



Chapter - 2

Acid, Bases And Salts

ACIDS :

- These are the substances which have sour taste.
- They turn blue litmus solution red.
- They give H^+ ions in aqueous solution.
- The term 'acid' has been derived from the Latin word, acidus, which means sour.

Strong Acids : HCl , H_2SO_4 , HNO_3

Weak Acids : CH_3COOH , Oxalic acid, Lactic acid

Concentrated Acid : Having more amount of acid + less amount of water

Dilute Acid : Having more amount of water + less amount of acid

BASES :

- These are the substances which are bitter in taste and soapy in touch.
- They turn red litmus solution blue.
- They give OH^- ions in aqueous solution.

Strong Bases : $NaOH$, KOH , $Ca(OH)_2$

Weak Bases : NH_4OH

Alkalies : These are bases which are soluble in water [$NaOH$, KOH , $Ca(OH)_2$].

SALTS :

These are the compounds formed from reaction of acid and base.

Example :

NaCl, KCl.

INDICATORS :

These are the substances which change their colour/smell in different types of substances.

TYPES OF INDICATORS

	Natural indicators		Synthetic indicators	
	S. No.	Indicator	Smell/Colour in acidic solution	Smell/Colour in basic solution
Natural Indicator	1.	Litmus	Red	Blue
	2.	Red cabbage leaf extract	Red	Green
	3.	Flower of hydrangea plant	Blue	Pink
	4.	Turmeric	No change	Red
Synthetic Indicator	1.	Phenolphthalein	Colourless	Pink
	2.	Methyl orange	Red	Yellow
Olfactory Indicator	1.	Onion	Characteristic smell	No smell
	2.	Vanilla essence	Retains smell	No smell
	3.	Clove oil	Retains smell	Loses smell

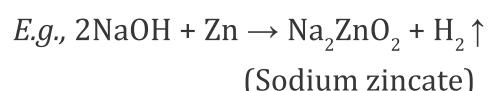
CHEMICAL PROPERTIES OF ACIDS AND BASES

Reaction of Metals with

Acids



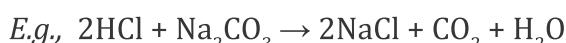
Bases



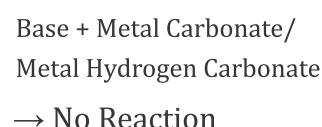
- * Hydrogen gas released can be tested by bringing burning candle near gas bubbles, it burst with pop sound.

Reaction of Metal Carbonates/Metal Hydrogen Carbonates with

Acids



Bases



* CO_2 can be tested by passing it through lime water.



When excess CO_2 is passed,



Reaction of Acids and Bases With Each Other



Neutralisation Reaction : Reaction of acid with base is called as neutralization reaction.



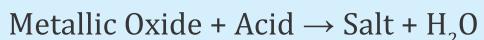
IF :



Reaction of Metallic Oxides with Acids

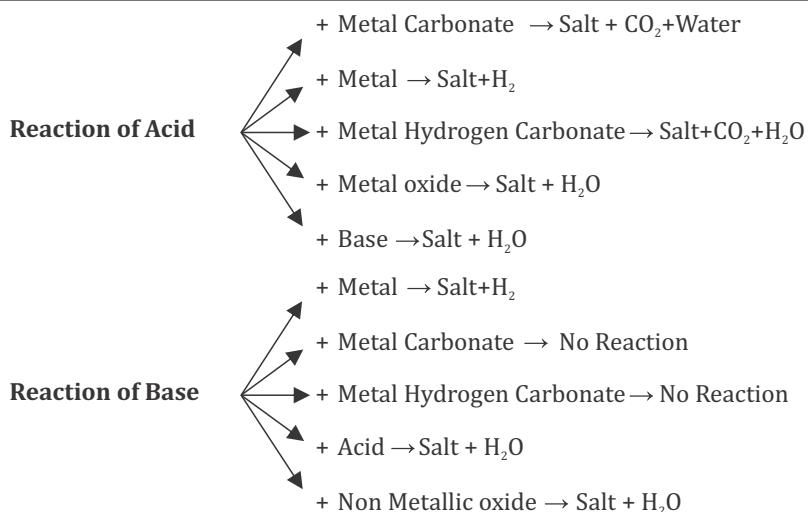
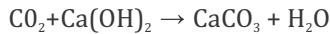
Metallic oxides are basic in nature.

