Acids, Bases & Salts

QUESTIONS

2004

Question 1.
Which of the methods, A, B, C, D or E is generally used for preparing the chlorides listed below from (i) to (v)

(A) Action of an acid on a metal
(B) Action of an acid on an oxide or carbonate
(C) Direct combination
(D) Neutralization of an alkali by an acid
(E) Precipitation (double decomposition)

1. Copper (II) chloride
2. Iron (II) chloride
3. Iron (III) chloride
4. Lead (II) chloride
5. Sodium chloride Each method is to be used only once.

Answer:
(1) B (2) A (3) C (4) E (5) D

2005

Question 1.

Match from A to F:
A: Acidic oxide,
B: Alkali,
C: Amphoteric oxide,
D: Basic oxide,
E: Deliquescence,
F: Efflorescence

1. The property of spontaneously giving up water of crystallization to the atmosphere.
2. A compound, soluble in water and the only negative ions in the soln. are hydroxide ions

Answer:

1. F: Efflorescence
2. B: Alkali

Question 2.

What is observed when, neutral litmus soln. is added to sodium hydrogen carbonate solution.

Answer:

$$NaHCO_3 + H_2O \rightarrow \underset{\text{[strong alkali]}}{NaOH} + \underset{\text{[weak acid]}}{H_2CO_3}$$

Alkaline Purple to — Blue

Question 3.

The preparation of lead sulphate from lead carbonate is a two-step process. (Lead sulphate cannot be prepared by adding dilute sulphuric from lead carbonate.)

1. What is the first step that is required to prepare lead sulphate from lead carbonate.)
   Ans. Treatment with dil. nitric acid to form soluble lead nitrate.
2. Write the equation for the reaction that will take place when this first step is carried out.
   Ans. $\mathbf{PbCO_3 + 2HNO_3 \rightarrow Pb(NO_3)_2 + H_20 + CO_2\uparrow}$
   Insoluble
3. Why is the direct addition of dil. H_2SO_4 to $PbCO_3$ an impractical method of preparing lead sulphate.
   Ans. Direct addition of dil. sulphuric acid to lead carbonate will lead to deposition of lead sulphate on the surface of lead carbonate which stops further reaction of sulphuric acid on it.

Question 4.

Fill in the blanks:

An acid is a compound which when dissolved in water forms hydronium ions as the only
(1) …. ions. A base is a compound which if soluble in water contains (2)…. ions. A base reacts with an acid to form a (3)…… and water only. This type of reaction is known as (4)…….

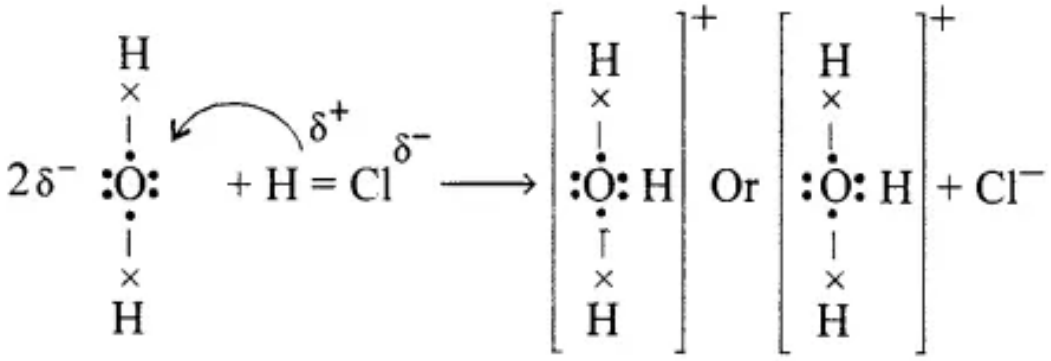
Answer:

1. Positive
2. Hydroxyl
3. Salt
4. neutralization.

Question 5.

Acid dissolve in water to produce positively charged ions. Draw the structure of these ions

Answer:



Question 6.

Name the ion other than ammonium ion formed when ammonia dissolves in water. Give one test that can be used to detect the presence of the ion product.

Answer:

Hydroxide ion.

2006

Question 1.

Mention the colour changes observed when the following indicators are added to acids:

1. Alkaline phenolphthalein solution.
   Ans. Pink solution becomes colourless
2. Methyl orange solution
   Ans. Orange solution changes to red or pink
3. Neutral litmus solution
   Ans. It turns red

Question 2.

Which of the following hydroxides is not an alkali – (Choose from the choices A, B, C and D)

(A) ammonium hydroxide
(B) calcium hydroxide
(C) copper hydroxide
(D) sodium hydroxide

2007

Question 1.

Complete the blanks from the list given:

Ammonia, Ammonium, Carbonate, Carbon dioxide, Hydrogen, Hydronium, Hydroxide, Precipitate, Salt, Water. A solution X turns blue litmus red, so it must contain (1) …. ions ; another solution Y turns red litmus blue and therefore, must contain (2)……. ions. When solutions X and Y are mixed together the products will be a (3) …. and (4) If a piece of magnesium were put into solution X, (5)….. gas would be evolved.

Answer:

1. hydronium
2. hydroxide
3. salt
4. water
5. hydrogen

Question 2.

Match the following:

	Column A		Column B
1.	Acid salt	A.	Sodium potassium carbonate
2.	Normal salt	B.	Alum
3.	Complex salt	C.	Sodium carbonate
4.	Double salt	D.	Sodium zincate
5.	Mixed salt	E.	Sodium hydrogencarbonate

Answer:

Column A		Column B	
1.	Acid salt	E.	Sodium hydrogen bicarbonate
2.	Normal salt	C.	Sodium carbonate
3.	Complex salt	D.	Sodium zincate
4.	Double salt	B.	Alum
5.	Mixed salt	A.	Sodium potassium carbonate

Question 3.

Write balanced equation for formation of $PbCl_2$ from $Pb(NO_3)_2$ soln. and NaCl soln.

Answer:

$Pb(NO_3)_2 + 2NaCl \rightarrow PbCl_2 + 2NaNO_3$

2008

Question 1.

What is the term defined i) A base which is soluble in water.
Answer:
Alkali.

2009

Question 1.

The acid which contains four hydrogen atoms –
(1) Formic acid
(2) Sulphuric acid
(3) Nitric acid
(4) Acetic acid

Question 2.

A black coloured solid which on reaction with dilute sulphuric acid forms a blue coloured solution is:
(A) Carbon
(B) Managanese (IV) oxide
(C) Lead (II) oxide
(D) Copper (II) oxide

Question 3.

Solution A is a strong acid
Solution B is a weak acid
Solution C is a strong alkali

Question 3(1).

Which solution contains solute molecules in addition to water molecules ?
Answer:
Solution B — weak acid

Question 3(2).

Which solution will give a gelatinous white precipitate with zinc sulphate solution? The precipitate disappears when an excess of the solution is added.
Answer:
Solution C — strong alkali

Question 3(3).

Which solution could be a solution of glacial acetic acid ?
Answer:
Solution B — weak acid

Question 3(4).

Give an example of a solution which is a weak alkali.
Answer:
Ammonium hydroxide — weak alkali

Question 4.

Write the equation(s) for the reaction(s) to prepare lead sulphate from lead carbonate.
Answer:

$$\underset{\text{Lead carbonate}}{PbCO_3} + \underset{\text{Nitric acid}}{2HNO_3} \longrightarrow \underset{\text{Lead nitrate}}{Pb(NO_3)_2} + \underset{\text{water}}{H_2O} + \underset{\text{carbon dioxide}}{CO_2}$$

$$\underset{\text{Lead nitrate}}{Pb(NO_3)_2} + \underset{\text{sulphuric acid}}{H_2SO_4} \longrightarrow \underset{\text{Lead sulphate}}{PbSO_4} + \underset{\text{Nitric acid}}{2HNO_3}$$

Question 5.

Define the following terms : Neutralization
Answer:
Neutralisation: The reaction in which an acid reacts with a base to form salt and water is known as neutralisation.

$$\textbf{Example :}\ \underset{\text{base}}{NaOH} + \underset{\text{acid}}{HCl} \longrightarrow \underset{\text{salt}}{NaCl} + \underset{\text{water}}{H_2O}$$

2010

Question 1.

A: Nitroso Iron (II) sulphate
B: Iron (III) chloride
C: Chromium sulphate
D: Lead (II) chloride
E: Sodium chloride.
Select from A, B, C, D and E –

1. A compound soluble in hot water but insoluble in cold water.
2. A compound which in the aqueous solution state,is neutral in nature.
3. A deliquescent compound.

Answer:

1. Lead (II) chloride
2. Sodium chloride
3. Iron (II) chloride

Question 2.

