Uses of Acids

(i) In batteries of cars and invertors. Sulphuric acid is used in automobile batteries.
(ii) In manufacture of synthetic fibres and plastics.
(iii) In preparing dyes, detergents, glucose from starch, fertilisers, explosives, etc.
(iv) For descaling pipes and cleaning metal surfaces and sanitary wares.
(v) Acetic acid is used in flavouring food items like pickles.

BASES

Bases are compounds which taste bitter example milk of magnesia. Ammonium hydroxide, or ammonia water, is very irritating to the nose and the eyes. This substance, called a hydroxide, or a base, is often used in home for cleaning.

Common Bases are

Base	Occurrence
Sodium hydroxide	Soap
Calcium hydroxide	Lime water
Potassium hydroxide	Soap
Ammonium hydroxide	Window cleaning solution
Magnesium hydroxide	Milk of Magnesia

Concentrated base : A base that has a relatively high percentage of the base in the aqueous solution is classified as a concentrated base.

Dilute base : A base, which has a relatively low percentage of the base dissolved in the aqueous solution, is classified as a dilute base.

Strong bases gives a large number of hydroxide ion or gets completely ionized when dissolved in water. For example, sodium hydroxide and potassium hydroxide.

Weak bases give lesser number of hydroxide ions or gets partially ionized. When dissolved in water. For example, ammonium hydroxide.

Properties of Bases

Physical properties :

(i) They have a bitter taste.

(ii) Soluble bases are good conductors of electricity.

(iii) They are soapy liquids, slippery to touch.

(iv) They are corrosive in nature. e.g. KOH, NaOH(caustic alkalies)

Chemical Properties :

(i) Reaction of metals with bases : Metals (e.g. Zn, Al, Sn) dissolve in NaOH (an alkali) to liberate hydrogen gas.

$$Zn + 2NaOH \longrightarrow \underset{\text{[Sod. Zincate]}}{Na_2ZnO_2} + H_2$$

(ii) Action with acids : Bases combine with acids to form salt and water only. It is a *neutralisation reaction.*

$$3NaOH(aq) + H_3PO_4(aq) \longrightarrow Na_3PO_4(aq) + 3H_2O(l)$$

Phosphoric acid — Trisodium phosphate

Uses of Bases

(i) Magnesium hydroxide and calcium hydroxide are used as antacid to neutralize acidity in the stomach.

(ii) A clear solution of calcium hydroxide is known as lime water, and commonly used as laboratory reagent.

(iii) Sodium hydroxide (caustic soda) is used in manufacturing of soap, synthetic fibres like rayon.

- Basicity of an acid does not depend upon the number of H atoms present but upon number of replaceable H atoms. For example, acetic acid (CH_3COOH) has four H atoms. But only one is replaced. It is monobasic in nature. Phosphoric acid (H_3PO_4) has three H atoms and all of them can be replaced. It is a tribasic acid.

  For acids, we use the term basicity because H^+ ions of the acid can be replaced only when it reacts with a base. Similarly, the term acidity is used for bases because OH^- ions of the base can be replaced only when it reacts with an acid.

- When water is added to the acid or a base, it results in decrease in concentration of $H^+(H_3O^+)$ or

OH^- per unit volume. Such a process is known as **dilution.**

(i) Process of dissolving acids or bases in water is exothermic.

(ii) Care must be taken while mixing concentrated nitric acid or sulphuric acid with water. The acid must always be added to water with constant stirring. If water is added to a concentrated acid, the heat generated may cause the mixture to splash out and cause burns.

- A substance which gives different colour in acidic and basic media and helps to differentiate the two types is known as an **Indicator.** Natural indicators can be extracted from a wide variety of flowers, fruits, roots, leaves and other parts of plants
- **Litmus** (a natural dye) is one of the most common and naturally available indicator. It is extracted from lichens (combination of alga and tungus). When this litmus is added to an acidic solution, it turns red and when added to a basic solution, it turns blue.
- **Tumeric powder (*haldi*),** which is used for flavouring food is also used as an natural indicator. Turmeric (*curcuma longa*) is a rhizomatous herbaceous perennial plant of ginger family. Turmeric stains turns red when washed with soap solution (basic media).
- **China rose** is obtained from a shrubby chinese rose (*Rosa Chinesis*). China rose indicator is prepared by keeping the *gudhal* petals in warm water for some time. The solution becomes coloured after some time and acts as an indicator. China rose indicator gives brown color in acidic media and green color in basic media.
- ***Phenolphthalein*** is a synthetic indicator. It turns colorless in acidic solutions and pink in basic solutions. If the concentration of indicator is particularly strong, it can appear purple.
- ***Methyl orange*** is also a synthetic indicator used more oftenly because of clear colour change. In a solution becoming less acidic, methyl orange moves from red to orange and finally to yellow with the reverse occuring for a solution increasing in acidity.

OH^- per unit volume. Such a process is known as **dilution.**

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- ***Universal indicators*** : It is a mixture of indicators often sold readymade as solution which can indicate pH values, usually over a range of 3-11, by successive changes of colour. The universal indicator show different colours at different concentrations of hydrogen ions in solution. For measurement of hydrogen ion concentration in a solution we generally use a **pH Scale.**

pH SCALE

It is a scale that is used for measuring H^+ ion (Hydrogen ion) concentration of a solution.
The term pH stands for "potential" of "hydrogen". It is the *amount of hydrogen ions in a particular solution.*

For acids pH < 7

For bases pH > 7

For neutral substances pH = 7

Importance of pH in Daily Life

(i) **Blood pH** : For proper functioning our body needs to maintain blood pH between 7.35 and 7.45. Values of blood pH greater than 7.8 or less than 6.8 often results in death.

