. Complete and balance the following equations:

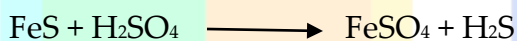
Ans. i. Aluminium + Hydrochloric acid \longrightarrow Aluminium chloride + Hydrogen



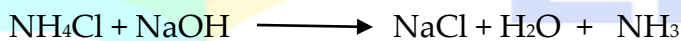
ii. Copper oxide + Sulphuric acid \longrightarrow Copper sulphate + Water



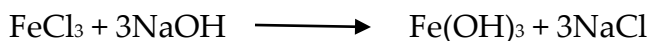
iii. Iron Sulphide + Sulphuric acid \longrightarrow Iron sulphate + Hydrogen Sulphide



iv. Ammonium chloride + Sodium hydroxide \longrightarrow Sodium chloride + Water + Ammonia



v. Ferric chloride + Sodium hydroxide \longrightarrow Ferric hydroxide + Sodium chloride



Additional short answer questions

1. Describe some general properties of acids.

Ans. Acids have sour taste, turn blue litmus red, corrosive in concentrated form and conduct electric current in their aqueous solutions.

2. Describe some general properties of bases.

Ans. Bases have bitter taste, turn red litmus blue, corrosive in concentrated form and conduct electric current in their aqueous solutions.

3. Name the acids present in: i. Rancid butter ii. Apples iii. Grapes iv. Fats

Ans. i) Butyric acid is present in Butter.

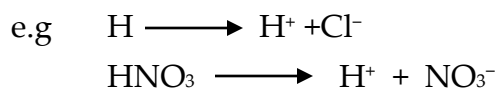
ii) Malic acid is present in apples.

iii) Tartaric acid is present in grapes.

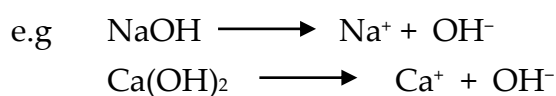
iv) Stearic acid is present in fats.

4. What do you know about Arrhenius concepts about acids and bases?

Ans. Acid is a substance which produces hydrogen ion (H^+) in the aqueous solution.



Base is a substance which produces hydroxide ion (OH^-) in the aqueous solution.



5. What is meant by dibasic acid and diacidic base?

Ans. The number of ionizable hydrogen ions (H^+) in an acid by a base is known as dibasic acid. The number of ionizable hydroxide ions (OH^-) in an acid by a base is known as diacidic base.

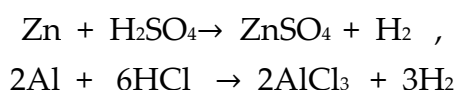
6. Why NH_3 acts as a Lewis base?

Ans. According to Lewis, base is a substance that can donate a pair of electrons. So NH_3 by sharing or donating two electrons have ability to donate a pair of electrons. Therefore NH_3 will act as a Lewis base to donate a pair of electrons.

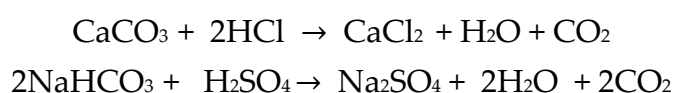
Additional long answer questions

1. Describe some chemical properties of acids.

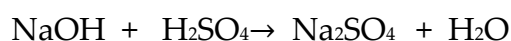
Ans. i). Reaction with metals:-



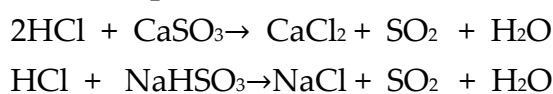
ii). Reaction with carbonates and bicarbonates:-



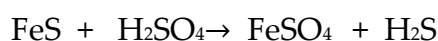
iii). Reaction with bases:-



iv). Reaction with sulphites and bisulphites:-



v). Reaction with sulphides:-



2. Describe uses of mineral acids in different fields.

Ans. i). Sulphuric acid (H_2SO_4) :- It is used in fertilizers, explosives, paints, dyes, drugs and batteries.

ii). Nitric acid (HNO_3):- It is used in fertilizers, explosives, paints, drugs and etching designs on copper plates.

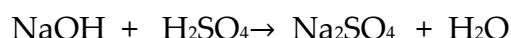
iii). Hydrochloric acid (HCl):- It is used for cleaning metals, tanning of hides and in printing industries.

iv). Benzoic acid ($\text{C}_6\text{H}_5\text{COOH}$):- It is used for food preservation.

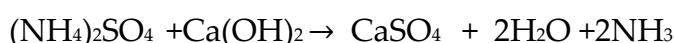
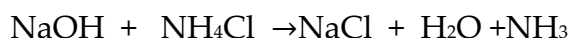
v). Acetic acid (CH_3COOH):- It is used for food flavouring and preservation. It is also used for pickle and to cure the sting of wasps.