Select the correct answer from A, B, C and D –

(1) A weak organic acid is:
A: Formic acid
B: Sulphuric acid
C: Nitric acid
D: Hydrochloric acid

(2) A complex salt is:
A : Zinc sulphate
B : Sodium hydrogen sulphate
C : Iron (II) ammonium sulphate
D : Tetrammine copper (II) sulphate

Question 3.

Give an equation for the conversions

1. $ZnSO_4$ to $ZnCO_3$
2. $ZnCO_3$ to $Zn(NO_3)_2$

Answer:

(1) $ZnSO_4 + Na_2CO_3 \rightarrow ZnCO_3 + Na_2SO_4$

zinc sulphate + sodium carbonate → zinc carbonate + zinc sulphate

(2) $ZnCO_3 + 2HNO_3 \rightarrow Zn(NO_3)_2 + H_2O + CO_2\uparrow$

zinc carbonate + nitric acid → zinc nitrate + water + carbon dioxide

Question 4.

A: NaOH sol. : B: weak acid C: Dil. H_2SO_4
Select the one which contains solute ions and molecules.
Answer:

1. Solution C

2. Solution A
3. Solution B

Question 5.

Give balanced equation/s for the preparation of the following salts:

1. Copper (II) sulphate from CuO.
2. Iron (III) chloride from Fe.
3. K_2SO_4 from KOH sol.
4. Lead (II) chloride from $PbCO_3$ (give two equations)

Answer:
(1)

$$CuO + H_2SO_2 \longrightarrow CuSO_4 + H_2O$$

Copper (II) oxide Copper sulphate

(2)

$$2Fe + 3Cl_2 \longrightarrow 2FeCl_3$$

Iron Chlorine . Ferric chloride

(3)

$$2KOH + H_2SO_4 \xrightarrow[200°C]{\text{Temp. above}} K_2SO_4 + 2H_2O$$

Potassium hydroxide Potassium sulphate

(4)

- $PbCO_3 + 2HNO_3 \longrightarrow Pb(NO_3)_2 + H_2O + CO_2$

Lead carbonate Lead nitrate
(Insoluble salt) (Soluble salt)

- $Pb(NO_3)_2 + 2HCl \longrightarrow PbCl_2 + 2HNO_3$

Lead nitrate Lead chloride

2011

Question 1.

Write the balanced chemical equation: Lead nitrate solution is added to sodium chloride solution
Answer:
$Pb(NO_3)_2 + 2NaCl \rightarrow PbCl_2 + 2NaNO_3$

Question 2.

Name the method used from the list:
A: Simple displacement
B: Neutralization
C: Decomposition by acid
D: Double decomposition
E: Direct synthesis

For preparation of the following salts –

1. Sodium nitrate
2. Iron (III) chloride
3. Lead chloride
4. Zinc sulphate
5. Sodium hydrogen sulphate.

Answer:

(1) Sodium nitrate	(B) Neutralisation
(2) Iron (III) chloride	(E) Direct synthesis
(3) Lead chloride	(D) Double decomposition
(4) Zinc sulphate	(A) Simple displacement
(5) Sodium hydrogen sulphate	(C) Decomposition by acid

2012

Question 1.

Match the following:

Column A	Column B
1. Acid salt A.	A. Ferrous ammonium sulphate
2. Double salt	B. Contains only ions
3. Ammonium hydroxide	C. Sodium hydrogen sulphate solution
4. Dilute hydrochloric acid	D. Contains only molecules
5. Carbon tetrachloride	E. Contains ions and molecules

Answer:

Column A	Column B
1. Acid salt A.	C. Sodium hydrogen sulphate solution
2. Double salt	A. Ferrous ammonium sulphate
3. Ammonium hydroxide	E. Contains ions and molecules
4. Dilute hydrochloric acid	B. Contains only ions
5. Carbon tetrachloride	D. Contains only molecules

2013

Question 1.

Select the words given below which are required to correctly complete the blanks –
[ammonia, ammonium, carbonate, carbon dioxide, hydrogen, hydronium, hydroxide, precipitate, salt water]:

1. A solultion M turns blue litmus red, so it must contain (1)……..ions ; another solution O turns red litmus blue and hence, must contain, (2)…… ions.
2. When solution M and O are mixed together, the products will be (3)……. and (4) ……..
3. If a piece of magnesium was put into a solution M,(5)……..gas would be evolved.

Answer:
(1) hydronium **(2)** hydroxide **(3)** salt **(4)** water **(5)** hydrogen.

Question 2.

Give a suitable chemical term for:

1. A salt formed by incomplete neutralisation of an acid by a base.
2. A definite number of water molecules bound to some salts.

Answer:

1. Acid salt
2. Water of crystallisation

Question 3.

Choosing the substances from the list given:
dil. Sulphuric acid, Copper, Iron, Sodium, Copper (II) carbonate, Sodium carbonate, Sodium chloride, Zinc nitrate
Write balanced equations for the reactions which would be used in the laboratory to obtain the following salts:

1. Sodium sulphate
2. Zinc carbonate
3. Copper (II) sulphate
4. Iron (II) sulphate.

Answer:

1. **Sodium sulphate**
   $Na_2CO_3 + H_2SO_4 \rightarrow Na_2SO_4 + H_zO + CO_2$

2. **Zinc carbonate**
   $Zn(NO_3)_2 + Na_2CO_3 \rightarrow ZnCO_3 + 2NaNO_3$
3. **Copper (II) sulphate**
   $CuCO_3 + H_2SO_4 \rightarrow CuSO_4 + h_2o + CO_2$
4. **Iron (II) sulphate.**
   $Fe + H_2SO_4 \rightarrow FeSO_4 + H_2$

Question 4.

Identify: An acid which is present in vinegar.
Answer:
Acetic acid or ethanoic acid.

2014

Fill in the blank from the choices given:

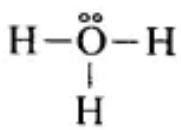
Question 1.

The basicity of Acetic Acid is **1**.

Question 2.

Draw the structure of the stable positive ion formed when an acid dissolves in water.
Answer:

$$HCl + H_2O \longrightarrow H_3O^+ + Cl^-$$



Question 3.

State the inference drawn from the following observations:
Salt S is prepared by reacting dilute sulphuric acid with copper oxide. Identify S.
Answer:
The compound or salt S is copper sulphate $CuSO_4$
$CuO + H_2SO_4 \rightarrow CuSO_4 + FlO$

Question 4.

Give balanced chemical equations to prepareation of the following salts:

1. Lead sulphate-from lead carbonate.
2. Sodium sulphate-using dilute sulphuric acid.
3. Copper chloride-using copper carbonate.

Answer:

(1) Lead sulphate from lead carbonate.

$PbCO_3 + HNO_3 \rightarrow Pb(NO_3)_2 + H_2O + CO_2$
$Pb(NO_3)_2 + H_2SO_4 \rightarrow PbSO_4 + 2HNO_3$

(2) Sodium sulphate using dilute sulphuric acid.

$Na_2CO_3 + H_2SO_4(dil) \rightarrow Na_2SO_4 + H_2O + CO_2$

(3) Copper chloride using copper carbonate.

$CuCO_3 + HCl(dil) \rightarrow CuCl_2 + H_2O + CO_2$
(Insoluble)

2015

Question 1.

Give balanced chemical equations for the following conversions.Fe→ Fed,
Fe →$FeCl_3$
Answer:
$2Fe + 3Cl_2 \xrightarrow{Heat} 2FeCl_3$

Question 2.

From the list of salts — AgCl, $MgCl_2$, $NaHSO_4$, $PbCO_3$, $ZnCO_3$, KNO_3, $Ca(NO_3)_2$ Choose the salt that most appropriately fits the description given below:

1. A deliquescent salt.

2. An insoluble chloride.

Answer:

1. A deliquescent salt = $MgCl_2$
2. An insoluble chloride=AgCl

Question 3.

From the following list of oxides — SO_2, SiO_2, Al_2O_3, MgO, CO, Na_2O -Select an oxide which dissolves in water forming an acid.
Answer:
SO_2

2016

Fill in the blank:

Question 1.

Higher the pH value of a solution, the more…… (acidic / alkaline) it is.
Answer:
Higher the pH value of a solution, the more **alkaline** it is.

Question 2.

