

Chapter 21 Chemical Analysis

Analytical chemistry deals with qualitative and quantitative analysis of substances.

Qualitative analysis : A salt consists of two parts known as radicals. The positively charged part of a salt (cation) which has been derived from a base is termed as basic radical and the negatively charged part of salt (anion) which has been derived from an acid is termed as acidic radical. In qualitative inorganic analysis, the given compound is analysed for the basic and acid radicals (*i.e.*, the cations and the anions), that it contains. For example zinc blende is analysed for the Zn^{2+} and S^{2-} ions that it contains.

Test for Different Gases

(1) Colourless gases

(i) **Tests for CO**₂ : It is colourless and odourless gas. It gives white ppt. with lime water which dissolves on passing excess of CO_2 . $Ca(OH)_2 + CO_2 \rightarrow CaCO_3 \downarrow + H_2O$ Lime water White ppt.

 $\begin{array}{c} CaCO_{3} + CO_{2} + H_{2}O \rightarrow Ca(HCO_{3})_{2} \\ White ppt. \quad Excess \qquad So \ \text{lub} \ le \end{array}$

(ii) **Test for CO**: It is colourless and odourless gas. It burns with a blue flame. $2CO + O_2 \rightarrow 2CO_2$

(iii) **Test for O_2 :** It is colourless and odourless gas. It rekindles a glowing splinter.

(iv) **Tests for H_2S :** It is a colourless gas with a smell of rotten eggs. It turns moist lead acetate paper black.

$$(CH_3COO)_2Pb + H_2S \rightarrow 2CH_3COOH + PbS_{Black}$$

(v) **Tests for** SO_2 : It is a colourless gas with a suffocating odour of burning sulphur. It turns acidified $K_2Cr_2O_7$ solution green. $3SO_2 + K_2Cr_2O_7 + H_2SO_4 \rightarrow K_2SO_4 + Cr_2(SO_4)_3 + H_2O$

(vi) **Tests for NH₃**: It is a colourless gas with a characteristic ammonical smell. It gives white fumes of NH_4Cl with HCl, $NH_3 + HCl \rightarrow NH_4Cl$. With Nessler's White fumes

reagents, it gives brown ppt. $2K_2[HgI_4] + NH_3 + KOH \rightarrow NH_2HgOHgI + 7KI + 2H_2O$ Nessler's reagent (Brownpo)

It gives deep blue colour with $CuSO_4$ solution, $CuSO_4 + 4NH_3 \rightarrow [Cu(NH_3)_4]SO_4$. NH_3 dissolves in Deepbluewater to give NH_4OH , which being basic, turns red litmus blue, $NH_3 + H_2O \rightarrow NH_4OH \rightleftharpoons NH_4^+ + OH^-$.

(vii) **Tests for HCl gas**: It is colourless gas with a pungent irritating smell. It turns moist blue litmus paper red i.e., it is acidic in nature. It gives white *ppt*. with $AgNO_3$ solution. This white *ppt*. is soluble in NH_4OH . $HCl + AgNO_3 \rightarrow AgCl + HNO_3$; Mhite ppt.

 $AgCl + 2NH_4OH \rightarrow [Ag(NH_3)_2] + 2H_2O$. Soluble

(viii) **Test for** CH_3COOH **vapours** : These vapours are colourless with a vinegar like smell.

(2) Coloured gases

(i) **Tests for Cl₂ :** It is a greenish yellow gas with a pungent smell. In small quantity it appears almost colourless. It bleaches a moist litmus paper, $Cl_2 + H_2O \rightarrow 2HCl + [O]$; $Colour + [O] \rightarrow Colourless$. Blue litmus paper first turns red and then becomes colourless.

(ii) Tests for Br₂: Brown vapours with a pungent smell. It turns moist starch paper yellow.

(iii) **Tests for I_2 :** Violet vapours with a pungent smell. It turns moist starch paper blue.

(iv) **Tests for NO₂** : Brown coloured pungent smelling gas. It turns moist starch *KI* paper blue

 $2KI + 2NO_2 \rightarrow 2KNO_2 + I_2$; $I_2 + Starch \rightarrow Blue \ colour$.

It turns ferrous sulphate solution black,

$$3FeSO_4 + NO_2 + H_2SO_4 \rightarrow Fe_2(SO_4)_3 + FeSO_4 \cdot NO + H_2O_{Rlack brown}$$

Systematic Procedure for Qualitative Analysis of Inorganic Salts

It involves the following steps : (1) Preliminary tests (2) Wet tests for acid radicals and (3) Wet tests for basic radicals.

(1) **Preliminary tests**

(i) *Physical examination* : It involves the study of colour, smell, density etc.

Colour	Salt	
Black	Oxides : MnO_2 , FeO, CuO, Co_3O_4 , Ni_2O_3	
	Sulphides :	
	$Ag_2S, CuS, Cu_2S, FeS, CoS, NiS$,	
	PbS , HgS , Bi_2S_3 (blackish brown)	
Blue	Hydrated $CuSO_4$, anhydrous $CoSO_4$	
Orange	KO_2 , some dichromate $(K_2Cr_2O_7)$, Sb_2S_3 ,	
	lerricyallides	
Green	Nickel salts, hydrated ferrous salts,	
	potassium permanganate $(KMnO_4)$, some	
	copper (II) salts	
Brownish yellow	SnS	

Table : 21.1 Colour

Dark brown	PbO_2 , Ag_2O , CdO , Fe_2O_3 , $CuCrO_4$, $FeCl_3$ (but yellow in aq. solution)
Pale brown	MnCO ₃
Light pink	Hydrated manganese salts
Reddish pink	Hydrated cobalt (II) salts
Red	HgI_2, Pb_3O_4
Yellow	CdS, PbI ₂ , AgBr, AgI, chromates

(ii) **Dry heating :** Substance is heated in a dry test tube.

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Observation	Result
(a) A gas or vapour is	Compounds with water
evolved.	of crystallisation
Vapour, evolved, test	Ammonium salts, acid
with litmus paper.	salts, and hydroxides.
	(usually accompanied by
	change of colour)
The vapour is alkaline.	Ammonium salts.
The vapour is acidic.	Readily decomposable
	salts of strong acids.
Oxygen is evolved	Nitrates,chlorates and
	certain oxides.
Dinitrogen oxide	Ammonium nitrate or
	nitrate mixed with an
	ammonium salt.
Dark-brown or reddish	Nitrates and nitrites of
fumes (oxides of	heavy metals.
nitrogen), acidic in	
reaction.	
CO_2 is evolved, lime	Carbonates or hydrogen
water becomes turbid.	carbonates.
NH_3 is evolved which	Ammonium salts.
turns red litmus blue.	
SO_2 is evolved, which	Sulphates and
turns acidified $K_2Cr_2O_7$	thiosulphates.
green, decolourises	
fuschin colour.	
H_2S is evolved, turns	Hydrates, sulphides or
lead acetate paper black,	sulphides in the presence
or cadmium acetate	of water.
yellow.	
Cl_2 is evolved, yellowish	Unstable chlorides e.g.,
	copper chlorides in the

green gas, bleaches	presence of oxidising
litmus paper, turns KI –	agents.
starch blue, poisonous.	
Br_2 is evolved (reddish	Bromides in the presence
brown, turns fluorescent	of oxidising agents.
paper red).	
I_2 is evolved, violet	Free iodine and certain
vapours condensing to	iodides
black crystals	
(b) A sublimate is formed	Ammonium and mercury
	salts.

White sublimate	As_2O_3, Sb_2O_3
Grey sublimate	Hg
Steel grey, garlic odour	As
Yellow sublimate	$S, As_2S_3 HgI_2(\text{Re}d)$

Action of heat on different compounds : Many inorganic salts decomposes on heating, liberating characteristic gases. A few such reactions are tabulated as follows,

$\xrightarrow{\Delta} 6PbO + O_2$ $2PbO_2 \xrightarrow{\Delta} 2PbO + O_2$ $2HgO \xrightarrow{\Delta} 2Hg + O_2$ $2Pb_3O_4 -$ (Silvery deposit) (Yellow $(\operatorname{Re} d)$ $(\operatorname{Re} d)$ (Brown) $CuSO_4.5H_2O \xrightarrow{\Delta} CuSO_4 + 5H_2O$ $CuCO_3 \xrightarrow{\Delta} CuO + CO_2$ ZnO_3 $ZnO_{Yellow(hot)} + CO_2$ (White) (Green) (White) White(cold) $2Ag_2O \rightarrow 4Ag + O_2$ $CuSO_4 \longrightarrow CuO + SO_3$ $2FeSO_4 \xrightarrow{\Delta} Fe_2O_3 + SO_2 + SO_3$ $2Zn(NO_3)_2 \xrightarrow{\Delta} 2ZnO + 4NO_2 + O_2$ $2AgNO_3 \xrightarrow{450^{\circ}C} 2Ag + 2NO_2 + O_2$ $2Cu(NO_3)_2 \rightarrow 2CuO + 4NO_2 + O_2$ (White) (Brown) $2Ag_2CO_3 \rightarrow 4Ag + 2CO_2 + O_2$ $2Pb(NO_3)_2 \rightarrow 2PbO + 4NO_2 + O_2$ $(NH_4)_2 Cr_2 O_7 \rightarrow N_2 + Cr_2 O_3 + 4H_2 O$ $2NaHCO_3 \rightarrow Na_2CO_3 + CO_2 + H_2O$ $NH_4HCO_3 \rightarrow NH_3 + CO_2 + H_2O$ $CaCO_3 \rightarrow CaO + CO_2$ $2NH_3 \xrightarrow{\text{Red hot}} N_2 + 3H_2$ $2NaNO_3 \rightarrow 2NaNO_2 + O_2$ $MgCO_3 \rightarrow MgO + CO_2$ $Al_2(SO_4)_3 \xrightarrow{\text{Red hot}} Al_2O_3 + 3SO_3$ $2Mg(NO_3)_2 \rightarrow 2MgO + 4NO_2 + O_2$ $2Ca(NO_3)_2 \rightarrow 2CaO + 4NO_2 + O_2$ $2CaSO_4.2H_2O \rightarrow 2CaSO_4.H_2O + 2H_2O$ $2AlCl_3.6H_2O \rightarrow Al_2O_3 + 6HCl + 9H_2O$ $2BeSO_4 \xrightarrow{\Delta} 2BeO + 2SO_2 + O_2$ (Plaster of Pari $2MgSO_4 \xrightarrow{\Delta} 2MgO + 2SO_2 + O_2$ $2ZnSO_4 \xrightarrow{\Delta} 2ZnO + 2SO_2 + O_2$ $2AgNO_3 \xrightarrow{350^{\circ}C} 2AgNO_2 + O_2$ $(COO)_2 Sn \xrightarrow{\Delta} SnO + CO_2 + CO$ $NH_4NO_2 \rightarrow N_2 + 2H_2O$ $CaC_2O_4 \rightarrow CaCO_3 + CO$ $NH_4NO_3 \rightarrow N_2O + 2H_2O$ $2KClO_3 \rightarrow 2KCl + 3O_2$ $2FeCl_3 \rightarrow 2FeCl_2 + Cl_2$ $2KMnO_4 \rightarrow K_2MnO_4 + MnO_2 + O_2$ $Li_2CO_3 \rightarrow Li_2O + CO_2$ $(COO)_2 Fe \rightarrow FeO + CO + CO_2$ $MgCl_2.6H_2O \rightarrow HgCl_2 + Hg$ $NH_4Cl \rightarrow NH_3 + HCl$ $2LiNO_3 \rightarrow Li_2O + 2NO_2 + \frac{1}{2}O_2$ $2CuCl_2 \xrightarrow{\Delta} Cu_2Cl_2 + Cl_2$ $Hg(NO_3)_2 \rightarrow Hg + 2NO_2 + O_2$ $2Co(NO_3)_2 \xrightarrow{\Delta} 2CoO + 4NO_2 + O_2$ $4K_2Cr_2O_7 \rightarrow 4K_2CrO_4 + 2Cr_2O_3 + 3O_2$ $2Mg(NH_4)PO_4 \xrightarrow{\Delta} Mg_2P_2O_7 + H_2O + 2NH_3$ $2Zn(NH_4)PO_4 \xrightarrow{\Delta} Zn_2P_2O_7 + H_2O + 2NH_3$ $K_4 Fe(CN)_6 \xrightarrow{\Delta} 4 KCN + Fe + 2C + N_2$ $ZnCl_2.2H_2O \xrightarrow{\Delta} Zn(OH)Cl + HCl + H_2O$ $2(ZnCl_2.H_2O) \xrightarrow{\Delta} Zn_2OCl_2 + 2HCl + H_2O$ $2[FeCl_3.6H_2O] \xrightarrow{\Delta} Fe_2O_3 + 9H_2O + 6HCl$ $2ZnSO_4 \xrightarrow{800^{\circ}C} 2ZnO + 2SO_2 + O_2$ $Na_2B_4O_7.10H_2O \xrightarrow{\Delta} Na_2B_4O_7 \xrightarrow{\Delta} 2NaBO_2 + B_2O_3$ (Glassy bead)

Table : 21.3

 $H_3BO_3 \xrightarrow{100^{\circ}C} HBO_2 \xrightarrow{160^{\circ}C} H_2B_4O_7 \xrightarrow{\text{Red hot}} B_2O_3$

$$ZnSO_{4}.7H_{2}O \xrightarrow[-H_{2}O]{70^{\circ}C} ZnSO_{4}.6H_{2}O \xrightarrow[-5H_{2}O]{100^{\circ}C} ZnSO_{4}.H_{2}O \xrightarrow[-5H_{2}O]{450^{\circ}C} ZnSO_{4}.H_{2}O \xrightarrow[-5H_{2}O]{45$$

(iii) Flame test

Characteristic flame colour : Certain metals and their salts impart specific colours to Bunsen burner flame.

(a) *Pb* imparts pale greenish colour to the flame.

(b) Cu and Cu salts impart blue or green colour to the flame.

(c) Borates also impart green colour to the flame.

(d) *Ba* and its salts impart apple green colour to the flame.

(e) *Sr* imparts crimson red colour to the flame.

(f) Ca imparts brick red colour to the flame.

(g) Na imparts yellow colour to the flame.

(h) K imparts pink-violet (Lilac) colour to the flame.

(i) *Li* imparts crimson-red, *Rb* imparts violet and *Cs* imparts violet colours to the flame.

(j) Livid- blue flame is given by As, Sb and Bi.

(iv) **Borax bead test :** The transparent glassy bead $(NaBO_2 + B_2O_3)$ when heated with inorganic salt and the colour produced gives some idea of cation present in it.

Colour of bead in	Colour of bead in	Basic radical
oxidising flame	reducing flame	present
Greenish when hot, blue in cold.	Red and opaque	Си
Dark green in hot and cold	Same	Cr
Deep – blue	Deep blue	Со
Yellow when hot	Green	Fe
Violet in hot and cold	Colourless	Mn
Brown in cold	Grey or black or opaque	Ni

Table : 21.4

Microcosmic salt bead test : Microcosmic salt, $Na(NH_4)HPO_4.4H_2O$ is also used to identify certain cations just like borax. When microcosmic salt is heated in a loop of platinum wire, a colourless transparent bead of sodium metaphosphate is formed.

 $Na(NH_4)HPO_4.4H_2O \rightarrow Na(NH_4)HPO_4 + 4H_2O$

 $Na(NH_4)HPO_4 \rightarrow NaPO_3 + NH_3 + H_2O$

Now $NaPO_3$ reacts with metallic oxides to give coloured orthophosphates.

 $NaPO_3 + CuO \rightarrow NaCuPO_4$ (Blue);

 $NaPO_3 + CoO \rightarrow NaCoPO_4$ (Blue);

 $NaPO_3 + Cr_2O_3 \rightarrow NaPO_3.Cr_2O_3$ (Green)

(v) Charcoal cavity test

Table : 21.5

(a) Compound fused in cavity directly	
Nature and colour of bead	Cation
Yellow, brittle bead	<i>Bi</i> ³⁺
Yellow, soft bead which marks on paper	<i>Pb</i> ²⁺
White, brittle	<i>Sb</i> ³⁺
White yellow when hot	ZnO
White garlic odour	As_2O_3
Brown	CdO
Grey metallic particles attracted by magnet	Fe, Ni, CO
Maleable beads	<i>Ag</i> and <i>Sn</i> (White), <i>Cu</i> (Red flakes)

(b) Compound mixed with Na_2CO_3 Crystalline



Sustance

Oxidising agents like NO_{3}^{-}, NO_{2}^{-} chlorates

Salts, NaCl, KCl;

Substance infusible, perform test (a)

(vi) Cobalt Nitrate test

Table	: 21	.6
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Colour	Composition	Result
Blue residue	$CoO.Al_2O_3$	Al
Green residue	CoO . ZnO	ZnO
Pink dirty residue	CoO . MgO	MgO
Blue residue	NaCoPO ₄	PO_4^{3-} in
		absence of Al.

(2) Wet tests for acid radicals : Salt or mixture separately and by observing the types of gases evolved. Separately with dil. H_2SO_4 and also with conc. H_2SO_4 Confirmatory tests of anions are performed.

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Observations	Acia Radical	Confirmatory test
Brisk effervescence with evolution of colourless and odourless gas. CO_3^{2-} (carbonate)		Gas turns lime water milky but milkyness disappears on passing gas inexcess, $Na_2CO_3 + H_2SO_4 \longrightarrow Na_2SO_4 + H_2O + CO_2$
		$Ca(OH)_2 + CO_2 CaCO_3 + H_2O$ lime water milky
		$CaCO_3 + H_2O + CO_2 \longrightarrow Ca(HCO_3)_2$ soluble
Brown fumes	NO_2^- (Nitrite)	Add <i>KI</i> and starch solution blue colour $2NaNO_3 + H_2SO_4 \longrightarrow Na_2SO_4 + 2HNO_2$;
		$HNO_2 \longrightarrow NO$ (colourless); $2NO + O_2(air) \longrightarrow 2NO_2$ (brown)
		$2KI + H_2SO_4 + 2NHO_2 \longrightarrow K_2SO_4 + 2H_2O + 2NO + I_2$
		$I_2 + \text{starch} \longrightarrow \text{blue colour}$
Smell of rotten eggs	S^{2-} (sulphide)	Gas turn lead acetate paper black
$(H_2S \text{ smell})$ on heating	Sodium carbonate extract $(SE)^*$ + sodium nitroprusside – purple colour,	
		$Na_2S + H_2SO_4 \longrightarrow H_2S + Na_2SO_4$
		$H_2S + (CH_3COO)_2Pb \longrightarrow PbS + 2CH_3COOH_{(black)}$
		$Na_2S + Na_2[Fe(CN)_5 NO] \longrightarrow Na_4[Fe(CN)_5 NOS]$ sodium nitroprusside (purple)
Colourless gas with pungent smell of burning sulphur	SO_3^{2-} (sulphite)	Gas turns acidified $K_2 Cr_2 O_7$ solution green [different from CO_3^{2-}] since
		$Na_2SO_3 + H_2SO_4 \xrightarrow{\Lambda} Na_2SO_4 + H_2O + SO_2$
		$Cr_2O_7^{2-} + 3SO_2 + 2H^+ \longrightarrow 2Cr^{3+} + 3SO_4^2 + H_2O_{(green)}$
		$Ca(OH)_2 + SO_2 CaSO_3$ (milky)
Solution gives smell of	CH ₃ COO ⁻	Aq. Solution + neutral $FeCl_3 \rightarrow blood$ red colour
vinegar	(acetate)	$3CH_{3}COONa + FeCl_{3} \longrightarrow Fe(CH_{3}COO)_{3} + 3NaCl_{(red)}$
White or yellowish white	S ₂ O ₃ ²⁻	Aq. Solution + $AgNO_3 \rightarrow$ white ppt. changing to black (viii) on warming
turbidity on warming	(thiosulphate)	, $Na_2S_2O_3 + 2AgNO_3 \longrightarrow Ag_2S_2O_3 + 2NaNO_3$ white ppt.
		$Ag_{2}S_{2}O_{3} + H_{2}O Ag_{2}S + H_{2}SO_{4}$ blackppt.

Table : 21.7 Observations with Dilute H_2SO_4

Table : 21.8 Observation with concentrated H_2SO_4

Observation	Acid Radical	Confiramatory Test
Colourless pungent gas giving white fumes with	Cl^- (chloride)	Add MnO_2 in the same test tube and heat-pale green Cl_2 gas (i)

aq. NH_4OH		S.E. + HNO_3 + $AgNO_3$ solution – white ppt. soluble in aq. NH_3 (ii)
		Chromyl chloride test (iii)
Reddish brown fumes	<i>Br</i> ⁻ (bromide)	Add Mn_2O and heat -yellowish brown Br_2 gas (iv)
		S.E. + HNO_3 + $AgNO_3$ solution -pale yellow ppt. partially soluble
		aq. NH_3 (v)
		Layer test (vi)
Violet pungent vapours	I^- (iodide)	$S.E. + HNO_3 + AgNO_3 \rightarrow$ yellow ppt. insoluble in aq. NH_3 (vii)
turning starch paper blue.		Layer test (vi)
Brown pungent fumes	NO_3^- (nitrate)	Ring test (viii)
intensified by the addition of <i>Cu</i> - turnigs.		
Colourless gases turning	$C_2 O_4^{2-}$ (oxalate)	Acidified $KMnO_4$ solution is decolorised (ix)
lime water milky and burning with blue flame.		$S.E. + CH_3COOH + CaCl_2$ white ppt. decolorising acidified $KMnO_4$
0		solution (x)

Reactions

Chloride : (i) $KCl + \operatorname{conc.} H_2SO_4 \longrightarrow KHSO_4 + HCl$ $HCl + NH_3 \longrightarrow NH_4Cl$ (white fumes) $4HCl + MnO_2 \longrightarrow MnCl_2 + Cl_2 + 2H_2O$ (ii) $KCl + AgNO_3 \longrightarrow AgCl \downarrow + KNO_3$ white ppt. $AgCl + aq. 2NH_3 \longrightarrow [Ag(NH_3)_2]Cl$ (iii) Chromyl- chloride test : Chloride +

 $K_2Cr_2O_7(\text{solid}) + \text{conc. H}_2SO_4 \xrightarrow{\text{heat}} \text{reddish}$ brown vapours of chromyl-chloride (CrO_2Cl_2) . Pass these vapours into NaOH, when yellow Na_2CrO_4 solution is formed. On adding CH_3COOH and $(CH_3COO)_2$ Pb, yellow ppt. of lead chromate $(PbCrO_4)$ is formed.

$$\begin{aligned} & KCl + \operatorname{conc.} H_2 SO_4 \xrightarrow{\Delta} KHSO_4 + HCl ; \\ & K_2 Cr_2 O_7 + 2H_2 SO_4 \xrightarrow{\Delta} 2KHSO_4 + 2CrO_3 + H_2 O \\ & \operatorname{conc.} \end{aligned}$$

$$CrO_3 + 2HCl \xrightarrow{\longrightarrow} CrO_2 Cl_2 + 2H_2 O \\ & CrO_2 Cl_2 + 4NaOH \xrightarrow{\longrightarrow} Na_2 CrO_4 + 2NaCl + 2H_2 O \\ & Na_2 CrO_4 + (CH_3 COO)_2 Pb \xrightarrow{\longrightarrow} PbCrO_4 \downarrow + 2CH_3 COONa \\ & \operatorname{yellowppt.} \end{aligned}$$

Bromide : (iv) $KBr + \text{conc. } H_2SO_4 \xrightarrow{\Delta} KHSO_4 + H$;

$$4HBr + MnO_{2} \xrightarrow{\Delta} Br_{2} + 2H_{2}O + MnBr_{2}$$
(v) $NaBr + AgNO_{3} \longrightarrow AgBr \downarrow + NaNO_{3}$
pale yellow ppt.
 $AgBr + aq. 2NH_{3} \longrightarrow [Ag(NH_{3})_{2}]Br$
partially soluble
(vi) Layer Test : S.E. + Cl₂ water

+ $CHCl_3 \xrightarrow{\text{shake}}$ yellowish orange colour in $CHCl_3$ layer (CS_2 or CCl_4 can be taken instead of $CHCl_3$);

$$2NaBr + Cl_2 \longrightarrow 2NaCl + Br_2$$

orange yellow
(soluble in CHCl_3)

In case of I^- , violet colour of I_2 in *CHCl*₃ layer, $2NaI + Cl_2 \longrightarrow 2NaCl + I_2$ (violet)

Iodide : (vii)
$$KI + \operatorname{conc.} H_2SO_4 \xrightarrow{\Delta} KHSO_4 + HI$$
;
 $2HI + H_2SO_4 \longrightarrow I_2 + 2H_2O + SO_2$
Nitrate : $NaNO_3 + H_2SO_4 \longrightarrow NaHSO_4 + HNO_3$
 $4HNO_3 \longrightarrow 4NO_2 + O_2 2H_2O$;
 $brown fumes$
 $Cu + 4HNO_3 \longrightarrow Cu (NO_3)_2 + 2NO_2 + 2H_2O$

(viii) **Ring test** : To water extract (all NO_3^- are water soluble) add freshly prepared $FeSO_4$ solution and then conc. H_2SO_4 carefully by the side of the test-

tube. A dark brown ring of $[Fe(H_2O)_5 NO]^{2+} SO_4^{2-}$ at the interface between the two liquids is formed.

$$2NaNO_{3} + H_{2}SO_{4} \longrightarrow 2NaHSO_{4} + 2HNO_{3};$$

$$2HNO_{3} + 6Fe SO_{4} + 3H_{2}SO_{4} \longrightarrow$$

$$3Fe_{2}(SO_{4})_{3} + 2NO + 4H_{2}O$$

$$[Fe(H_2O)_6]SO_4 + NO \longrightarrow [Fe(H_2O)_5 NO]^{2+} SO_4^{2-} + H_2O_6 + H_2O_6]SO_4 + NO \longrightarrow [Fe(H_2O)_5 NO]^{2+} SO_4^{2-} + H_2O_6]SO_4 + H_2O_6]SO_6 + H_2O_6]SO_6]SO_6 + H$$

Oxalate :

$$Na_2C_2O_4 + H_2SO_4 \longrightarrow Na_2SO_4 + H_2O + CO + CO_2$$

white ppt

CO burns with blue flame and CO_2 turns lime water milky.