E.g., CaO, MgO are basic oxides.



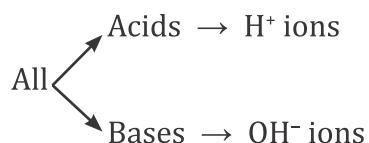
Reaction of Non-metalic Oxides with Bases

Non-metalic oxides are acidic in nature.



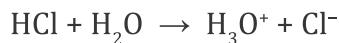
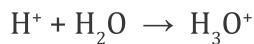
What do all Acids and Bases have in common

- All acids have H⁺ ions in common.
- Acids produce H⁺ ions in solution which are responsible for their acidic properties.
- All bases have OH⁻ (hydroxyl ions) in common.

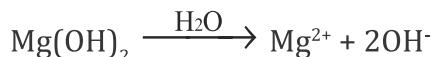
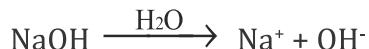


Acid or Base in Water Solution

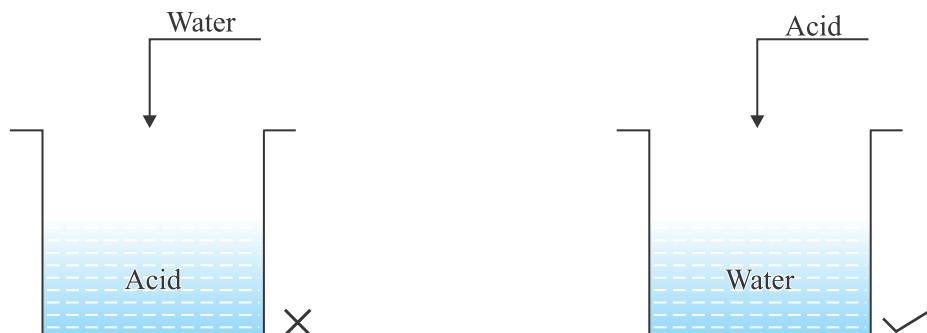
- Acids produce H^+ ions in presence of water.
- H^+ ions cannot exist alone, they exist as H_3O^+ (hydronium ions).



Bases when dissolved in water gives OH^- ions.



- Bases soluble in water are called alkali.
- While diluting acids, it is recommended that the acid should be added to water and not water to acid because the process of dissolving an acid or a base in water is highly exothermic.



If water is added to acid, the heat generated may cause the mixture to splash out and cause burns and the glass container may also break due to excessive local heating.

Adding water to acid may

Cause mixture to splash out

Break the glass container

Mixing an acid or a base with H_2O results in decrease of concentration of ions (H_3O^+/OH^-) per unit volume. Such a process is called as dilution.

Strength of Acid and Base

Strength of acid or base can be estimated using universal indicator.



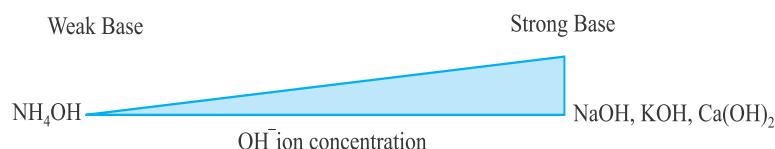
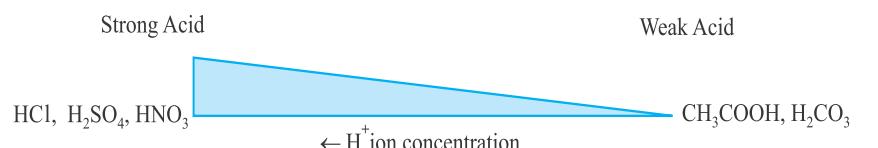
Universal indicator : is a mixture of several indicators. It shows different colours at different concentrations of H^+ ions in the solution.

pH Scale : A scale for measuring H^+ ion concentration in a solution . p in pH stands for 'potenz' a German word which means power.

pH = 7 → neutral solution

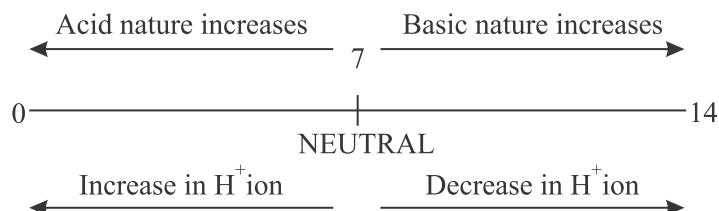
pH less than 7 → acidic solution

pH more than 7 → basic solution



On diluting an acid : pH increases ↑

On diluting a base : pH decreases ↓



Importance of pH in everyday life

- | | |
|--|---|
| 1. Plants and animals are pH sensitive | • Our body works within the pH range of 7-7.8.
• When pH of rain water is less than 5.6, it is called acid rain. |
| 2. pH of the soil | • Plants require a specific pH range for their healthy growth. |