Match the following salts given below:

(1) $Pb(NO_3)_2$ from PbO
(2) $MgCl_2$ from Mg
(3) $FeCl_3$ from Fe
(4) $NaNO_3$ from NaOH
(5) $ZnCO_3$ from $ZnSO_4$
With their correct method of preparation from: A, B, C, D and E.
(A) Simple displacement
(B) Titration
(C) Neutralization
(D) Precipitation
(E) Combination

Answer:

Column I	Column II
(1) $Pb(NO_3)_2$ from PbO	(C) Neutralization
(2) $MgCl_2$ from Mg	(A) Simple displacement
(3) $FeCl_3$ from Fe	(E) Combination
(4) $NaNO_3$ from NaOH	(B) Titration
(5) $ZnCO_3$ from $ZnSO_4$	(D) Precipitation

2017

1. Fill in the blanks from the choices given in brackets –

Question 1.

When a metallic oxide is dissolved in water, the solution formed has a high concentration of_____ ions. [H^+,H_3O^+, OH]

Answer:

When a metallic oxide is dissolved in water, the solution formed has a high concentration of OH" ions.

Question 2.

.**Choose the correct answer from the options –**

(1) to increase the pH value of a neutral solution, we should add: A. An acid; B. An acid salt; C. An alkali; D. A salt,

(2) Anhydrous iron [in] chloride is prepared by:

(A) direct combination;
(B) Simple displacement;
(C) Decomposition;
(D) Neutralization.

Answer:

C. an alkali

Question 3.

Write a balanced chemical equation for the preparation of each of the following salts:

1. Copper carbonate,
2. Ammonium sulphate crystals.

Answer:

$CuSO_4(aq) + Na_2CO_3(uq) \rightarrow Na_2SO_4(aq) + CuCO_3(s)$

$2NH_4OH(aq) + H_2SO_4(aq) \rightarrow (NH_4)_2SO_4 + 2H_2O$

Additional Questions

Question 1.

Define the following as per ionic theory with examples and ionic equations wherever relevant
(1) acid
(2) base
(3) alkali
(4) neutralization
Answer:
(1) Acid — An acid is a compound which when dissolved in water yields – hydronium ions (H_3O^+) as the only positively charged ion.

$$HCl + H_2O \rightleftharpoons H_3O^+ + Cl^-$$

(2) Base — A base is a compound which reacts with hydronium ions of an acid – to give salt and water

$CuO + 2HCl \rightarrow CuCl_2 + H_2O$

(3) Alkali — An alkali is a compound which when dissolved in water yields Hydroxyl ions (OH^-) as they are negatively charged ions.

$$NaOH\ (aq.) \rightleftharpoons Na^+ + OH^-$$

Alkali is a base soluble in water.

(4) **Neutralization — $|H^+|$** ions of an acid completely or combine with $|OH^+|$ ions of a base to give salt and water only.

Acid + Base → Salt + Water
$HCl + NaOH \rightarrow NaCl + H_2O$

Question 2.

Differentiate between:

1. Organic and inorganic acids
2. Hydracids and oxyacids with examples.

Answer:
(1)
Organic acids – Those acids which are derived from plants, e.g., citric acid, acetic acid, tartaric acid **Inorganic acids –** Acids derived from minerals e.g. HCl_2,h_2SO_4
(2)
Hydracids – Acids containing hydrogen and a non-metallic element other than oxygen, e.g. HCl, HBr, HI.

Oxyacids – Acids containing hydrogen, another element and oxygen, e.g. HNO_3, H,SO_4.

Question 3.

State on what basis does the strength of an acid and an alkali depend on.
Answer:
Strength of acids depends upon concentration of hydronium ion $|H_3O^+|$ present in an aqueous solution
of an acid. Strength of alkali depends on the concentration of the hydroxyl ions $|OH^-|$ present in an aqueous solution of an alkali.

Question 4.

Differentiate between (1) strong and weak acid (2) strong and weak alkali with suitable examples and ionic equations.
Answer:
(1) Strong Acid – Is an acid which dissociates – almost completely in aqueous solution there by producing a – high concentration of hydrogen $[H^+]$ ions [or H_3O^+ions]
Examples: Hydrochloric, Sulphuric and Nitric acid.

$$HNO_3 + H_2O \rightleftharpoons H_3O^+ + NO_3^-$$
$$H_2SO_4 + 2H_2O \rightleftharpoons 2H_3O^+ + SO_4^{2-}$$
[contains almost-only ions]

Weak Acid – Is an acid which dissociates – only partially in a aqueous solution thereby producing a – low concentration of hydrogen $[H^+]$ ions [or H_3O^+ ions].

$$CH_3COOH \rightleftharpoons CH_3COO^- + H^+$$
[contains - molecules and ions]

(2) Strong Alkali – Is an alkali which dissociates – almost completely in aqueous solution thereby producing a – high concentration of hydroxyl $[OH^-]$ ions.

$$NaOH\ [aq] \rightleftharpoons Na^+ + OH^-$$
$$KOH\ [aq] \rightleftharpoons K^+ + OH^-$$
[contains almost - only ions]

Examples: Lithium, Sodium and Potassium hydroxide
Weak alkali – Is an alkali which dissociates – only partially in aqueous solution thereby producing a – low concentration of hydroxyl $[OH^-]$ ions.

$$NH_4OH\ [aq] \rightleftharpoons NH_4^+ + OH^-$$

[contains - molecule and ions]

Examples: Ammonium hydroxide and Calcium hydroxide.

Question 5.

Name the ions formed when – HCl ; HNO_3 ; H_2SO_4 ; CH_3COOH ; NaOH and NH_4OH ionise in aq. soln.

Answer:

$$HCl\ (aq) + H_2O\ (l) \longrightarrow \underset{\text{Hydronium ion}}{H_3O^+\ (aq)} + \underset{\text{Chloride ion}}{Cl^-\ (aq)}$$

$$HNO_3\ (aq) + H_2O\ (l) \longrightarrow \underset{\text{Hydronium ion}}{H_3O^+\ (aq)} + \underset{\text{Nitrate ion}}{NO_3^-\ (aq)}$$

$$H_2SO_4\ (aq) + 2H_2O\ (l) \longrightarrow \underset{\text{Hydronium ion}}{2H_3O^+\ (aq)} + \underset{\text{Sulphate ion}}{SO_4^{2-}\ (aq)}$$

$$CH_3COOH\ (aq) + H_2O\ (l) \rightleftharpoons \underset{\text{Hydronium ion}}{H_3O^+\ (aq)} + \underset{\text{Acetate ion}}{CH_3COO^-\ (aq)}$$

$$NaOH\ (aq) \longrightarrow \underset{\text{Sodium ion}}{Na^+\ (aq)} + \underset{\text{Hydroxyl ion}}{OH^-\ (aq)}$$

$$NH_4OH\ (aq) \rightleftharpoons \underset{\text{Ammonium ion}}{NH_4^+\ (aq)} + \underset{\text{Hydroxyl ion}}{OH^-\ (aq)}$$

Question 6.

State giving reasons which is a stronger acid – dil. HCl or cone. H_2CO_3.

Answer:

Dil. HCl is a stronger acid than cone. H_2CO_3

Reason: HCl ionises almost completely in aqueous solution thereby producing a high concentration of Hp ions in aqueous solution. On the other hand, H_2CO_3 ionises to a very small extent producing a low concentration of HO^+ ions. More the concentration of H_3O^+ ions in solution, stronger is the acid. Hence dil. HCl is a stronger acid than cone. H_2CO_3.

Question 7.

State why the basicity of acetic acid is one and acidity of calcium hydroxide is two.

Answer:

Basicity of an acid is the number of hydrogen ions which can be produced from one molecule of the acids on complete dissociation. Acetic acid, CH.COOH gives

one H^+ per molecule the acid, hence acetic acid is monobasic i.e., its basicity is **one.**

$$CH_3COOH\ (aq) \rightleftharpoons CH_3COO^-\ (aq) + H^+\ (aq)$$

Acidity of a base is the number of hydroxyl ions which can be produced from one molecule of the base on complete dissocation. $Ca(OH)_2$ (calcium hydroxide) gives two hydroxyl ions per molecule of the base, hence calcium hydroxide is diacidic i.e., its acidity is **two.**

Question 8.

Give three reasons with equations wherever required, why sulphuric acid is a dibasic acid.

Answer:

Sulphuric acid (H_2SO_4) is a dibasic acid as explained below:

(1)

It ionises in aqueous solution to produce two hydrogen ions per molecule of the acid.