(ix)
$$5C_2O_4^{2-} + 2MnO_4^{-} + 16H^+ \longrightarrow 10 CO_2 + 2Mn^{2+} + 8H_2O_{colourless}$$

(x) $CaCl_2 + NaC_2O_4 \longrightarrow CaC_2O_4 \downarrow + 2NaCl CaC_2O_2$

decolourises acidified KMnO₄.

Specific test in solution

(i) **Sulphate** : S.E. add dil. (to decompose CO_3^{2-} until reaction ceases). Add $BaCl_2$ solution. White ppt. insoluble in conc. HNO_3 , $BaCl_2 + NaSO_4 \longrightarrow BaSO_4 \downarrow + 2NaCl$ white ppt.

(ii) **Borate** : Ignite the mixture containing borate, conc. H_2SO_4 . And ethanol in a china-dish with a burning splinter –green edged flame of ethyl borate.

$$2Na_{3}BO_{3} + 3H_{2}SO_{4} \rightarrow 2H_{3}BO_{3} + 3Na_{2}SO_{4};$$

$$H_{3}BO_{3} + 3C_{2}H_{5}OH \xrightarrow{\Delta} (C_{2}H_{5}O)_{3}B + 3H_{2}O$$
burns with green flame
(volatile)

In presence of Cu^{2+} , perform this test in a test tube since Cu^{2+} salts are not volatile.

(iii) $S.E. + HNO_3 +$ ammonium molybdate solution. Heat, yellow crystalline ppt. confirms

$$\begin{aligned} &Na_3PO_4 + 12(NH_4)_2MoO_4 + 24HNO_3 \xrightarrow{\Delta} \\ &(NH_4)_3PO_4 \cdot 12MoO_3 + 21NH_4NO_3 + 3NaNO_3 + 12H_2O_4 \\ &\text{yellowppt.} \end{aligned}$$

Arsenic also gives this test. Hence presence of phosphate should also be checked after group II.

(iv) *Fluoride* : Sand +salt (F^-) +conc. H_2SO_4 ; heat and bring a water wetted rod in contact with vapours at the mouth of the test tube. A white deposit on the rod shows the presence to F^-

$$NaF + H_2SO_4 \xrightarrow{\Lambda} NaHSO_4 + HF$$

$$SiO_2 + 4HF \xrightarrow{\Lambda} SiF_4 + 2H_2O$$

$$3SiF_4 4H_2O \longrightarrow 2H_2SiF_6 + H_4SiO_4$$

white

(3) Wet tests for basic radicals	: Analysis	of Basic	Radicals
		Tabl	

Group	Basic radicals	Group reagent	Ppt. as	Explanation		
I	$Ag^{+}, Hg_{2}^{2+}(I), Pb^{2+}$	dil HCl	Chloride	K_{SP} values of chlorides are low,		
			$(AgCl, Hg_2Cl_2, PbCl_2)$	hence precipitated. Others have		
				higher K_{SP} values hence not		
				precipitated.		
II	$Cu^{2+}, Cd^{2+}, Pb^{2+}$,	H_2S gas in	Sulphides	K_{SP} values of sulphides are low		
	Hg^{2+} (II), Bi^{3+} , As^{3+} ,	presence of dil.	(CuS , As_2S_3 etc.)	hence precipitated by low $[S^{2-}]$		
	<i>Sb</i> ³⁺ , <i>Sn</i> ²⁺	HCl		ion. <i>HCl</i> (with common H^+ ion)		
				decreases ionization of H_2S		
				which gives low $[S^{2-}]$. Hence II		
				group is precipitated. Others		
				with higher K_{SP} values not		
				precipitated.		
III	<i>Al</i> ³⁺ , <i>Cr</i> ³⁺ , <i>Fe</i> ³⁺	NH_4OH in	Hydroxide, <i>Al(OH)</i> ₃	K_{SP} values of $Al(OH)_3$ etc. are		
		presence of	etc.	low. NH_4Cl (with common NH_4^+		
		NH ₄ Cl		ion) decreases ionization of		
				NH_4OH giving low $[OH^-]$. Hence		
				group III is precipitated.		

IV	Zn ²⁺ , Ni ²⁺ , Mn ²⁺ , Co ²⁺	H ₂ S in ammonical medium	Sulphides (<i>ZnS</i> etc.)	K_{SP} valuesofsulphidesofgroupIVarehighhenceprecipitationtakesplaceinhigher $[S^{2-}]$ Basicmediumincreasesionizationof H_2S increasing $[S^{2-}]$ hence
				precipitation of group IV.
v	$Ca^{2+}, Ba^{2+}, Sr^{2+}$	$(NH_4)_2 CO_3 + NH_4 Cl$	Carbonates (<i>CaCO</i> ₃	K_{SP} values of carbonate are less
			etc.)	than that of group VI (Mg^{2+})
				hence precipitation before
				Mg^{2+} .
VI	$Mg^{2+}, (Na^+, K^+)$ also	$NH_4OH + Na_2HPO_4$	White ppt.	-
	included)	(only for Mg^{2+})	$(MgHPO_4)$	
0	NH_4^+	-	-	Tested independently from original
(Zero)				solution.

Chemical reactions involved in the tests of basic radicals

Group I : When dil. *HCl* is added to original solution, insoluble chlorides of lead, silver mercurous mercury are precipitated.

 $Pb(NH_3)_2 + 2HCl \longrightarrow PbCl_2 + 2HNO_3;$

 $AgNO_3 + HCl \longrightarrow AgCl + HNO_3$

 $Hg(NO_3)_2 + 2HCl \longrightarrow HgCl_2 + 2HNO_3$

Pb^{2+} (lead)

(i) $PbCl_2$ is soluble in hot water and on cooling white crystals are again formed.

(ii) The solution of $PbCl_2$ gives a yellow precipitate with potassium chromate solution which is insoluble in acetic acid but soluble in sodium hydroxide.

$$\begin{split} PbCl_{2} + K_{2}CrO_{4} & \longrightarrow PbCrO_{4} + 2KCl \ ; \\ & \text{yellowppt.} \end{split}$$

$$PbCrO_{4} + 4NaOH & \longrightarrow Na_{2}PbO_{2} + Na_{2}CrO_{4} + 2H_{2}O \end{split}$$

(iii) The solution of $PbCl_2$ forms a yellow precipitate with potassium iodide solution.

$$PbCl_2 + 2KI \longrightarrow PbI_2 + 2KCl$$

Yellow ppt.

(iv) White precipitate of lead sulphate is formed with dilute H_2SO_4 . The precipitate is soluble in ammonium acetate, $PbCl_2 + H_2SO_4 \longrightarrow PbSO_4 + 2HCl$;

$$PbSO_4 + 2CH_3COONH_4 \longrightarrow Pb(CH_3COO)_2 + (NH_4)_2SO_4$$

Ag⁺(silver)

(i) AgCl dissolves in ammonium hydroxide, $AgCl + 2NH_4OH \longrightarrow Ag(NH_3)_2Cl + 2H_2O$ Diamnine silver (1) Chloride

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(ii) On adding dilute HNO_3 to the above solution, white precipitate is again obtained

 $Ag(NH_3)_2Cl + 2HNO_3 \longrightarrow AgCl + 2NH_4NO_3$ White ppt.

(iii) On adding *KI* to the complex solution, yellow precipitate is obtained.

$$Ag(NH_3)_2Cl + KI \longrightarrow AgI + KCl + 2NH_3$$

 Hg_2^{2+} (mercurous)

(i)
$$Hg_2Cl_2$$
 turns black with NH_4OH ,
 $Hg_2Cl_2 + 2NH_4OH \longrightarrow Hg + Hg(NH_2)Cl + NH_4Cl + 2H_2O$

(ii) The black residue dissolves in aqua-regia forming mercuric chloride.

$$\begin{aligned} & 3HCl + HNO_3 \longrightarrow NOCl + 2H_2O + 2Cl \\ & 2Hg(NH_2)Cl + 6Cl \longrightarrow 2HgCl_2 + 4HCl + N_2 \\ & Hg + 2Cl \longrightarrow HgCl_2 \end{aligned}$$

(iii) The solution of H_gCl_2 forms white or slatecoloured precipitate with stannous chloride.

$$2HgCl_{2} + SnCl_{2} \longrightarrow Hg_{2}Cl_{2} + SnCl_{4}$$
white ppt.
$$Hg_{2}Cl_{2} + SnCl_{2} \longrightarrow 2Hg + SnCl_{4}$$
Grey ppt.

(iv) The solution of H_gCl_2 with copper turning forms a grey deposit.

$$HgCl_2 + Cu \longrightarrow Hg + CuCl_2$$

Grey ppt.

Group II: When hydrogen sulphide is passed in acidified solution, the radicals of second group are precipitated as sulphides. The precipitate is treated with yellow ammonium sulphide. The sulphides of IIB are first oxidised to higher sulphides which then dissolve to form thio-compounds.

$$Ag_{2}S_{3} + 2(NH_{4})_{2}S_{2} \longrightarrow 2(NH_{4})_{2}S + As_{2}S_{5}$$

$$Sb_{2}S_{3} + 2(NH_{4})_{2}S_{2} \longrightarrow 2(NH_{4})_{2}S + Sb_{2}S_{5}$$

$$SnS + (NH_{4})_{2}S_{2} \longrightarrow (NH_{4})_{2}S + SnS_{2}$$

$$As_{2}S_{5} + 3(NH_{4})S \longrightarrow 2(NH_{4})_{3}AsS_{4}$$

$$Ammonium$$

$$Hioarsena te$$

$$Sb_{2}S_{5} + 3(NH_{4})_{2}S \longrightarrow 2(NH_{4})_{2}SbS_{4}$$

$$Ammonium$$

$$Hioartimo nate$$

$$SnS_{2} + (NH_{4})_{2}S \longrightarrow (NH_{4})_{2}SnS_{3}$$

$$Ammonium$$

$$Hiostanna te$$

All the three are soluble.

In case, the precipitate does not dissolve in yellow ammonium sulphide, it may be either H_gS or PbS or Bi_2S_3 or CuS or CdS. The precipitate is heated with dilute HNO_3 . Except H_gS , all other sulphides of *IIA* are soluble.

$$\begin{split} & 3PbS + 8HNO_3 \rightarrow 3Pb(NO_3)_2 + 2NO + 3S + 4H_2O \\ & Bi_2S_3 + 8HNO_3 \rightarrow 2Bi(NO_3)_3 + 2NO + 3S + 4H_2O \\ & 3CuS + 8HNO_3 \rightarrow 3Cu(NO_3)_2 + 2NO + 3S + 4H_2O \\ & 3CdS + 8HNO_3 \rightarrow 3Cd(NO_3)_2 + 2NO + 3S + 4H_2O \end{split}$$

Hg^{2+} (mercuric)

HgS is dissolved in aqua-regia,

$$3HgS + 2HNO_3 + 6HCl \rightarrow 3HgCl_2 + 3S + 2NO + 4H_2O$$

The solution is divided into two parts:

Part I : Stannous chloride solution reduces H_gCl_2 first into white $H_{g_2}Cl_2$ and then to grey metallic mercury.

Part II : Copper displaces H_g from H_gCl_2 which gets coated on copper turnings as a shining deposit. **Pb²⁺ (lead)**

In case the sulphide dissolves in dilute HNO_3 , a small part of the solution is taken. Dilute H_2SO_4 is added. If lead is present, a white precipitate of lead sulphate appears, $Pb(NO_3)_2 + H_2SO_4 \rightarrow PbSO_4 + 2HNO_3$ (White ppt.)

In absence of lead, the remaining solution is made alkaline by the addition of excess of NH_4OH . Bismuth forms a white precipitat of $Bi(OH)_3$, copper forms a deep blue coloured solution while cadmium forms a colourless soluble complex,

$$\begin{array}{c} Bi(NO_3)_3 + 3NH_4OH \longrightarrow Bi(OH)_3 + 3NH_4NO_3\\ & White ppt.\\ Cu(NO_3)_2 + 4NH_4OH \longrightarrow [Cu(NH_3)_4](NO_3)_2 + 4H_2O;\\ & Tetrammin \ e \ cupric \ nitrate\\ & (deep \ blue \ solution)\\ Cd(NO_3)_2 + 4NH_4OH \longrightarrow [Cd(NH_3)_4](NO_3)_2 + 4H_2O \end{array}$$

Tetrammin e cadmium nitrate (colourles s solution)

 Bi^{3+} (bismuth) : The precipitate dissolves in dilute *HCl*, $Bi(OH)_3 + 3HCl \longrightarrow BiCl_3 + 3H_2O$

Part I : Addition of excess of water to $BiCl_3$ solution gives a white precipitate due to hydrolysis.

$$BiCl_3 + H_2O \longrightarrow BiOCl + 2HCl$$

Bismuth Oxychlorid e (White ppt.)

Part II : The solution of $BiCl_3$ is treated with sodium stannite when a black precipitate of metallic bismuth is formed, $2BiCl_3 + 3Na_2SnO_2 + 6NaOH \longrightarrow$

 $3Na_2SnO_3 + 2Bi + 6NaCl + 3H_2O$ sod. stannate

 Cu^{2+} (copper) : Blue coloured solution is acidified with acetic acid. When potassium ferrocyanide is added a chocolate coloured precipitate is formed,

$$Cu(NH_{3})_{4}(NO_{3})_{2} + 4CH_{3}COOH \longrightarrow$$

$$Cu(NO_{3})_{2} + 4CH_{4}COONH_{4}$$

$$2Cu(NO_{3})_{2} + K_{4}[Fe(CN)_{6}] \longrightarrow Cu_{2}[Fe(CN)_{6} + 4KNO_{3}$$
Chocolate ppt.

 Cd^{2+} (cadmium) : H_2S is passed through colourless solution. The appearance of yellow precipitate confirms the presence of cadmium,

$$Cd (NH_3)_4 (NO_3)_2 + H_2S \longrightarrow CdS + 2NH_4NO_3 + NH_3$$

Yellow ppt.

Group IIB : In case the precipitate dissolves in yellow ammonium sulphide, the tests of the radicals arsenic, antimony and tin are performed. The sulphide is treated with concentrated hydrochloric acid. Antimony and tin sulphide dissolve while arsenic sulphide remains insoluble.

*As*³⁺ (arsenic) : The insoluble sulphide is treated with concentrated nitric acid which is then heated with ammonium molybdate. Yellow precipitate of ammonium arsenomolybdate is formed.

$$As_{2}S_{5} + 10 HNO_{3} \longrightarrow 2H_{3}AsO_{4} + 10 NO_{2} + 2H_{2}O + 5S$$

$$Arsenic acid$$

$$H_{3}AsO_{4} + 12(NH_{4})_{2} MoO_{4} + 21 HNO_{3} \longrightarrow$$

$$(NH_4)_3 AsO_4 . 12MoO_3 + 21NH_4NO_3 + 12H_2O_{\text{Yellowppt.}}$$

 Sn^{2+} or Sn^{4+} (tin) : Solution of sulphide in concentrated HCl is reduced with iron fillings or granulated zinc.

$$SnS_{2} + 4HCl \longrightarrow SnCl_{4} 2H_{2}S$$
White ppt.
$$SnCl_{4} + Fe \longrightarrow SnCl_{2} + FeCl_{4}$$
Grey

 $HgCl_2$ solution is added to above solution which gives first a white precipitate that turns to grey.

$$2H_gCl_2 + SnCl_2 \longrightarrow H_gCl_2 + SnCl_4$$

White ppt.

$$Hg_2Cl_2 + SnCl_2 \longrightarrow 2Hg + SnCl_2$$
Grey

Sb²⁺ (antimony) : Filtrate of sulphide in concentrated HCl is divided into two parts.

Part I : On dilution with excess of water, a white precipitate of antimony oxychloride is obtained.

$$SbCl_3 + H_2O \longrightarrow SbOCl + 2HCl$$

White ppt.

Part II : H_2S is circulated. Orange precipitate is

formed,
$$2SbCl_3 + 3H_2S \longrightarrow Sb_2S_3 + 6HCt_{Orange ppt.}$$

Group III : addition of excess of of ammonium chlori

$$\begin{aligned} AlCl_{3} + 3NH_{4}OH &\longrightarrow Al(OH)_{3} + 3NH_{4}Cl \\ & \text{Gelatinous ppt.} \end{aligned}$$

$$CrCl_{3} + 3NH_{4}OH &\longrightarrow Cr(OH)_{3} + 3NH_{4}Cl \\ & \text{Green ppt.} \end{aligned}$$

$$FeCl_{3} + 3NH_{4}OH &\longrightarrow Fe(OH)_{3} + 3NH_{4}Cl \\ & \text{Brownish red ppt.} \end{aligned}$$

Fe³⁺ (iron) : The brownish red precipitate dissolves in dilute HCl. The solution is divided into two parts.

Part I : $K_4[Fe(CN)_6]$ solution is added which forms deep blue solution or precipitate.

$$Fe(OH)_{3} + 3HCl \longrightarrow FeCl_{3} + 3H_{2}O$$

$$4FeCl_{3} + 3K_{4}[Fe(CN)_{6}] \longrightarrow Fe_{4}[Fe(CN)_{6}]_{3} + 12KCl$$
Prussian blue

Part II : Addition of potassium thiocyanate solution gives a blood red colouration.

$$FeCl_3 + 3KCNS \longrightarrow Fe(CNS)_3 + 3KCl$$

Blood red colour

Cr³⁺(chromium) : The green precipitate is fused with fusion mixture $(Na_2CO_3 + KNO_3)$. The fused product is extracted with water or the precipitate is heated with *NaOH* and bromine water.

$$2Cr(OH)_{3} + 3KNO + 2Na_{2}CO_{3} \longrightarrow$$

$$2Na_{2}CrO_{4} + 3KNO_{2} + 2CO_{2} + 3H_{2}O$$
or
$$2NaOH + Br_{2} \longrightarrow NaBrO_{4} + NaBr + H_{2}O$$

$$NaBrO \longrightarrow NaBr + [O]$$

$$2Cr(OH)_{3} + 4NaOH + 3[O] \longrightarrow 2NaCrO_{4} + 5H_{2}O$$

The solution thus obtained contains sodium chromate. The solution is acidified with acetic acid and treated with lead acetate solution. A yellow precipitate appears.

$$Na_2CrO_4 + Pb(CH_3COO)_2 \longrightarrow PbCrO_4 + 2CH_3COONa_{Yellowppt}$$

Al³⁺(aluminium) : The gelatinous precipitate dissolves in NaOH, $Al(OH)_3 + NaOH \longrightarrow NaAlO_2 + 2H_2O$

The solution is boiled with ammonium chloride when $Al(OH)_3$ is again formed.

$$NaAlO_2 + NH_4Cl + H_2O \longrightarrow Al(OH)_3 + NaCl + NH_3$$

rough the filtrate of the third group, sulphides of fourth group are precipitated. NiS and CoS are black and insoluble in concentrated HCl while MnS (buff coloured), ZnS (colourless) are soluble in conc. HCl.

 Zn^{2+} (zinc) : The sulphide dissolves in HCl. $ZnS + 2HCl \longrightarrow ZnCl_2 + H_2S$

When the solution is treated with NaOH, first a white precipitate appears which dissolves in excess of NaOH

$$ZnCl_{2} + 2NaOH \longrightarrow Zn(OH)_{2} + 2NaCl$$
White ppt.
$$Zn(OH)_{2} + 2NaOH \longrightarrow Na_{2}ZnO_{2} + 2H_{2}O$$
(Soluble)

On passing H_2S , white precipitate of zinc sulphide formed is

$$Na_2ZnO_2 + H_2S \longrightarrow ZnS_{\text{White ppt.}} + 2NaOH$$

Mn²⁺ (manganese) : Manganese sulphide dissolves in HCl $MnS + 2HCl \longrightarrow MnCl_2 + H_2S$

On heating the solution with NaOH and Br_2 water, manganese dissolve gets precipitated.

$$MnCl_2 + 2NaOH \longrightarrow Mn(OH)_2 + 2NaCl$$

 $Mn(OH)_2 + O \longrightarrow MnO_2H_2O$

Group IV : On passing
$$H_2S$$
 the third array makehide f

$$\xrightarrow{\text{Orange ppt.}} Sb_2S_3 + 6HCl$$

Orange ppt.
Hydroxides are precipitated on

$$NH_4OH \longrightarrow Al(OH)_3 + 3NH_4Cl$$

Gelatinous ppt.
$$3NH_4OH \longrightarrow Cr(OH)_3 + 3NH_4Cl$$

The precipitate is treated with excess of nitric acid and PbO_2 or Pb_3O_4 (red lead). The contents are heated. The formation of permanganic acid imparts pink colour to the supernatant liquid.

$$2MnO_{2} + 4HNO_{3} \longrightarrow 2Mn(NO_{3})_{2} + 2H_{2}O + O_{2}$$
$$2Mn(NO_{3})_{2} + 5Pb_{3}O_{4} + 26HNO_{3} \longrightarrow$$
$$2HMnO_{4} + 15Pb(NO_{3})_{2} + 12H_{2}O$$
Permanganic acid (pink)

The above test fails in presence of *HCl*.

Ni²⁺ (nickel) and Co²⁺ (cobalt)

The black precipitate is dissolved in aqua- regia.

$$3\textit{NiS} + 6\textit{HCl} + 2\textit{HNO}_3 \longrightarrow 2\textit{NiCl}_2 + 2\textit{NO} + 3\textit{S} + 2\textit{H}_2\textit{O}$$

$$3CoS + 6HCl + 2HNO_3 \longrightarrow 3CoCl_2 + 2NO + 3S + 4H_2O$$

The solution is evaporated to dryness and residue extracted with dilute *HCl*. It is divided into three parts.

Part I : Add NH_4OH (excess) and dimethyl glyoxime. A rosy red precipitate appears, if nickel is present,

$$CH_{3} - C = NOH$$

$$NiCl_{2} + 2 \qquad | \qquad + 2NH_{4}OH \longrightarrow$$

$$CH_{3} - C = NOH$$

$$OH \qquad O$$

$$| \qquad \uparrow$$

$$CH_{3} - C = N$$

$$V = C - CH_{3}$$

$$| \qquad VI = C - CH_{3}$$

Part II : Add CH_3COOH in excess and KNO_2 . The appearance of yellow precipite confirms the presence of cobalt.

$$KNO_{2} + CH_{3}COOH \longrightarrow CH_{3}COOK + HNO_{2}$$

$$CoCl_{2} + 2KNO_{2} \longrightarrow Co(NO_{2})_{2} + 2KCl$$

$$Co(NO_{2})_{2} + 2HNO_{2} \longrightarrow Co(NO_{2})_{3} + NO + H_{2}O$$

$$Co(NO_{2})_{3} + 3KNO_{2} \longrightarrow K_{3}[Co(NO_{2})_{6}]$$

Part III : Solution containing either nickel or cobalt is treated with $NaHCO_3$ and bromine water. Appearance of apple green colour is observed, the solution is heated when black precipited is formed, which shows the presence of nickel, $CoCl_2 + 2NaHCO_3 \longrightarrow Co(HCO_3)_2 + 2NaCl$

$$Co(HCO_3)_2 + 4NaHCO_3 \longrightarrow Na_4Co(CO_3)_3 + 3H_2O + 3CO_2$$

 $Br_2 + H_2O \longrightarrow 2HBr + O$

$$2Na_4Co(CO_3)_3 + H_2O + O \xrightarrow{\qquad >} 2Na_3Co(CO_3)_3 + 2NaOH$$

sod. cobalti carbonate
(Green colouration)

$$NiCl_{2} + 2NaHCO_{3} \longrightarrow NiCO_{3} + 2NaCl + H_{2}O + CO_{2}$$
$$2NiCO_{3} + [O] \longrightarrow Ni_{2}O_{3} + 2CO_{2}$$

Group V : Ammonium carbonate precipitates V group radicals in the form of carbonates are soluble in acetic acid.

$$BaCO_{3} + 2CH_{3}COOH \longrightarrow (CH_{3}COO)_{2}Ba + CO_{2} + H_{2}O$$

$$SrCO_{3} + 2CH_{3}COOH \longrightarrow (CH_{3}COO)_{2}Sr + CO_{2} + H_{2}O$$

$$CaCO_{3} + 2CH_{3}COOH \longrightarrow (CH_{3}COO)_{2}Ca + CO_{2} + H_{2}O$$

 Ba^{2+} (barium) : Barium chromate is insoluble and precipitated by the addition of potassium chromate solution,

 $Ba(CH_3COO)_2 + K_2CrO_4 \longrightarrow BaCrO_4 + 2CH_3COOK$

 Sr^{2+} (Strontium) : Strontium sulphate is insoluble and precipitated by the addition of ammonium sulphate solution, $Sr(CH_3COO)_2 + (NH_4)_2SO_4 \longrightarrow SrSO_4 + 2CH_3COONH_4$ White ppt.