3. pH in our digestive system	<ul style="list-style-type: none"> Our stomach produces HCl acid which helps in digestion. During indigestion, stomach produces more acid and cause pain and irritation. To get rid of this pain, people uses antacid (mild base) like milk of magnesia $[\text{Mg}(\text{OH})_2]$ to neutralize excess acid.
4. pH change as cause of tooth decay	<ul style="list-style-type: none"> Tooth decay starts when pH of mouth is lower than 5.5. Tooth enamel made up of calcium phosphate (hardest substance in body) does not dissolve in water but corrodes when pH is lower than 5.5 due to acids produced by degradation of food particles by bacteria. Using toothpaste (generally basic) tooth decay can be prevented.
5. Self defence by animals and plants through chemical warfare	<p>(a) Bee sting leaves an acid which cause pain and irritation. Use of a mild base like baking soda on stung area gives relief.</p> <p>(b) Stinging hair of nettle leaves inject methanoic acid causing burning Sensation or pain. Rubbing with leaf of dock plant give relief.</p>

pH of Salts :

- (i) Strong Acid + Strong Base \rightarrow Neutral Salt : pH = 7 eg. NaCl
- (ii) Salt of strong acid + Weak base \rightarrow Acidic salt : pH < 7 eg. NH_4Cl
- (iii) Salt of strong base + Weak acid \rightarrow Basic salt : pH > 7 eg. $\text{CH}_3\text{COO}\text{Na}$



Chemicals from Common Salt (NaCl)

1.	2.	3.	4.	5.
Sodium Hydroxide (NaOH)	Bleaching Powder (CaOCl ₂)	Baking Soda (NaHCO ₃)	Washing Soda (Na ₂ CO ₃ ·10H ₂ O)	Plaster of Paris (CaSO ₄ ·½H ₂ O)

1. Sodium Hydroxide (NaOH) : When electricity is passed through an aqueous solution of NaCl (brine), it decomposes to form NaOH. (Chlor-alkali process)

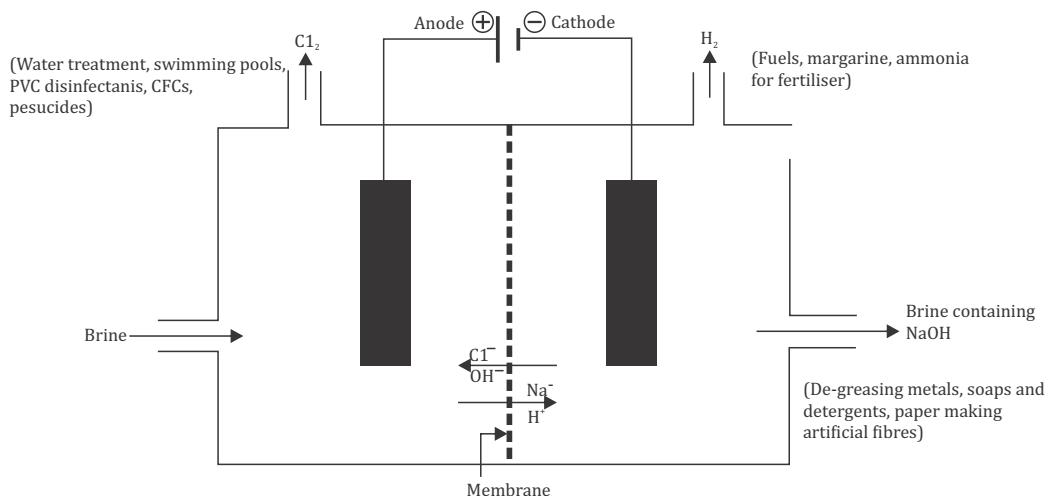


Figure 2.8 Important products from the chlor-alkali process



At anode : Cl₂ gas

At cathode : H₂ gas

Near cathode : NaOH solution is formed.