OR

It contains two replace all hydrogen ions per molecule of the acid.

$$H_2SO_4\ (aq) \rightleftharpoons 2H^+\ (aq) + SO_4^{2-}\ (aq)$$

(2)

It ionises in two steps in aqueous solution as shown below:

$$H_2SO_4\ (aq) + H_2O\ (l) \longrightarrow H_3O^+\ (aq) + HSO_4^-\ (aq)$$
$$HSO_4^-\ (aq) + H_2O\ (l) \longrightarrow H_3O^+\ (aq) + SO_4^{2-}\ (aq)$$
$$H_2SO_4\ (aq) + 2H_2O\ (l) \longrightarrow 2H_3O^+\ (aq) + SO_4^{2-}\ (aq)$$

(3)

It forms two types of salt, e., normal salt and acid salt as shown below:

$$H_2SO_4\ (aq) + NaOH\ (aq) \longrightarrow \underset{\text{Acid salt}}{NaHSO_4\ (aq)} + H_2O\ (l)$$

$$H_2SO_4\ (aq) + 2NaOH\ (aq) \longrightarrow \underset{\text{Normal salt}}{Na_2SO_4\ (aq)} + 2H_2O$$

Question 9.

State how acids are defined as per Arrhenius's and Lowry – Bronsted's theory.

Answer:

Arrhenius Theory –

Acids are substances which – dissociate in aqueous solution to give H^+ ions. Strong acids dissociate – almost completely, while weak acids dissociate partially.

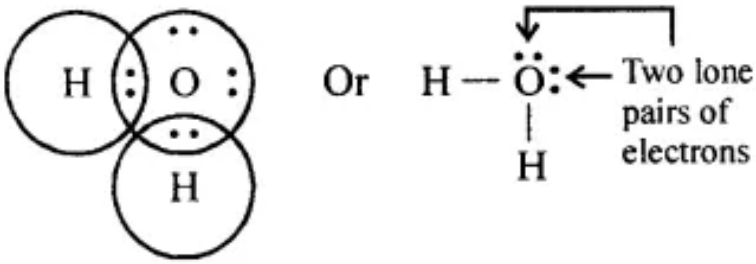
Question 10.

Oxygen atom in water has two Hone pair of electrons'. Explain the meaning of the term in italics. With the help of an electron dot diagram show the formation of hydronium ion and ammonium ion from a water molecule and an ammonia molecule respectively.

Answer:

A pair of electrons not shared with any other atom for bond formation is called a lone pair of electrons. In water, the central atom – oxygen has two lone pair of electrons as shown ahead:

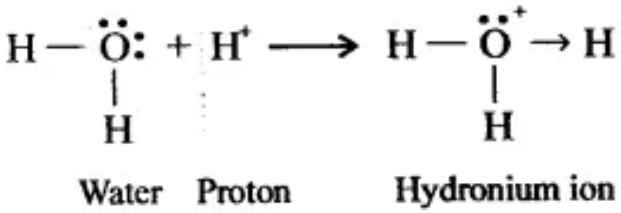
Structure of water molecule



Formation of hydronium ion- (H_3O^+): When an acid is dissolved in water the proton (H^+) released by the acid add onto the lone pair electrons of the oxygen atom of a water molecule. The proton (H^+) accepts the lone pair of electrons forming a coordinate bond (shown by an arrow).

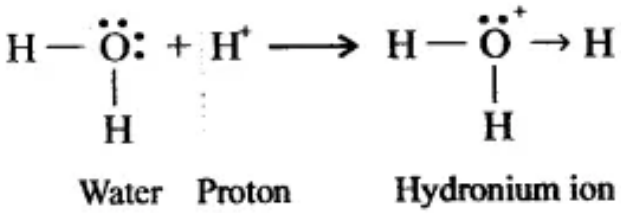
$HCl \rightarrow H^+ + Cl^-$

Water Proton Hydronium ion



Formation of ammonium ion (NH_4^+): When ammonia gas is dissolved in water, the proton released by water adds onto the lone pair of electrons of the nitrogen atom of the ammonia molecule. The proton (H^+) accepts the lone pair of electrons forming a coordinate bond (shown by an arrow).

$$H_2O \rightleftharpoons H^+ + OH^-$$



Question 11.

State how you would obtain:

1. Sulphuric acid from an acidic oxide
2. KOH from a basic oxide.

Answer:
(**1)**
Sulphuric acid from acidic oxide

$$SO_3 + H_2O \longrightarrow H_2SO_4$$

Sulphur trioxide (Acidic oxide) — Sulphuric acid

(2)

$$K_2O + H_2O \longrightarrow 2KOH$$

Potassium oxide (Basic oxide) — Potassium hydroxide

Question 12.

State two chemical properties each with equations of a solution containing
(1) H^+ ions
(2) OH
Answer:
(1) Properties of a solution containing H^+ ions: Acids when dissolved in water produce H_2O^+ or H ions. Typical chemical properties of aqueous solution of acids are:

(a) Neutralisation: H^+ ions react with OH ions from alkalies to give water

$$H^+ + OH^- \longrightarrow H_2O$$

(From acid) (From alkali) Water

(b) Reaction with active metals: Active metals like Al, Zn, Fe, etc., react with dil. acids (HCl, H_2SO_4) to give hydrogen gas. In this reaction H^+ is reduced to H,

by the active metal. For example,

$$Zn \longrightarrow Zn^{2+} + 2e^-$$
$$2H^+ + 2e^- \longrightarrow H_2\uparrow$$
$$Zn + 2H^+ \longrightarrow Zn^{2+} + H_2$$

(2) Properties of solution containing OH^- ions: Alkalies when dissolved in water produce OH" ions. Typical reaction of aqueous solution of alkalies are;

(a) Neutralisation: OH^+ ions react with H^+ ions from acids to give water.

$$OH^- + H^+ \longrightarrow H_2O$$

(From alkalies) (From acids) Water

(b) Reaction with solutions of metallic salts: Hydroxides of metals other than Group 1 and 2 are generally insoluble in water. Such hydroxides are precipitated from their respective salt solutions by OH" ions. For example,

$$Fe^{3+} + 3OH^- \longrightarrow Fe(OH)_3$$

(From $FeCl_3$) Red brown ppt.

Question 13.

Give equations for the decomposition of a metallic
(1) chloride
(2) nitrate with cone. H_2SO_4.

Answer:

(1) Reaction of cone. H_2SO_4 with metallic chloride:

$$NaCl(s) + H_2SO_4(conc.) \xrightarrow{<200°C} NaHSO_4 + HCl\uparrow$$
$$2NaCl(s) + H_2SO_4(conc.) \xrightarrow{>200°C} Na_2SO_4 + 2HCl\uparrow$$

(2) Reaction of cone. H_2SO_4 with metallic nitrate

$$KNO_3(s) + H_2SO_4(conc.) \xrightarrow{<200°C} KHSO_4 + HNO_3\uparrow$$
$$2KNO_3(s) + H_2SO_4(conc.) \xrightarrow{>200°C} K_2SO_4 + 2HNO_3\uparrow$$

Question 14.

State in the above reactions a reason for the formation of the respective acids from cone. H_2SO_4.

Answer:

The reason for the formation of the respective acids from cone. H_2SO_4 is the volatility of the acid formed. At room temperature or above HCl is a gas while

HNO_3, which is a liquid at room temperature, volatileses at the reaction temperature (w 200°C).

Question 15.

Convert
(1) $NaHCO_3$
(2) Na_2CO_3 to unstable carbonic acid by action with dil. H_2SO_4.
State the reason why ammonia is evolved when an ammonium salt and alkali are heated.
Answer:

1. $2NaHCO_3 + H_2SO_4$ (dil.) $\rightarrow Na_2SO_4 + 2H_2CO_3$
2. $Na_2CO_3 + H_2SO_4$ (dil.) $\rightarrow Na_2SO_4 + H_2CO_3$

Ammonia is evolved when an ammonium salt and alkali are heated.

$$NH_4Cl(s) + Ca(OH)_2(s) \xrightarrow{\Delta} CaCl_2(s) + H_2O(g) + NH_3(g)$$

This is because a non-volatile base, $Ca(OH)_2$ displace a volatile base, NH_4OH which decomposes to given NH_3 and H_2O.

Question 16.

Define pH value. What would you say about the pH of a solution in which (i) H^+ ions = OH^- ions

1. evolves $CO_2$when heated with Na_2CO_3
2. OH" ions > H^+ ions.

Answer:
pH value: The pH value of a solution is defined as the negative logarithm (to the bsise 10) of the hydrogen ion concentration expressed in mol L^{-1}. Thus,
$_pH = -\log_{10} [H^+]$
Where $[H^+]$ stands for hydrogen ion concentration in mol L^{-1}.

1. A solution in which $[H^+] = [OH^-]$, is neutral with pH = 7.
2. A solution which evolves CO_2 with $NaCO_3$ is acidic in nature with pH < 7.
3. A solution in which $[OH^-] > [H^+]$ is basic in nature with pH >7.

Question 17.

State whether litmus is a common acid-base indictor or a universal indicator.
Answer:
Litmus is a common acid-base indicator. It is not a universal indicator.

Question 18.