Ca²⁺ (calcium) : Calcium oxalate is insoluble and precipitated by the addition of ammonium oxalate.

$$Ca(CH_{3}COO)_{2} + (NH_{4})_{2}C_{2}O_{4} \xrightarrow{} CaC_{2}O_{4} + 2CH_{3}COONH_{4}$$

White ppt.

Group VI : In the filtrate of V group, some quantity of ammonium oxalate is added as to remove Ba, Ca and Sr completely from the solution. The clear solution is concentrated and made alkaline with NH_4OH . Disodium hydrogen phosphate is now added, a white precipitate is formed.

$$MgCl_{2} + Na_{2}HPO_{4} + NH_{4}OH \longrightarrow$$

$$Mg(NH_{4})PO_{4} + 2NaCl + H_{2}O$$

$$Megnesium ammonium phosphate (White not)$$

Zero group NH_4^+ (ammonium) : The substance (salt or mixture) when heated with *NaOH* solution evolves ammonia.

$$NH_4Cl + NaOH \longrightarrow NaCl + NH_3 + H_2O$$

When a rod dipped in *HCl* is brought on the mouth of the test tube, white fumes of ammonium chloride are formed, $NH_3 + HCl \longrightarrow NH_4Cl$ White fumes To the aqueous solution of ammonium salt when Nessler's reagents is added, brown coloured precipitate is formed.

$$2K_{2}HgI_{4} + NH_{4}Cl + 4KOH \longrightarrow$$

$$Hg \bigvee O + 7KI + KCl + 3H_{2}O$$

$$Hg \bigvee O$$

I Iodide of Millon's base (Brown ppt.)

Volumetric analysis

Volumetric analysis is a quantitative analysis. It involves the measurement of the volume of a known solution required to bring about the completion of the reaction with a measured volume of the unknown solution.

Titration : The process of addition of the known solution from the burette to the measured volume of solution of the substance to be estimated until the reaction between the two is just complete, is termed as titration. Thus, a titration involves two solutions;

(i) **Unknown solution :** The solution consisting the substance to be estimated is termed unknown solution. The substance is termed titrate.

(ii) **Standard solution :** The solution in which an accurately known amount of the reagent (titrant) has been dissolved in a known volume of the solution is termed standard solution. There are two types of reagents (titrants) :

(a) *Primary standards* : These can be accurately weighed and their solutions are not to be standardised before use. Oxalic acid $(H_2C_2O_4.2H_2O)$, potassium dichromate $(K_2Cr_2O_7)$, silver nitrate (A_8NO_3) , copper sulphate $(CuSO_4.5H_2O)$, ferrous ammonium sulphate $[FeSO_4(NH_4)_2SO_4.6H_2O]$, sodium thiosulphate $(Na_2S_2O_3.5H_2O)$, etc., are the examples of primary standards.

(b) Secondary standards : The solutions of these reagents are to be standardised before use as these cannot be weighed accurately. The examples are sodium hydroxide (*NaOH*), potassium hydroxide (*KOH*), hydrochloric acid (*HCl*), sulphuric acid (H_2SO_4), potassium permanganate (*KMnO*₄), iodine, etc.

Law of equivalence : It is applied in all volumetric estimations. According to it, the chemical substances react in the ratio of their chemical equivalent masses.

$$\frac{\text{Mass of substance } A}{\text{Mass of substance } B} = \frac{\text{Chemical equivalent mass of } A}{\text{Chemical equivalent mass of } B}$$

or	Mass of substance A			
01	Chemical equivalent mass of A			
_	Mass of substance B			
_ (Chemical equivalent mass of B			

or gram equivalent of A = gram equivalent of B

or milli-gram equivalent of A = milli-gram equivalent of B

The point at which the amounts of the two reactants are just equivalent is known as equivalence point or end point. An auxiliary substance which helps in the usual detection of the completion of the titration or equivalence point or end point is termed as indicator, *i.e.*, substances which undergo some easily detectable changes at the equivalence point are used as indicators.

Methods of expressing concentrations of solutions

The concentration of a solution can be expressed in various ways.

(1) Percent by mass

(2) Molarity

(3) molality

(4) Mole fraction

(5) Normality

Types of titrations : Titrations can be classified as :

(1) Acid base titrations or acidimetry and alkalimetry

(2) Oxidation reduction titrations or redox titrations

(3) Precipitation titrations

(4) Complexometric titrations.

(1) Acid-base titrations : When the strength of an acid is determined with the help of a standard solution of base, it is known as **acidimetry**. Similarly, when the strength of a base (alkali) is determined with the help of a standard solution of an acid, it is known as **alkalimetry**. Both these titrations involve neutralisation of an acid with an alkali. In these titrations H^+ ions of the acid combine with OH^- ions of the alkali to form unionised molecules of water.

$$\begin{array}{l} HA + BOH & \longrightarrow BA + H_2O \\ \text{Acid} & \text{Alkali} & \longrightarrow BA + H_2O \\ \text{water} \\ \text{or} & H^+ + A^- + B^+ + OH^- \longrightarrow B^+ + A^- + H_2O \\ \text{or} & H^+ + OH^- \longrightarrow H_2O \end{array}$$

The end point in these titrations is determined by the use of organic dyes which are either weak acids or weak bases. These change their colours within a limited range of hydrogen ion concentrations, *i.e.*, pH of the solution. Phenolphthalein is a suitable indicator in the titrations of strong alkalies (free from carbonate) against strong acids or weak acids. Methyl orange is

used as an indicator in the titrations of strong acids against strong and weak alkalies. As no indicator gives correct results in the titrations of weak acids against weak bases, such titrations are performed by some other methods (physical methods).

(2) **Oxidation reduction titrations :** The titrations based on oxidation-reduction reactions are called redox titrations. The chemical reactions proceed with transfer of electrons (simultaneous loss or gain of electrons) among the reacting ions in aqueous solutions. Sometimes these titrations are named after the reagent used, as:

(i) **Permanganate titrations :** These are titrations in which potassium permanganate is used as an oxidising agent in acidic medium. The medium is maintained by the use of dilute sulphuric acid. Potassium permanganate acts as a self-indicator. The potential equation, when potassium permanganate acts as an oxidising agent, is :

$$2KMnO_4 + 3H_2SO_4 \longrightarrow K_2SO_4 + 2MnSO_4 + 3H_2O + 5[O]$$

or $MnO_4^- + 8H^+ + 5e \longrightarrow Mn^{2+} + 4H_2O$

Before the end point, the solution remains colourless (when $KMnO_4$ solution is taken in burette) but after the equivalence point only one extra drop of $KMnO_4$ solution imparts pink colour, *i.e.*, appearance of pink colour indicates the end point. Potassium permanganate is used for the estimation of ferrous salts, oxalic acid, oxalates, hydrogen peroxide, etc. The solution of potassium permanganate is always first standardised before its use.

(ii) **Dichromate titrations :** These are titrations in which, potassium dichromate is used as an oxidising agent in acidic medium. The medium is maintained acidic by the use of dilute sulphuric acid. The potential equation is

$$K_2Cr_2O_7 + 4H_2SO_4 \longrightarrow K_2SO_4 + Cr_2(SO_4)_3 + 4H_2O + 3[O]$$

or $Cr_2O_7^{--} + 14H^+ + 6e^- \longrightarrow 2Cr^{3+} + 7H_2O$

The solution of potassium dichromate can be directly used for titrations. It is mainly used for the estimation of ferrous salts and iodides. In the titration of $K_2Cr_2O_7$ versus ferrous salt either an external indicator (potassium ferricyanide) or an internal indicator (diphenyl amine) can be used.

(iii) *Iodimetric and iodometric titrations* : The reduction of free iodine to iodide ions and oxidation of iodide ions to free iodine occurs in these titrations.

 $I_2 + 2e^- \longrightarrow 2I^-$ (reduction)

 $2I^- \longrightarrow I_2 + 2e^-$ (oxidation)

These are divided into two types :

(a) *Iodimetric titrations* : These are the titrations in which free iodine is used. As it is difficult to prepare

the solution of iodine (volatile and less soluble in water), it is dissolved in potassium iodide solution.

$$KI + I_2 \longrightarrow KI_3$$

Potassium tri-iodide

This solution is first standardised before use. With the standard solution of I_2 . Substances such as sulphite, thiosulphate, arsenite, etc., are estimated.

(b) *Iodometric titrations* : In iodometric titrations, an oxidising agent is allowed to react in neutral medium or in acidic medium, with excess of potassium iodide to liberate free iodine.

KI + oxidising agent $\longrightarrow I_2$

Free iodine is titrated against a standard reducing agent usually with sodium thiosulphate. Halogens, oxyhalogens, dichromates, cupric ion, peroxides, etc., can be estimated by this method.

$$\begin{split} I_2 + Na_2S_2O_3 &\longrightarrow 2NaI + Na_2S_4O_6 \\ 2CuSO_4 + 4KI &\longrightarrow Cu_2I_2 + 2K_2SO_4 + I_2 \\ K_2Cr_2O_7 + 6KI + 7H_2SO_4 &\longrightarrow \\ &Cr_2(SO_4)_3 + 4K_2SO_4 + 7H_2O + 3I_2 \end{split}$$

In iodimetric and iodometric titrations, starch solution is used as an indicator. Starch solution gives blue or violet colour with free iodine. At the end point the blue or violet colour disappears when iodine is completely changed to iodide.

(3) **Precipitation titrations :** The titrations which are based on the formation of insoluble precipitates, when the solutions of two reacting substances are brought in contact with each other, are called **precipitation titrations**. For example, when a solution of silver nitrate is added to a solution of sodium chloride or a solution of ammonium thiocyanate, a white precipitate of silver chloride or silver thiocyanate is formed.

$$AgNO_{3} + NaCl \longrightarrow AgCl + NaNO_{3}$$
$$AgNO_{3} + NH_{4}CNS \longrightarrow AgCNS + NH_{4}NO_{3}$$

Such titrations involving silver nitrate are called argentometric titrations.

(4) **Complexometric titrations :** A titration, in which an undissociated complex is formed at the equivalence point, is called **complexometric titration**. These titrations are superior to precipitation titrations as there is no error due to co-precipitation.

$$Hg^{2+} + 2SCN^{-} \longrightarrow Hg(SCN)_2$$

 $Ag^+ + 2CN^- \longrightarrow [Ag(CN)_2]^-$

EDTA (ethylenediamine tetra-acetic acid) is a useful reagent which forms complexes with metals. In the form of disodium salt, it is used to estimate Ca^{2+}

and Mg^{2+} ions in presence of eriochrome black-*T* as an indicator.

Equivalent masses of acids and bases : Equivalent masses of some acids and bases are given in the following table

Acid	Basicity	Mol. Mass	Eq. Mass
НСІ	1	36.5	$\frac{36.5}{1}$ = 36.5
HNO ₃	1	63	$\frac{63}{1}$ =63.0
H_2SO_4	2	98	$\frac{98}{2}$ =49.0
CH ₃ COOH	1	60	$\frac{60}{1}$ =60.0
$H_2C_2O_4.2H_2O$	2	126	$\frac{126}{2}$ =63.0
H ₃ PO ₄	3	98	$\frac{98}{3}$ =32.7
<i>H</i> ₃ <i>PO</i> ₃	2	82	$\frac{82}{2}$ =41.0
H ₃ PO ₂	1	66	$\frac{66}{1}$ =66.0

Table : 21.10

Table	:	21.11	
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Alkali	Acidity	Mol. Mass	Eq. Mass
NaOH	1	40	$\frac{40}{1} = 40$
КОН	1	56	$\frac{56}{1} = 56$
Ca(OH)2	2	74	$\frac{74}{2} = 37$
NH ₄ OH	1	35	$\frac{35}{1} = 35$

Calculations of Volumetric analysis

The following points should be kept in mind while making calculations of volumetric exercises.

(i) 1_g equivalent mass of a substance reacts completely with 1_g equivalent mass of any other substance. 1_g equivalent mass of a substance means equivalent mass of the substance in grams. For example,

$$1g$$
 equivalent mass of $NaOH = 40g$ of $NaOH$

$$1g$$
 equivalent mass of $H_2SO_4 = 49g$ of H_2SO_4

1g equivalent mass of $KMnO_4$ in acidic medium

= 31.6 g of $KMnO_4$

1g equivalent mass of hydrated oxalic acid

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= 63 g of hydrated oxalic acid

Note : Equivalent mass is a variable quantity and depends on the reaction in which the substance takes part. The nature of the reaction should be known before writing the gram equivalent mass of the substance. For example in the reactions.

 $2NaCl + 2H_2SO_4 \longrightarrow 2NaHSO_4 + 2HCl$ (i)

$$2NaCl + H_2SO_4 \longrightarrow Na_2SO_4 + 2HCl \qquad \dots (ii)$$

The value of g equivalent mass of H_2SO_4 in reaction (i) is 98g and in reaction (ii) 49g.

(ii) N	Number	of	g	equivalents
--------	--------	----	---	-------------

_ Mass of the substance	in g
Equivalent mass of the su	ubstance
Number of a molec -	Mass of the substance in g
Number of g moles –	Molecular mass of the substance
_ Volume in litres of the sub	bstance at N.T.P. (only for
=22.4	

gases)

Number of milli-equivalent = $\frac{Massin g \times 10}{2}$	000
Equivalent m	lass
Number of milli-moles = $\frac{Massin g \times 1000}{Massin g \times 1000}$	
Molecular mass	
(iii) Molarity - No. of moles of the solute	w
No. of litres of the solution $-$	$m \times V$

Molarity \times molecular mass = strength of the solution (g/L) No. of moles of the solute = Molarity \times No. of litres of solution Mass of the solute in g(w) = molarity \times No. of litres of solution \times mol. mass of solute

Normality =
$$\frac{\text{No. of } g \text{ equivalent of the solute}}{\text{No. of litres of the solution}} = \frac{w}{E \times V}$$

Normality \times equivalent mass = strength of the solution (*g*/*L*)

No. of equivalents of the solute = Normality $\times\,$ No. of litres of solution

Mass of the solute in g(w) = Normality × No. of litres of solution × Eq. mass of the solute

Molecular mass	_ Normality
Equivalent mass -/	Molarity
Normality $= n \times \mathbb{I}$	Molarity

(iv) **Normality equation** : When solutions *A* and *B* react completely.

$$N_A V_A = N_B V_B$$

Normality of $A \times$ volume of A = Normality of $B \times$ volume of B

or
$$\frac{\text{Strength } A}{\text{Eq. mass } A} \times V_A = \frac{\text{Strength } B}{\text{Eq. mass } B} \times V_B$$

 $\frac{\text{Wt. of metal hydroxide}}{\text{wt, of metal oxide}} = \frac{\text{Eq. wt. of metal hydroxide}}{\text{Eq. wt. of metal oxide}}$
 $= \frac{\text{Eq. wt of metal} + \text{Eq. wt of } OH}{\text{Eq. wt. of metal} + \text{Eq. wt of } O^{2-}}$

(v) When the solution is diluted, the following formulae can be applied :

 $N_1V_1 = N_2V_2$ or $M_1V_1 = M_2V_2$ or $S_1V_1 = S_2V_2$

Before dilution = After dilution

(vi) If a number of acids are mixed, the combined normality of the mixture, N_x , is given

 $N_x V_x = N_1 V_1 + N_2 V_2 + N_3 V_3 + \dots$

Where V_x is the total volume of the mixture, N_1 and V_1 are the normality and volume respectively of one acid, N_2 and V_2 of the second acid and so on.



- Glass rod should never be used in flame test as it gives a golden yellow colour due to sodium present in it. An asbestos fibre can be safely used in place of platinum wire.
- ∠ The transparent bead in borax bead test is made of $NaBO_2 + B_2O_3$.
- ✓ Filter ash test is an alternative to cobalt nitrate test and gives better results.
- \mathscr{L} Both CO_2 and SO_2 turn lime water milky.

 $Ca(OH)_{2} + CO_{2} \longrightarrow CaCO_{3} \downarrow + H_{2}O$ (Milkiness) $Ca(OH)_{2} + SO_{2} \longrightarrow CaSO_{3} \downarrow + H_{2}O$ (Milkiness)

Eq. wt. of KMnO₄ is different in acidic, alkaline and neutral medium *i.e.*, 31.6, 158 and 52.67 respectively.

				Chem	ical Analysis 945
				[BHU 19	987; AFMC 1995; MHCET 2003]
	O Ordina	ary Thinking		(a) <i>Cr</i>	(b) <i>Ni</i>
		ary rinnking		(c) <i>Na</i>	(d) <i>Mn</i>
		Objective Questions	11.	When concentrated <i>H</i>	V_2SO_4 is added to dry KNO_3 ,
				brown fumes evolve.	These fumes are[CPMT 1988; IIT 1
				(a) SO_2	(b) SO_3
	Prelimin	ary Test		(c) <i>NO</i>	(d) NO_2
1.	In borax bead test, compound is formed	which of the following [CBSE PMT 2002] (b) Tetra borate	12.	Which one of the coloured flame when t (a) Barium salt (c) Borate	following salt give green the salt is tested by Pt wire (b) Calcium salt (d) Lead salt
	(c) Double oxide	(d) Ortho borate	13.	A precipitate of calciu	ım oxalate will not dissolve
2.	The metal that does n	ot give the borax-bead test		in	
	is	5		(a) HC	(b) <i>HNO</i>
		[MP PMT 1999]		(a) M_{cl}	(d) Acotic acid
	(a) Chromium	(b) Nickel	14.	Sodium sulphite on	heating with dilute HCl
	(c) Lead	(d) Manganese	-7.	liberates a gas which	[NCERT 1972]
3.	Which of the following	g is coloured compound?		(a) Turns lead acetate	paper black
	(a) $C_{\mu}F$	[BCECE 2005]		(b) Turns acidified p	otassium dichromate paper
	(a) V_2		gree	n	0
_			_	(c) Burns with a blue (d) Smells like vinega	r
4.	The composition of 'Go	(h) DU	0] 15.	Starch-iodide paper is	used for the test of
	(a) $PbCrO_4$	$(b) PbI_2$	-3.	(a) Iodine	(b) Iodide ion
	(c) As_2S_3	(d) $BaCrO_4$		(c) Oxidising agent	(d) Reducing agent
5.	The alkaline earth me colour to the bunsen f in the form of its chlor	tal that imparts apple green Tame when introduced in it ride is [EAMCET 1979]	16.	Which of the foll precipitate with <i>AgNC</i>	lowing salt gives white D_3 solution and dil. H_2SO_4
	(a) Barium	(b) Strontium		(a) CuCl	(b) $BaCl$
	(c) Calcium	(d) Magnesium		(a) $PhCl$	(d) $Cu(NQ)$
6.	Which gives violet co test	loured bead in borax bead	17.	Two gases when mix the gases are	ed give white dense fumes,
	()	[BHU 1988; MP PET 1997]		(a) NH_3 and SO_2	(b) SO_2 and steam
	(a) Fe^{2+}	(b) Ni^{2+}		(c) NH_3 and HCl	(d) NH_3 and N_2O
	(c) Co^{2+}	(d) Mn^{2+}	18.	Blue borax bead is obt	ained with
7.	Sodium borate on re-	action with H_2SO_4 (conc.)		[M	ADT Bihar 1982; MP PET 1995]
	and C_2H_5OH gives a	compound A which burns		(a) <i>Zn</i>	(b) Cobalt
	with green flame. The (2) H B O	compound A Is[MP PET 1994] (b) $(C H) B O$	10	(c) Chromium	(d) Fe
	(a) $H_2 B_4 O_7$	(b) $(C_2 H_5)_2 B_4 O_7$	19.	the burner flame	Ing imparts green colour to
	(c) H_3BO_3	(d) $(C_2H_5)_3BO_3$		(a) $B(OMe)_3$	(b) <i>Na(OMe)</i>
8.	On mixing two colou	rless gases, a deep brown		(c) $Al(OPr)_3$	(d) $Sn(OH)_2$
	(a) $N_{\cdot}Q$ and Q_{\cdot}	(b) NO and O_{1}	20.	In laboratory burners,	we use [DCE 2004]
	(a) N_2O and O_2	(d) None of these		(a) Producer gas	(b) Oil gas
_	(c) $N_2 O_3$ and O_2	(u) None of these		(c) Gobar gas	(d) Coal gas
y .	ash when its salt is he	ated with Na_2CO_3 solid and	21.	A colourless gas with	the smell of rotten fish is [AFMC 2005]
	$Co(1VO_3)_2$ on a charCoa	(h) (h)		(d) H_2 S	(U) PH_3
	(a) Cu	(D) <i>Mg</i>		(c) SO_2	(a) None of these
10.	(c) <i>Al</i> The metal that does no	(d) Zn of give the borax bead test is	22.	wnich BLUE LIQUIE equimolar amounts of (a) N ₂ O	two gases at -30° C?[IIT 2005] (b) N_2O_3

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23.	(c) N_2O_4 MnO_2 and H_2SO_4 add yellow gas liberated is (a) Cl_2 (c) N_2	(d) N_2O_5 ded to $NaCl$, the greenish [Orissa JEE 2005] (b) NH_3 (d) H_2	9.	(b) The solution will be (c) A yellow solution w (d) A yellow precipitate Which of the followin when H_2S gas is passe (a) Acidic AcMO	come dark green ill be obtained e will be obtained ng gives black precipitate d through its solution[CPMT 1974
_	Wet Test for			(a) Actuic $AgNO_3$	(d) Coppor pitrate
	wet lest for			(c) Ammonical Baci ₂	(d) copper intrate
1.	Which of the follow	ving statement(s) is(are)	10.	A salt gives violet va conc. H_2SO_4 . It contain	pours when treated with ns [DPMT 1981; CPMT 1971]
	correct when a mixtur	The of Nacl and $K_2Cr_2O_7$ is	00. 4344	(a) <i>Cl</i> ⁻	(b) <i>I</i> ⁻
	gently warmed with co	nc. $H_2 SO_4$ [IIT 1998; CPMT 198	88; AMU	1984: (C) Br ⁻	(d) NO_3^-
		MP PMT 2002]	11.	When Cl_2 water is	added to a salt solution
	(a) A deep red vapour if(b) The vapour when jgives a vellow solution	passed into <i>NaOH</i> solution		containing chloroform violet. Salt contains	, chloroform layer turns
	(a) Chloring and is avail	$k_1 = k_2 = k_1 = k_2 = k_1 = k_1 = k_2 = k_1 $			[CPMT 1982]
	(c) CHIOTINE gas is evol	reu		(a) <i>Cl</i> ⁻	(b) <i>I</i> ⁻
2	Starch can be used	as an indicator for the		(c) NO_3^-	(d) S^{2-}
2.	detection of traces of	[CPMT 1992]	12.	A salt is heated first	with dil. H_2SO_4 and then
	(a) Glucose in aqueous	solution		with conc. H_2SO_4 . No r	reaction takes place. It may
	(b) Proteins in blood			be [CPMT 1978]	
	(c) Iodine in aqueous s	olution		(a) Nitrate	(b) Sulphide
	(d) Urea in blood			(c) Oxalate	(d) Sulphate
3.	Which of the following to form a brown compl	combines with <i>Fe</i> (II) ions ex[AIIMS 1982, 87; AFMC 1988]	13. ;	Phosphate radical wi gives precipitate of whi	th ammonium molybdate ch colour
	CBSE PMT 2000; Pb.	PMT 2000; MP PET 2000, 01]		(a) Violet	(b) Pink
	(a) $N_2 O$			(c) Canary yellow	(d) Green
	(c) $N_2 O_3$	(d) $N_2 O_5$	14.		
4.	Sodium nitroprusside,	when added to an alkaline		(a) $PbCl_2$	(b) $PbSO_4$
	ion due to the formatio	in of [IIT 1995]		(c) <i>AgCl</i>	(d) $CaCO_3$
	(a) $Na[Fe(H_2O)_5 NOS]$	(b) $Na_2[Fe(H_2O)_5 NOS]$	15.	Nitrates of all the meta	ls are [DPMT 1983, 89]
	(c) $Na_{\circ}[Fe(CN), NOS]$	(d) $Na \left[Fe(CN) \right]$		(a) Coloured	(b) Unstable
F	In the chromyl chloride	$(u) = [u_4 [i = (oi)]_{5} = [i = 0]$	11 10821	(c) Soluble in water	(d) Insoluble in water
5.	(a) $K_2 CrO_4$	(b) CrO_3	0 19921	colour of the ring is due	by ring test. The brown to the formation of
	(c) $K_2 C r_2 O_7$	(d) $(NH_4)_2 Cr_2 O_7$		MP PMT 2000): MP PET 2002: CPMT 2004]
6.	Which of the follow	ving will not produce a		(a) Ferrous nitrite	(b) $FeSO_A NO$
	precipitate with AgNO ₃	solution [MP PMT 1990]		(c) $FeSO ANO_2$	(d) Ferrous nitrate
	(a) F^- (c) CO_3^{2-}	(b) Br^{-} (d) PO_{4}^{3-}	17.	Which of the follow dissolve even in large e	ing precipitate does not xcess of <i>NH OH</i> [MP PMT 1991]
7.	When a mixture of so	lid <i>NaCl</i> , solid $K_2Cr_2O_7$ is		(a) AgCl	(b) AgBr
	heated with conc. H_2S	O_4 , orange red vapours are		(c) A q I	(d) None of these
	obtained of the compound NCERT	and[CPMT 1974, 78, 81, 88; DPM 1977; AFMC 1982; AMU 1984]	MT 1983, 18.	89 ; Aqueous solution of a <i>AgNO</i> , solution gives a	a salt when treated with a white precipitate, which
	(a) Chromous chloride	(b) Chromyl chloride		dissolves in <i>NH</i> . <i>OH</i> . R.	adical present in the salt is
_	(c) Chromic chloride	(d) Chromic sulphate		(a) Cl^{-}	(b) P ⁺⁻
8.	Chromyl chloride vapo	urs are dissolved in <i>NaOH</i>		(a) U^{-}	(U) Br
	then			(C) 1	(a) NO_3
	(a) The solution will re	emain colourless			

- When CO_2 is passed into lime water it turns 19. milky. When excess of CO_2 is passed, milkyness disappears because
 - (a) Reaction is reversed
 - (b) Water soluble $Ca(HCO_3)_2$ is formed
 - (c) Vaporisable calcium derivative is formed
 - (d) None of these
- **20.** A mixture when heated with conc. H_2SO_4 with MnO_2 brown fumes are formed due to
 - (a) Br⁻ (b) NO_3^-
 - (c) Cl⁻ (d) I^{-}
- 21. A substance on treatment with dil H_2SO_4 liberates a colourless gas which produces (i) turbidity with baryta water and (ii) turns acidified dichromate solution green. The reaction indicates the presence of [IIT 1992]
 - (a) CO_3^{2-} (b) S^{2-}
 - (c) SO_3^{2-} (d) NO_{2}^{-}
- 22. In the test of sulphate radical, the white precipitate of sulphate is soluble in
 - (b) Conc. H_2SO_4 (a) Conc. HCl
 - (d) None of these (c) Conc. HNO_3
- **23.** To an inorganic mixture dil. H_2SO_4 is added in cold; colourless, odourless gas is evolved. The mixture contains

		[AMU 1982]
(a) Sulphit	te (b) Acetate
(c) Nitrite	(d) Carbonate

Which reagent is used to remove SO_4^- and Cl^- 24.