Uses :

H₂ : Fuels, margarine

Cl₂ : Water treatment, PVC, CFC's

HCl : Cleaning steels, medicines

NaOH : Degreasing metals, soaps and paper making

Cl₂ + NaOH → Bleach : Household bleaches, bleaching fabrics

2. Bleaching Powder (CaOCl_2) : It is produced by the action of chlorine on dry slaked lime.



Uses :

- (a) Bleaching cotton and linen in textile industry
- (b) Bleaching wood pulp in paper factories.
- (c) Oxidizing agent in chemical industries.
- (d) Disinfecting drinking water.

3. Baking Soda (Sodium Hydrogen Carbonate) (NaHCO_3) :



Baking soda

- It is mild non-corrosive base.
- When it is heated during cooking :



Uses :

- (a) For making baking powder (mixture of baking soda and tartaric acid). When baking powder is heated or mixed with water, CO_2 is produced which causes bread and cake to rise making them soft and spongy.
- (b) An ingredient in antacid.
- (c) Used in soda acids, fire extinguishers.

4. Washing Soda ($\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$) : Recrystallization of sodium carbonate gives washing soda. It is a basic salt.



Uses :

- (a) In glass, soap and paper industry.
- (b) Manufacture of borax.
- (c) Cleaning agent for domestic purposes.
- (d) For removing permanent hardness of water.



5. Plaster of Paris (Calcium sulphate hemihydrates) ($\text{CaSO}_4 \cdot \frac{1}{2}\text{H}_2\text{O}$) :

On heating gypsum ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$) at 373K, it loses water molecules and becomes Plaster of Paris (POP).

It is a white powder and on mixing with water it changes to gypsum.



Uses :

- (a) Doctors use POP for supporting fractured bones.
- (b) For making toys, material for decoration.
- (c) For making surfaces smooth.

Water of Crystallization : It is a fixed number of water molecules present in one formula unit of a salt.

E.g., $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ has 5 water molecules.

$\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$ has 10 water molecules.

$\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ has 2 water molecules.

VERY SHORT ANSWER TYPE QUESTION 1 MARK

- Q. 1 To protect tooth decay we are advised to brush our teeth regularly. The nature of tooth paste used is-
- a) acidic b) neutral c) basic d) corrosive
- Q. 2 A compound x in aqueous solution turns red litmus solution into blue Identify 'x'
- a) Hydrochloric acid b) Ammonium hydroxide sol
 - c) Sodium chloride solution d) Vinegar
- Q. 3 Which one is stronger acid with pH=5 or with pH=2.
- Q. 4 What happens when chlorine is passed over dry slaked lime.

(CBSE-2010, 2011)

- Q. 5 Dry HCl gas does not change the colour of dry blue litmus paper why?
- Q. 6 Fill in the blanks-
- a) The chemical formula of plaster of paris is _____.
 - b) Neutral substances have a pH=_____.
 - c) Gold can be dissolved in _____.
 - d) Commonly used antacid is _____.

Q.7 Given below are the results of solutions tested with universal paper indicator.

Sulphuric acid	Red
Metal polish	Dark blue
Washing up liquid	Yellow
Milk of Magnesia	Light blue
Oven cleaner	Purple
Car battery acid	Pink

Arrange the solutions with increasing pH values.

Q.8 Complete the following reaction-

- I) $\text{Na}_2\text{CO}_3 + \text{HCl} \longrightarrow$
- ii) $\text{NaOH} + \text{HCl} \longrightarrow$
- iii) $\text{CuO} + \text{HCl} \longrightarrow$
- iv) $\text{Zn} + \text{NaOH} \longrightarrow$
- v) $\text{Ca}(\text{OH})_2 + \text{Cl}_2 \longrightarrow$

Q.9 Fill the missing data in following table

	Name of salt	Salt obtained from		
		Formula	Base	Acid
1	Ammonium chloride	NH_4Cl	NH_4OH	_____
2	Copper sulphate	CuSO_4	_____	H_2SO_4
3	Sodium Chlorede	NaCl	NaOH	_____
4	Magnesium Nitrate	$\text{Mg}(\text{NO}_3)_2$	_____	HNO_3
5	Potassium sulphate	K_2SO_4	_____	_____
6	Calcium nitrate	$\text{Ca}(\text{NO}_3)_2$	$\text{Ca}(\text{OH})_2$	_____

Q.10 Classify into strong and weak acid-

Hydrochloric acid, Formic acid nitric acid, acetie acid, Sulphuric acid, citric acid (NCERT Exemplar)