State the colour change in a neutral litmus in presence of
(1) acidic
(2) alkaline medium.
Answer:
Neutral litmus is purple in colour

1. In acidic medium colour of neutral litmus changes from purple to red.
2. In alkaline medium colour of neutral litmus changes from purple to blue.

Question 19.

State the colour change in a universal indicator e.g. pH paper on

1. slightly acidic soil
2. slightly alkaline soil
3. dairy milk
4. human blood tested for medical diagnosis.

Answer:

1. In slightly acidic soil colour of universal indicator changes to yellow.
2. In slightly alkaline soil colour of universal indicator changes to blue.
3. In dairy milk colour of universal indicator change to green.
4. In human blood colour of universal indicator changes to green (pH = 7.3).

Question 20.

Define
(1) salt
(2) normal salt
(3) acid salt – with relevant examples and equations.
Answer:
(1) Salts: A salt is a compound formed by partial or complete replacement of the replaceable hydrogen ions of an acid by a metallic ion or ammonium ion.

$$NaOH(aq) + H_2SO_4(aq) \longrightarrow NaHSO_4(aq) + H_2O\ (l)$$

(Partial repalcement)

$$2NaOH(aq) + H_2SO_4(aq) \longrightarrow Na_2SO_4(aq) + 2H_2O\ (l)$$

(Complete replacement)

(2) Normal salt: The salt formed by complete replacement of the replaceable hydrogen ions present in a molecule of the acid by metallic or ammonium ion. For example,

$$2NaOH(aq) + H_2SO_4(aq) \longrightarrow \underset{\text{(Normal Salt)}}{Na_2SO_4(aq)} + 2H_2O\ (l)$$

$2NaOH(aq) + H_2CO_3(aq) \rightarrow Na_2CO_3(aq) + 2H_2O$ (l)

$NH_4OH(aq) + HCl(aq) \rightarrow NH_4Cl(aq) + H.O$ (l)

(3) Acid salt: The salt formed by partial replacement of the replaceable hydrogen ions present in a molecule of the acid by metallic or ammonium ion. For example,

$NaOH(aq) + H_3PO_4(aq) \rightarrow NaH_2PO_4(aq) + H_2O(l)$
$2NaOH(aq) + H_3PO_4(aq) \rightarrow Na_2HPO_4(aq) + 2H_2O$ (l)
$KOH(aq) + H_2SO_4(aq) \rightarrow KHS0_4(aq) + H_2O(l)$
$NH_4OH(aq) + H_2CO_3(aq) \rightarrow NH_4HCO_3(aq) + H.O$ (l)

Question 21.

State:

1. the formation
2. the components of – a basic salt.

State which of following salts is an – acid, normal or basic salt.

1. bleaching powder
2. potassium mercuric iodide
3. sodium sulphite
4. sodium hydrogen sulphite
5. sodium silver cyanide
6. basic lead nitrate
7. potassium zincate
8. alum
9. calcium bicarbonate
10. basic copper chloride
11. trisodium phosphate.

Answer:

(1) Formation of a basic salt: A basic salt is formed by partial replacement of hydroxyl group of a diacidic or triacidic base with an acid radical (or an anion other than OH).

(2) Components of a basic salt: A basic salt contains a cation (other than H^+ ion), a hydroxyl ion (OH^- from base) and an anion (other than OH^- ion). For

example,

$CuOH)NO_3$	$Cu(OH)Cl$
Basic copper nitrate	Basic copper chloride

1. Bleaching powder, CaOCl, (Normal salt/Mixed salt)
2. Potassium mercuric iodide, $K_2(HgI_4)$.
   (Normal salt/Complex salt)
3. Sodium sulphate, Na_2SO_4 (Normal salt)
4. Sodium hydrogen sulphite, $NaHSO_3$ (Acid salt)
5. Sodium silver cyanide, $Na[Ag(CN)_2]$
   (Normal salt/Complex salt)
6. Basic lead nitrate, $Pb(OH)NO_3$ (Basic salt)
7. Potassium zincate, K_2ZnO_2 (Normal salt)
8. Alum or potash alum, $K_2SO_4.Al_2(SO_4)_3.24H_2O$
   (Normal salt/Double salt)
9. Calcium bicarbonate, $Ca(HCO_3)_2$ (Acid salt)
10. Basic copper chloride, Cu(OH)Cl (Basic salt)
11. Trisodium phosphate, Na_3PO_4 (Normal salt)

Question 22.

Name three (1) sulphates (2) chlorides insoluble in water and – two (1) oxides (2) carbonates soluble in water.

Answer:

(1) Three sulphates insoluble in water

Lead sulphate ($PbSO_4$), Calcium sulphate ($CaSO_4$), and Barium sulphate ($BaSO_4$).

(2) Three chloride insoluble in water

Silver chloride (AgCl), Lead chloride ($PbCl_2$), and Mercury chloride (Hg_2Cl_2 or HgCl).

(1) Two oxides soluble in water

Sodium oxide (Na_2O), and Potassium oxide (K_2O)

(2) Two carbonates soluble in water

Sodium carbonate (Na_2CO_3), and Ammonium carbonate [$(Na_4)_2CO_3$]

Question 23.

State the method only, generally used for the preparation of the following salts

(1) $Zn(NO_3)_2$

(2) NH_4Cl

(3) $ZnSO_4$

(4) ZnS
(5) $CaCO_3$
(6) $FeCl_3$
(7) $PbCl_2$
(8) $Pb(NO_3)_2^-$

Answer:

Salt	**Method of preparation**
1. $Zn(NO_3)_2$	Neutralisation of insoluble base by acid/Decomposition of insoluble carbonate by acid
2. NH_4Cl	Neutralisation (titration) of soluble base by acid/Decomposition of soluble carbonate by acid
3. $ZnSO_4$	Neutralisation of insoluble base by acid/Decomposition of insoluble carbonate by acid
4. ZnS	Direct combination (Synthesis)/Double decomposition (Precipitation)
5. $CaCO_3$	Double decomposition (Precipitation)
6. $Fecl_3$	Direct combination (Synthesis)/
7. $pbCl_2$	Double decomposition (Precipitation)
8. $Pb(NO_3)_2$	Neutralisation of insoluble base by acid/Decompostion of insoluble carbonate by acids

Question 24.

Give balanced equations for the preparation of the following salts –

(a)
(1) $CuSO_4$
(2) $NaHSO_4$
(3) Na_2SO_4
(4) $FeSO_4$
(5) $BaSO_4$
(6) $PbSO_4$ – using dil. H_2SO_4

(b)

(1) $NaHSO_4$
(2) $CuSO_4$ – using cone. H_2SO_4.

Answer:

(a) Using dil. H_2SO_4

1. $CuO\ (s) + H_2SO_4\ (aq) \rightarrow CuSO_4\ (aq) + 2H_2O\ (l)$
2. $NaOH\ (aq) + H_2SO_4\ (aq) \rightarrow NaHSO_4\ (aq) + H_2O(l)$
3. $2NaOH\ (aq) + H_2SO_4\ (aq) \rightarrow Na_2SO_4\ (aq) + 2H_2O(l)$
4. $Fe\ (s) + H_2SO_4\ (aq) \rightarrow FeSO_4\ (aq) + H_2\ (g)$
5. $BaCl_2\ (aq) + H_2SO_4\ (aq) \rightarrow BaSO_4\ (s) + 2HCl\ (aq)$
6. $Pb(NO_3)_2 + H_2SO_4\ (aq) \rightarrow PbSO_4\ (s) + 2HNO_3\ (aq)$

(b) Using cone. H_2SO_4

(1) $NaOH\ (aq) + H_2SO_4\ (conc.) \longrightarrow NaHSO_4\ (aq) + H_2O\ (l)$

(2) $Cu(s) + 2H_2SO_4(conc.) \xrightarrow{\Delta} CuSO_4(aq) + SO_2(g) + 2H_2O$

$CuO(s) + H_2SO_4(conc.) \longrightarrow CuSO_4(aq) + H_2O\ (l)$

Question 25.

Starting from insoluble ZnO how would you obtain insoluble $ZnCO_3$ by precipitation.

Answer:

$ZnO\ (s) + 2HCl\ (aq) \rightarrow ZnCl_2\ (aq) + H_2O(l)$

$ZnCl_2\ (aq) + Na_2CO_3\ (aq) \rightarrow ZnCO_3\ (s) + 2NaCl\ (aq)$

Dissolve zinc oxide in minimum quantity of dil. HCl. Add to it a saturated solution ofNa_2CO_3 in water till
no more precipitation takes place. Filter and dry the $ZnCO_3$ so obtained.

Question 26.

Give balanced equations for the action of a dilute acid on
(1) zinc carbonate,
(2) potassium bicarbonate for the preparation of the respective salt.