(ii) **Acid rain** : When pH of rain water is less than 5.6, it is called acid rain. Rain containing excess of acids is called an acid rain. Rain becomes acidic when pollutants like carbon dioxide, sulphur dioxide and nitrogen dioxide are released into the atmosphere and these oxides dissolve in rain drops to form carbonic acid, sulphuric acid and nitric acid, respectively. Acid rain causes huge damage to buildings, historical monuments, especially marble structures etc.

(iii) **pH in our digestive system** : We know that hydrochloric acid (HCl) produced in our stomach helps in digestion of food without harming stomach. However excess of acid causes indigestion and leads to pain as well as irritation. To get rid of this people use bases called "antacids". A popular antacid is "Milk of magnesia" which is insoluble magnesium hydroxide, $Mg(OH)_2$.

(iv) **pH of the soil** : For their healthy growth plants require a specific pH. Farmers use fertilisers to improve crop yield. But excessive use of fertilisers

makes the soil acidic. Plants do not grow well in either too acidic or too basic soil. If the soil is too acidic, basic quick lime (calcium oxide) or slaked lime (calcium hydroxide) is added to it. If the soil is too basic, organic matters that releases acids are added to it, to neutralise basic nature of soil.

(v) **pH change as the cause of tooth decay :** Tooth decay starts when the pH of mouth is lower than 5.5. Tooth enamel, made up of calcium phosphate is the hardest substance in the body. It does not dissolve in water, but is corroded when the pH in mouth is below 5.5.

(vi) **Self defence by animals and plants through chemical warfare :** We have already learnt that bee-sting leaves an acid (formic acid or methanoic acid, HCOOH) which causes pains and irritation. To get relief from it we apply a mild base like baking soda.

- Many factories wastes are acidic in nature. If it is allowed to flow into the water bodies, it causes huge damage to water plants and animals. Therefore, all factory waste should be neutralised by adding basic substances berfore releasing into the water bodies.

Approximate pH values of some common substances:

Substance	pH value	Substance	pH value
Hydrochloric acid	1.0	Bread	5.5
Sulphuric acid	1.2	Potatoes	5.8
Gastric juice	2.0	Rain water	6.2
Lemon	2.3	Milk	6.6
Vinegar (Acetic acid)	2.8	Pure water	7.0
Soft drink	3.0	Egg	7.8
Apple	3.1	Sea water	8.5
Grape	3.1	Ammonium hydroxide	11.1
Tomato	4.2	Sodium hydroxide	13.0
Banana	4.6		
Battery acid,	0	Stomach acid,	1
Baking soda, $NaHCO$	8	Washing soda, Na_2CO	9
Milk of magnesia, $Mg(OH)_2$	10	Aqueous household ammonia, NH	11
Limewater, $Ca(OH)$	12	Drano, 0.1 M $NaOH$	13
Drano, 1.0 M $NaOH$	14		

SALTS

A **salt** is an *ionic compound* which dissociates to yield a positive ion other than hydrogen ion (H^+) and negative ion other than hydroxyl ion (OH^-) e.g.

$$\underset{\text{(fused / aqueous solution)}}{NaCl} \longrightarrow Na^+ + Cl^-$$

Classification of Salts

(i) Acidic Salt : If a polybasic acid (Example, H_2SO_4, H_3PO_4, H_2SO_3 etc.) is neutralised partly by a base, the salt formed is acidic.

$$H_2CO_3 + NaOH \longrightarrow NaHCO_3 + H_2O.$$

(ii) Normal Salt : In case the acid and base neutralise completely the salt formed is a normal salt.

$$\underset{\text{(Carbonic acid)}}{H_2CO_3} + 2NaOH \rightarrow \underset{\text{(Normal salt)}}{Na_2CO_3} + H_2O$$

(iii) Basic Salts : This type of salts are formed by incomplete neutralization of a base with an acid or by partial replacement of hydroxy radicals of a diacids or triacidic base with an acid radical.

$Pb(OH)NO_3$ - Basic lead nitrate.

$$[Pb(OH)_2 + HNO_3 \longrightarrow Pb(OH)NO_3 + H_2O]$$

(iv) Double Salt - Such a salt is formed by mixing saturated solution of two simple salts followed by crystallisation of the saturated solution.

Example : $FeSO_4(NH_4)_2SO_4.6H_2O$ — Mohr's salt – it is a mixture of $FeSO_4$ (Simple salt) and $(NH_4)_2\ SO_4$ (Simple salt)

(v) Complex salt- Such a salt is formed by mixing saturated solution of simple salts followed by crystallisation of the solution similar to double salts.

Potassium mercuric iodide - $K_2[HgI_4]$

Simple ion - K^+

Complex ion - $[HgI_4]^{2-}$

Sodium Hydroxide (NaOH) or Caustic Soda

It is prepared on commercial scale by the electrolysis of strong solution of sodium chloride (NaCl) also called **brine.** The process is called **chlor-alkali process.**

The overall reaction taking place is :

$$2NaCl\,(aq) + 2\,H_2O(\ell) \longrightarrow H_2(g) + Cl_2(g) + 2NaOH\,(aq)$$

Chlorine gas is given off at the anode, and hydrogen gas at the cathode. Sodium hydroxide solution is formed near the cathode.