Answer

- 1 c)
- 2 b)



11. Name the acid present in ant sting.
12. What happens when egg shell is added to nitric acid ?
13. Name a salt which does not contain water of crystallization.
14. Name two constituents of baking powder.
15. What is the pH of gastric juices released during digestion ?
16. Which solution is used to dissolve gold ?
17. How will you test a gas which is liberated when HCl acid reacts with an active metal ?
18. Why does flow of acid rain water into a river make the survival of aquatic life in the river difficult ?
19. When conc. acid is added to water, whether the process is exothermic or endothermic ?
20. Which by-product of chlor-alkali process is used for manufacturing bleaching powder ?

Practical Based MCQ's

1. On putting a drop of liquid on a pH paper a student observer a small patch of blue color on pH paper. The liquid is most probably-
a) H_2O b) HCl c) NaOH d) H_2SO_4
2. The correct method of finding the pH of solution is—
 - a) Heat the solution in test-tube and expose the pH paper to the vapours formed—
 - b) Pour solution on pH paper
 - c) Dip the pH paper in solution
 - d) Put a drop of solution on pH paper using dropper (CBSE-2011)
3. The colour obtained on pH paper for highly acid basic and neutral solutions are respectively.
 - a) blue, orange, green
 - b) yellow, blue, green

- c) red, blue, green
d) red, green, blue
4. Four student- 'A', 'B', 'C' and D measured pH value of water, lemon juice and sodium bicarbonate solution. The student who has expressed correct pH values in decreasing order.
- a) Water > lemon juice > Sod. bicarbonate solution
 - b) Lemon juice > Water > Sod. bicarbonate solution
 - c) Sod. bicarbonate solution > water > lemon juice
 - d) Water > Sod. bicarbonate solution > lemon juice (CBSE-2010)
5. If we add some sodium carbonate in distilled water, the pH of solution will be-
- a) less than 7
 - b) more than 7
 - c) exactly 7
 - d) very close to 7
6. Dil HCl is added to sodium carbonate. It is observed that:-
- a) No change takes place
 - b) A loud sound is produced immediately
 - c) Immediately a brick effervescence occur
 - d) The solution turns black.
7. A student added Zn grannules to dil HCl and made following observations:-
- I) The surface of Zn become black
 - ii) A colourless gas evolved which burns with pop/sound
 - iii) The solution remains colurless

The correct observations are-

- a) I and II b) I and III c) II and III d) I, II and III

8. Four students performed reactions of zinc and sodium carbonate with dil Hydrochloric acid sodium hydroxide and present their result as follows.

The (✓) represent evolution of gas and 'x' represent no reaction.



	Zn	Na_2CO_3
A	✓	✓
	Zn	Na_2CO_3
NaOH	✓	✗

	Zn	Na_2CO_3
B	✓	✗
	Zn	Na_2CO_3
NaOH	✓	✓

	Zn	Na_2CO_3
C	✗	✗
	Zn	Na_2CO_3
NaOH	✓	✓

	Zn	Na_2CO_3
D	✓	✓
	Zn	Na_2CO_3
NaOH	✗	✗

The right set of observation is

- a) A b) B c) C d) D

9. A colourless and odourless gas is liberated when hydrochloric acid is added to solution of Sod. carbonate. The name of gas is -

- a) Carbon di oxide
b) Nitrogen dioxide
c) Sulphur dioxide
d) Sulphur trioxide

10. When did HCl reacts with Zn metal the gas liberated is -

- a) Oxygen b) Nitrogen c) Chlorine d) Hydrogen

Answer

- 1 c)
2 d)
3 d)
4 c)
5 b)
6 c)
7 a)
8 a)
9 a)
10 d)

Assertion Reasoning Based Questions

1. A gas is produced when cone H_2SO_4 is added to solid sodium chloride taken in a test-tube. The gas coming out through the delivery tube is passed over a dry blue litmus paper.
 - I. Blue colour of litmus changes into Red
 - II. Blue colour of litmus does not change into
 - i) I is correct
 - ii) II is correct
 - iii) I and II both are correct
 - iv) I and II both are wrong
2. A white coloured powder is used by the doctors for supporting fractured bones-
 - I. It is plastic of Paris
 - II. It is Gypsum
 - i) I is correct
 - ii) II is correct
 - iii) Both I and II are correct
 - iv) Both I and II are wrong