Answer:

1. **Zinc carbonate**
   $ZnCO_3 + 2HNO_3 \rightarrow Zn(NO_3)_2 + H_2O + CO$

2. **Potassium bicarbonate**
   $2KHCO_3 + H_2SO_4 \rightarrow K_2S0_4 + 2H_2O + 2CO_2$

Question 27.

Give balanced equations for the decomposition of
(1) calcium bicarbonate by dil. HCl,
(2) calcium carbonate by dil. HNO_3,
(3) sodium sulphite by dil. H_2SO_4,
(4) zinc sulphide by dil. H_2SO_4.

Answer:

1. $Ca(HCO_3)_2 + 2HCl \rightarrow CaCl_2 + 2H_2O + 2CO_2$
2. $CaCO_3 + 2HNO_3 \rightarrow Ca(NO.)_2 + H_2O + CO_2$
3. $Na_2SO_3 + H_2SO_4$ (dil.) $\rightarrow Na_2SO_4 + H_2O + SO_2$
4. $ZnS + H_2SO_4 \rightarrow ZnSO_4 + H_2S$

Question 28.

State what will be the effect of each of the following solution on blue litmus –
(1) K_2CO_3 soln
(2) KCl soln.
(3) NH_4NO_3
Answer:

1. K_2CO_3 is a salt of a strong base (KOH) and weak acid (H_2CO_3). Hence its aqueous solution will be basic in nature. It will have no effect on blue litmus solution.
2. KCl is a salt of a strong acid (HCl) and a strong base (KOH). Hence its aqueous solution will be neutral in nature. It will have no effect on blue litmus solution.
3. NH_4NO_3 is a salt of a strong acid (HNO_3) and weak base (NH_4OH). Hence its aqueous solution will be acidic in nature. It will turn blue litmus solution red.

Question 29.

Select the correct acid, base or salt from the list in bracket for each of the statements given below:

1. An example of an acid derived from a mineral is…….. (citric acid / nitric acid / acetic acid)
   Ans. Nitric acid

2. An example of a base which is not a alkali is….. (caustic soda / zinc hydroxide / liquor ammonia / caustic potash)
   Ans. Zinc hydroxide

3. An example of a strong acid is dilute…… (acetic acid / sulphuric acid / tartaric acid / carbonic acid)

Ans. Sulphuric acid

4. An example of a weak alkali is…. (potassium hydroxide / calcium hydroxide / sodium hydroxide) solution.
   Ans. Calcium Hydroxide

5. An acid having basicity 1 is…… (carbonic acid / acetic acid / sulphurous acid)
   Ans. Acetic acid

6. An acid obtained by dissolving sulphur trioxide in water is…. (sulphurous acid / sulphuric acid oleum)
   Ans. Sulphuric acid

7. A volatile acid obtained when nitre reacts with nonvolatile concentrated sulphuric acid on heating is (hydrochloric acid / sulphuric acid/ nitric acid)
   Ans. Nitric acid

8. A base obtained when lead nitrate undergoes thermal decomposition is……. (trilead tetroxide / lead (IV) oxide/ lead (II) oxide. .
   Ans. Lead (II) oxide

9. An acid obtained when concentrated nitric acid is heated with sulphur is…….. (sulphurous acid / sulphuric acid / nitrous acid)
   Ans. Sulphuric acid

10. The more volatile acid obtained when the less volatile acid reacts with sodium bicarbonate is…… (sulphuric acid / carbonic acid / nitric acid)
    Ans. Carbonic acid

11. The insoluble base obtained when sodium hydroxide reacts with iron (III) chloride is…. (iron (II) hydroxide / iron (III) hydroxide / iron (II) oxide)
    Ans. Iron (III) hydroxide.

12. A solution whose pH is above 7 is….. (vinegar / milk / liquor ammonia.
    Ans. Liquor Ammonia

13. The salt formed when sulphuric acid reacts with excess caustic soda solution is…… (sodium bisulphite / sodium sulphate / sodium sulphite / sodium bisulphate).
    Ans. Sodium sulphate

14. An example of an acid salt is……. [CH_3COONa/$NaNO_3$/ Na_2HPO_4/$NaKCO_3$]
    Ans. Na_2HPO_4

15. An example of a soluble salt is …… (AgCl / $PbSO_4$ /$CaSO_4$ / $CaCl_2$)
    Ans. $CaCl_2$

16. An example of an insoluble salt is….. (Na_2CO_3 \ K_2CCl,/ $MgCO_3$ / $(NH_4)_2\ CO_3$)
    Ans. $MgCO_3$

17. A salt prepared by neutralization in which titration is involved is…….. ($MgCl_2$ / $CaCl_2$ / NH,Cl / $CuCl_2$)
    Ans. NH_4Cl
18. An insoluble salt prepared by direct combination or synthesis is……. [$FeCl_3$ / $FeSO_4$ / FeS/$Fe(NO_3)_2$] **Ans.** FeS

19. A salt prepared by precipitation i.e. by double decomposition of two salt solutions is…… (Na_2SO_4/$PbSO_4$ / $ZnSO_4$ / $CuSO_4$)
    Ans. PbSO.
20. A salt prepared by simple displacement i.e. action of dilute acid on a metal is_____ ($PbCl_2$/ CuCL, / $AlCl_3$/ HgCl)
    Ans. $AlCl_3$
21. Decomposition of calcium hydrogen carbonate with…. [dil. HNO_3 /dil. HCl/dil. H_2SO_4] results in formation of calcium chloride.
    Ans. dil.HCl

22. Action of dilute acid on a metallic sulphide results in evolution of_____ [SO_2/H_2S/CO_2] gas.
    Ans. H_2S

23. A salt which on hydrolysis produces a neutral solution is……. (sodium chloride / ammonium chloride / sodium carbonate)
    Ans. Sodium chloride

Unit test Paper 3 A —Acids, Bases and Salts

I. Name the following:

1. A basic solution which does not contain a metallic element.
   Ans. Ammonium Hydroxide.

2. A normal salt of sodium formed from acetic acid.
   Ans. Sodium acetate, COCOON a.
3. A base which reacts with an acid to give a salt which .on hydrolysis gives a slightly acidic solution.
   Ans. Ammonium hydroxide (NH_4OH)

OR

Calcium hydroxide [$Ca(OH)_2$].

4. An ion which combines with a polar covalent molecule to form an ammonium ion.
   Ans. Hydrogen ion a proton (H^+).

5. A soluble salt formed by direct combination between a light metal & a greenish yellow gas.
   Ans. $AlCl_3$

2. Identify which of the following terms matches with the appropriate description 1 to 5.

A: Hydracid
B: Monobasic acid
C: Less volatile acid
D: Weak acid
E: Tribasic acid
F: Dibasic acid
G: More volatile acid

1. An acid having basicity 1 and having only one replaceable hydrogen ion per molecule of the acid.
   Ans. Monobasic acid

2. An acid which dissociates to give a low concentration of H^+
   Ans. Weak acid

3. An acid containing hydrogen and a non-metallic element other than oxygen.
   Ans. Hydracids.

4. The type of acid which generally displaces another acid when the acid is heated with a salt.
   Ans. Less volatile acid

5. The type of acid which reacts with a base to give an acid salt and a normal salt.
   Ans. Dibasic acid

3. State which of the following methods is generally used for preparing the salts 1 to 5 given below:

A: Neutralisation – insoluble base and dil. acid
B: Neutralisation – alkali and dil. acid
C: Simple displacement – active metal and dil. acid
D: Direct combination
E: Precipitation (double decomposition) .