		[Pb. PMT 2002]
(a) <i>Bas</i>	<i>O</i> 4	(b) NaOH
(c) <i>Pb</i> ($NO_{2})_{2}$	(d) <i>KOH</i>

..... is formed when potassium iodide is heated 25. with conc. H_2SO_4 [CPMT 1971]

(a)	HI	(b)	I_2
(c)	HIO_3	(d)	KIO

Chromyl chloride test is performed for the 26. confirmation of the presence of the following in a mixture

[CPMT 1990; KCET 1992; RPET 1999]

(a) Sulphate (b) Chromium

(c) Chloride (d) Chromium and chloride

A reagent that can distinguish between a chloride 27. and a peroxide is [EAMCET 1976] (a) Water (b) Dil. H_2SO_4

> (c) KOH solution (d) NaCl

- Which reagent below would enable you to remove 28. sulphate ions from a solution containing both sulphate and chloride ions[NCERT 1975; CPMT 1979, 81] (a) Sodium hydroxide (b) Barium hydroxide (c) Barium sulphate (d) Potassium hydroxide Ozone when reacts with potassium iodide solution 29. liberates certain product, which turns starch paper blue. The liberated substance is......[Orrisa JEE 2002
 - (a) Oxygen (b) Iodine (c) Hydrogen iodide (d) Potassium hydroxide
- 30. When *KBr* is treated with conc. H_2SO_4 a reddishbrown gas is evolved. The evolved gas is[EAMCET 1978] (a) Bromine
 - (b) Mixture of bromine and HBr
 - (c) HBr
 - (d) NO_2
- A solution of a salt in dilute sulphuric acid 31. imparts deep blue colour with starch iodine solution it confirms the presence of which of the following

[MP PET 2003; NCERT 1974; CPMT 1977]

- (a) NO_2^{-} (b) *I*⁻
- (d) CH_3COO^- (c) NO_{3}^{-}
- Ammonia reacts with excess of chlorine to form 32. [DPMT 2000]

	F==========
(a) N_2 and HCl	(b) NH_4Cl and NCl_3
(c) NCl_3 and HCl	(d) N_2 and NH_4Cl

33. A brown ring appears in the test for

[EAMCET 1978; KCET 1991; Bihar CEE 1995;

_	-				-		
	AI	IMS	1996;	DCE	19	99]

- (a) Nitrate (b) Nitrite (c) Bromide (d) Iron
- Which of the following anions would decolourise 34.
- acidified KMnO₄ solution
 - (a) SO_4^{2-} (b) S^{2-}
 - (d) CH_3COO^{-1} (c) NO_3^-

The gas which is absorbed by ferrous sulphate 35. solution giving blackish brown colour is[AMU 1999] (a) NO (b) CO

- (d) NH₂ (c) N_2
- Which one of the following anions is not easily 36. removed from aqueous solutions by precipitation[IIT 1995
 - (a) Cl⁻ (b) NO_3^-
 - (c) CO_3^{-2} (d) SO_4^{-2}

 Na_2CO_3 cannot be used to identify 37. [BVP 2004]

- (a) CO_3^{2-} (b) SO_3^{2-}
- (c) S²⁻ (d) SO_4^{2-}

- The number of hydroxide ions, produced by one 38. molecule of sodium carbonate (Na_2CO_3) on hydrolysis is [Pb. CET 2002] (a) 2 (b) 1 (c) 3 (d) 4
- Gas A is bubbled through slaked lime when a 39. white precipitate is formed. On prolonged bubbling, the precipitate is dissolved. on heating the resultant solution, the white precipitate reappears with the evolution of gas B. The gases A and B respectively are
 - (a) CO₂ and CO (b) CO and CO_2
 - (c) CO and CO (d) CO_2 and CO_2
- **40.** By passing H_2S gas in acidified $KMnO_4$ solution, we get
 - [MP PET 1997]

- (a) K_2S (b) *S* (c) $K_2 SO_3$ (d) MnO_2
- Which of the following doesn't give a ppt. with 41. silver nitrate solution.

	[J & K 2005]
(a) Ethyl bromide	(b) Sodium bromide
(c) Calcium chloride	(d) Sodium chloride

Wet Test for Basic radical

Which sulphide is soluble in $(NH_4)_2 CO_3$ 1.

(a)	SnS	(b)	As_2S_3
(c)	Sb_2S_3	(d)	CdS

- 2. When acetic acid and $K_4 Fe(CN)_6$ is added to a copper salt, a chocolate precipitate is obtained of the compound
 - (a) Copper cyanide (b) Copper ferrocyanide
 - (c) Basic copper sulphate (d)Basic copper cyanide
- A precipitate of the following would be obtained 3. when HCl is added to a solution of stannous sulphide (*SnS*) in yellow ammonium sulphide[**CPMT 1977; NCERT 1973** olution is aqueous
 - (a) SnS (b) SnS_2

(c)
$$Sn_2S_2$$
 (d) $(NH_4)_2SnS_3$

When H_2S is passed through in II group 4. sometimes solution becomes milky. It indicates the presence of

[MP PMT 1995]

- (a) Acidic salt (b) An oxidising agent
- (d) A reducing agent (c) Thiosulphate
- Conc. HNO_3 is added before proceeding to test for 5٠ group III members. This is to [NCERT 1974] (a) Oxidise any remaining H_2S
 - (b) Convert ferrous ion into ferric ion
 - (c) Form nitrates which give granular ppts

6. A salt gives bright red colour to the flame. This colour indicates the presence of					
	(a) <i>Ba</i> ²⁺	(b) Sr ²⁺			
	(c) Ca ²⁺	(d) Cr^{3+}			
7.	The compound insoluble	in acetic acid is			
		[CPMT 1989]			
	(a) Calcium oxide	(b) Calcium carbonate			
	(c) Calcium oxalate	(d) Calcium hydroxide			
8. ^{[D}	when <i>HCl</i> is added to its	g give white precipitate s aqueous solution			
	(a) Hg^+	(b) Mg^{++}			
	(c) Zn ⁺⁺	(d) <i>Cd</i> ⁺⁺			
9.	Of the following sulphid in dilute acids but solubl	es which one is insoluble e in alkalies [CPMT 1990]			
	(a) <i>PbS</i>	(b) <i>CdS</i>			
	(c) <i>FeS</i>	(d) Sb_2S_3			
10.	Reagent used in the qu group is	alitative analysis of IVth			
	(a) <i>HCl</i>	(b) H_2S (alkaline)			
	(c) $(NH_4)_2 S$	(d) None of these			
11.	Which of the following precipitated by passing	ng radicals will not be H_2S in concentrated acid			
	solution	[BHU 1986]			

(d) Increase ionisation of ammonium hydroxide

12. Which of the following pairs would be expected to form precipitate when solution are mixed[NCERT 1984]

(b) Antimony

(d) Cadmium

- (a) K^+, SO_4^{2-} (b) Na^+, S^{2-}
- (c) Ag^+, NO_3^- (d) Al^{3+}, OH^{-}
- H_2S will precipitate the sulphides of all the 13. metals from the solution of chlorides of Cu, Zn and Cd, if

[MP PMT 1985]

(a) Copper

(c) Arsenic

- (b) The solution is acidic
- (c) The solution is dilute acidic
- (d) Any of these solutions is present
- Addition of solution of oxalate to an aqueous 14. solution of mixture of Ba^{++}, Sr^{++} and Ca^{++} will precipitate

[MP PMT 1985]

- (a) *Ca*⁺⁺ (b) Ca^{++} and Sr^{++} (c) Ba^{++} and Sr^{++}
 - (d) All the three
- Which one among the following pairs of ions 15. cannot be separated by H_2S in dilute hydrochloric acid [IIT 1986]

(a) Bi^{3+} , Sn^{4+} (b) Al^{3+}, Hg^{2+}

				Che	mical Analysis 949
	(c) Zn^{2+}, Cu^{2+}	(d) Ni^{2+}, Cu^{2+}		(a) <i>Fe</i> [<i>Fe</i> (<i>CN</i>) ₄]	(b) <i>Fe</i> [<i>Fe</i> (<i>CN</i>) ₆]
16.	Distinguishing reagen	t between silver and lead		(c) $Fe_4[Fe(CN)_6]$	(d) $K_2Fe[Fe(CN)_6]$
	salts is	[MADT Bihar 1984]	26.	If Na^+ ion and S^{2-} io of the following will	on is larger than <i>Cl</i> ⁻ ion, which l be least soluble in water[AMU (Eng
	(a) H_2S gas			(a) <i>MgS</i>	(b) NaCl
	(b) Hot dilute HCl sol	ution		(c) Na_2S	(d) $MgCl_2$
	(c) NH_4Cl (solid) + N	H_4OH solution	27.	An aqueous solution	on of an inorganic salt on
	(d) NH_4Cl (solid) + (N	$(H_4)_2 CO_3$ solution		treatment with <i>HCl</i>	gives a white precipitate. This
17.	Group reagent for th basic radicals for the c	e precipitation of group II ualitative analysis table is[MA	ADT Bil	ara1982].+2	[MP PMT 2001] (b) <i>Ha</i> ²⁺
	(a) Dil. $HCl + H_2S$			(c) Zn^{2+}	(d) Cd^{2+}
	(b) NH_4Cl (solid) + N	H_4OH solution + H_2S	28.	Lead sulphate is solu	uble [MP PET 1999]
	(c) (NH_{\star}) CO ₂ solution	n		(a) In conc. nitric ac	cid
	(d) None of these			(b) In conc. hydroch	loric acid
18	The jon that cannot h	e precipitated by both HCl		(c) In a solution of a	ammonium acetate
10.	and H_2S is	[IIT 1982; CPMT 1989]		(d) In water	
	(a) Ph^{2+}	(b) Cu^+	29.	Which one of the fol	llowing sulphides is yellow
	(a) 1^{+}	(d) S_{μ}^{2+}		(a) Zine culphido	[MP PMT 1999]
	(c) Ag			(a) Zinc sulplide	(d) Lead sulphide
19.	$PD(CH_3COO)_2$ givesc	olour with H_2S [DPMT 2000]	30.	When H_2S gas is	s passed through the HCl
	(a) Orange	(D) Rea (d) White	9	containing aqueous	solutions of <i>CuCl</i> ₂ , <i>HgCl</i> ₂ , <i>BiCl</i> ₃
20	(c) black Fe^{2+} ion can be disting	(u) while Ee^{3+} ion by DPMT 20	001	and <i>CoCl</i> ₂ , which doe	es not precipitate out[MP PMT 2002]
20.	(a) NH SCN	(b) A_{qNO} .	00]	(a) <i>CuS</i>	(b) <i>HgS</i>
	(c) $PaCl$	(d) None of these		(c) Bi_2S_3	(d) <i>CoS</i>
	(c) $BuCi_2$		31.	Group reagent for a	nalytic group <i>IV</i> is
21.	aqueous solution of F	eCl ₃ [Roorkee Qualifying 1998]		(a) $NH_4Cl + NH_4OH$	[Kurukshetra CET 2002]
	(a) $K_4[Fe(CN)_6]$	(b) H_2S		(b) $NH_4Cl + NH_4OH$	$+ H_2S$
	(c) NH_4CNS	(d) KCNS		(c) $NH_4OH + (NH_4)_2$	2 <i>CO</i> ₃
22.	Which of the followin	g substances are soluble in		(d) $HCl + H_2S$	
	concentrated HNO ₃	[Roorkee Qualifying 1998]	32.	When H_2S is passed	through Hg_2S we get [AIEEE 2002]
	(a) BaSO $_4$	(b) <i>CuS</i>		(a) <i>HgS</i>	(b) $HgS + Hg_2S$
	(c) <i>PbS</i>	(d) <i>HgS</i>		(c) $Hg_2S + Hg$	(d) Hg_2S
23.	Which of the followi titrations	ng cannot give iodometric	33.	How do we differen group III	tiate between Fe^{3+} and Cr^{3+} in
	2.	[AIIMS 1997]		(a) By taking excess	[AIEEE 2002] s of NH_4OH solution
	(a) Fe^{3+}	(b) Cu^{2+}		(b) By increasing <i>NI</i>	H_4^+ ion concentration
	(c) Pb^{2+}	(d) Ag^{2+}		(c) By decreasing <i>O</i>	H^- ion concentration
24.	Which of the following	mixture is chromic acid		(d) Both (b) and (c)	
	(a) $K_2 C r_2 O_7$ and $H C l$	[Pb. PMT 2000]	34.	$[X] + H_2SO_4 \rightarrow [Y] a$ smell	a colourless gas with irritating
	(b) K_2SO_4 and conc. H_2	SO_4		$[Y] + K_2 C r_2 O_7 + H_2 S C$	$D_4 \rightarrow \text{green solution}$
	(c) $K_2Cr_2O_7$ and conc.	H_2SO_4		[X] and [Y] is	[IIT-JEE (Screening) 2003]
	(d) H_2SO_4 and HCl			(a) SO_3^{2-}, SO_2	(b) <i>CI</i> [−] , <i>HCI</i>
25.	Which of the follow coloured	ving compounds is brown		(c) S^{2-}, H_2S	(d) CO_3^{2-}, CO_2
		[AFMC 2001]	35.	In the analysis of reagent H_2S gas is get	f basic radicals, the group enerally used in the groups[MP PMT

	(a) I and II groups	(b) II and III groups	44.	In the precipitation	of the iron group in	
	(c) III and V groups	(d) II and IV groups		qualitative analysis, am	monium chloride is added	
36.	A mixture of two salt	s is not water soluble but		before adding ammoniu	m hydroxide to[AIIMS 1980; NG	CERT
	dissolves completely in	dilute hydrochloric acid to		CPMT 1971, 73, 77,78	3, 80, 81, 83, 86; KCET 1999]	
	form a colourless solut	(b) $B_{\pi}(C)$ and $Z_{\pi}(S)$	PMT 19	998) Decrease concentrat	ion of OH^- ions	
	(a) $AgNO_3$ all KBr	(b) $BaCO_3$ and ZhS		(b) Prevent interference	by phosphate ions	
MG	(c) $FeCl_3$ and $CaCO_3$	(d) $Mn(NO_3)_2$ and		(c) Increase concentrati	on of Cl^- ions	
MgSC				(d) Increase concentrati	on of NH_4^+ ions	
37.	Which of the followi	ng is not precipitated as	45.	Ferric ion forms a pruss	sian blue coloured ppt. due	
	(a) Copper	(b) Arsenic	- IVI I 20	to		
	(c) Cadmium	(d) Lead		[CPMT 198	80; BHU 1980; MP PET 1995;	
38.	Concentrated sodium	hydroxide can separate a		Kurukshetra CEE 1998	3; RPET 1999; MP PMT 2001]	
	mixture of			(a) $K_4 Fe(CN)_6$	(b) $Fe_4[Fe(CN)_6]_3$	
	(a) $7n^{2+}$ and Dh^{2+}	[MP PMT 2000] (b) $4l^{3+}$ and $7n^{3+}$		(c) $KMnO_4$	(d) $Fe(OH)_3$	
	(a) $Z\pi^{-1}$ and PD^{-1} (c) Cr^{3+} and Fe^{3+}	(b) Al^{3+} and Zh^{3+}	46.	When H_2S gas is passed	d into a certain solution, it	
39.	AgCl dissolves in amm	onia solution giving		reacts to form a white	precipitate. The solution	
00	0	[MP PMT 1989; MP PET 2001]		referred to contains ion	s of [EAMCET 1979]	
	(a) Ag^+ , NH_4^+ and Cl^-	(b) $Ag(NH_2)^+$ and Cl^-		(a) Lead	(b) Zinc	
	(1) + (1)	(d) + (n) + a d C =		(c) Copper	(d) Nickel	
	(c) $Ag_2(NH_3)$ and Cl	(d) $Ag(NH_3)_2$ and Cl	47.	A precipitate of wo	ould be obtained on adding	
40.	What product is forme $K \begin{bmatrix} E_0(CN) \end{bmatrix}$ with the set	d by mixing the solution of $E_{0}C_{1}$ [Bearline 1980]		HCl to a solution of (Sb	$_{2}S_{3}$) in yellow ammonium	
	$K_4[Fe(CN)_6]$ with the so	(b) Equation forme encoded		sulphide		
	(a) Ferro-ferricyanide	(d) None of these			[CPMT 1979]	
<i>1</i> 1.	In fifth group (NH_{\star})	$CO_{\rm c}$ is added to precipitate		(a) Sb_2S_3	(b) $5b_2S_5$	
4	out the carbonates	We do not add Na CO		(c) <i>SbS</i>	(d) SbS $_2$	
	because		48.	A 0.3 <i>M</i> HCl solution c	ontains the following ions	
	beeuuse	[AIIMS 1982]		$Hg^{++}, Cd^{++}, Sr^{++}, Fe$	e^{++} , Cu^{++} The addition of	
	(a) $CaCO_3$ is soluble in	$1 Na_2CO_3$		H_2S to above solution v	vill precipitate	
	(b) Na_2CO_3 increases	the solubility of fifth group		(a) Cd, Cu and Hg	(b) Cd, Fe and Sr	
	carbonates			(c) Hg, Cu and Fe	(d) Cu, Sr and Fe	
	(c) M_gCO_3 will be pred	cipitated out in fifth group	49.	Which of the following	gives a ppt. with $Pb(NO_3)_2$	
	(d) None of these			but not with $Ba(NO_3)_2$	[CPMT 1979; MP PET 1997]	
42.	Al^{3+} , Fe^{3+} , Zn^{2+} and	Ni^{2+} ions are present in an		(a) NaCl		
1	acidic solution. Exces	ss of ammonium chloride		(b) Sodium acetate		
	solution is added f	followed by addition of		(c) Sodium nitrate		
	ammonium hydroxide	solution. The available		(d) Sodium hydrogen ph	losphate	
	precipitate will contain	[MP PMT 1996]	50.	On adding excess of a	mmonium hydroxide to a	
	(a) $2n(OH)_2$ and $Ni(OH)_2$)2	•	copper sulphate solution	1 [MP PMT 1995]	
	(b) $Al(OH)_3$ and $Fe(OH)_3$	$)_3$		(a) Blue precipitate of	of copper hydroxide is	
	(c) $Zn(OH)_2$ and $Al(OH)_2$)3	obtained			
	(d) $Ni(OH)_2$ and $Fe(OH)_2$)3		(b) Black precipitate of	copper oxide is obtained	
43.	When H_2S is passed th	rough a mixture containing		(c) A deep blue solution	is obtained	
	Cu^{+2} , Ni^{+2} , Zn^{+2} in act	dic solution then ion will		(d) No change is observe	ed	
	precipitate		51.	A black sulphide is form	ned by the action of H_2S	
		[RPMT 2002]		on		
	(a) Cu^{+2} , Ni^{+2}	(b) Ni^{+2}			[IIT 1978]	
	(c) Cu^{+2}, Zn^{+2}	(d) Cu^{+2}		(a) Cupric chloride	(b) Cadmium chloride	
				(c) Zinc chloride	(d) Sodium chloride	

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52.	An aqueous solution C Hg^{2+} , Pb^{2+} , and Cd^{2} HCl(6N) precipitates	ontains the ions as Hg_2^{2+} , ⁺ . The addition of dilute [IIT 1995]	62.	Sodium carbonate can ammonium carbonate f fifth group radicals beca (a) Sodium ions interf	not be used in place of or the precipitation of the ause ere with the detection of
	(a) Hg_2Cl_2 only	(b) $PbCl_2$ only		fifth group radicals	
	(c) $PbCl_2$ and $HgCl_2$	(d) Hg_2Cl_2 and $PbCl_2$		(b) Concentration of car	rbonate ions is very low
53.	In the group III radical	s, in place of NH_4Cl which		(c) Sodium will react w	ith acidic radicals
	of the following can be	used[AIIMS 1980, 82; MP PMT	1985]	(d) Magnesium will be j	d to dotoct
	(a) NH_4NO_3	(b) $(NH_4)_2 SO_4$	03.	ICPMT 108	u to uetect a: AIIMS 1007: MP PET 1000]
	(c) $(NH_4)_2 CO_3$	(d) NaCl		(a) $Cr \Omega_{1}^{2-}$	(b) PO_{3}^{3-}
54.	When HCl gas is provide the solution of $BaCl_2$, a where $BaCl_2$, a where $BaCl_2$, a where $BaCl_2$, and $BaCl_2$, a where $BaCl_2$, a solution of $BaCl_2$, a solution	bassed through saturated ite ppt. is obtained. This is		(c) MnO_4^-	(d) NH_4^+
	due to	[CPMT 1979]	64.	A light greenish coloured On passing H_2S into the	d salt was soluble in water. e solution a black precipitate
	(a) Impurities in $BaCl_2$	(b) Impurities in <i>HCl</i>	0.7	was obtained which dis metal ion present is	solve readily in <i>HCl</i> . The [BHU 1981]
55.	Which compound does	not dissolve in hot dilute	εx	(a) Co^{+2}	(b) Fe^{2+}
	HNO ₃		65	(C) M Vellow ammonium suln	(u) mn
	(a) <i>HgS</i>	(b) <i>PbS</i>	0).	reagent for the separati	on of (b) PbS and Pi S
	(c) <i>CuS</i>	(d) <i>CdS</i>		(a) Higs and Fos	(b) Fbs and bl_2s_3
56.	The ion that can be pre	cipitated by <i>HCl</i> as well as		(c) Bi_2S_3 and CuS	(d) CdS and As_2S_3
	H_2S 1S		66.	$Fe(OH)_3$ can be sepa	arated from $Al(OH)_3$ by
	(a) Ph^{2+}	(h) Fe^{3+}		addition of	[BHI] 1081]
	(c) $7n^{2+}$	(d) Cu^{2+}		(a) Dil. <i>HCl</i>	(b) <i>NaCl</i> solution
57.	Which of the followin	g sulphate is insoluble in		(c) <i>NaOH</i> solution	(d) NH_4Cl and NH_4OH
-,	water	[MNR 1995]	67.	The reagents NH_4Cl	and aqueous NH_3 will
	(a) $CuSO_4$	(b) $CdSO_4$		precipitate	[IIT 1991]
	(c) $PbSO_4$	(d) $Bi(SO_4)_3$		(a) Ca ²⁺	(b) Al^{+3}
58.	A solution when treat	ed with dimethyl glyoxime	_	(c) Mg^{2+}	(d) Zn^{2+}
	(a) <i>Ni</i>	(b) V	982; BH 68.	IU 1979] The aqueous solutions be coloured in the case	of the following salts will
	(c) <i>Co</i>	(d) <i>Mn</i>		(a) $Zn(NO_3)_2$	(b) $LiNO_3$
59.	volume of water, the	white precipitate produced		(c) <i>CrCl</i> ₃	(d) Potash alum
	1S	[MP PMT 1985; CPMT 1979]	69.	A mixture containing separated for identifica	Cu^{2+} and Ni^{2+} can be tion by
	(a) $Bi(OH)_3$	(b) Bi_2O_3		(a) Passing H_2S in acid	l medium
_	(c) BiOCl	(d) Bi_2OCl_3		(b) Passing H_2S in alka	aline medium
60.	Mark the compound <i>NH</i> ₄ <i>OH</i>	which turns black with		(c) Passing H_2S in neu	tral medium
		[AFMC 1981; MP PMT 1995]		(d) Passing H_2S in dry	mixture
	(a) Lead chloride	(b) Mercurous chloride	7 0.	Addition of $SnCl_2$ to Hg	<i>Cl</i> ₂ gives <i>ppt</i> [BVP 2003]
61	(c) Mercuric chioride	(a) Silver chioride		(a) White turning to rec	d (b) White turning to
	(a) Pink	(b) Black		gray (c) Black turning to wh	ite (d) None of these
	(c) Colourless	(d) Green	71.	When dilute aqueous so added to <i>KI</i> solution	lution of $AgNO_3$ (excess) is, positively charged sol.