Uses

(i) Sodium hydroxide is most used base in the laboratory.

(ii) It is used in many industries, mostly as strong chemical base in manufacture of pulp and paper, textiles, drinking water, soap and detergents etc.

(iii) It is used as a *drain cleaner.*

Baking Soda, Sodium Hydrogen Carbonate, ($NaHCO_3$)

It is produced using sodium chloride as one of the raw materials.

$$NaCl + H_2O + CO_2 + NH_3 \longrightarrow NH_4Cl + NaHCO_3$$

When heated the following reaction occurs

$$2\,NaHCO_3 \xrightarrow{heat} Na_2CO_3 + H_2O + CO_2$$

Uses :

(i) **In baking powder :** The most practical use of baking soda is as a *leavening agent in baking.* In combination with a liquid and an acid, baking soda undergoes a chemical reaction that releases bubbles of carbon dioxide. Trapped in butter these carbon dioxide bubbles enable the baked food to rise.

(ii) **As an antacid :** The cause of acidity is presence of excess HCl in stomach. Baking soda reacts with acid due to its alkaline nature and neutralizes acidity (i.e. acts as an antacid).

$$NaHCO_3 + HCl \longrightarrow NaCl + H_2O + CO_2$$

(iii) **In fire extinguishers :** It is used in *soda-acid fire exinguisher:* In soda acid fire extinguishers, CO_2, formed by the action of H_2SO_4 on baking soda, expells water from the fire extinguisher which exinguishes the fire.

- During summer, the milkmen usually add a very small amount of baking soda to fresh milk. It acts as a preservative. Actually in hot weather milk is expected to decompose and release lactic acid which is likely to make milk sour. Baking soda

($NaHCO_3$) reacts with acid to form salt and water. In this way it neutralises the acid and the milk does not become sour.

Washing Soda, $Na_2CO_3 . 10H_2O$, Sodium Carbonate

Sodium carbonate can be obtained by heating baking soda; recrystallisation of sodium carbonate gives washing soda. It is also a basic salt.

$$Na_2CO_3 + 10H_2O \longrightarrow Na_2CO_3 \cdot 10H_2O$$

Sodium carbonate — Hydrated sodium carbonate (Washing soda),

Uses :

(i) Sodium carbonate (washing soda) is used in glass, soap and paper industries.

(ii) It is used in the manufacture of sodium compounds such as borax.

(iii) It is used for removing permanent hardness of water.

Bleaching Powder

Calcium hypochlorite is a chemical compound with formula $CaOCl_2$. It is a yellowish powder with smell of chlorine. It is widely used for water treatment and as a bleaching agent (bleaching powder). It is a yellow white solid which has a strong smell of chlorine.

Manufacture of bleaching powder : It is manufactured by the following method.

$$2Ca(OH)_2 + 2Cl_2 \longrightarrow CaOCl_2 + CaCl_2 + 2H_2O$$

Uses:

(i) Calcium hypochlorite is used for the disinfection of drinking water or swimming pool water.

(ii) Calcium hypochlorite (known as 'bleaching powder') is also used for bleaching cotton and linen and used in the manufacture of chloroform.

Plaster of Paris, $CaSO_4 . 1/2\ H_2O$

It can be obtained by heating gypsum ($CaSO_4 . 2H_2O$) i.e. by calcination of gypsum.

$$(CaSO_4 . 2H_2O) + \text{heat} \longrightarrow (CaSO_4 . \tfrac{1}{2}H_2O) + \tfrac{1}{2}H_2O$$

Plaster of paris is a white powder and on mixing with water it changes to gypsum once again giving a hard solid mass.

$$CaSO_4 + 2\,H_2O \rightarrow CaSO_4.\,2H_2O.$$

Uses : It is used

(i) for interior decoration. As a false ceiling, studio sets etc.

(ii) for making moulds or casts for toys, pottery, cermics etc.

(iii) in surgical bandages for setting fractured bones.

(iv) in setting up of air-tight apparatus by sealing the gaps.

- Plaster of Paris must be always stored in air-tight bags. In case moisture is present, it will slowly change into gypsum which is very hard. This means that it will no longer be useful either for setting fractured bones or in making moulds.

Hygroscopy

The property of a substance to absorb moisture when exposed to atmosphere at ordinary temperature but do not dissolve in it is known as **hygroscopy** and such a substance is known as hygroscopic substance e.g. Anhydrous calcium chloride ($CaCl_2$), Conc.H_2SO_4, phosphorous pentoxide (P_2O_5), quick lime (CaO) etc.

- Aqua regia consists of 3 parts HCl to 1 part HNO_3 ,it is an Excellent oxidant ,Can dissolve gold and platinum ,it produces yellow fumes from the reaction of HCl and HNO_3 to produce nitrosyl chloride, NOCl, chlorine gas, Cl_2, and water, H_2O.

Exercise

DIRECTIONS : This section contains multiple choice questions. Each question has 4 choices (a), (b), (c) and (d) out of which only one is correct.