1. $PbCO_3$
2. $Zn(NO_3)_2$
3. NaCl
4. $Cu(NO_3)_2$
5. FeS

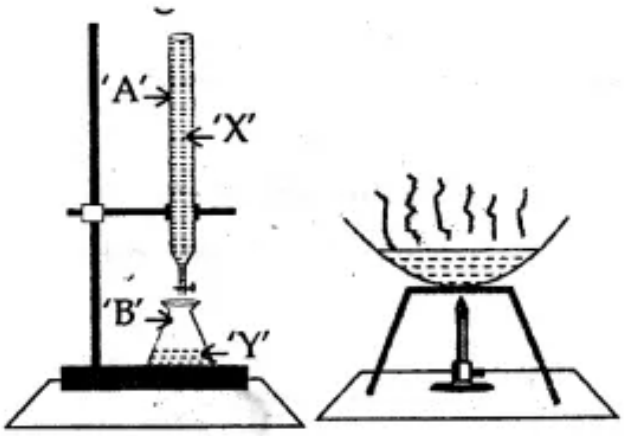
Answer:

1. **$PbClIO_3$:** Precipitation (Double decomposition) **(E)**
2. **$Zn(NO_3)_2$:** Simple displacement-active metal and dil. acid **(C)**
3. **NaCl:** Neutralisation-alkali and dil. acid **(B)**
4. **$(CuNO_3)_2$:** Neutralisation + insoluble base and dil. acid **(A)**
5. **FeS:** Direct combination **(D)**

4. Give balanced equations for the preparation of the following salts:

2. Calcium oxide → Calcium chloride → Calcium carbonate
   Ans. $CaO + 2HCl \rightarrow CaCl_2 + H_2O$
3. Zinc sulphide Zn→ Zinc sulphate
   Ans. $Zn + S \rightarrow ZnS$
4. Iron (II) chloride ← Fe→ Iron (III) chloride
   Ans. $Fe + 2HCl \rightarrow FeCl_2 + H_2$
5. Lead (II) oxide → Lead nitrate→ Lead sulphate
   Ans. $PbO + 2HNO_3 \rightarrow Pb(NO_3)_2 + H_2O$
6. Copper (II) oxide → Copper (II) sulphate ←Copper (II)hydroxide
   Ans. $CuO + H_2SC_4 \rightarrow CuSO_4 + H_2O$

5. The diagram represents the preparation of sodium sulphate salt from dil. H_2SO_4 acid and sodium hydroxide.



1. Name the apparatus 'A'.
   Ans. Burette

2. Name the substance 'X' placed in 'A' and the (substance 'Y' placed in B.
   Ans. Dil. H_2SO_4 Sodium Hydroxide

3. State the reason for conducting the titration using the apparatus 'A' and 'B'
   Ans. Titration is conducted to determine the completion of the neutralisation reaction, i.e. to determine the amount of sulphuric acid required to neutralise a known amount of sodium hydroxide.

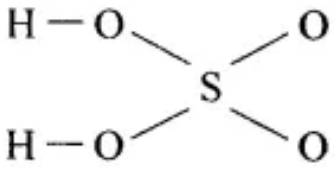
4. State which solution is transferred to the evaporating dish and evaporated to point of crystallisation for obtaining the salt.
   Ans. Sodium Sulphate.

5. State why titration is not conducted for the preparation of copper (II) sulphate crystals by neutralisation.
   Ans. This is because copper (II) oxide is not soluble in water.

6. Give reasons for the following:

Question 6(1).

Concentrated sulphuric acid is a weaker acid compared to dilute sulphuric acid.
Answer:
Sulphuric acid,H_2SO_4 is a covalent compound as shown below.



When dissolved in water, polar water molecules helps in its ionisation, thus producing B,O^+ ions responsible for its acidic nature. More water (i.e., dilute acid) means more H_3O^+ ions and hence stronger acid.

Question 6(2).

An aqueous solution of the salt ammonium chloride is acidic in nature while an aqueous solution of sodium chloride is neutral.
Answer:

$$NH_4Cl + H_2O \rightarrow \underset{\text{[weak alkali]}}{NH_4OH} + \underset{\text{[strong acid]}}{HCl}$$

$$\underset{\text{[aq. soln. of NaCl is neutral]}}{NaCl} + \underset{\text{[strong alkali]}}{H_2O} \rightarrow NaOH + \underset{\text{[strong acid]}}{HCl}$$

From above equation it is clear that NH_4Cl forms weak alkali which is acidic in nature where as NaCl from strong alkali which is neutral.

Question 6(3).

In the preparation of an insoluble salt from another insoluble salt by precipitation [double decomposition], dilute nitric acid and not dilute sulphuric acid is generally used.
Answer:
Direct addition of dil. H_2SO_4 to $PbCO_3$ is an impractical method of preparing lead

sulphate since $PbSO_4$ is insoluble and forms a coating on $PbCO_3$, thereby the reaction slowly comes to a stop.

Question 6(4).

Acetic acid does not form an acid salt but forms a normal salt.
Answer:
Acetic acid (CH_3COOH) is a monobasic acid, i.e. it contains only one replaceable hydrogen ion per molecule of the acid. As such it can only form normal salts.

Question 6(5).

Sulphurous acid forms two types of salts on reaction with an alkali.
Answer:
Sulphurous acid (H_2SO_3) is a dibasic acid, i.e., it contains two replaceable hydrogen ions per molecule. As such, it can form normal salt (say Na_2SO_3) as well as acid salt ($NaHSO_3$) on reaction with an alkali.

Analytical Chemistry – Use Of Ammonium & Sodium Hydroxide

2003

QUESTIONS

Question 1.
Write the observations and balanced equations for the following reactions:

1. Sodium hydroxide is added drop-wise till in excess to a solution of zinc sulphate.
2. Ammonium hydroxide is added in excess to a solution of copper sulphate.

Answer:
(1) A white ppt formed redissolves in excess of sodium hydroxide solution.

$$ZnSO_4 + 2NaOH \longrightarrow Na_2SO_4 + Zn(OH)_2\downarrow$$

(Gel. White ppt.)

$$Zn(OH)_2 + 2NaOH \longrightarrow Na_2ZnO_2 + 2H_2O$$

Sodium zincate

(White solution)

(2) Pale blue ppt formed dissolves in excess of ammonium hydroxide solution to form deep blue solution.
$CuSo_4 + 2NH_4H \rightarrow (NH_4)_2SO_4 + Cu(OH)_2\downarrow$

$$Cu(OH)_2 + (NH_4)_2SO_4 + 2NH_4OH \rightarrow [Cu(NH_3)_4]\ SO_4 + 4H_2O$$

Tetra-amine

copper (II) sulphate

(deep blue colour)

2004

Question 1.
Sodium hydroxide solution is added first in a small amount then in excess to the aqueous salt solutions of
(a) copper [II] sulphate,
(b) zinc nitrate,
(c) lead nitrate,
(d) iron
State in each case:

1. the colour of the precipitate when NaOH is added in a small quantity;

2. the nature of the precipitate (i.e. soluble or insoluble) when NaOH is added in excess.

Answer:

(1)
(a) Blue
(b) White
(c) White
(d) Reddish brown

(2)
(a) Insoluble
(b) Soluble
(c) Soluble
(d) Insoluble.

Question 2.
Write balanced equations for –
(a) Aluminium
(b) Zinc – is warmed with NaOH (caustic soda)
Answer:
(a) $Al + 2NaOH + 2H_2o \rightarrow 2NaAlo_2 + 3H_2$
(b) $Zn + 2NaOH \rightarrow Na_2Zno_2 + H_2$

2005

Question 1.
The questions below refers to the following salt solutions listed A to F:
A: Copper nitrate, B: Iron [U] sulphate, C: Iron [III] chloride, D: Lead nitrate, E: Magnesium sulphate, F: Zinc chloride.

(1) Which soln. becomes a deep/inky blue colour when excess of ammonium hydroxide is added to it.
Ans. A: Copper nitrate

(2) Which solution gives a white precipitate with excess ammonium hydroxide solution.
Ans. D: Lead nitrate

2006

Question 1.
From the list of substances given – Ammonium sulphate,Lead carbonate, Chlorine, Copper nitrate ferrous sulphate- State a solution of the compound which gives a dirty green precipitate with sodium hydroxide.
Answer:
Ferrous sulphate

Question 2.
Write a balanced equation for the reaction between – aluminium oxide and sodium hydroxide
Answer:
$Al_2o_3 + 2NaOH \rightarrow 2NaAlo_2 + H_2O$

Question 3.
Give one test to distinguish between the following – Iron (III) chlorine soln. and copper chloride solution.
Answer:
Add NaOH solution in excess of the two solutions. The one in which white ppt. initially formed dissolves in excess of NaOH solution is $Zn(No_3)_2$ solution and the other is $Ca(No_3)_2$ solution.

2008

Question 1.
The salt which in soln. gives a pale green precipitate with NaOH solution and a white ppt. with $BaCl_2$ soln. is:
(a) Iron (III) sulphate
(b) Iron (II) sulphate
(c) Iron (II) chloride
(d) Iron (III) chloride

2009

Question 1.
Find the odd one with reason (note: valency is not a criterion):
$Al(OH)_3$ $Pb(OH)_2$ $Mg(OH)_2$ $Zn(OH)_2$
Answer:
$Mg(OH)_2$ [Because all others are amphoteric hydroxides]

Question 2.
Identity the substance P based on the information given below:
The deliquescent salt P, turns yellow on dissolving in water, and gives a reddish brown precipitate with sodium hydroxide solution.
Answer:
Ferric chloride.