	Particles of <i>AgI</i> are for ion [BHU 2003]	rmed due to adsorption of		(
	(a) NO_3^-	(b) O_2^{-}		(
	(c) Ag ⁺	(d) <i>K</i> ⁺		(
72.	Heamoglobin is a comp	lex of [CPMT 2003]	82.	I
	(a) Fe^{3+}	(b) Fe^{2+}		(
	(c) <i>Fe</i> ⁴⁺	(d) Cu^{2+}		
73.	A colourless crystalline HCI . On adding $NaOH$ precipitate which is in:	salt 'X' is soluble in dilute solution, it gives a white soluble in excess of <i>NaOH</i> .	80	(
	(a) $Al_2(SO_4)_3$	(b) <i>ZnSO</i> ⁴	03.	ł
	(c) $MgSO_4$	(d) $SnCl_2$		I
74.	Precipitate of group IV H_2S is	cations takes place when		(
	(a) Highlarianiand	[RPET 2003]	84.	(
	(a) Highly Ionised	(d) None of these		č
75.	In Nessler's reagent for	the detection of ammonia		(
, 0	the active species is	[Kerala (Med.) 2003]	85.	I I
	(a) Hg_2Cl_2	(b) Hg^{2+}	0.01	I
	(c) $Hg_{2}I_{2}$	(d) HgI_4^{2-}		(
76.	On addition of aqueous white gelatinous prec	<i>NaOH</i> to a salt solution, a ipitate is formed, which	86.	(\ {
	contains	alkall. The salt solution		(
	(a) Chromium ions	(b) Aluminium ions		(
	(c) Barium ions	(d) Iron ions	87.	I
77.	A solution prepared in white turbidity even in when water is added	conc. <i>HCl</i> sometimes gives a the absence of 1 st group, to it. It is due to the		9 ((
	presence of	an a 3+	88.	
	(a) Hg^{2+}	(b) <i>Sb</i> ³¹		
_	(c) Ag^{3+}	(d) Sb^{3+} or Bi^{3+} or both		(
78.	Which of the following in dilute solutions may	pairs of ions when mixed give precipitate	89.	1
	[CPMT 1976; NCERT	1987; Kurukshetra CEE 1998]	-	ŗ
	(a) Na^+, SO_4^{2-}	(b) NH_4^+, CO_3^{2-}		Ċ
	(c) Na^+, S^{2-}	(d) Fe^{3+}, PO_4^{3-}		(
7 9 .	Which one of the fol	llowing sulphides is only		(
	completely precipitated is made dilute	d when the acidic solution	90.	(2
	(a) HaS	(b) <i>PbS</i>		(
	(c) CdS	(d) CuS		(
80.	A reagent used to test t	he presence of Fe^{2+} ion is	91.	A
		[KCET 1998]		r
	(a) H_2S	(D) NH_4CNS		ł
	(c) $K_4 Fe(CN)_6$	(d) $K_3 Fe(CN)_6$		(
81.	Identify the statemer regarding copper sulph	nt which is not correct ate	[1) UP

	(a) It reacts with KI to g	give iodine
	(b) It reacts with <i>KCl</i> to	give Cu ₂ Cl ₂
	(c) It reacts with NaOH a	and glucose to give <i>Cu</i> ₂ O
	(d) It gives CuO on stror	ng heating in air
•	Mark the correct statem	ent [MP PMT 2002]
	(a) I group basic radicals	s precipitate as chlorides
	(h) IV group basic	radicals precipitate as
	sulphides	radicals precipitate as
	(c) V group basic	radicale procipitato ac
	(c) v group basic	radicals precipitate as
	(d) All of those statemer	at and connect
	The following four colu	tions are kent in concrete
•	beakers and copper met	tal is put in each of them
	Which solution will beco	ome blue after some time [MP]
	(a) A_{qNO} solution	(b) $Z_{n}(N(x))$ solution
	(a) $R_{2}(N_{C})$ solution	(d) NaNO colution
	(c) $Ba(NO_3)_2$ solution	(a) $MaNO_3$ solution
•	Cu^{2+} ions will be redu	uced to Cu^+ ions by the
	addition of an aqueous s	solution of [AIIMS 1992]
	(a) <i>KF</i>	(b) <i>KCl</i>
	(c) <i>KI</i>	(d) <i>KOH</i>
•	Which radicals are pre	cipitated in $(NH_4)_2CO_3$ in
	presence of alkali	[Pb. PMT 2001]
	(a) <i>Ca, Ba, Sr</i>	(b) <i>Mg</i>
	(c) Both	(d) None
•	Which of the following	ng is soluble in yellow
	ammonium sulphide	[MP PET 1994, 97]
	(a) CuS	(b) <i>CdS</i>
	(c) SnS	(d) <i>PbS</i>
•	Which mixture is sep	arated by conc. aqueous
	solution of sodium hydro	oxide
	(a) Al^{3+} and Sn^{2+}	(b) Al^{3+} and Fe^{3+}
	(c) Al^{3+} and Zn^{2+}	(d) Zn^{2+} and Pb^{2+}
	H_2S is passed through	n an acidified solution of
	Ag. Cu and Zn . Which the	forms precipitate[BHU 1998]
	(2) A_{α}	(b) 7 ⁿ
	(a) Ag	(0) Zn
	(c) <i>Cu</i>	(d) None of these
•	The presence of NH_4Cl	in the test solution while
	precipitating group	III-A hydroxides (in
	qualitative inorganic an	alysis) helps in
	(a) Lowering $\left[OH^{-}\right]$	(b) Lowering $[NH_4OH]$
	(c) Increasing $\left[\Omega H^{-} \right]$	(d) Increasing $\begin{bmatrix} NH & OH \end{bmatrix}$
•	On saturating aqueous	solution of <i>Cu</i> (II), <i>Pb</i> (II)
	and Zn (II) ions with H_2	s will precipitate
	(a) Only CuS	(b) Only <i>PbS</i>
	(c) Both CuS and PbS	(d) CuS, PbS and ZnS
	A chloride dissolves a	ppreciably in cold water
	when placed on a platin	ium wire in Bunsen flame,
	no distinctive colour is	noted, which cation could
	be present	[Pb. PMT 1998]
	(a) Mg^{2+}	(b) Ba^{2+}
	(c) Ph^{2+}	(d) Ca^{2+}
		(u) Ca

[UPSEAT 2001]

A solid (A) which has photographic effect reacts 92. with the solution of a sodium salt (B) to give a pale yellow ppt. (C). Sodium salt on heating gives brown vapour. Identify A, B and C.

(a)	AgNO ₃ , NaBr, AgBr	(b)	$AgNO_3, NaCl, AgCl_2$
-----	--------------------------------	-----	------------------------

(c) $AgNO_3$, NaBr, $AgCl_2$ (d) $AgCl, NaBr, AgBr_2$

In qualitative analysis, in order to detect second 93. group basic radical, H_2S gas is passed in the presence of dilute HCl to

[KCET 2004]

- (a) Increase in dissociation of H_2S
- (b) Decrease the dissociation of salt solution
- (c) Decrease the dissociation of H_2S

(d) Increase the dissociation of salt solution

 H_2S gas when passed through a solution of a 94. contains HCl precipitate the cations of group of qualitative analysis but not those belonging to the fourth group. It is because

[CBSE PMT 2005]

- (a) Presence of HCl decreases the sulphide ion concentration
- (b) Presence of HCl increases the sulphide ion concentration
- (c) Solubility product of group II sulphides is more than that of group IV sulphides
- (d) Sulphides of group IV Cations are in HCl
- A metal nitrate reacts with KI to give a black 95. precipitate which on addition of excess of KI convert into orange colour solution. The cation of the metal nitrate is

	[IIT-JEE (Sc
(a) Hg^{2+}	(b) <i>Bi</i> ³⁺
(c) <i>Pb</i> ²⁺	(d) <i>Cu</i> ⁺
	1

- Which of the following basic radicals will not be 96. precipated by H_2S gas in the presence of NH_3 [Pb. CET12003] What weight of sodium hydroxide is required to
 - (a) Mn^{2+}
 - (c) Cd^{2+} (d) Ca^{2+}
- On passing H_2S black ppt. of II group is obtained. 97. The mixture may not contain [CPMT 1989] (b) Cd^{++}

(a)
$$Pb^{++}$$
 (b) Cd^{++}

- (c) Hg^{++} (d) Cu⁺⁺
- 98. Ferrous and ferric ions in solution may be distinguished by using
 - (a) Silver nitrate solution
 - (b) Lead acetate solution
 - (c) Acidified solution of potassium permanganate
 - (d) Sodium chloride solution
- Solution of II A group precipitate in dil. HNO₃ when 99. treated with NH_AOH becomes blue because of the presence of (b) Cd

(a) Mg

- (c) Bi (d) Cu **100.** When calomel react with NH_4OH solution the compound formed is [Orissa JEE 2004] (a) $NH_2 - Hg - Cl$ [BCECE 2005]
 - (b) $Hg_2Cl_2NH_3$
 - (c) $Hg(NH_3)_2Cl_2$ (d) $HgCl_2NH_3$
- 101. Copper sulphate solution react with KCN [BCECE 2005] (b) CuCN (a) $K_3[Cu(CN)_4]$
 - (c) $Cu(CN)_2$ (d) $K_2[Cu(CN)_4]$
- 102. A metal nitrate reacts with KI to give a black precipitate which on addition of excess of KI convert into orange colour solution. The cation of the metal nitrate is [IIT 2005] (a) *Hq*²⁺ (b) *Bi*³⁺
 - (c) *Pb*²⁺ (d) Cu^+
- **103.** H_2S gas when passed through a solution of a contains *HCl* precipitates the cations of group of qualitative analysis but not those belonging to the fourth group. It is because

[CBSE PMT 2005]

- (a) Presence of HCl decreases the sulphides ion concentration
- (b) Presence of HCl increases the sulophide ion concentration
- (c) Solubility product of group II sulphides is more than that of group IV sulphides
- (d) Sulphides of group IV cations are in HCl.
- **104.** Sodium nitroprusside when added to an alkaline solution of sulphide ions produce a [AFMC 2005]
 - (a) Red colouration (b) Blue colouration
 - (c) Purple colouration (d) Brown colouration

Volumetric Analysis

neutralise 100 ml of 0.1 N – HCl [MP PMT 1994] (b) Ni^{2+} (~) (1.) a

(a) 4.0 <i>gm</i>	(b) 0.04 gm
(c) 0.4 <i>gm</i>	(d) 2.0 <i>gm</i>

The range of methyl orange as an indicator is in 2. between pH

(a) 6 – 8	(b) 8 – 9
(c) 3 - 5	(d) 2 - 4

Phenolphthalein is not a good indicator for 3. titrating

[NCERT 1977]

- (a) NaOH against oxalic acid
- (b) Ferrous sulphate against KMnO₄
- (c) NaOH against HCl
- (d) NaOH against H_2SO_4

- reening) 2005]

4.	15 <i>ml</i> of <i>N</i> /10 <i>n</i> eutralises 12 <i>ml</i>	<i>NaOH</i> solution completely of H_2SO_4 solution. The	12.	200 ml 0.6 N H_2SO_4 are mixed together.	and 100 <i>ml</i> of 0.3 <i>N HCl</i> Acidic normality of the
	normality of H_2SO_4 solution will be			10501 [MP PET 1995]5	[DPMT 1001]
	(a) N/5	(b) <i>N</i> /10		(a) $0.5 N$	(b) $O \circ N$
	(c) N/8	(d) <i>N</i>		(c) $0.3 N$	(d) $0.6 N$
-	A 100 ml solution of 0	1 N HCl was titrated with	12.	10 ml of 10 M H.SO	is mixed to 100 ml 1M
3.	0.2 $N - NaOH$ solution of 0	ition. The titration was	-3,	NaOH solution. The re-	sultant solution will be[NCERT 1971
	discontinued after	adding 30 <i>ml</i> of <i>NaOH</i>		(a) Acidic	(b) Neutral
	solution. The remaining	ng titration was completed		(c) Weakly alkaline	(d) Strongly alkaline
	by adding 0.25 $N - KC$	<i>OH</i> solution. The volume of poleting the titration is	14.	Volume of $0.1 M$ H.SO	required to neutralize 30
	nom required for con		-1.	$ml \text{ of } 0.2 \text{ N } NaOH \text{ is } \Gamma$	EAMCET 1978: MP PMT 2001
	(a) 16 ml	(h) 22 ml		(a) 30 ml	(b) 15 <i>m</i> l
	(a) $10 \ ml$			(c) 40 ml	(d) $60 ml$
c	(c) 35 mil		15.	5N H _s SO, was dilute	ed from 1 litre to 10 litres.
0.	0.68 <i>gram</i> . what is the	equivalent weight of metal[JII	PMER 2	cobor mality of the solution	on obtained is
	(a) 17	(b) 34		(a) 10 N	(b) 5 <i>N</i>
	(c) 68	(d) 52	_	(c) 1 <i>N</i>	(d) 0.5 N
7.	If 20 <i>ml</i> of 0.25 <i>N</i> stro strong base are mixed is [KCET 2002]	ng acid and 30 <i>ml</i> of 0.2 <i>N</i> of , then the resulting solution	16.	0.45 <i>g</i> of an acid (moly 0.5 <i>N KOH</i> for compl of acid is	wt. = 90) required 20 <i>ml</i> of ete neutralization. Basicity
	(a) 0.25 N basic	(b) $0.2 N$ acidic			[CPMT 1979]
	(a) 0.25 N basic	$(d) \cap \mathcal{D} N$ has is		(a) 1	(b) 2
0	(c) 0.25 N acture	(u) 0.2 W basic		(c) 3	(d) 4
8.	what volume at $N.1.P.$ of gaseous NH_3 will be required to be passed into 30 ml of NH_2SO_4		17.	Equivalent weight of cr	ystaline oxalic acid is[MP PMT 199
	solution to bring dow	in the acid strength of this		(a) 12	(b) 63
	solution to 0.2 N	[UPSEAT 2001]		(c) 53	(d) 40
	(a) 357.2 <i>ml</i>	(b) 444.4 <i>ml</i>	18.	Volume of $\frac{N}{M}H_{2}SO$, re	equired to neutralize 10 <i>ml</i>
	(c) 537.6 ml	(d) 495.6 <i>ml</i>			
0	8 ml of $\frac{N}{M}$ HCl are r	equired to neutralize 20 ml		$5 N Na_2 CO_3$ is	
9.	$\frac{10}{10}$ met ale l	equired to neutralize 20 mil		(a) 100 <i>ml</i>	(b) 50 <i>ml</i>
	solution of Na_2CO_3	in water. Normality of		(c) 500 ml	(d) 1000 <i>ml</i>
	Na_2CO_3 solution is	$(\mathbf{b}) \circ \circ 4 \circ \mathbf{N}$	19.	The equivalent weigl medium will be	nt of <i>KMnO</i> 4 in alkaline
	(a) 0.40 N	(d) $1 4 N$			[MP PMT 2001]
10	C) 4.0 M	crystalling ovalic acid (og		(a) 31.60	(b) 52.66
10.	wt. = 63 to prepare	e N/10 250 ml oxalic acid		(c) 79.00	(d) 158.00
	solution is [MP PMT 1996]		20.	An aqueous solution of is made up to 250 <i>ml</i> . required to completely solution is	6.3 <i>g</i> oxalic acid dehydrate The volume of 0.1 <i>N NaOH</i> y neutralize 10 <i>ml</i> of this
	(c) $15.75 a$	(d) $6.3 a$			[IIT-IEE (Screening) 2001]
11.	15 ml of 0.2 N alka	li is required to complete		(a) 40 ml	(b) 20 <i>m</i> l
	neutralization of	30 <i>ml</i> acid solution.		(c) 10 ml	(d) $4 ml$
	Concentration of the acid solution is		21.	In the standardization	of $Na_2S_2O_3$ using $K_2Cr_2O_7$ by
		[NCERT 1985; CPMT 1986]	-	iodometry, the equivale	ent weight of $K_2Cr_2O_7$ is
	(a) 0.1 <i>N</i>	(b) 0.3 <i>N</i>			[IIT-JEE (Screening) 2001]
	(c) 0.15 <i>N</i>	(d) 0.4 <i>N</i>		(a) (Molecular weight)	/2
				(b) (Molecular weight)	/6
				(c) (Molecular weight)	/3



volume ·

volume

	(c) 40	(d) 63		(c) $\frac{N}{N}$	(d) <i>N</i>
39.	The ratio of amounts of all the metal ions from 100 <i>ml</i> of 1 <i>M CuSO</i> ₄ is	H_2S needed to precipitate 100 ml of 1 M AgNO ₃ and [MP PET 2001]	48.	10 2 <i>N</i> – <i>HCl</i> will have that	e same molar concentrati
	(a) 1:2	(b) 2 : 1		us	[CPMT 190
	(c) Zero	(d) Infinity		(a) 0.5 $N - H_2 SO_4$	(b) 1.0 $N - H_2 SO_4$
40.	The equivalent weight	t of a divalent metal is		(c) 2 $N - H_2 SO_4$	(d) 4 $N - H_2 SO_4$
	(a) 63.64	(b) $\frac{63.64}{6.02 \times 10^{23}}$	49.	Which of the followin by passing H_2S	ng pair does not distingu: [CPMT 199
	(c) $32.77 \times 6.02 \times 10^{23}$	(d) 63 64 × 6 02 × 10 ^{23}		(a) <i>Hg</i> , <i>Pb</i>	(b) <i>Cd</i> , <i>Pb</i>
41	For the preparation α	f sodium thiosulphate by		(c) As, Cu	(d) Zn, Mn
41.	"Springs reaction", the r (a) $Na_2S + Na_2SO_3 + Cl_2$ (b) $Na_2S + SO_2$	reactants used are[EAMCET 2	200 30.	If 100 <i>ml</i> of 1 <i>N</i> sulp 100 <i>ml</i> of 1 <i>M</i> sodium be [MP PET 1999]	huric acid were mixed w hydroxide, the solution w
	(c) $Na_2SO_3 + S$			(a) Acidic	(b) Basic
	(d) $Na_2S + Na_2SO_3 + I_2$			(c) Neutral	(d) Slightly acidic
42.	Phenolphthalein is most titration of	t suitable indicator for the	51.	100 cm^3 of 0.1 N HCl cm^3 of 0.2 N NaO solution is	solution is mixed with 1 H solution. The resulti
	(a) CH_3COOH and NH_4O_2	Н			[MP PET 199
	(b) CH_3COOH and $NaOH$	[(a) 0.1 N and the solu	tion is basic
	(c) HCl and NH_4OH			(b) 0.05 <i>N</i> and the sol	lution is basic
	(d) H_2CO_3 and NH_4OH			(c) 0.1 N and the solu	tion is acidic
43.	The simplest formula o	of a compound containing		(d) 0.05 <i>N</i> and the sol	lution is acidic
	50% of element <i>X</i> (at. w <i>Y</i> (at. <i>wt</i> =20) is	vt. 10) and 50% of element [DPMT 2000]	52.	For preparing 0.1 N s its impure sample, of is known, the weight	solution of a compound from which the percentage pur t of the substance require
	(a) X_2Y_3	(b) <i>XY</i> ₂		will be	[MP PET 199
	(c) X_2Y	(d) XY		(a) More than the the	oretical weight
44.	The equivalent weight	of a metal is 4.0. The		(b) Less than the theo	retical weight
	weight is	[DPMT 2000]		(c) Same as theoretica	al weight
	(a) 12	(b) 8		(d) None of these	
	(c) 36	(d) 24	53.	The equivalent weight	t of $Zn(OH)_2$ in the following its $[Zn(OH)_2]$
45.	Indicator for the titra	tion of <i>HCl</i> and Na_2CO_3		$Zn(OH)(NO_3) + H_2O$	$113, [2n(011)_2 + (100_3)]$
	would be			2(011)(1.03) * 1120]	[MH CET 199
	(a) $K_{\Lambda}Fe(CN)_{\kappa}$	[RPMT 1999] (b) <i>K</i> ₃ <i>Fe</i> (<i>CN</i>) _{<}		(a) $\frac{\text{Formula wt.}}{2}$	(b) $\frac{\text{Formula wt.}}{1}$
	(c) Phenolphthalein	(d) Methyl orange		$(c) 3 \times formula wt$	(d) $2 \times \text{formula wt}$
	· · ·				

46. 20 ml of a N solution of $KMnO_4$ just reacts with 20 ml of a solution of oxalic acid. The weight of oxalic acid crystals in 1N of the solution is[JIPMER 1999] (a) 31.5 q (b) 126 q

(4) 51.5 9	(0) 120 9
(c) 63 g	(d) 6.3 <i>g</i>

47. 0.53 gm of Na_2CO_3 has been dissolved in 100 ml of a sodium carbonate solution. The normality of the solution will be [MP PMT 1996]

(a)
$$\frac{N}{5}$$
 (b) $\frac{N}{2}$

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- (c) $3 \times \text{formula wt.}$ (d) $2 \times \text{formula wt.}$
- 54. In the titration of strong acid and weak base, the indicator used is [MH CET 1999]
 - (b) Phenolphthalein (a) Thymol blue
 - (c) Thymolphthalein (d) Methyl orange

To neutralize 25 ml of 0.25 M Na_2CO_3 solution 55. how much volume of 0.5 *M HCl* is required[MP PET 1994]

- (b) 25 *ml* (a) 12.5 *ml* (c) 37.5 ml (d) 50 ml
- 56. 0.16 gm of a dibasic acid required 25 ml of
 - decinormal NaOH solution for complete

neutralization. The mol is [CPMT 1989; MP PET	lecular weight of the acid 1993]	66.	Which indicator can be used in the titration of strong acid and strong base	of
(a) 32	(b) 64		(a) Only phenolphthalein (b)Only methyl oran	ige
(c) 128	(d) 256		(c) Either of the two (d) Red litmus	
When 100 $ml N - NaOH$ N sulphuric acid solution resulting solution will b	solution and 10 <i>ml</i> of 10 on are mixed together, the e[DPMT 1982; MP PET 1993]	67.	The indicator used in titrating weak acid (<i>e.g.</i> oxalic acid) with a strong base (<i>e.g.</i> caustic soda solution is	7. 1)
(a) Alkali	(b) Weakly acidic		[IIT-JEE 1985; CPMT 1990; MNR 1980);
(c) Strongly acidic	(d) Neutral		NCERT 1973, 77; MP PMT 1994	ŧ]
Cosin used to detect e	end point of precipitation		(a) Methyl orange (b) Methyl red	
titration by adsorption i	s called[KCET (Med). 2000]		(c) Fluorescein (d) Phenolphthalein	
(a) Absorption indicator	r (b) Adsorption indicator	68.	The pink colour of phenolphthalein in alkalin	ıe
(c) Chemical indicator	(d) Normal indicator		medium is	
0.1914 <i>g</i> of an organic a 20 <i>ml</i> of water. 25 <i>ml</i> of the complete neutraliza The equivalent weight o	cid is dissolved in approx. O.12 <i>N NaOH</i> required for ation of the acid solution. f the acid is		[CPMT 1990 (a) Due to negative form (b) Due to positive form [MP PET 2000])]
(a) 65	(b) 64		(c) Due to OH^- ions	
(c) 63.80	(d) 62.50		(d) Due to neutral form	
Molecular weight of a equivalent weight is	a tribasic acid is W, its	69. [(Phenolphthalein does not act as an indicator for the titration between [NCERT 1976 CPMT 1974, 79])r 5]
(a) 2W	(b) <i>W</i> /3		(b) $P_{\pi}(OH)$ and $HC_{\pi}(OH)$	
(c) 3W	(d) $W - 3$		(b) $Ba(OH)_2$ and HCi	
Approximate atomic v	veight of an element is		(c) NaUH and acetic acid	
26.89. If its equivalent	weight is 8.9, the exact		(u) Oxane actu anu $\underline{N} \underline{N} \underline{M} O_4$	_
atomic weight of elemen	nt would be	70.	If we Distriptions of N_{d} (<i>O</i>) with <i>HCl</i> the usual result is	a ICI

(a) 26.89	(b) 8.9
(c) 17.8	(d) 26.7

57.