1. Ammonium hydroxide is a weak base because
   (a) it has low vapour pressure
   (b) it is only slightly ionised
   (c) it is not a hydroxide of any metal
   (d) it has low density
2. On passing excess of carbon dioxide through lime water
   (a) milkiness of lime water increases
   (b) there is no change in milkiness of lime water
   (c) milkiness of lime water disappears
   (d) None of the above is correct.
3. HCl gas changes the colour of
   (a) dry litmus paper
   (b) wet litmus paper
   (c) Both dry and wet litmus paper
   (d) None of the above is correct
4. Which of the following is an alkali ?
   (a) $Ca(OH)_2$
   (b) KOH
   (c) $Mg(OH)_2$
   (d) $CaCO_3$
5. The poisonous effect of acid present in stings of bees and ants can be neutralised by use of a solution that contains
   (a) acetic acid
   (b) formic acid
   (c) sodium hydroxide
   (d) sodium chloride.
6. When the stopper of a bottle containing colourless liquid was removed, the bottle gave smell like that of vinegar. The liquid in the bottle could be
   (a) hydrochloric acid
   (b) sodium hydroxide solution
   (c) acetic acid solution
   (d) saturated sodium hydrogen carbonate solution
7. The colour of pH paper when put in distilled water changed to green. Now some common salt is added to water and pH paper is tested in this solution. The colour of pH paper in this case is likely to be

(a) green
(b) yellow
(c) red
(d) blue

8. A drop of liquid sample was put on pH paper. The colour of pH paper turned blue. The liquid sample could be
(a) lemon juice
(b) hydrochloric acid
(c) sodium hydrogen carbonate
(d) ethanoic acid.

9. Which of the following is not required to find the pH of a given sample ?
(a) pH paper
(b) Litmus paper
(c) Universal indicator
(d) Standard pH chart

10. Universal indicator solution is named as such because
(a) it is available universally
(b) it has a universal appearance
(c) it can be used for entire pH range
(d) All the above are correct

11. The pH of gastric juice that is released during digestion is
(a) more than 7
(b) 7
(c) less then 7
(d) can't be predicted

12. Acids and bases are important because of
(a) their use in industry
(b) their effects on human health
(c) their effect on farmer's crop
(d) All the above are correct.

13. Which of the following is a weak base ?
(a) NaOH
(b) KOH
(c) NH_4OH
(d) None of these

14. A salt derived from strong acid and weak base will dissolve in water to give a solution which is
(a) acidic
(b) basic
(c) neutral
(d) None of these

15. Plaster of Paris is made from
    (a) lime stone
    (b) slaked lime
    (c) quick lime
    (d) gypsum
16. Chemical formula of baking soda is
    (a) $MgSO_4$
    (b) Na_2CO_3
    (c) $NaHCO_3$
    (d) $MgCO_3$
17. Washing soda has the formula
    (a) $Na_2CO_3.7H_2O$
    (b) $Na_2CO_3.10H_2O$
    (c) $Na_2CO_3.H_2O$
    (d) Na_2CO_3
18. Plaster of Paris hardens by
    (a) giving of CO_2
    (b) changing into $CaCO_3$
    (c) combining with water
    (d) giving out water
19. Which of the following is 'quicklime'?
    (a) CaO
    (b) $Ca(OH)_2$
    (c) $CaCO_3$
    (d) $CaCl_2.6H_2O$
20. Plaster of Paris has the formula
    (a) $CaSO_4.1/2H_2O$
    (b) $CaSO_4.H_2O$
    (c) $CaSO_4.1.1/2H_2O$
    (d) $CaSO_4.2H_2O$
21. Which of the following compounds is neutral to litmus ?
    (a) $NaNO_3$
    (b) $CuSO_4.5H_2O$
    (c) $NaHCO_3$
    (d) $Ca(OH)_2$
22. The pH is less than 7 of the solution of
    (a) $FeCl_3$
    (b) NaCN
    (c) NaOH
    (d) NaCl
23. A compound whose aqueous solution will have the highest pH—

(a) NaCl
(b) Na_2CO_3
(c) NH_4Cl
(d) $NaHCO_3$

24. If pH of A, B, C and D are 9.5, 2.5, 3.5 and 5.5 respectively, then strongest acid is
(a) A
(b) C
(c) D
(d) B

25. Aqueous solution of which of the following salt will change the colour of red litmus to blue?
(a) Na_2CO_3
(b) $Na_2CO_3.10H_2O$
(c) Both of these
(d) None of these

26. If the tartaric acid is not added in baking powder, sometimes the cake has a bitter taste. This bitter taste is due to which of the following compounds present in cake?
(a) $NaHCO_3$
(b) Na_2CO_3
(c) CO_2
(d) All of these

27. Which of the following is known as dead burnt plaster?
(a) Quick lime
(b) Slaked lime
(c) Lime stone
(d) Gypsum

28. Select the reaction that is called *'slaking of lime'*
(a) $CaCO_3 \longrightarrow CaO + CO_2$
(b) $CaO + 2HCl \longrightarrow CaCl_2 + H_2O$
(c) $CaCO_3 + H_2O \longrightarrow Ca(OH)_2 + CO_2$
(d) $CaO + H_2O \longrightarrow Ca(OH)_2$

29. Which of the following pairs of substances are chemically same?
(a) Lime water and milk of lime
(b) Dead burnt plaster and gypsum
(c) Both the above
(d) None of the above is correct

30. Baking powder is
(a) a mixture
(b) a compound

(c) an element
(d) a salt

31. The chemical name of bleaching powder is
(a) calcium chloride
(b) calcium oxychloride
(c) calcium chloroxide
(d) none of these