3. Describe some chemical properties of bases.

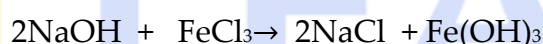
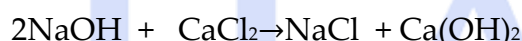
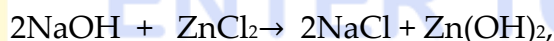
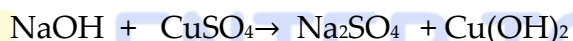
i). Reaction with acids:-



ii). Reaction with ammonium salts:-



iii). Precipitation of hydroxides:-



4. Describe uses of bases in different fields.

Ans. i). Sodium hydroxide (NaOH) :- It is used in manufacturing of soap.

ii). Calcium hydroxide ($\text{Ca}(\text{OH})_2$) :- It is used in manufacturing of bleaching powder, softening of hard water and in acidic soil.

iii). Magnesium hydroxide ($\text{Mg}(\text{OH})_2$) :- It is used for acidity of stomach and bee's sting.

iv). Aluminium hydroxide ($\text{Al}(\text{OH})_3$) :- It is used for fire extinguishing.

v). Ammonium hydroxide (NH_4OH) :- It is used to remove grease stains from clothes.

5. What are indicators and write about universal indicator?

Ans. Indicators are the organic compounds. They have different colour in acidic and alkaline solutions. Litmus paper is red in acidic solutions and blue in alkaline solutions.

Phenolphthalein is colourless in acidic solutions and red in alkaline solutions. Methyl orange is red in acidic solutions and yellow in alkaline solutions.

A mixed indicator is called universal indicator or simply pH indicator. The pH indicator is dipped in a solution and then it is compared with the scale given from 0 to 14.

6. What is pH meter and write its uses?

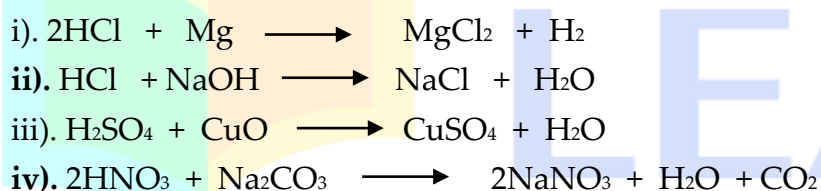
Ans. The pH of a solution can be measured with a pH meter. It consists of a pH electrode connected to a meter. The electrode is dipped into the solution and the meter shows the pH either on a scale or digitally.

- i). pH is used to determine acidic or basic nature of a solution.
- ii). It is used to produce medicines.
- iii). It is used to prepare solutions of required concentrations.

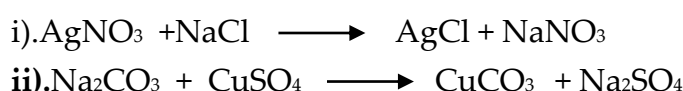


7. How soluble salts and insoluble salts are prepared?

Ans.i). Soluble salts:- Soluble salts are prepared in water and recovered by the process of crystallization and evaporation. Four types of preparation of soluble salts are there.

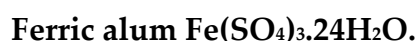
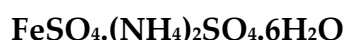


ii). Solutions of soluble salts are mixed to form one soluble salt and one insoluble salt.



8. Write about the double salts, mixed salts and complex salts.

Ans.i). Double salts:- Double salts are formed by two normal salts. e.g Mohr's salt



ii). **Mixed salts:-** Mixed salts contain more than one basic or acidic radicals. E.g Bleaching powder $\text{Ca}(\text{OCl})\text{Cl}$.

iii). **Complex salts:-** Complex salts on dissociation provides a simple cation and a complex anion or vice versa. e.g $\text{K}_4[\text{Fe}(\text{CN})_6]^{-4}$

9. Describe the common and industrial uses of salts.

Ans. i).Sodium chloride (NaCl):- It is used for cooking purposes and for manufacturing of sodium metal, caustic soda and washing soda.

ii).Sodium carbonate (Na_2CO_3):- It is used for manufacturing of glass, detergents, pulp, caustic soda, borax, soap and paper.

iii).Sodium sulphate (Na_2SO_4):- It is used for preparation of glass paper and detergents.

iv).Sodium silicate (Na_2SiO_3):- It is used for manufacturing of detergents and adhesives.

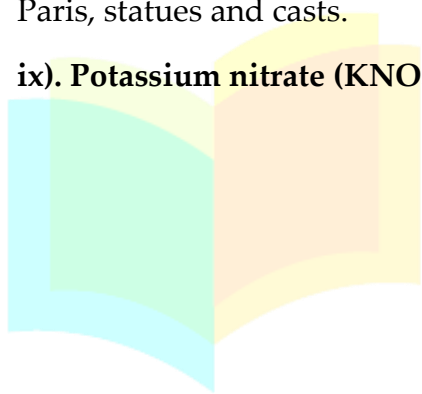
v).Sodium tetra borate ($\text{Na}_2\text{B}_4\text{O}_7$):- It is used for manufacturing of Pyrex glass, glazes, enamel and in leather industry.

vi). Calcium chloride (CaCl_2):- It is used as drying and freezing agent.

vii). Calcium oxide (CaO):- It is used for manufacturing of alcohol, steel making, slaked lime, bleaching powder, calcium carbide, sugar and soda lime.

viii). Calcium sulphate (CaSO_4):- It is used as fertilizer and for manufacturing of plaster of Paris, statues and casts.

ix). Potassium nitrate (KNO_3):- It is used as fertilizer and for manufacturing of flint glass.



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