58.

59.

60.

61.

62. 1 qm of hydrogen is found to combine with 80 gms of bromine. 1 gm of calcium (valency 2) combines with 4 gms of bromine. The equivalent weight of calcium is

		[NCERT 1982]
(a) 10	(b) 20	
(c) 40	(d) 80	
	(a) 10 (c) 40	(a) 10 (b) 20 (c) 40 (d) 80

63. 4.0 gram caustic soda is dissolved in 100 cc solution. The normality of solution is[MP PMT 1995] (-) ~ `

(a) 1.0	(b) 0.1
(c) 0.5	(d) 4.0

Which of the following is required to neutralize 1 64. litre N – NaOH

(a) 1 $l - N - H_2 SO_4$	(b) 1 $l - M - H_2 SO_4$
(c) 1 $l - 2N - H_2 SO_4$	(d) 1 $l - 0.5N - H_2SO_4$

65. What will be the volume of *CO*₂ at S.T.P., obtained by heating 9.85 g of $BaCO_3$ (Atomic number of Ba= 137)

	[MP PMT 2003]
(a) 1.12 <i>litre</i>	(b) 0.84 <i>litre</i>
(c) 2.24 litre	(d) 4.06 litre

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- **66.** Which indicator can be used in the titration of

- titration of Na_2CO_3 with HCl, the usual result is [CBSE PM
 - (a) No visible change will occur
 - (b) The indicator reacts with the acid
 - (c) The indicator reacts with the base

(d) Sodium chloride and carbonic acid will be formed

- 71. Methyl orange gives red colour in [NCERT 1972]
 - (a) Sodium carbonate solution
 - (b) Sodium chloride solution
 - (c) Hydrochloric acid solution
 - (d) Potassium hydroxide solution
- **72.** A 0.1 N solution of Na_2CO_3 is titrated with 0.1 N *HCl* solution. The best indicator to be used is [NCERT 1971; DPMT 1983; AFMC 1992; CPMT 1983, 97] (a) Potassium ferricyanide (b) Phenolphthalein (c) Methyl red (d) Litmus paper
- When $KMnO_4$ solution is titrated with a solution 73. containing Fe^{2+} ion, the indicator used in this titration is

	[CPMT 1989; AIIMS 1996]
(a) Phenolphthalein	(b) Methyl orange
(c) $K_3[Fe(CN)_6]$	(d) None of these

The strength of a solution (S) in gram/litre, is 74. related to its normality (N) and equivalent weight of solute (e) by the formula

(a) $S = \frac{N}{E}$	(b) $S = \frac{E}{N}$
(c) $S = N.E$	(d) All of these

The normality of 1 *M* solution of H_3PO_4 will be 75.

[AIIMS	1983,	91]

(a) 1 N (b) 0.5 N (c) 2 N (d) 3 N

76. In the reaction
$$I_2 + 2S_2O_3^- \rightarrow 2l^- + S_4O_6^{2-}$$
; the equivalent weight of iodine will be equal to

[MNR 1985; UPSEAT 2000]

(a) Molecular weight

(b) 1/2 the molecular weight

(c) 1/4 the molecular weight

(d) Twice the molecular weight

To what extent must a given solution of 77. concentration of 40 mg silver nitrate per ml be diluted to yield a solution of concentration of 16 $mg AgNO_3$ per ml [NCERT 1977]

(a) Each *ml* must be diluted to 2.5 *ml*

(b) To each *ml* of solution 2.5 *ml* of water should be added

(c) To 2.5 ml of solution 2 ml of water should be added

(d) To 1.5 ml of solution 1.5 ml of water should be added

78.	10 ml of conc. H_2SO_4 ((18 molar) is diluted to 1
	<i>litre</i> . The approximate	strength of dilute acid
	could be	[CPMT 1971]
	(a) 0.18 <i>N</i>	(b) 0.36 <i>N</i>
	(c) 0.09 <i>N</i>	(d) 18.00 <i>N</i>

- For preparing one litre N/10 solution of H_2SO_4 , 79. we need H_2SO_4 [DPMT 1982]
 - (a) 98 gms (b) 10 qms
 - (c) 100 gms (d) 4.9 gms
- 80. What is the concentration of nitrate ions if equal volumes of 0.1 M AgNO₃ and 0.1 M NaCl are mixed together

		[NCERT 19	981; CI	PMT 19	83]
	(a) 0.1 <i>N</i>	(b) 0.2 <i>M</i>			
	(c) 0.05 <i>M</i>	(d) 0.25 M	I		
81.	To neutralise 10 ml of	M/5 NaOH	the v	volume	of
	M/20 HCl required is		[EAM	CET 19	80]
	(a) 10 <i>ml</i>	(b) 15 <i>ml</i>			
	(c) 40 ml	(d) 25 <i>ml</i>			
82.	To change the strength	of 25 <i>ml</i> of	0.15	M HCl	to

- (c) 40 ml (d) 80 ml
- 84. What volume of water is to be added to 50 ml of 4 N NaOH solution to obtain a 1 N solution[MP PET 2002] (a) 100 ml (b) 150 ml
 - (d) 250 ml (c) 200 ml

85. In alkaline condition $KMnO_4$ reacts as follows, $2KMNO_4 + 2KOH \rightarrow 2K_2MnO_4 + H_2O + O.$ The eq. wt. of $KMnO_4$ is [DPMT 2000] (a) 79 (b) 31.6

- (c) 158 (d) 52.7 86. When a standard solution of NaOH is left in the [Kerala PMT 2004]
 - air for a few hours.
 - (a) A precipitate will form.
 - (b) Strength will decrease.
 - (c) The concentration of Na^+ ions will decrease.
 - (d) All are wrong.
- In the iodometric estimation in laboratory, which 87. process is involved ? [Orissa JEE 2004]
 - (a) $Cr^2 O_7^{2-} + H^+ + \Gamma \rightarrow 2Cr^{3+} + I_2$, $I_2 + S_2 O_3^{2-} \rightarrow S_4 O_6^{2-} + \Gamma$ (b) $MnO_4^- + H^+ + \Gamma \rightarrow MnO_2 + I_2$ $I_2 + S_2 O_3^{2-} \rightarrow S_4 O_6^{2-} + \Gamma$
 - (c) $MnO_4^{-} + OH^{-} + \Gamma \rightarrow MnO_2 + I_2$

$$I_2 + S_2 O_3^{2-} \to S_4 O_6^{2-} + I^-$$

- (d) $Cr_2O_7^{2-} + OH^- + \Gamma \rightarrow 2Cr^{3+} + I_2$ $I_2 + S_2 O_3^{2-} \rightarrow S_4 O_6^{2-} + \Gamma$
- 88. What is the volume of 0.1 *N*-*HCl* required to react completely with 1.0 qm of pure calcium carbonate.

[DPMT 2004]

(~	N 10	$0 m^3$	(h)	150	3
(a	i) IC	$0 \ cm^{\circ}$	(D)	150	cm

$(\mathbf{u}) 250 cm$ $(\mathbf{u}) 200 cm$	(c)	250 cm^3	(d)	200 cm	3
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- The weight of a residue obtained by heating 2.76 89. g of silver carbonate is [Pb. PMT 2004] (a) 2.76 q (b) 2.98 q (c) 2.16 g (d) 2.44 g
- **90.** What is the molarity of H_2SO_4 solution if 25 *ml* is exactly neutralised with 32.63 ml of 0.164 M. NaOH [DCE 2003] (a) 0.107 M (b) 0.126 M

(c)
$$0.214 M$$
 (d) $-0.428 M$

To change the strength of 25 ml of 0.15 M HCl to 0.1 M the quantity of water that is to be added is **[EAMCET 1979]** (a) 27.5 ml (b) 12.5 ml (c) 12.5 m (c) 1(a) 37.5 ml (b) 12.5 ml (a) 0.925 g (b) 0.0125 g (c) 25.0 ml (d) 18.75 ml (c) 0.25 q (d) 1 q The volume of 0.1 $M H_2SO_4$ that is needed to 83. completely neutralise 40 ml of 0.2 M NaOH is[EAMCE 197979] What will be the volume of a 12 M solution, if it is

equivalent to 240 ml 18 M solution [BVP 2004] (a) 10 ml (b) 20 ml (a) 6 litre (b) 600 litre

93.	(c) 400 <i>litre</i> The volume of $\frac{N}{10}$ <i>NaC</i>	(d) 0.36 <i>litre</i> H require to neutralise 100	3.	The salt used for performing 'bead' test in qualitative inorganic analysis is [UPSEAT 2001] (a) $K_2SO_4 Al_2(SO_4)_2 24H_2O$
	ml of $\frac{N}{N}$ HCl is	[Pb. CET 2000]		(b) $FeSO_4.(NH_4)_2SO_4.6H_2O$
	25			(c) $Na(NH_4)HPO_4.4H_2O$
	(a) 30 ml	(b) 100 ml		(d) $CaSO_4 2H_2O$
	(c) 40 ml	(d) 25 ml	4.	Where chlorine water is added to an aqueous
94.	The volume of 0.6 M N 30 cm^3 of 0.4 M HCl is	[Pb. CET 2001]		solution of potassium halide in presence of chloroform, a violet colour is obtained. On adding
	(a) 40 cm^3	(b) 30 cm ³		more of chlorine water, the violet colour
	(c) 20 cm ³	(d) 10 cm ³		This test confirms the presence of the following in
95·	Solubility of iodine in	water may be increased by		aqueous solution [CPMT 1990]
	adding			(a) Iodide (b) Bromide
	(a) Chloroform	[DCE 2004]		(c) Chloride (d) Iodide and bromide
	(a) Chioroform	(b) Potassium iodide	5۰	Upon the addition of a solution A to a strongly
<u>06</u>	(c) Carbon discipliate	(d) Source in form		precipitate was obtained which did not dissolve
90.	If 30 <i>IIII</i> of H_2 and 2 water what is left at the	O_2 reacts to form	20051	even after large addition of water. Solution A
	(a) $10ml$ of H	(b) $rml of H$	2005]	contained [NCERT 1971]
	(a) found of H_2	$(0) \text{sint of } n_2$		(a) Sodium phosphate (b) Sodium carbonate
	(c) 10ml of O_2	(d) $5ml$ of O_2	6	(c) Sodium sulphate (d) Sodium chloride
97.	The primary standard $Na_2S_2O_3$ is	solution for estimation of	0. [Crissa JEE 2005] or an action of an anton a few drops of or an action of an anton a few drops of the following if present will not decelourize the
	(a) I_2 solution	(b) $KMnO_4$		<i>KMnO</i> ₄ solution [MP PMT 1997]
	(c) $K_2 C r_2 O_7$	(d) Oxalic acid		(a) NO_2^- (b) S^{2-}
98.	Acidic solution of S_2O	$_{3}^{2-}$ is converted to in		(c) Cl^{-} (d) CQ^{2-}
	presence of I_2		[Orissa JEE 2005]
	(a) $S_4 O_6^{2-} + I^-$	(b) $SO_4^{2-} + I^-$	7.	The brown ring test for NO_2 and NO_3^- is due to
		(d) $S O^{2-} + T^{-}$		the formation of complex ion with the formula
	(c) $SO_3 + I$	(u) $S_4 O_6 + I_3$		[KCET (Eng./Med.) 2000; Kerala PMT 2004]
				(a) $[Fe(H_2O)_6]^{-1}$ (b) $[Fe(NO)_5]^{-1}$
	Critica	al Thinking	Q	(c) $[re(H_2O)5NO]$ (d) $[re(H_2O)(NO)5]$ Mixture is bested with dil $H(SO)$ and the lead
		5	0.	acetate paper turns black by the evolved gases. The
		Objective Questions		mixture contains
				(a) Sulphite (b) Sulphide
1.	A white solid 'A' on he	ating gives off a gas which		(c) Sulphate (d) Thiosulphate
	turns lime water mil	ky. The residue is yellow	9.	To a solution of a substance, gradual addition of
	is [MP PMT 1999]	ite on coomig. This solid A		precipitate which does not dissolve in excess of
	(a) Zinc sulphate	(b) Zinc carbonate		NH_4OH . However, when HCl is added to the
	(c) Lead sulphate	(d) Lead carbonate		original solution, a white precipitate is formed.
2.	A salt on treatment wi	th dil. <i>HCl</i> gives a pungent		The solution contained [BHU 1973]
	smelling gas and a ye	ellow precipitate. The salt		(a) Lead salt (b) Silver salt
	gives a vellow pre	cipitate with potassium	10	(c) Mercurous sait (d) copper sait If $NaOH$ is added to an aqueous solution of zinc
	chromate. The salt is	[MP PET 1996]	10.	ions, a white precipitate appears and on adding
	(a) NiSO $_4$	(b) BaS_2O_3		excess NaOH, the precipitate dissolves. In this
		(d) Cuso		solution zinc exists in the
	(c) PbS_2O_3	$(u) Cuso_A$		
	(c) PbS_2O_3	(u) $Cuso_4$		[NCERT 1981; MP PET 1993] (a) Cationic part

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- (b) Anionic part
- (c) Both in cationic and anionic parts
- (d) There is no zinc in the solution
- **11.** On performing a borax-bead test with a given inorganic mixture for qualitative analysis, the colour of the bead was found to be emerald green both in oxidising and reducing flame. It indicates the possibility of the presence of

		[MP PMT 2001]
(a) <i>Co</i> ⁺²	(b) <i>Ni</i> ⁺²	
(c) <i>Cr</i> ⁺³	(d) Cu^{+2}	

- 12. A red solid is insoluble in water. However it becomes soluble if some *KI* is added to water. Heating the red solid in a test tube results in liberation of some violet coloured fumes and droplets of a metal appear on the cooler parts of the test tube. The red solid is [AIEEE 2003] (a) $(NH_4)_2Cr_2O_7$ (b) HgI_2 (c) HgO (d) Pb_3O_4
- **13.** An aqueous solution of $FeSO_4$, $Al_2(SO_4)_3$ and chrome alum is heated with excess of Na_2O_2 and filtered. The materials obtained are
 - (a) A colourless filtrate and a green residue
 - (b) A yellow filtrate and a green residue
 - (c) A yellow filtrate and a brown residue
 - (d) A green filtrate and a brown residue
- 14. Phosphoric acid (H_3PO_4) is tribasic acid and one of its salts is sodium dihydrogen phosphate (NaH_2PO_4) . What volume of 1 *M NaOH* solution should be added to 12 *g* of sodium dihydrogen phosphate (mol. wt. 120) to exactly convert it into trisodium phosphate Na_3PO_4

(a) 80 ml (b) 100 ml (c) 200 ml (d) 300 ml

15. Three separate samples of a solution of a single salt gave these test results : One formed a white precipitate with excess ammonia solution, one formed a white precipitate with dil. *NaCl* solution and one formed a black precipitate with H_2S . The salt could be [Pb. PMT 1998]

(a) $AgNO_3$ (b) $Pb(NO_3)_2$

(c) $Hg(NO_3)_2$ (d) $MnSO_4$

16. 10 *ml* of concentrated *HCl* were diluted to 1 *litre*.
20 *ml* of this diluted solution required 25 *ml* of 0.1 *N* sodium hydroxide solution for complete neutralization, the normality of the concentrated hydrochloric acid will be

(a) 8.0	(b) 9.5
(c) 12.5	(d) 15.0

17. To a 25 ml of H_2O_2 solution, excess of acidified solution of KI was mixed. The liberated I_2 require 20ml of 0.3M hypo solution for neutralization. The volume strength of H_2O_2 will be [MP PET 2003]

(a) 1.34 <i>ml</i>	(b) 1.44 <i>ml</i>
(c) 1.60 ml	(d) 2.42 <i>ml</i>

- 18. A chemistry student trying to detect the metallic ion in a salt, makes a paste on a clean platinum wire loop of the salt with concentrated *HCl*. When he takes a small amount of this paste and keeps it in a non-luminous Bunsen flame, the colour of the flame changes to grassy green. He should, therefore, conclude that the metal is[Manipal MEE (a) Barium (b) Calcium (c) Potassium (d) Strontium
- **19.** A white crystalline substance dissolves in water. On passing H_2S in this solution, a black precipitate is obtained. The black precipitate dissolves completely in hot HNO_3 . On adding a few drops of conc. H_2SO_4 a white precipitate is obtained. This precipitate is that of **[CPMT 1990]** (a) $BaSO_4$ (b) $SrSO_4$
 - (c) $PbSO_4$ (d) $CdSO_4$
- 20. The best explanation for the solubility of *MnS* in dil. *HCl* is that [UPSEAT 2001]
 - (a) Solubility product of $MnCl_2$ is less than that of M[MFT 1996]
 - (b) Concentration of Mn^{2+} is lowered by the formation of complex ions with chloride ions
 - (c) Concentration of sulphide ions is lowered by oxidation to free sulphur
 - (d) Concentration of sulphide ions is lowered by formation of the weak acid H_2S

Assertion & Reason For ANMS Aspirants

Read the assertion and reason carefully to mark the correct option out of the options given below :

- (a) If both assertion and reason are true and the reason is the correct explanation of the assertion.
- (b) If both assertion and reason are true but reason is not the correct explanation of the assertion.
- *(c)* If assertion is true but reason is false.
- (d) If the assertion and reason both are false.
- (e) If assertion is false but reason is true.
- **1.** Assertion : Lime water becomes turbid on passing CO_2 but becomes clear on passing more CO_2 .
 - Reason : Lime water is calcium hydroxide, $Ca(OH)_2$.

[AIIMS 2000]

2. Assertion : Sb(III) is not precipitated as sulphide when in its alkaline solution H_2S is passed.

	Reason	:	The concentration of S^{2-} ion in alkaline medium is inadequate for precipitation.
			[AIIMS 2004]
3.	Assertion	:	<i>CuS</i> will give H_2S in dilute acid test.
	Reason	:	All sulphides react with dil. H_2SO_4 ,
			on heating, to give H_2S .
4.	Assertion	:	$PbCl_2$ will give HCl in conc. H_2SO_4 test.
	Reason	:	All chlorides react with conc. H_2SO_4 ,
			on heating, to give <i>HCl</i>
5.	Assertion	:	$ZnCO_3$ will not give any gas when
			treated with conc. H_2SO_4 .
	Reason	:	CO_3^{2-} can only be detected in dil. acid
6.	Assertion		CdS is vellow in colour.
	Reason	:	Cd^{2+} salts are vellow in colour.
7.	Assertion	:	A brown gas which intensifies on
			adding <i>Cu</i> -turnings in conc. H_2SO_4
			test is NO _{2.}
	Reason	:	Copper reacts with conc. HNO_3 to
			give NO ₂ .
8.	Assertion	:	CuS is blue in colour.
	Reason	:	All Cu^{2+} salts are blue in colour.
9.	Assertion	:	Acidified $K_2Cr_2O_7$ is turned green
			when SO_2 is passed through it.
	Reason	:	In this reaction SO_2 acts as a
			reducing agent.
10.	Assertion	:	White ppt. of $AgCl$ is soluble in
			NH ₄ OH.
	Reason	:	It is due to the formation of soluble complex.
11.	Assertion	:	All soluble sulphides gives white ppt. with $BaCl_2$ solution.
	Reason	:	BaS is insoluble in water.
12.	Assertion	:	A solution of $BiCl_3$ in conc. HCl when
			diluted with water gives white ppt.
	Reason	:	$BiCl_3$ in insoluble in dil. HCl .
13.	Assertion	:	Addition of NH_4OH to an aqueous
			solution of $BaCl_2$ in the presence of
			<i>NH</i> ₄ <i>Cl</i> (excess) precipitates
			$Ba(OH)_2$.
	Reason	:	$Ba(OH)_2$ is insoluble in water.
			[AIIMS 2005]

Preliminary Test 3 4 d 5 1 а 2 С а а 6 d 7 d 8 9 10 b с с 11 d 12 13 d 14 b 15 а а 16 b 17 с 18 b 19 а 20 b 21 b 22 b 23 а



Wet Test for Acid Radical

1	abd	2	С	3	b	4	d	5	C
6	а	7	b	8	d	9	а	10	b
11	b	12	d	13	C	14	С	15	C
16	b	17	C	18	а	19	b	20	а
21	C	22	d	23	d	24	С	25	b
26	С	27	b	28	b	29	b	30	а
31	а	32	C	33	а	34	b	35	а
36	b	37	а	38	а	39	d	40	b
41	а								

Wet Test for Basic Radical

1	b	2	b	3	b	4	b	5	b
6	b	7	C	8	а	9	d	10	b
11	d	12	d	13	C	14	d	15	а
16	b	17	а	18	b	19	C	20	a
21	abcd	22	bcd	23	C	24	C	25	b
26	a	27	a	28	а	29	b	30	d
31	b	32	C	33	d	34	C	35	d
36	b	37	C	38	C	39	d	40	b
41	C	42	b	43	d	44	а	45	b
46	b	47	b	48	а	49	а	50	C
51	а	52	d	53	а	54	C	55	а
56	а	57	d	58	а	59	C	60	b
61	a	62	d	63	d	64	b	65	d
66	C	67	b	68	C	69	a	70	b
71	C	72	b	73	C	74	d	75	d
76	b	77	d	78	d	79	C	80	d
81	b	82	d	83	а	84	C	85	а
86	C	87	b	88	C	89	a	90	d
91	C	92	а	93	C	94	а	95	b
96	a	97	b	98	C	99	d	100	a
101	а	102	b	103	а	104	с		

Volumetric Analysis

1	С	2	С	3	b	4	С	5	а
6	a	7	d	8	С	9	b	10	b
11	a	12	a	13	а	14	a	15	d
16	b	17	b	18	С	19	d	20	а
21	b	22	d	23	a	24	a	25	a
26	d	27	C	28	d	29	c	30	c
31	d	32	b	33	С	34	b	35	a
36	c	37	b	38	d	39	a	40	b

41	d	42	b	43	C	44	a	45	d
46	C	47	C	48	С	49	а	50	C
51	b	52	b	53	b	54	d	55	а
56	С	57	d	58	b	59	C	60	b
61	d	62	b	63	а	64	d	65	а
66	С	67	d	68	а	69	d	70	а
71	с	72	С	73	d	74	с	75	d
76	b	77	a	78	b	79	d	80	c
81	с	82	b	83	с	84	b	85	c
86	b	87	b	88	d	89	с	90	а
91	а	92	d	93	С	94	C	95	b
96	d	97	а	98	а				

Critical Thinking Questions

1	b	2	b	3	c	4	а	5	с
6	d	7	С	8	b	9	С	10	d
11	С	12	b	13	С	14	С	15	а
16	C	17	а	18	а	19	С	20	d

Assertion and Reason

1	b	2	C	3	d	4	d	5	е
6	c	7	а	8	d	9	а	10	a
11	е	12	c	13	b				

Answers and Solutions

Preliminary Test

1. (a) $Na_2B_4O_7.10H_2O \xrightarrow{-10 H_2O} Na_2B_4O_7$

$$\xrightarrow{\Delta} 2NaBO_2 + B_2O_3$$

$$CuO + B_2O_3 \rightarrow Cu(BO_2)_2$$

(Copper meta borate blue

- **2.** (c) Borax bead test is generally given by transition elements.
- 5. (a) Ba^{2+} imparts green colour to the flame.
- 6. (d) As Mn^{+2} has all it's electrons (5) unpaired in it's d-orbital, so it's extra stable configuration requires high excitation energy and so it gives violet colour.

8. (b)
$$2NO + O_2 \rightarrow 2NO_2$$

(Deep brown gas)

9. (c) *CoAlO*₂ is formed which is blue. Follow cobalt nitrate-charcoal test.

10. (c) Metals which form basic compounds and have coloured salts give the borax bead test.

11. (d)
$$2KNO_3 + H_2SO_4 \rightarrow 2KHSO_4 + 2NO_2 \uparrow$$

(Brown gas)

- **12.** (a) Barium salt gives green coloured flame as it has low ionization energy
- (d) Calcium oxalate will not dissolve in acetic acid (weak acid) but only in strong acid
- 14. (b) $Na_2S + dil.2HCl \rightarrow 2NaCl + H_2S$

$$H_2S + H_2SO_4 + K_2Cr_2O_7 \xrightarrow{\text{acidic}} K_2SO_4 + Cr_2(SO_4)_3 + S$$
(green)

- (a) Starch Iodide paper is used for the test of Iodine, as
 Starch + Iodine → Starch Iodide
- 16. (b) Flame colour of *Ba* salt is green $2AgNO_3 + BaCl_2 \rightarrow 2AgCl + Ba(NO_3)_2$. White ppt.
- **17.** (c) $NH_3 + HCl \rightarrow NH_4Cl$ dense white fumes
- **18.** (b) $CoO + B_2O_3 \xrightarrow{\text{Heat}} Co(BO_2)_2$ Copper metabrate (blue)
- **20.** (b) In laboratory burners, oil gas is generally used. Oil gas is mixture of $CH_4 + CO + CO_2 + H_2$
- **21.** (b) $H_2S \rightarrow$ colourless gas with unpleasant odour of rotten eggs.
 - $SO_2 \rightarrow$ colourless gas with a pungent suffocating odour

 $PH_3 \rightarrow$ colourless gas with unpleasant garlic like odour or rotten fish odour.