32. Which of the following is not a hydrated salt?
(a) Blue vitriol
(b) Baking soda
(c) Washing soda
(d) Epsom salt

33. Select the one that does not give $CO_2(g)$ when treated with dil H_2SO_4.
(a) Marble
(b) Lime stone
(c) Lime
(d) Baking soda

34. When HCl (g) is passed through water, it
(a) does not ionise in solution
(b) ionises in solution
(c) gives both hydrogen ions and hydroxyl ions in solution.
(d) None of the above is correct

35. Which of the following indicators is colourless in acidic medium?
(a) Methyl orange
(b) Turmeric powder
(c) Litmus
(d) Phenolphthalein

36. An indicator that turns reddish-brown when dissolved in soap solution is
(a) litmus
(b) china rose
(c) turmeric powder
(d) None of these

37. Which of the following is a strong acid:
(a) Acetic acid
(b) Citric acid
(c) Nitric acid
(d) Tartaric acid

38. The presence of which of the following acid causes indigestion:

(a) Citric acid
(b) Oxalic acid
(c) Acetic acid
(d) Hydrochloric acid

39. When few drops of lemon are mixed with milk
(i) it turns sour
(ii) no change takes place
(iii) properties of milk are changed
(iv) properties of milk remain same
Which of the above statements is/are correct?
(a) (ii) & (iii)
(b) (i) & (ii)
(c) (i) & (iii)
(d) (i) only

40. Which of the following is a strong base?
(a) Ammonium hydroxide (NH_4OH)
(b) Sodium hydroxide (NaOH)
(c) Water (H_2O)
(d) Sulfuric acid (H_2SO_4)

41. Acids are ..... in taste while bases are ..... in taste
(a) sweet, salty
(b) sweet, sour
(c) sour, salty
(d) sour, bitter

42. A base which dissolves in water is called
(a) soluble base
(b) alkali
(c) acid
(d) oxide

43. Choose the correct statement(s)
(i) Most of the acids are water soluble
(ii) Acids react with metallic oxides and hydroxides to form metallic salt and water only.
(iii) Acids react with metallic carbonates to form metallic salt and hydrogen gas and water
(iv) Acetic acid is used as a food preservative
(a) (i) & (ii) only
(b) (iii) & (iv)
(c) (i), (ii) & (iv)
(d) all the above

44. Acid rain is caused due to .....
(a) CO_2, O_2, SO_2
(b) CO_2, NO_2, H_2

(c) SO_2 N_2, O_2
(d) CO_2, SO_2, NO_2

45. The acidic soil which is not good for healthy growth of plants, is neutralized by
(a) ammonium hydroxide (NH_4OH)
(b) calcium oxide (CaO)
(c) sodium hydroxide (NaOH)
(d) magnesium hydroxide ($Mg(OH)_2$

46. Acid contained in the sting of an ant is.....
(a) acetic acid
(b) formic acid
(c) lactic acid
(d) ascorbic acid

47. Natural indicator litmus is extracted from
(a) lichens
(b) earthworms
(c) ants
(d) algae

48. The industrial waste is ..... in nature
(a) acidic
(b) basic
(c) neutral
(d) both (a) & (b)

49. When vinegar reacts with baking soda the gas evolved is
(a) hydrogen
(b) oxygen
(c) carbon dioxide
(d) nitrogen dioxide

50. Which of the following gas is evolved on reaction of dilute hydrochloric acid with sodium sulphite?
(a) Carbon dioxide
(b) Hydrogen
(c) Sulphur dioxide
(d) Sulphur trioxide

51. On which of the following acid rain has adverse effects?
(a) Marble structures
(b) Historical monuments
(c) Aquatic life
(d) All of these

52. Which of the following is acidic salt(s)
(i) Sodium bisulphate
(ii) Potasium chloride

(iii) Potassium bisulphite
(iv) Sodium carbonate
(a) (i), (ii) and (iv)
(b) (ii) and (iv)
(c) (i), (ii) and (iii)
(d) (i) and (iii)

53. pH of human body varies within the range of
(a) 6.0 to 6.5
(b) 5.5 to 5.8
(c) 7.0 to 7.8
(d) 7.0 to 11.0

54. Calamine solution contains
(a) zinc hydroxide
(b) zinc carbonate
(c) sodium hydrogen carbonate
(d) magnesium hydroxide

55. Why bases are kept in glass bottles?
(a) Bases produce OH^- ions in aqueous solutions
(b) Basic solutions are conducting in nature
(c) Bases are corrosive in nature
(d) Basis have soapy texture

56. Which of the following statement regarding bases is false?
(a) Bases produce hydroxide ions when dissolved in water
(b) Bases are soapy to touch
(c) Bases are extremly corrosive in nature
(d) Basic solutions are non conducting in nature

57. Which of the following statement is true?
(a) Acids are bitter in taste
(b) Bases are sour in taste
(c) The reaction between acid and a base is exothermic reaction
(d) The reaction between an acid and a base is endothermic reaction.