2010

Question 1.
Give an equation for –

1. ZnO reacts with NaOH solution.
2. Conversion of – $Zn(No_3)_2$ to $Zn(OH)_2$

Answer:
(1)

$$ZnO + 2NaOH \rightarrow Na_2ZnO_2 + H_2O$$

sodium zincate

(2)

$$Zn(NO_3)_2 + 2NaOH \rightarrow Zn(OH)_2\downarrow + 2NaNO_3$$

zinc nitrate — sodium hydroxide — zinc hydroxide — sodium nitrate

$$Zn(OH)_2 \xrightarrow{\Delta} ZnO + H_2O$$

zinc hydroxide — zinc oxide — water

Question 2.
Select the correct answer from A, B, C –
A: Sodium hydroxide soln. B: A weak acid C: Dilute sulphuric acid. The solution which with zinc sulphate solution will give a white precipitate.
Answer:
A: Sodium hydroxide soln.

2011

Question 1.
Choose the correct answer from the choices given:Hydroxide of this metal is soluble in NaOH solution. A: Magnesium
B: Lead
C: Silver
D: Copper

Question 2.
Sodium hydroxide solution is added to the solutions containing the ions mentioned in List 1.
List 1 –
(i) Pb^{2+} (ii) Fe^{2+} (iii)Zn^{2+} (iv) Fe^{3+} (v) Cu^{2+} (vi)Ca^{2+}
List 2 – Gives the details of the precipitate. A: Reddish brown B: White insoluble in excess, C: Dirty green D: White soluble in excess, E: White soluble in excess F: Blue.

Match the ions with their coloured precipitates in List 2.
Answer:

	List 1	List 2
(*i*)	Pb^{2+}	D : White soluble in excess
(*ii*)	Fe^{2+}	C : Dirty green
(*iii*)	Zn^{2+}	D : White soluble in excess
(*iv*)	Fe^{3+}	A : Reddish brown
(*v*)	Cu^{2+}	F : Blue
(*vi*)	Ca^{2+}	B : White insoluble in excess.

Question 3.
Give a balanced chemical equation in each case when-

1. Zinc oxide dissolves in sodium hydroxide.
   Ans. $ZnO + 2NaOH \rightarrow Na_2 Zno_2 + H_20$
2. Zinc is heated with NaOH solution.
   Ans. $Zn + 2NaOH \rightarrow Na_2 Zno_2 + H_2\uparrow$

2012

Question 1.
Name: The gas evolved on reaction of Aluminium with boiling concentrated caustic alkali solution.
Ans.
Hydrogen gas

Question 2.
State one observation for:

1. Excess NH_4OH soln. is added to $Pb(No_3)_2$
   Ans. White ppt. insoluble in excess ammonium hydroxide.
2. NaOH soln. is added to $FeCl_3$ in excess.
   Ans. Reddish brown precipitate is formed which in insoluble in excess of NaOH.

2013

Question 1.
State two relevant observations for the reaction:
Ammonium hydroxide solution is added to copper (II) nitrate solution in small quantities and then in excess.
Answer:
With small amount of ammonium hydroxide, a bluish white precipitate is formed. This precipitate dissolves in excess of ammonium hydroxide to form a deep blue solution.

2014

Question 1.
State your observation: When excess sodium hydroxide is added to calcium nitrate solution.
Answer:
White ppt. formed is spairingly soluble.

$$Ca(NO_3)_2 + NaOH \longrightarrow \underset{\text{White ppt.}}{Ca(OH)_2\downarrow} + NaNO_3$$

2015

Question 1.
To a salt solution 'Y' a small quantity of ammonium hydroxide solution is added slowly and then in excess. A pale blue precipitate is formed which dissolves in excess to form a clear inky blue solution. Identify the positive ion in the salt 'Y'
Answer:
Cu^{2+} (Copper ion)

2016

Question 1.
State your observations when ammonium hydroxide solution is added drop by drop and then in excess to each of the following solutions:
(1) copper sulphate solution
(2) zinc sulphate solution
Answer:
(1)

$$CuSO_4 + 2NH_4OH \rightarrow \underset{\text{Pale Blue Precipitates}}{Cu(OH)_2} + (NH_4)_2SO_4$$

$$Cu(OH)_2 + 2(NH_4)_2SO_4 + 2NH_4OH \rightarrow \underset{\text{Deep blue solution}}{[Cu(NH_3)_4]SO_4} + 4H_2O$$

Pale blue precipitates are formed and then these precipitates dissolve in excess of ammonium hydroxide to form deep blue solution.
(2)

$$ZnSO_4 + NH_4OH \rightarrow \underset{\text{White gelatinous}}{Zn(OH)_2\downarrow} + (NH_4)_2SO_4$$

$$Zn(OH)_2 + (NH_4)_2SO_4 + 2NH_4OH \rightarrow \underset{\text{Colourless}}{[Zn(NH_3)_4]SO_4} + 4H_2O$$

When ammonium hydroxide is added drop by drop white gelatinous precipitate of zinc hydroxide is formed and on adding excess of ammonium hydroxide colourless solution is formed.

2017

Question 1.
State one relevant observation – Action of sodium hydroxide solution on iron [II] sulphate solution.
Answer:
A dirty green precipitate is formed which is insoluble in excess of sodium hydroxide solution.

Question 2.
How will you distinguish between – Ammonium hydroxide & sodium hydroxide using $CuS0_4$
Answer:
Sodium hydroxide forms a pale blue precipitate which is insoluble in excess of sodium hydroxide.
Ammonium hydroxide forms a pale blue precipitate which redissolves in excess of ammonium hydroxide to form deep blue colouration.

Additional Questions

Question 1.
Salts of…… (normal / transition) elements are generally coloured. From the ions $K_{,}^{+}$, Cr^{3+}, Fe^{2+}, $Ca^{2+}So_3^{2-}$, Mno_4^{1-}, No_3^{1-} the ions generally coloured are
Answer:
Normal; Cr^{3+}, Fe^{2+}, Mno_4^{1}

Question 2.
The hydroxide which is soluble in excess of NaOH is [$Zn(OH)_2$ / $Fe(OH)_3$ / $Fe(OH)_2$]
Answer:
$Zn(OH)_2$

Question 3.
The salt which will not react with NH_4OH solution [$ZnCl_2$/$CuCl_2$/NH_4 Cl/$FeCl_2$]
Answer:
NH_4Cl

Question 4.
The substance/s which react/s with hot cone. NaOH soln. and undergoes a neutralization reaction…….. [Al_20_3/Al/$Al(OH)_3$]
Answer:
Al_20_3

Question 5.
To distinguish soluble salts of zinc and lead, ……[NaOH/NH_4OH] can be used.
Answer:
NaOH

Question 6.
Oxides and hydroxide of certain metals i.e…… (iron/ zinc/copper/aluminium/magnesium/Iead] are amphoteric and react with…… [acids/alkali/acids and alkalis].

Answer:
zinc, aluminium and lead; acids and alkalis

Complete the following equations:

1. $MgCl_2 + NH_4OH \rightarrow$ …… +……..
2. $Zn + NaOH \rightarrow$ …… +…….
3. $ZnO + NaOH \rightarrow$ …… +……
4. $Al(OH)_3 + KOH \rightarrow$ ……. +……..
5. $Zn(OH)_2 + NaOH$ (excess) → ……. + ……..
6. $Pb(No_3)_2 + NH_4OH \rightarrow$ …… + ……..
7. $Al_2 O_3 + KOH \rightarrow$ ……. +……
8. $FeCl_3 + NaOH \rightarrow$ ……+ …….

Answer:

(i) $MgCl_2 + 2NH_4OH \longrightarrow \mathbf{2NH_4Cl + Mg(OH)_2\downarrow}$

(ii) $Zn + 2NaOH \longrightarrow \mathbf{Na_2ZnO_2} + \mathbf{H_2}$
[sodium zincate]

(iii) $ZnO + 2NaOH \longrightarrow \mathbf{Na_2ZnO_2} + \mathbf{H_2O}$
[sodium zincate]

(iv) $Al(OH)_3 + KOH \longrightarrow \mathbf{KAlO_2} + \mathbf{2H_2O}$
[potassium aluminate]

(v) $Zn(OH)_2 + 2NaOH$ (excess) $\longrightarrow \mathbf{Na_2ZnO_2} + \mathbf{2H_2O}$
[sodium zincate]

(vi) $Pb(NO_3)_2 + 2NH_4OH \longrightarrow \mathbf{2NH_4NO_3 + Pb(OH)_2\downarrow}$

(vii) $Al_2 O_3 + 2KOH \longrightarrow \mathbf{2KAlO_2} + \mathbf{H_2O}$
[potassium aluminate]

(viii) $FeCl_3 + 3NaOH \longrightarrow \mathbf{3NaCl + Fe(OH)_3\downarrow}$