22. (b)
$$NO(g) + NO_2(g) \xrightarrow{-30^\circ C} N_2O_3(l)$$

(BLUE)

23. (a) Yellowish-green gas of chlorine with sufocating odour is evolved when the solid chloride mixed with manganese dioxide is heated with concentrated H_2SO_4 .

 $NaCl + H_2SO_4 \rightarrow NaHSO_4 + HCl$ $MnO_2 + 4HCl \rightarrow MnCl_2 + 2H_2O + Cl_2$

Wet Test for Acid Radical

1. (abd) Chromyl chloride test $4 NaCl + K_2 Cr_2 O_7 + 3H_2 SO_4 \xrightarrow{\text{heat}}$

$$K_{2}SO_{4} + 2Na_{2}SO_{4} + 2CrO_{2}Cl_{2} + 3H_{2}O_{\text{chromylchloride (orange red)}}$$

$$4NaOH + CrO_{2}Cl_{2} \rightarrow 2NaCl + Na_{2}CrO_{4} + 2H_{2}O_{\text{Sod. chromate (Yellow)}}$$

$$Na_{2}CrO_{4} + (CH_{3}COO)_{2}Pb \rightarrow 2CH_{3}COONa +$$

 $\begin{array}{c} PbCrO_4 \downarrow \\ Lead chromate \\ (yellowppt.) \end{array}$

- 2. (c) Starch is colourless but Starch + Iodine \rightarrow Starch Iodine (violet) \rightarrow Starch Iodine
- **3.** (b) Brown ring test with (*FeSO*_{4..}*NO*)

4. (d)
$$Na_4[Fe(CN)_5 NO] + S^{2-} \rightarrow Na_4[Fe(CN)_5 NOS]$$

Sodium thio-nitropruss ide (violet)

6. (a) With F^- , no precipitate is obtained because of low lattice energy of AgF, so it remains in ionized state

(b)
$$NaCl + H_2SO_4 \rightarrow NaHSO_4 + HCl$$

 $K_2Cr_2O_7 + 2H_2SO_4 \rightarrow 2KHSO_4 + 2CrO_3 + H_2O$
 $CrO_3 + 2HCl \rightarrow CrO_2Cl_2$
(orange red vapour)

8. (d)
$$CrO_2Cl_2 \xrightarrow{NaOH} Na_2CrO_4 \xrightarrow{CH_3COOH} CH_3COOP_{H_3CO}}$$

$$[(CH_3COO)_2Pb] \xrightarrow{\text{COO}_2CO} \rightarrow PbCrO_2$$
yellowppt.

9. (a)
$$2AgNO_3 + H_2S \rightarrow Ag_2S + 2HNO_3$$

Black ppt.

7.

10. (b) Iodine vapours are violet
$$\therefore$$
 the salt must contain I^- as
 $KI + H_2SO_+ \rightarrow KHSO_+ + HI_-$

$$2HI + H_2SO_4 \rightarrow I_2 + 2H_2O + SO_2$$

- 11. (b) As Cl^- is more electronegative than Br^- and $I^ \therefore$ it replaces them from their salt as $2I^- + Cl_2 \rightarrow I_2 + 2Cl^- \Rightarrow$ Violet vapour $2Br^- + Cl_2 \rightarrow Br_2 + 2Cl^- \Rightarrow$ Brown vapour
- 12. (d) The salt must have SO_4^{2-} group which is also present in the acid so reaction is not takes place.
- **13.** (c) Phosphates give canary yellow precipitate with ammonium molybdate in the presence of conc. HNO_3

$$H_3PO_4 + 12(NH_4)_2MoO_4 + 21HNO_3$$

(NH_4)₃ PO_4 .12 $MoO_3 + 21NH_4NO_3 + 12H_2O_3$
ammonium phosphomo lybdate
(canary yellow ppt.)

- 15. (c) Nitrates and acetates of all metals are water soluble.
- 16. (b) When NO₃⁻ is passed through FeSO₄ (neutral) and then few drops of conc. H₂SO₄ is added then the brown ring is obtained.
 FeSO₄ + NO → Fe(NO)SO₄

- 17. (c) AgCl and AgBr dissolve in NH_4OH and form complexes but AgI doesn't react with NH_4OH . e.g. $AgCl + 2NH_4OH \rightarrow [Ag(NH_3)_2]Cl + 2H_2O$ complex
- 18. (a) When Cl^- , Br^- and F^- are treated with $AgNO_3$ solution in presence of dilute HNO_3 , corresponding silver halide is obtained which is soluble in NH_4OH , NaCN, and $Na_2S_2O_3$.

$$\begin{array}{c} AgNO_{3} + NaCl \longrightarrow AgCl \downarrow + NaNO_{3} \\ & \text{white} \end{array}$$

$$\begin{array}{c} AgCl + dil.2NH_{4}OH \longrightarrow \left[Ag(NH_{3})_{2}\right]Cl + 2H_{2}O \\ & \text{complex} \end{array}$$

19. (b) $Ca(OH)_2 + CO_2 \longrightarrow CaCO_{3(S)} + H_2O$ lime water white precipitate $CaCO_3 + CO_2(\text{excess}) + H_2O \longrightarrow Ca(HCO_3)_2$

20. (a) It is a lab method for the preparation of
$$Br_2$$
 e.g.
2 $KBr + MnO_2 + H_2SO_4 \rightarrow$

$$Br_2 + 2 KHSO_4 + MnSO_4$$

21. (c)
$$Na_2SO_3 + 2HCl(dil.) \rightarrow 2NaCl + H_2O + SO_2$$
,
 $K_2Cr_2O_2 + H_2SO_4 + 3SO_4 \rightarrow K_2SO_4 + Cr_2(SO_4)_3 + H_2O$
(Green)

- **22.** (d) As the sulphate radical is a strong oxidising agent, it is insoluble in acids and so detection of sulphate radicle requires no other reagent.
- 23. (d) Sulphite radicle will give a burning sulphur odour. Acetate radical will give a sweet, venegar odour. Nitrite will give a reddish brown gas. Carbonate will give a colourless, odourless gas, *i.e.* CO₂.
- 24. (c) $PbSO_4$ and $PbCl_2$ are insoluble in cold water hence the reagent $Pb(NO_2)_2$ is used to remove SO_4^{2-} and Cl^{-}

$$2KI + 2H$$
 SO (Conc.) $\rightarrow 2KHSO + 2HI$

$$(6) 2KI + 2H_2SO_4 (Colic.) \rightarrow 2KHSO_4 + 2HI$$

$$MnO_2 + H_2SO_4 \rightarrow MnSO_4 + H_2O + (O)$$

$$2HI + (O) \rightarrow H_2O + I_2$$

$$2KI + MnO_2 + 3H_2SO_4 \rightarrow I_2 + MnSO_4 + 2H_2O$$

$$+2KHSO_4$$

26. (c) It is a test for chloride ion.

(h)

25

39.

40.

- 27. (b) Dil. H_2SO_4 doesn't react with chloride but reacts with peroxide
- **28.** (b) $Ba(OH)_2$ is not highly basic and bond is not easily broken
- **29.** (b) Ozone react with *KI* solution to liberate I_2 gas.

30. (a)
$$2KBr + MnO_2 + 3H_2SO_4 \rightarrow MnSO_4 + 2KHSO_4 + 2H_2O + Br_2 \uparrow_{\text{(reddish brown gas)}}$$

- **32.** (c) $NH_3 + 3Cl_2 \rightarrow NCl_3 + 3HCl$
- **33.** (a) At the junction of salt solution and $FeSO_4$ solution with conc. H_2SO_4 a brown ring is obtained ($FeSO_4$.NO) Brown ring

34. (b)
$$2KMnO_4 + 3H_2SO_4 + 5H_2S \rightarrow K_2SO_4 + 2MnSO_4 + 8H_2O + 5S$$

- 35. (a) $3FeSO_4 + NO_2 + 3H_2SO_4 \rightarrow Fe_2(SO_4)_3 + FeSO_4.NO + H_2O_{(Black brown)}$
- **36.** (b) As most of the nitrates are soluble in water.
- 37. (a) SO²⁻₃, S²⁻ and SO²⁻₄ salts from comparatively stronger acids (than H₂CO₃) in solution hence evolve CO₂ with Na₂CO₃ solution and give effervesence. While CO²⁻₃ does not react with Na₂CO₃ solution
 38. (a) Na₂CO₂ + 2H₂O → 2NaOH + H₂CO₂
 - (a) $Na_2CO_3 + 2H_2O \rightarrow 2NaOH + H_2CO_3$ and $2NaOH \implies 2Na^+ + 2OH^-$ Hence, it is clear that $2OH^-$ ions will be formed on hydrolysis of one molecule of sodium corbonate.
 - (d) According to the equation, $Ca(OH)_2 + CO_2 \xrightarrow{\Delta} CaCO_3 + H_2O$ $CaCO_3 + H_2O + CO_2 \longrightarrow Ca(HCO_3)_2$ $Ca(HCO_3)_2 \xrightarrow{\Delta} CaO + H_2O + 2CO_2$

Hence, the gas A and B are CO_2 and CO_2 respectively

- (b) $2KMnO_4 + 3H_2SO_4 \rightarrow K_2SO_4 + 2MnSO_4 + 5S + 8H_2O_4$
- **41.** (a) It doesn't provide free Br^- ions to react with AgNO₃.

Wet Test for Basic Radical

1. (b) As_2S_3 forms complex with $(NH_4)_2CO_3$

2. (b)
$$Cu(NH_3)_4(NO_3)_2 + 4CH_3COOH \rightarrow Cu(NO_3)_2 + 4CH_3COONH_4$$

$$2Cu(NO_3)_2 + K_4[Fe(CN)_6] \rightarrow Cu_2Fe(CN)_6 + 4KNO_3$$

3. (b) $SnS + (NH_4)_2 S_2 \xrightarrow{HCl} (NH_4)_2 S + SnS_2$

- 4. (b) For the solution to become milky H_2S must be oxidised to SO_2
- 5. (b) HNO_3 oxidises Fe^{2+} to Fe^{3+} otherwise Fe^{2+} is not completely precipitated as hydroxide
- 6. (b) Sr^{2+} give bright red colour to the flame
- 7. (c) Calcium oxalate will not dissolve in acetic acid (weak acid) but only in strong acid

8. (a)
$$2Hg + 2HCl \rightarrow Hg_2Cl_2 + H_2$$

white ppt.

- **9.** (d) It is an acidic salt
- 10. (b) In presence of *NH*₄*OH*, dissociation of *H*₂*S* is remarkably high so increases the solubility product of IVth group sulphides $H_2S \square 2H^+ + S^{2-}$

$$NH_4OH \rightarrow NH_4^+ + OH^-$$

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

- **11.** (d) As cadmium belongs to the IInd group and is precipitated as sulphide and not as chloride.
- (d) Aluminium is in IIIrd group and is precipitated as hydroxide [*Al*(*OH*)₃].

$$HCl \rightarrow H^+ + Cl^-; \quad H_2S \rightarrow 2 H^+ + S^{2-}$$

- 14. (d) Oxalate of these metals are insoluble
- **15.** (a) Both will precipitate as sulphide.
- 16. (b) Both Pb and Ag form white ppt. of their chlorides. But $PbCl_2$ is soluble in hot water while AgCl does not dissolve in hot water.

19. (c)
$$(CH_3COO)_2Pb + H_2S \rightarrow 2CH_3COOH + PbS \downarrow_{black ppt}$$

20. (a) $(NH_4)SCN$ is a red colour substance.

21. (abcd)
$$FeCl_3 + K_4 [Fe(CN)_6] \rightarrow Fe_4 [Fe(CN)_6]_3$$

Ferri ferrocy and (Blue)
 $2FeCl_3 + 3H_2S \rightarrow Fe_2S_3 + 6HCl$

$$3NH_4CNS + FeCl_3 \rightarrow Fe(CNS)_3 + 3NH_4Cl$$
(Blood red)
$$Fe(CL_3 + 3KCNS) \rightarrow Fe(CNS)_3 + 3KCl$$

$$FeCl_{3} + 3KCNS \rightarrow Fe(CNS)_{3} + 3KCl$$
(Blood red)

- **24.** (c) (Conc. $H_2SO_4 + K_2Cr_2O_7$) mixture is called as chromic acid.
- **26.** (a) $NaCl > MgCl_2 > Na_2S > MgS$ Solubility decreasing order

36.

30. (d) Cobalt sulphide does not ppt. in second group.

(b)
$$BaCO_3 + 2HCl \rightarrow BaCl_2 + H_2O + CO_2$$

 $ZnS + 2HCl \rightarrow ZnCl_2 + H_2S$
(dil.)

37. (c) Cd^{2+} is not precipitated by H_2S in concentrated acid solution that is why the solution is diluted before passing H_2S through it.

39. (d)
$$AgCl + 2NH_3 \rightarrow [Ag(NH_3)_2]Cl = [Ag(NH_3)_2]^+ + Cl^-$$

complex

40. (b)
$$Fe^{3+} + K_4[Fe(CN)_6] \rightarrow K[Fe[Fe(CN)_6]] + 3K$$

Prussian blue

- **41.** (c) As Na_2CO_3 is a strong electrolyte it will cause the precipitation of $MgCO_3$. So $(NH_4)_2CO_3$ is used as it's a weaker electrolyte than Na_2CO_3 .
- 42. (b) As the concentration of OH⁻ ions is less due to common ion effect but enough to precipitate the IIIrd group radicals as hydroxides, as the solubility product of III group hydroxides is lower than IV, V and VI group hydroxides.
- **44.** (a) As NH_4Cl is a strong electrolyte. It supresses the ionization of NH_4OH , so the concentration of OH^- ions in the solution is decreased, but it is sufficient to precipitate the III group basic radicals because the solubility product of III group hydroxides is lower than IV, <u>V and VI</u> group hydroxides. As

$$\begin{array}{c|c} NH4OH \Box & NH4^+ & + OH^- \\ NH4Cl \rightarrow & NH_4^+ & + Cl^- \\ Common & \text{ion effect} \end{array}$$

45. (b)
$$4FeCl_3 + 3K_4[Fe(CN)_6] \rightarrow Fe_4[Fe(CN)_6]_3 + 12KCl$$

Prussian
Blue colour

- 46. (b) ZnS is white.
- 47. (b) $Sb_2S_3 + 2(NH_4)_2S_2 \rightarrow 2(NH_4)_2S + Sb_2S_5$
- 48. (a) The second group radicals will precipitate because their solubility product is very low so sulphates will be precipitated.
- **49.** (a) As $Pb(NO_3)_2$ is an ionic compound so the reaction is easy. $Pb(NO_3)_2 + 2NaCl \rightarrow 2NaNO_3 + PbCl_2$, but $Ba(NO_3)_2$ has a higher lattice energy, so no reaction takes place.

50. (c)
$$4NH_4OH + CuSO_4 \rightarrow [Cu(NH_3)_4]SO_4 + 4H_2O_{(excess)}$$

51. (a)
$$CuCl_2 + H_2S \rightarrow CuS_{(Black ppt.)} + 2HCl_{(Black ppt.)}$$

- **52.** (d) As they have low K_{sp} value.
- 53. (a) NH_4^+ ions are required to supress the ionization of NH_4OH but sufficient to precipitate the III group radicals. $(NH_4)_2SO_4$ can't be used as SO_4^{2-} ions will precipitate Ba^{2+} as $BaSO_4$
- 54. (c) White precipitate obtained is of $BaCl_2$, as the Cl^- ion's concentration increases due to the addition of HCl, the ionic product becomes more than solubility product and thus, $BaCl_2$ is precipitated
- **55.** (a) $HgS + HNO_3 \rightarrow No$ reaction
- **56.** (a) Pb^{2+} as it's precipitated as chloride and sulphide in Ist and IInd group respectively
- 57. (d) As $Bi(SO_4)_3$ is a covalent compound with high lattice energy and hence it is insoluble in water.
- **58.** (a) The solution must contain Ni^{+2} as it forms a complex with DMG giving $[Ni(DMG)_2]$ which is red in colour.

59. (c)
$$BiCl_3 + H_2O \rightarrow BiOCl_{(white ppt)} + 2HCl_{(white ppt)}$$

60. (b)
$$Hg_2Cl_2 + 2NH_4OH \rightarrow NH_2 - Hg - Cl + Hg_{(Black ppt)} + NH_4Cl + 2H_2OH$$

61. (a) Colour of anhydrous *COCl*₂ is blue and when it comes in contact with moisture then it turns in pink.

62. (d) When $(NH_4)_2CO_3$ is used then the concentration of CO_3^{2-} is comparatively low but when Na_2CO_3 is added then concentration of CO_3^{2-} increases so Mg^{2+} will be precipitated along with other 5th group radicals

63. (d) Nessler's reagent gives red precipitate with
$$NH_4^+$$

NH

$${}_{4}Cl + 2K_{2}[HgI_{4}] + 4KOH \rightarrow$$

$$NH_{2} - Hg - O - Hg - I + 7KI + KCl + 3H_{2}C$$
Iodide of Millon's base (Brown ppt)

- **64.** (b) *FeS* is soluble in *HCl*. Also Fe^{2+} salts are green.
- **65.** (d) Cd^{+2} belongs to II A group while As^{+3} to II B. All the sulphides of II B are soluble in yellow ammonium sulphide but those of II A are insoluble.
- **66.** (c) As $Fe(OH)_3$ is soluble in NaOH whereas $Al(OH)_3$ is not.
- 67. (b) $NH_3 + H_2O \rightarrow NH_4OH$ due to common ion effect NH_4^+ ion concentration increases which leads to the
- precipitation of Al(OH)₃.
 68. (c) CrCl₃, as Cr⁺³ ⇒ 3d³, has unpaired electron in d-orbital as a result it will show paramagnetism and thus forms coloured complexes.
- **69.** (a) Cu^{2+} will be precipitated as CuS in acidic medium where as Ni^{2+} is not precipitated.
- **70.** (b) Even $SnCl_2$ added into $HgCl_2$ solution to give white gray colour.

76. (b)
$$Al^{+3} + (OH^{-})_3 \rightarrow Al(OH)_3$$
 (white ppt.)

which is soluble in excess alkali.

- (d) As the ionic product of Sb³⁺ and Bi³⁺ is very low and Cl⁻ is present in high concentration, therefore Sb and Bi get precipitated, as
 Sb³⁺ + 3Cl⁻ → SbCl₃
- **78.** (d) $Fe_3(PO_4)_2$ is insoluble in water.
- **79.** (c) Sulphide having high ionic product are completely precipitated in acidic medium. *CdS* has maximum ionic product hence it is completely precipitated.

80. (d)
$$3FeCl_2 + 2K_3[Fe(CN)_6] \rightarrow Fe_3[Fe(CN)_6]_2 + 6KCl$$

blue colour

83. (a)
$$Cu + 2AgNO_3 \rightarrow Cu(NO_3)_2 + 2Ag$$

84. (c)
$$2CuSO_4 + 4KI \rightarrow 2CuI + 2K_2SO_4 + I_2$$
.
Cuprous iodide

85. (a) *Ca*, *Ba*, *Sr* these radicals are precipitated in basic medium.

88. (c)
$$Cu^{2+} + H_2 S \rightarrow CuS \downarrow_{\text{black ppt.}} \downarrow$$

$$89. (a) NH_4OH \square NH_4^+ + OH$$

 $NH_4Cl \rightarrow NH_4^+ + Cl^-$

*NH*₄*Cl* decreases the dissociation of *NH*₄*OH* by common ion effect

93. (c) *HCl* suppresses ionisation of weakly dissociated H_2S , with the result only the ionic product of the sulphides of group II radicals exceed their corresponding solubility product and hence only these are precipitated.

97. (b)
$$Cd^{++} + H_2S \rightarrow CdS_{\text{Yellowppt}} + H_2O$$

98. (c) Acidified solution of potassium permanganate. $Fe^{+2} \xrightarrow{KMnO_4} Fe^{+3}$

$$Fe^{+3} \xrightarrow{KMnO_4} \text{No reaction}$$
99. (d) $CuCl_2 + 2HNO_3 \rightarrow Cu(NO_3)_2 + 2HCl$
 $Cu(NO_3)_2 \text{ reacts with } NH_4OH \text{ and gives } Cu(NH_3)_4^{2+}$
which has deep blue colour.
102. (b) $Bi(NO_3)_3(aq) + 3KI(aq) \longrightarrow BiI_3(s)$
 $+ 3KNO_3(aq) \qquad \text{Black}$

$$\begin{array}{ccc} BiI_3({\rm s})+{\it KI}(aq) & \longrightarrow {\it K}[BiI_4] \\ & & & \\ & & \\ \mbox{Orange colour} \end{array}$$
 103. (a) HCl suppresses ionisation of weakly dissociated H2S,

with the result only the ionic product of the sulphides of group II radicals exceed their corresponding solubility product and hence only these are precipitated.
 Ma S + Na [Fe(NO)(CN)] →

104. (c)
$$Na_2S + Na_2[Fe(NO)(CN)_5]$$

sodum nitropruss ide

 $Na_3[Fe(ONSNa)(CN)_5]$ or $Na_4[Fe(CN)_5NOS]$ violet coloured complex purple colour complex

Volumetric Analysis

1. (c)
$$0.1 = \frac{x \times 1000}{40 \times 100} \Rightarrow x = 0.45 \text{ gms}$$

- **2.** (c) As methyl orange is a weak base.
- 3. (b) Phenolphthalein is an indicator for strong base and weak acid, but $KMnO_4$ oxidises it.

4. (c)
$$N_1 V_1 = N_2 V_2$$
, $\frac{1}{10} \times 15 = N_2 \times 12 \implies N_2 = \frac{1}{8} N_1$

5. (a) In the neutralization of acid and base $N \times V$ of both must be equivalent $N \times V$ of $HCl = 0.1 \times 100 = 10$

 $N \times V$ of $NaOH = 0.2 \times 30 = 6$

as to obtain $10 N \times V$ of base

$$4 N \times V \text{ of base is required}$$

$$N \times V \text{ of } KOH = 0.25 \times 16 = 4$$

$$N_1V_1 = N \times V + N \times V$$

$$NaOH$$

$$0.1 \times 100 = 0.2 \times 30 + 0.25 \times V$$

$$10 = 6 + 0.25 V$$

$$V = \frac{400}{0.25} \implies V = 16 ml$$

6. (a) 1 - 0.68 = 0.32 g oxygen

$$\frac{0.68}{eq.wt.} = \frac{0.32}{8} \implies eq.wt. = \frac{0.68 \times 8}{0.32} = 17$$

7. (d)
$$V_1 = 20 \ ml, \ N_1 = 0.25 \ N, \ V_2 = 30 \ ml$$

 $N_2 = 0.2N$
 $\therefore N = \frac{N_1 V_1 + N_2 V_2}{V_1 + V_2} = \frac{20(0.25) + 30(0.2)}{20 + 30}$
 $= \frac{5 + 6}{50} = \frac{11}{50} = 0.2N \text{ basic}$

9. (b)
$$N_1 V_1 = N_2 V_2 \Rightarrow \frac{1}{10} \times 8 = N_2 \times 20$$
, $\therefore N_2 = 0.04 N_2$
10. (b) $N = \frac{W_B \times 1000}{E \times V} \Rightarrow \frac{N}{10} = \frac{x \times 1000}{63 \times 250}$

 $\therefore x = 1.575 \, grams$

11. (a)
$$N_1V_1 = N_2V_2$$

 $15 \times 0.2 = 30 \times x \therefore x = 0.1 N$

- 12. (a) $N_1V_1 + N_2V_2 = N_3V_3$ $200 \times 0.6 + 100 \times 0.3 = N_3V_3$ and $V_3 = V_2 + V_1 = 300 \ ml$ $\therefore N_3 = 0.5 \ N$
- 13. (a) $10 M H_2 SO_4 \Rightarrow 20 N H_2 SO_4$ $\therefore 20 \times 10 = 200 \text{ for } H_2 SO_4 \text{ and}$ $100 \times 1 = 100 \text{ for } NaOH$ $\therefore \text{ Acidity} > \text{Basicity}$

14. (a)
$$0.1M \text{ of } H_2SO_4 \Longrightarrow 0.2N \text{ of } H_2SO_4$$

 $\therefore N_1V_1 = N_2V_2 \qquad [N = 2m \text{ for } H_2SO_4]$
 $0.2 \times V_1 = 30 \times 0.2$
 $\therefore V_1 = 30 \ ml$

15. (d)
$$N_1 V_1 = N_2 V_2$$
 $5N \times 1$ lit = $x \times 10$ lit.
 $\therefore x = 0.5 N$

16. (b) Normality =
$$N = \frac{W_B \times 1000}{Eq.wt \times V}$$

$$\therefore \text{ Eq. Wt} = \frac{0.45 \times 1000}{0.5 \times 20} = 45$$
$$\therefore \text{ Basicity} = \frac{\text{Molec. Wt}}{\text{Eq. Wt}} = \frac{90}{45} = 2$$

17. (b)
$$\stackrel{COOH}{\downarrow}$$
 $2H_2O \rightarrow 126$ is molecular wt.
 $COOH$
 \therefore Equivalent wt. = Molecular wt. / 2 = 63

18. (c)
$$N_1 V_1 = N_2 V_2 \implies 5 \times 10 = \frac{1}{10 x} \times x \quad \therefore x = 500 \, ml$$

19. (d)
$$KMnO_4 \rightarrow K_2MnO_4$$

$$\frac{\text{Molecular weight}}{1} = \frac{158}{1} = 158$$

21. (b) Hyposolution are used as the reducing agent with potassium dicromate solution $\frac{+6}{K} = \frac{-1}{K} \frac{1}{K} \frac$

$$K_{2}Cr_{2}O_{7} = \frac{C}{6}$$
22. (d) $N_{1}V_{1} = N_{2}V_{2}$
 $N \times 25 = \frac{109.5 \times 32.9}{36.5} \Rightarrow N = \frac{109.5 \times 32.9}{36.5 \times 25}$
 $N_{3}V_{3} = N_{4}V_{4}$ ($V_{3} = \frac{m}{d}, V_{3} = \frac{125}{1.25}$)
 $\frac{109.5 \times 32.9}{36.5 \times 25} \times 100 = 0.84 \times V \Rightarrow V = 470 \, ml$
23. (a) $N_{1}V_{1} = N_{2}V_{2}$

(a)
$$V_1 = V_2 V_2$$

 $0.1 \times V_1 = 0.13 \times 80 \Rightarrow V_1 = 104 \ ml$

24. (a) Molarity =
$$\frac{wt. \times 1000}{\text{Eq. wt.} \times \text{vol.}}$$

 $0.1 = \frac{wt. \times 1000}{40 \times 250}$
 \therefore wt. required = 1 gm
25. (a) $1 = \frac{x \times 1000}{63 \times 100} \Rightarrow x = 6.3$ gms

26. (d)
$$10 \times x = 1 \times 1$$

 $x = 0.1 \ liter = 100 \ cc$

 \therefore resulting normality = 0.05 *N*, basic.