58. Which of the following statement is false?
(a) China rose is a natural indicator
(b) Repeated cultivation by farmers makes soil acidic
(c) Ant or bee sting contains acetic acid
(d) Majorly factories waste are acidic in nature

59. Which of the following is the best explanation of statement; Ammonium hydroxide is a commonly used alkali

(a) It is a weak base insoluble in water
(b) It is a weak base soluble in water
(c) It is a strong base insoluble in water
(d) It is a strong base soluble in water

60. What happens when a solution of an acid is mixed with a solution of a base in a test tube ?
(i) The temperature of the solution increases
(ii) The temperature of the solution decreases
(iii) The temperature of the solution remains the same
(iv) Salt formation takes place
(a) (i) only
(b) (i) and (iii)
(c) (ii) and (iii)
(d) (i) and (iv)

61. A sample of soil is mixed with water and allowed to settle. The clear supernatant solution turns the pH paper yellowish-orange. Which of the following would change the colour of this pH paper to greenish-blue?
(a) Lemon juice
(b) Vinegar
(c) Common salt
(d) An antacid

62. If a few drops of a concentrated acid accidentally spills over the hand of a student, what should be done?
(a) Wash the hand with saline solution
(b) Wash the hand immediately with plenty of water and apply a paste of sodium hydrogencarbonate
(c) After washing with plenty of water apply solution of sodium hydroxide on the hand
(d) Neutralise the acid with a strong alkali

63. Common salt besides being used in kitchen can also be used as the raw material for making
(i) washing soda
(ii) bleaching powder
(iii) baking soda
(iv) slaked lime
(a) (i) and (ii)
(b) (i), (ii) and (iv)
(c) (i) and (iii)
(d) (i), (iii) and (iv)

64. To protect tooth decay we are advised to brush our teeth regularly. The nature of the tooth paste commonly used is
(a) acidic
(b) neutral
(c) basic
(d) corrosive

65. Which of the following is(are) true when HCl (g) is passed through water?
(i) It does not ionise in the solution as it is a covalent compound.
(ii) It ionises in the solution
(iii) It gives both hydrogen and hydroxyl ion in the solution
(iv) It forms hydronium ion in the solution due to the combination of hydrogen ion with water molecule
(a) (i) only
(b) (iii) only
(c) (ii) and (iv)
(d) (iii) and (iv)

66. Which one of the combination is completely correct

	(A) Name of contents	(B) Chemical formula	(C) Use
1)	Lactic acid	$CH_3-\underset{\displaystyle OH}{\underset{\vert}{CH}}-COOH$	Used as a food preservative
2)	Citric acid	$C_6H_8O_7$	Present in lemon, orange etc
3)	Sulphuric acid	H_2SO_4	Commonly used in automobile batteries
4)	Sodium hydroxide	NaOH	Used for manufacturing of soaps
5)	Potassium hydroxide	KOH	Used for manufacturing of fertilizers

(a) 1, 4, 3
(b) 2, 3, 4
(c) 2, 4, 5
(d) 1, 3, 5

67. What is correct for following ?
(i) Lemon Juice
(ii) Solution of washing soda

(iii) Toothphaste
(iv) Stomach Juices
(v) Vinegar

(a) i, iv, v are acids and ii, iii are bases
(b) ii, iii are acids i, iv, v are bases
(c) i, iii, iv, v are acids and ii is a base
(d) i, ii, iii are acids and iv, v are bases

Hints & SOLUTIONS

1. **(b)**
2. **(c)**
3. **(b)**
4. **(b)** Alkali is a base which are water soluble.
5. **(c)** Sodium hydroxide being a base neturalises the acid.
6. **(c)**
7. **(a)** NaCl solution in water is neutral i.e., pH = 7, the same as that of distilled water as NaCl is a salt of strong acid and strong base.
8. **(c)** The blue colour of pH paper indicates basic nature of solution. Only sodium hydrogen carbonate solution show basic nature, all others are acidic.
9. **(b)** Litmus paper does not give any information about the pH values.
10. **(c)** It can be for entire pH range.
11. **(c)** Gastric juice is acidic.
12. **(d)**
13. **(c)** NH_4OH as it is not get completely ionized in aqueous solution.
14. **(a)**
15. **(d)**
16. **(c)**
17. **(b)**
18. **(c)**
19. **(a)**
20. **(a)**
21. **(a)** $NaNO_3$ as it is a salt of strong acid and strong base. $Ca(OH)_2$ is a base $CuSO_4.5H_2O$ is a salt of weak base and strong acid while $NaHCO_3$ is a salt of strong base and weak acid so they all effects litmus.
22. **(a)**
23. **(b)** Na_2CO_3 when react with water form strong base and weak acid. So its aqueous solution is highly basic and thus it has highest pH.
24. **(d)** Less the pH, more acidic is the solution. The pH of acid B is 2.5 which is minimum.
25. **(c)**
26. **(b)**
27. **(b)**
28. **(d)**
29. **(a)**
30. **(a)**
31. **(b)**
32. **(b)**
33. **(c)**