SHORT TYPE QUESTIONS (3 Marks)

1. Why does bleaching powder smell strongly of chlorine and does not dissolve completely in water ?
2. Hold one moist and one dry strip of blue litmus paper over dry HCl acid gas. Which strip will turn red and why ?
3. What is Plaster of Paris ? How is it obtained from gypsum ?
4. What is the role of toothpastes in preventing cavities ?
5. Explain why sour substances are effective in cleaning copper vessels ?
6. A white powder is added while baking breads and cakes to make them soft and fluffy. What is the name of the powder ? What are its main ingredients ?
7. How washing soda is prepared from baking soda ?
8. Though the compounds such as glucose and alcohol have hydrogen atoms in their molecule, yet they are not categorized as acids. Why ?
9. What is the reaction called when an acid reacts with base to produce salt and water ? Give example also.
10. Why pickles and curd are not stored in copper and brass utensils ?
11. On passing excess CO_2 through lime water, it first turns milky and then becomes colourless. Explain why ? Write chemical equations.
12. How are bases different from alkalis ? Are all bases alkalis ?
13. While constructing a house, a builder selects marble flooring and marble top for kitchen where vinegar and juices of lemon, tamarind etc. are more often used for cooking. Will you agree to this selection and why ?
14. Indicate with the help of a diagram the variation of pH with change in concentration of H^+ (aq) and OH^- (aq) ions.
15. Write the name and formulae of three hydrated salts.
16. What happens when calcium carbonate is made to react with hydrochloric acid ? Give the equation of reaction.

17. Why metallic oxides are called basic oxides and non-metallic oxides are called acidic oxides ?
18. What is pH scale ? What is pH value of salt formed by a
(a) weak acid and strong base ?
(b) strong acid and strong base ?
- Q.19 A metal compound 'A' reacts with dil H_2SO_4 to produce a gas which extinguishes a burning candle. Identify compound 'A' and gas produced. Write a balanced chemical equation for the reaction if one of compound formed is sodium sulphate (CBSE-2016)
- Q.20 The pH of salt used to make tasty and crispy pakoras is 14. Identify and write the chemical equation for its formation list its two uses.
(CBSE-2018)
- Q.21 A compound which is prepared by gypsum has the property of hardening when mixed with water identify and write its chemical formulae. Write the chemical equation for preparation and mention any one use of it? (CBSE sample paper-2018)
- Q.22 Identify the acid and base which form sodium hydrogen carbonate. Write the chemical equation in support of your answer state whether the compound is acidic, basic or neutral. Also write the pH. (CBSE-2019)
- Q.23 A compound 'x' on heating with excess of conc. H_2SO_4 also react with Na metal to give colourless gas 'z' Identify 'x' 'y' and 'z' and also write the equation for formation of 'y' and also write the role of conc H_2SO_4 in the reaction (CBSE-2018)
- Q.24 2ml of sodium hydroxide solution is added to few pieces of granulated Zn metal taken in test-tube. When the contents are warmed, a gas is evolved which is bubbled through soap solution before testing. Write the equation of chemical reaction involved and test to detect gas. Name the gas which will be evolved when same metal reacts with solution of strong acid.
(CBSE-2018)



LONG ANSWER TYPE QUESTIONS (5 Marks)

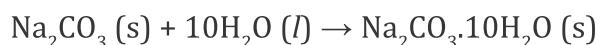
1. What is water of crystallization? Write the common name and chemical formula of a commercially important compound which has ten water molecules. How is this compound obtained? Write chemical equations also. List any two uses of this compound.
2. Identify the compound X on the basis of the reactions given below. Also, write the name and chemical formulae of A, B and C.



3. An element P does not react with dil. H_2SO_4 . If forms an oxide PO which turns red litmus into blue. Will you call P as a metal or a non-metal? Give reason.
4. What is bleaching powder chemically. How it is prepared. What happens when bleaching powder is exposed to air for long time? Give any two important uses of bleaching powder.

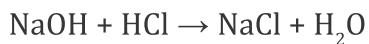
Hints to Long Answer Type Questions

1. Washing soda ($\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$)

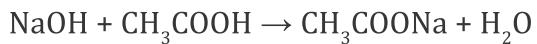


2. $2\text{NaOH} + \text{Zn} \rightarrow \text{Na}_2\text{ZnO}_2 + \text{H}_2$

(X) (A)



(B)



(C)

3. 'P' is a metal.