53. (b) Equivalent weight of

$$Zn(OH)_{2} = \frac{M \operatorname{olecular weight}}{\operatorname{acidity}} = \frac{M}{1}$$
Acidity of $Zn(OH)_{2} = 1$, only one OH is replaced.
55. (a) $M_{1}V_{1} = M_{2}V_{2}$
 $(Na_{2}CO_{3}) = (HCI)$
 $0.25M \times 25 = 0.5M \times V_{2}$
 $V_{2} = \frac{0.25M \times 25}{0.5M} = 12.5 ml$
56. (c) $\frac{0.16}{x} \times \frac{1000}{25} = \frac{1}{10} \implies \frac{6.4}{x} = \frac{1}{10} \implies x = 64$
Mol. wt. = 64 × 2 = 128
57. (d) If $N_{1}V_{1} = N_{2}V_{2}$ then the solution will be neutral
 $\therefore 1 \times 100 = 10 \times 10$
 $100 = 100 \implies \operatorname{solution}$ in neutral
59. (c) Volume = 25 ml = $\frac{25}{1000}$ litre
Normality = $\frac{wt}{eq.wt \times \operatorname{Volume}} \implies 0.12 = \frac{0.1914 \times 1000}{E \times 25}$
 $eq.wt. = \frac{0.1914 \times 1000}{0.12 \times 25} = 63.8$
60. (b) Eq. wt = $\frac{\operatorname{Molecular Wt.}}{\operatorname{basicity}} = \frac{W}{3}$
61. (d) Valency = $\frac{26.89}{8.9} = 3$
at. mass = Eq.wt × valency = $8.9 \times 3 = 26.7$
62. (b) $\because 4 gms$ of Br_{2} combines with 1 gm of Ca
 $\therefore 80 gms$ of Br_{2} combines with $\frac{1}{4} \times 80 = 20$
Therefore,
equivalent wt of $Ca = 20$
63. (a) $N = \frac{4 \times 1000}{40 \times 100} = 1N$
64. (d) $N_{1}V_{1} = N_{2}V_{2}$
 $1 \times 1 = 0.5 \times 2 \times 1$
as $0.5 N$ will give double the amount of H^{+} ions
65. (a) $BaCO_{3} \Rightarrow BaO + CO_{2} \uparrow$
 $\therefore 197 g BaCO_{3}$ on decompose gives = 22.4 litre CO_{2}
 $\therefore 1g BaCO_{3}$ will give $=\frac{22.4}{197} = \operatorname{litre } CO_{2}$
 $= \frac{22.4 \times 9.85}{197} = 1.12 \ \operatorname{litre } CO_{2}$
66. (c) As the resultant solution will be neutral so either of them
can be used.
67. (d) Phenolphthalein is used as it is colourless and becomes
pink only in basic medium.
69. (d) Here KMO itself works as an indicator.

- 70. (a) The resulting solution is colourless.
- 71. (c) As it is a weak aromatic base so it gives colour in acidic medium.
- 72.
- (c) As the resulting solution is acidic.(d) Here *KMnO*₄ is used as an indicator as well as a reactant. 73.
- (c) Strength $=\frac{W}{V}=NE$ 74.

- (d) As H_3PO_4 can donate $3H^+$ in the solution, as a result 75. the normality of solution is 3N, as Molarity \times basicity = Normality (b) $I_2 + 2S_2O_3^- \rightarrow 2I^- + S_4O_6^{2-}$ 76. \therefore Eq. wt. = $\frac{1}{2}$ × molecular wt. $x = \frac{40}{16} = 2.5 \ ml$ (a) $40 \times 1 = 16 \times x \implies$ 77. 78. (b) $18 M \text{ of } H_2 SO_4 = 36 N \text{ of } H_2 SO_4$ $N_1V_1 = N_2V_2 \Longrightarrow 36 \times 10 = N_2 \times 1000$ $\therefore N_2 = 0.36 N$ (d) $\frac{1}{10} = \frac{W \times 1000}{\text{eq.wt} \times \text{vol.}} = \frac{W \times 1000}{49 \times 1000} \Rightarrow W = 4.9 \text{ gms}$ 79. 80. (c) $M_1V_1 = M_2V_2$ $0.1 \times V = M_2 \times 2V \Rightarrow M_2 = \frac{1 \times V}{2V} = 0.05M$ (c) $N_1V_1 = N_2V_2 \Rightarrow \frac{1}{5} \times 10 = \frac{1}{20} \times V_2 \Rightarrow V_2 = 40 \ ml$ 81. (b) $N_1 V_1 = N_2 V_2$ 82. $0.15 \times 25 = 0.1V_2 \Longrightarrow V_2 = 37.5 \, ml$ Water to be added = $37.5 - 25 = 12.5 \ ml$ (c) $N_1V_1 = N_2V_2 \Rightarrow 0.2 \times V_1 = 0.2 \times 40 \Rightarrow V_1 = 40 \, ml$ 83. (c) $Mn^{+7} \rightarrow Mn^{+6} = \frac{158}{1} = 158$ 85.
 - 88. (d) Given, N = 0.1, w = 1.0 gm, equivalent weight = 50, V = ? $V = \frac{w \times 1000}{1 \times 1000} = \frac{1 \times 1000}{200} = 200 \text{ cm}^3$

$$V = \frac{1}{Eq.wt. \times N} = \frac{1}{50 \times 0.1} = 200 \text{ cm}$$

89. (c) $2Ag_2CO_3 \xrightarrow{\Delta} 4Ag + 2CO_2 + O_2$
[$(2 \times 108) + 12 + 48$] 4×108
 $2(216 + 12 + 48)$ 4×108
 $2 \times 276 = 552$ 4×108
 $\therefore 552 \text{ gm}$ silver carbonate gives silver $= 432 \text{ gm}$.
 $\therefore 2.76 \text{ gm}$ silver carbonate gives $\frac{432 \times 2.76}{552} 2.16 \text{ gm}$
90. (a) $0.164 \text{ M NaOH} \cong 0.164 \text{ N NaOH}$
We know, $N_1V_1 = N_2V_2$; $N_1 \times 25 = 0.164 \times 32.63$

0.214
$$N H_2 SO_4 \cong \frac{0.214}{2} M H_2 SO_4$$

(:: basicity of $H_2 SO_4$ is 2
 $\cong 0.107 M H_2 SO_4$

)

91. (a) We know,
$$[H^+] = 10^{-pH} = 10^{-13}$$
;
 $\therefore [OH^-] = \frac{10^{-14}}{10^{-13}} = 10^{-1}$
Hence, normality of solution = 0.1
We know, $w = \frac{NEV}{1000} = \frac{0.1 \times 74 \times 250}{2 \times 1000} = 0.925 \ gm$
92. (d) $N_1 V_1 = N_2 V_2$ or $M_1 V_1 = M_2 V_2$
 $\therefore 12 \times V_1 = 18 \times 240$
 $V_1 = \frac{18 \times 240}{12} \ 260 \ ml = 0.36 \ litre$

93. (c) For complete neutralisation,

milli equivalent of base = milli equivalent of acid $N_1V_1 = N_2V_2 \Rightarrow \frac{1}{10} \times V_1 = \frac{1}{25} \times 100$; $V_1 = 40$ ml. 94. (c) Normality = molarity × basicity or acidity (for *HCl*) $N_2 = 0.4 \times 1 = 0.4 N$ basicity =1 (for *NaOH* acidity =1) $N_1 = 0.6 \times 1 = 0.6 N$ $V_1 = ? V_2 = 30$ cm³ From the equation, $N_1V_1 = N_2V_2$ $0.6 \times V_1 = 0.4 \times 30$ $V_1 = \frac{0.4 \times 30}{0.6} = 20$ cm³ 95. (b) The solubility of I_2 in water increases by the addition of *KI*

95. (b) The solubility of I_2 in water increases by the addition of *K* due to ormation of polyhaldie ion, *i.e.*, I_3^-

$$KI + I_2 \rightarrow KI_3$$

96. (d)
$$H_2 + \frac{1}{2}O_2 \rightarrow H_2O$$

1 mole $\frac{1}{2}$ mole 1 mole
1 volume $\frac{1}{2}$ volume
1 ml H_2 reacts with $\frac{1}{2}$ ml O_2
30ml of H_2 reacts with $=\frac{1}{2} \times 30 = 15$ ml O_2
(20-15) = 5ml of O_2 will left at the end of the reaction.
97. (a) Standard solution of I_2 is used to estimate sulphite,

98. (a)
$$I_2 + Na_2S_2O_3 \rightarrow 2NaI + Na_2S_4O_6$$

 $I_2 + S_2O_2^{--} \rightarrow 2I^- + S_4O_2^{--}$

Critical Thinking Questions

1. (b)
$$ZnCO_3 \xrightarrow{\Delta} ZnO + CO_2$$

Turns lime water milky
(Hot) $ZnO \square ZnO_{(Cool)}$
2. (b) $Ba^{+2} + 2CH_3COO^- \rightarrow (CH_3COO)_2Ba$
 BaS_2O_3 gives SO_2 gas with dil. HCl and also yellow ppt.
of Barium chromate.
 $(CH_3COO)Ba + K_2CrO_4 \rightarrow 2CH_3COOK + BaCrO_4 \downarrow$
(yellowppt.)
3. (c) $Na(NH_4)HPO_4 \xrightarrow{\Delta} NaPO_3 + NH_3 + H_2O$
Microcosmic salt Sodium meta phosphate (transparent)
4. (a) It is a test for iodide.
5. (c) $Ba(NO_3)_2 + Na_2SO_3 \rightarrow Ba(NO_2)_2 + Na_2SO_4$
 Na_2SO_4 is insoluble in water.
6. (d) Except CO_3^{--} all other ions are reduced by $KMnO_4$

- 6. (d) Except CO_3^{--} all other ions are reduced by $KMnO_4$ solution.
- 7. (c) The brown ring test for NO_2^- and NO_3^- is due to formation of $[Fe(H_2O)_5 NO]^{2+}$
- 8. (b) It must be sulphide as $Pb(CH_3COO)_2 + H_2S \rightarrow PbS + 2CH_3COOH$ (Black ppt.)
- 9. (c) Hg_2Cl_2 is white insoluble salt.

$$Hg_{2}Cl_{2} + 2NH_{4}OH \rightarrow Hg + Hg(\underline{NH_{2})Cl + NH_{4}}Cl + 2H_{2}O$$
Black
Black

- 10. (d) $Zn^{2+} + 2NaOH \rightarrow Zn(OH)_2 + 2Na^+$ $Zn(OH)_2 + 2NaOH \rightarrow Na_2ZnO_2 + 2H_2O.$
- **11.** (c) Chromium ion gives in hot and cold. Oxidising and reducing flame green-colour.
- 12. (b) $HgI_2 + 2KI \rightarrow K_2(HgI_4)$ soluble Red solid $HgI_2 \rightarrow Hg + I_2$ violet foams.
- 13. (c) Yellow filtrate is due to chromate ions (CrO_4^{--}) and green residue is due to $Fe(OH)_2$.

14. (c)
$$1 \times V = \frac{12}{120} \times 2 = 200 \, ml$$
.

15. (a) $AgNO_3$ react with all conditions and gives corresponding result.

$$\begin{split} AgNO_3 + 2NH_3 &\rightarrow [Ag(NH_3)_2]NO_2 + H_2O\\ & \text{White ppt} \end{split}$$

$$AgNO_3 + NaCl &\rightarrow AgCl + NaNO_3\\ & \text{White ppt} \end{aligned}$$

$$2AgNO_3 + H_2S &\rightarrow Ag_2S + 2HNO_3. \end{split}$$

Black ppt

16. (c) $HCl \qquad NaOH \\ N_1V_1 = N_2V_2$

$$N_1 \times 20ml = 0.1 \times 25$$

$$N_1 = \frac{0.1 \times 25}{20} = 0.125$$
.

If one *litre HCl* present in 0.125

Therefore in 10 *ml*
$$\frac{0.125}{1000} \times 10 = 12.5$$

The normality of conc. *HCl* is 12.5*N*. **17.** (a) 20 *ml* of $0.3N Na_2S_2O_3$

- = 20ml of $0.3NI_2$ Solution
 - = 20 ml of $0.3 N H_2 O_2$ solution

$$\equiv 25 \, ml$$
 of $0.08 \, N \, H_2 O_2$ solution

Mass of
$$H_2O_2$$
 100*ml* solution = $\frac{0.08 \times 17 \times 100}{1000}$

 $= 0.136 \ gm$

% = 0.136

68 gm H_2O_2 evolve oxygen at NTP = 22400 ml

0.00136 $gm H_2O_2$ evolve oxygen at NTP

$$=\frac{22400}{68} \times 0.00136 = 0.448$$

For 0.1*N*, the solution is of 0.448 volume.

 \therefore 3N, volume = 0.448 × 3 = 1.344 ml.

18. (a) '*Ba*' gives characteristic green flame in Bunsen burner.

19. (c)
$$Pb^{+2} + H_2S \xrightarrow[Backpt]{acidic} PbS \downarrow + H_2 \uparrow$$

 $(Blackpt])$
 $3PbS + 8HNO_3 \rightarrow 3Pb(NO_3)_2 + 2NO + 3S + 4H_2O$
 $Pb(NO_3)_2 + H_2SO_4 \rightarrow PbSO_4 \downarrow + 2HNO_3 \uparrow$
(white ppt)

20. (d) It is a characteristic property of IV group concentration of sulphide ions is lowered by formation of the weak acid H_2S .

Assertion and Reason

1. (b) Lime water become turbid on passing CO_2 into it because both reacts to produce insoluble calcium carbonate.

both reacts to produce insoluble calcium

$$Ca(OH)_2 + CO_2 \rightarrow CaCO_3 + H_2O$$

Lime Water Calcium Carbonate
Calcium Carbonate

If more CO_2 is passed than soluble calcium bicarbonate is formed which clear the solution

$$\begin{array}{c} CaCO_3 + H_2O + CO_2 \rightarrow Ca(HCO_3)_2 \\ \text{Insoluble} \end{array} \xrightarrow[\text{Calcium bi Carbonate} \\ \text{(Soluble)} \end{array}$$

2.

5.

The reason that lime water is $Ca(OH)_2$ is also correct. Here, both assertion and reason are correct but reason is not a correct explanation of assertion.

- (c) Assertion is true but reason is false. Sb(III) is a basic radical of *IIB* group for which group reagent is H_2O is presence of dilute *HCl*. It is necessary to maintain the proper hydrogen ion concentration for the precipitation of IV group cations.
- 3. (d) CuS is one such exception which is not decomposed by dil. H_2SO_4
- 4. (d) $PbCl_2$ does not react with conc. H_2SO_4 as $PbSO_4$ is insoluble in water.
 - (e) $ZnCO_3$ will react with conc. H_2SO_4 to give CO_2 Radicals of dil. acid test are decomposed by conc. H_2SO_4 in cold.
- 6. (c) Cd^{2+} salts are generally white in colour, however, CdS is yellow in colour.
- 7. (a) Both assertion and reason are correct and reason is the correct explanation of assertion.
- 8. (d) Cu^{2+} salts are generally blue in colour, however, CuS is black in colour.
- **9.** (a) Both assertion and reason are correct and reason is the correct explanation of assertion.
- **10.** (a) Both assertion and reason are correct and reason is the correct explanation of assertion.
- (e) Sulphides do not give any test with BaCl₂ (aq.) as BaS is soluble in water.
- 12. (c) It is due to the formation of insoluble BiOCl on hydrolysis. $BiCl_3 + H_2O \rightarrow BiOCl + 2HCl$ White ppt.

Chemical Analysis

1. What volume of a solution of hydrochloric acid containing 73 g of acid per litre would sufficient for the exact neutralization of sodium hydroxide obtained by allowing 0.46 g metallic sodium to act upon water

(*Cl* = 35.5, *Na* = 23.0, 0 = 16) (a) 10 *ml* (b) 15 *ml* (c) 20 *ml* (d) 8 *ml*

- 2. A white sodium salt dissolves readily in water to give a solution which is neutral to litmus. When silver nitrate solution is added to the solution, a white precipitate is formed which does not dissolve in dilute nitric acid. The anion could be
 - (a) SO_4^{2-} (b) CO_3^{2-}

(c) S^{2-} (d) Cl^{-}

3. Sometimes yellow turbidity appears on passing H_2S gas even in the absence of the second group radicals. This happens because

(a) Sulphur is present in the mixture as an impurity

(b) The fourth group radicals are precipitated as sulphides

- (c) The H_2S is oxidized by some acid radicals
- (d) The third group radicals are precipitated
- **4.** The colour of $CuCr_2O_7$ solution in water is green because

[Bihar CEE 1995]

- (a) $Cr_2 O_7^{2-}$ ions are green
- (b) Cu^{++} ions are green
- (c) Both ions are green
- (d) Cu^{++} ions are blue and $Cr_2O_7^{2-}$ ions are yellow
- **5.** Pb^{++} , Cu^{++} , Zn^{++} , and Ni^{++} ions are present in a given acidic solution. On passing hydrogen sulphide gas through this solution the available precipitate will contain

[MP PMT 1996; MP PET/PMT 1998]

(a) PbS and NiS	(b) <i>PbS</i> and <i>CuS</i>
(c) CuS and ZnS	(d) CuS and NiS

6. In acidic medium, dichromate ion oxidises ferrous ion to ferric ion. If the *gram* molecular weight of potassium dichromate is 294 *grams*, its *gram* equivalent weight is.....*grams*

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- (a) 294 (b) 127 [UPSEAT_2001] (d) 24.5
- 7. Metallic tin in the presence of *HCl* is oxidise $K_2 Cr_2 O_7$ to stannic chloride. What volume of decinormal dichromate solution would be reduced by 1 *g* of tin

[UPSEAT 2001]

- (a) 168.49 ml (b) 175.49 ml (c) 178.56 MT 1998] (d) 162.38 ml
- 8. 50 ml 10 $N H_2SO_4$, 25 ml 12N-HCl and 40 ml 5 $N - HNO_3$ were mixed together and the volume of the mixture was made 1000 ml by adding water. The normality of the resultant solution will be

[MP PET/PMT 1998; MP PMT 2002]

(a) $1 N$	(b) 2 <i>N</i>
(c) 3 <i>N</i>	(d) 4 N

9. An aqueous solution of colourless metal sulphate M, gives a white precipitate with NaOH. This was soluble in excess of NaOH. On passing H_2S through this solution a white precipitate is formed. The metal M in the salt is

[KCET 1990]

- (a) Ca
 (b) Ba

 (c) Al
 (d) Zn
- **10.** A compound is soluble in water. If ammonia is added, a red precipitate appears which is soluble in dilute *HCl*. The compound has

(a) Aluminium	(b) Zinc
(c) Iron	(d) Cadmium

11. Nessler's reagent is

[CPMT 1997; MP PET/PMT 1998]

- (a) $KHgI_4$ (b) $K_2HgI_4 + NH_4OH$
- (c) $K_2HgI_4 + KOH$ (d) $KHgI_4 + NH_4OH$
- **12.** Neutral ferric chloride is added to the aqueous solution of acetate. The blood red colour is obtained, it is due to the compound
 - (a) $Fe(OH)_2$ (b) $Fe(OH)_3$ (c) $Fe(CH_3COO)_3$ (d) $Fe(OH)_2(CH_3COO)$

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13.	Mark the gas which turns lime water milky		(a) $ZnCl_2$	(b) <i>CdCl</i> ₂			
	(a) H_2S	(b) SO_2	(c) $COCl_2$	(d) $CuCl_2$			
	(c) <i>Cl</i> ₂	(d) CO_2					
14.	Which of the following reactions with H_2S does						
	not produce met	allic sulphide	[AIIMS 1997]	1			
		Answers	and Solutions				

1. (a)
$$\frac{0.46}{23} = \frac{73}{36.5} \times V(l)$$

 $V = 10 \, ml$

2. (d)
$$NaCl + H_2O \rightarrow NaCl_{(aq)}$$

 $NaCl + AgNO_3 \rightarrow AgCl \xrightarrow{HNO_3}$ Insoluble
 $(aq) \qquad (aq) \qquad \text{white ppt} \qquad \xrightarrow{dil}$

- 3. (b) This is due to the precipitation of fourth group radical as sulphides due to high concentration of S^{2-} in the solution as a result yellow turbidity is obtained
- 4. (d) Cu^{++} ions are blue and $Cr_2O_7^{--}$ ions are yellow, yellow and blue combination gives-green colour.
- 5. (b) As both Pb^{2+} and Cu^{2+} require acidic medium and low concentration of S^{2-} to be precipitated as sulphide and low concentration of S^{2-} is provided by common ion effect of *HCl* and *H*₂*S*.
- 6. (c) In acidic medium potassium dicromate shows + 6 oxidation state $\frac{M}{6} = \frac{294}{6} = 49$

7. (a)
$$0.1 \times V = \frac{2}{119}$$

 $V = 168.06 \, ml$.

8. (a)
$$H_2SO_4 \quad HCl \quad HNO_3 \quad \text{Total volume}$$

 $N_1V_1 + N_2V_2 + N_3V_3 = N \times 1000 \, ml$
 $N = \frac{N_1V_1 + N_2V_2 + N_3V_3}{1000}$
 $= \frac{50 \times 10 + 25 \times 12 + 40 \times 5}{1000}$
 $N = \frac{500 + 300 + 200}{1000} = \frac{1000}{1000} = 1N$
9. (d) $Zn^{+2} + 2NaOH \rightarrow Na_2ZnO_2 + 2H_2O$
(white ppt.)
 $Na_2ZnO_2 + H_2S \rightarrow ZnS + 2NaOH$

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10. (c)
$$FeCl_3 + 3NH_4OH \rightarrow Fe(OH)_3 + 3NH_4Cl_{(red)}$$

$$2Fe(OH)_3 + 6HCl \rightarrow 2FeCl_3 + 6H_2O$$
(soluble)
(soluble

11. (c) Nessler's reagent
$$= K_2 HgI_4 + KOH$$

12. (c)
$$3CH_3COONa + FeCl_3 \rightarrow Fe(CH_3COO)_3 + 3 NaCl Blood red ppt.$$

(White ppt.)

13. (bd) CO_2 and SO_2 turns lime water milky, as

$$Ca(OH)_{2} (aq.) + CO_{2} \rightarrow CaCO_{3} \downarrow + H_{2}O$$

$$Ca(OH)_{2} + SO_{2} \rightarrow CaSO_{3} \downarrow + H_{2}O$$

$$(milky) \downarrow + H_{2}O$$

$$(milky)$$

14. (c) In $COCl_2$ metal is not present.