34. **(b)** It gives H^+ ions which combine with water to produce H_3O^+ ions and Cl^- ions
35. **(d)** Phenolphthalein gives color in basic media. It gives pink colour.
36. **(c)**
37. **(c)** As HNO_3 is a mineral acid.
38. **(d)**
39. **(c)** When lemon juice is mixed with milk the milk turns sour and changes into 'paneer'. The properties of milk are completely different from that of 'paneer'.
40. **(b)** Sodium hydroxide (NaOH) is a strong base while ammonium hydroxide (NH_4OH) is a weak base. Water is neutral in nature, neither acidic nor basic.
41. **(d)** All acids are sour in taste, like tartaric acid in tamarind and acetic acid in vinegar while all bases are bitter in taste like baking soda.
42. **(b)** Bases soluble in water are called alkalis. Only the oxides of sodium, potassium, and calcium are soluble in water, so these form sodium hydroxide potassium hydroxide and calcium hydroxide. These are the strongest bases.
43. **(c)** The third statement is wrong because acid reacts with metal carbonates to form metallic salt, carbon dioxide gas and water
44. **(d)** Acid rain is caused due to increased pollution in the air. The poisonous gases like sulphur dioxide, carbon dioxide and nitrogen dioxide react with water to form sulphuric acid, carbonic acid and nitric acid respectively.
45. **(b)** Acidic soil is harmful for the plants as the plants cannot grow well in it. So the soil is neutralized by adding a base, calcium oxide (CaO)
46. **(b)** The sting of an ant contains formic acid. Its effect can be neutralized by rubbing moist baking soda on the affected part.
47. **(a)** Natural indicator is obtained from lichens and is purple in colour. It turns acidic solution red and basic solution blue.
48. **(a)** Usually the factory wastes are acidic in nature and are neutralized by adding basic substances. The acidic waste can kill fishes when released in water bodies.
49. **(c)** Vinegar is acetic acid and baking soda is sodium hydrogen carbonate (a base). Whenever an acid re-

acts with a metal carbonate it produces carbon dioxide gas.

$$CH_3COOH + NaHCO_3 \longrightarrow CH_3COONa + H_2O + CO_2$$

50. **(c)** Acids on reaction with sulphites and bisulphites produces sulphur dioxide.

$$\underset{\text{Sodium sulphite}}{Na_2SO_3\,(aq)} + \underset{\text{hydrochloric acid}}{2HCl\,(aq)} \longrightarrow \underset{\text{sodiumchloride}}{2NaCl\,(aq)} + \underset{\text{water}}{H_2O(l)} + \underset{\text{sulphuri dioxide}}{SO_2(g)\uparrow}$$

51. **(d)** Acid rain effects all of them. Acid rain corrodes historical monuments and marble structures. Acid rain alter the pH of water bodies by making it more acidic thus affects acquatic plants and animals.

52. **(d)** Sodium bisulphate ($NaHSO_4$) and potassium bisulphite ($KHSO_3$) both are acidic salts.

53. **(c)**

54. **(b)**

55. **(c)**

56. **(d)** Basic solutions are conducting in nature. Conduction depends on the number of hydroxide ions produced when dissolved in water.

57. **(c)** This reaction is exothermic i.e. Heat is evolved

$$HCl + NaOH \rightarrow NaCl + H_2O + Heat$$

58. **(c)** Ant or bee sting contains formic acid

59. **(b)**

60. **(d)** $HCl + NaOH \longrightarrow NaCl + H_2O + Heat$

61. **(d)**

62. **(b)** Acid burns should be neutralised with mild bases like $NaHCO_3$. Neutralizing acid spills with strong bases, such as NaOH can cause a violent exothermic reaction, and the base itself can cause just as much damage as the original acid spill.

63. **(c)** $NaCl + H_2O + CO_2 + NH_3 \longrightarrow NH_4Cl + NaHCO_3$

Baking soda

$$2NaHCO_3 \xrightarrow{\text{heat}} Na_2CO_3 + H_2O + CO_2$$

$$\underset{\text{Sodium carbonate}}{Na_2CO_3} + 10\,H_2O \longrightarrow \underset{\substack{\text{Hydrated sodium carbonate}\\ \text{(washing soda)}}}{Na_2CO_3.10\,H_2O}$$

64. **(c)**

65. **(c)** Though HCl gas is a covalent compound, in the aqueous solution it ionizes to form H^+ (aq) and Cl^- (aq) ions.

66. **(b)**

67. **(a)** Lemon juice contains citric acid. Stomach juice contains HCl vinegar contains CH_3COOH. Washing soda solution and toothpaste are basic.

Chapter 5 Metals and Non-Metals

METALS AND NON-METALS

There are more than 114 elements present in the periodic table. These elements can be broadly classified into two categories i.e., metals and non-metals. Out of 114 elements, 22 are non-metals.

METALS

Physical Properties of Metals

(i) They are usually shiny i.e. have a metallic luster.
(ii) Metals have a high density
(iii) Metals are ductile i.e. they can be drawn into wires.
(iv) Metals are malleable i.e. they can be founded into thin sheets.
(v) Metals are good conductors of electricity.
(vi) Metals have high melting point and are generally in solid state at room temperature.
(vii) Metals are good conductors of heat and sound.

Chemical Properties of Metals

(i) Reaction of metals with acids: Metals can react with acid in a single displacement reaction to make hydrogen gas and an aqueous solution of a salt.

$$Zn(s) + \text{dil } H_2SO_4(aq) \rightarrow ZnSO_4(aq) + H_2(g)\uparrow$$

Hydrogen gas is not evolved when a metal reacts with nitric acid. It is because HNO_3 is a strong oxidising agent. It oxidises the H_2 produced to water and itself gets reduced to any of the nitrogen oxides (N_2O, NO, NO_2).

(ii) Reaction of metal, with solutions of other metal salts:

Some metals are more reactive than others. Such metals can displace less reactive metals from their compounds in solution or molten form.

$$Zn + CuSO_4(aq) \longrightarrow ZnSO_4(aq) + Cu(s)$$

The relative electron releasing tendencies of some metals are summed up in the **Activity series** also called **Reactivity series.**

K = Potassium (Most reactive)	Most reactive
Na = Sodium	
Ba = Barium	
Ca = Calcium	
Mg = Magnesium	
Al = Aluminium	
Zn = Zinc	
Cr = Chromium	
Fe = Iron	
Cd = Cadmium	
Co = Cobalt	
Ni = Nickel	Reactivity
Sn = Tin	Decreases
Pb = Lead	
H = Hydrogen	
Cu = Copper	
Hg = Mercury	
Ag = Silver	
Au = Gold	
Pt = (Platinum) (least reactive)	↓ Least reactive

- Metals above hydrogen in the activity series give out hydrogen gas on reaction with a dilute acid such as HCl, H_2SO_4 etc. These are called **active metals.**
- Metals placed below hydrogen in activity series do not evolve hydrogen on reaction with dilute acids. These are considered as **inactive metals**.
- Metals like gold and platinum placed at the bottom of activity series are known as **Noble metals** and they are chemically very little reactive.

(iii) Reaction with oxygen (formation of oxides) :

Many metals burn in the oxygen of the air to produce a metal oxide.

$$2Mg(s) + O_2(g) \longrightarrow 2MgO(s)$$

Many metals over a period of time tarnish in air. The metal slowly reacts with the oxygen of the air forming a dull layer of the metal oxide on the surface of the metal.

The reactivity series :

K-Potassium Na-Sodium Ca-Calcium Mg-Magnesium	Burn very easily with a bright flame

Al-Aluminium
Zn-Zinc
Fe-Iron
Pb-Lead
Cu-Copper
} React slowly with air when heated

Ag-Silver
Au-Gold
} No reaction

(iv) Action of metal oxide with water : Oxides of some metals (i.e. Na, K, Mg etc.,) dissolve in water to yield soluble hydroxides known as **alkalies** e.g.

$$Na_2O(s) + H_2O(l) \longrightarrow 2NaOH(aq)$$

Oxides of same metals (e.g. Ca, Al etc.) do react with water but the corresponding hydroxides are not soluble in water. They remain as suspension. These hydroxides are known as **bases** e.g.,

$$CaO(s) + H_2O(l) \longrightarrow Ca(OH)_2(s)$$

$$Al_2O_3(s) + 3H_2O(l) \longrightarrow 2Al(OH)_3(s)$$

(v) Action of metal oxide with acids : Metal oxides react with acids to form corresponding salts and water e.g.

$$CaO(s) + 2HCl(aq) \longrightarrow CaCl_2(aq) + H_2O(l)$$

The oxides which exhibit the characteristics of both acids and bases are known as **amphoteric oxides** e.g., ZnO, Al_2O_3 etc.

$$ZnO(s) + 2NaOH(aq) \longrightarrow Na_2ZnO_2(aq) + H_2O(l)$$

(base) Sod. zincate

(vi) Reaction of metals with water : Metals react with water and produce a metal oxide and hydrogen gas. Metal oxides that are soluble in water dissolve in it to further form metal hydroxide. But all metals do not react with water.

Metals like potassium and sodium react violently with cold water. In case of sodium and potassium, the reaction is so violent and exothermic that the evolved hydrogen immediately catches fire.

$$2K(s) + 2H_2O(l) \rightarrow 2KOH(aq) + H_2(g) + \text{heat energy}$$

The reaction of calcium with water is less violent.

$$Ca(s) + 2H_2O(l) \longrightarrow Ca(OH)_2(aq) + H_2(g)$$

Metals like aluminium, iron and zinc do not react either with cold or hot water. But they react with steam to form the metal oxide and hydrogen.

$$2Al(s) + 3H_2O(g) \longrightarrow Al_2O_3(s) + 3H_2(g)$$

$$3Fe(s) + 4H_2O(g) \longrightarrow Fe_3O_4(s) + 4H_2(g)$$

Uses of Metals

(i) Metals are very important for modern humans it is not possible to imagine our life without them.

(ii) Metals are used in manufacturing of bridges, railways, aeroplanes, diesel mobile units (DMU), electric mobile units (EMU), motor cars, electric motors, telephones, televisions, interplanetary space vehicles, or even common articles like cooking utensils and coins.

(iii) Metals are very important for the economy of a country. Some metals, such as titanium, chromium, manganese and zirconium are strategic metals. These metals and their alloys find wide applications in atomic energy, space science projects, jet engines and high grade steels.

(iv) Gold and silver ornaments are obtained from small pieces of metals by hammering.

Noble Metal

Noble metals are metals that are resistant to corrosion or oxidation, unlike most base metals. Examples include tantalum, gold, platinum, and rhodium.

Precious Metal

A precious metal is a rare metallic chemical element of high economic value precious metals include the platinum group metals: ruthenium, rhodium, palladium, osmium, iridium, and platinum, of which platinum is the most widely traded.

Alloy

An alloy is a mixture of two or more elements in solid solution in which the major component is a metal. Most pure metals are either too soft, brittle or chemically reactive for practical use. Combining different ratios of metals as alloys modify the properties of pure metals to produce desirable characteristics. The aim of making alloys is generally to make them less brittle, harder, resistant to corrosion, or have a more desirable color and luster. Examples of alloys are steel