

ANIADYINGAL CHEMISTRY

SINGLE CORRECT CHOICE TYPE Each of these questions has 4 choices (a), (b), (c) and (d) for its answer, out of which ONLY ONE is correct.

- 1. Yellow ammonium sulphide solution is a suitable reagent for the separation of
 - (a) HgS and PbS (b) PbS and Bi_2S_3
 - (d) CdS & As_2S_3 (c) Bi_2S_3 & CuS
- 2. When intimate mixture of potassium dichromate and KCl is heated with conc. H₂SO₄ which of the following is produced in the form of red vapours?
 - (a) CrO₃ (b) Cr_2O_3
 - (c) CrO_2Cl_2 (d) CrCl₃
- 3. The following figure shows a reaction scheme for a compound X, identify X.

Colourless solution
$$\leftarrow$$
 Water X Flame test Red colour
heat with dil HCl
White precipitate Brown gas evolved

(a)
$$CaBr_2$$
 (b) $Ca(NO_3)_2$

- (d) $Mg(NO_3)_2$ (c) $Ca(NO_2)_2$
- 4. Which of the following complexes will give white precipitate with BaCl₂ (aq.)?
 - (a) $[Co(NH_3)_4SO_4]NO_2$ (b) [Cr(NH₃)₄SO₄]Cl
 - (c) $[Cr(NH_3)_5Cl]SO_4$ (d) Both (b) & (c)
- When NH₄Cl is mixed with Nessler's reagent in the solution, 5. a ppt is obtained. The colour of the ppt. is
 - (a) Blue (b) Black (c) White
 - (d) Brown
- The composition of yellow compound obtained when 6. Nessler's reagent is added to a compound containing ammonium ion is

(a)
$$Hg+Hg_2Cl_2$$
 (b) $H_2NHgCl+Hg$
(c) $NH_2Hg_2I_3$ (d) NH_2HgI_2

$$-\not$$

7. The alkali metal nitrate that evolves reddish brown fumes on thermal decomposition is (a) LiNO₃ (b) NaNO₃

- (c) KNO₃ (d) CsNO₃
- KMnO₄ can not oxidise which of the following compound?
 - (a) H_2SO_4 (b) $H_2C_2O_4$
 - (d) $K_2C_2O_4$ (c) KHC_2O_4
- When H₂S gas is passed through ammonical sodium nitroprusside solution, then
 - (a) The complex compound Na_4 [Fe(CN)₅NOS] is formed
 - (b) The complex $[Fe(CN)_3NOS]^{-2}$ is formed
 - (c) The complex $[Fe(CN)_5 NOS]^{-4}$ is formed
 - (d) None of them is produced
- 10. When Br⁻ ion is reacted with conc. H₂SO₄, then the product formed will be
 - (a) Br₂ (b) HBr
 - (c) HBr & Br_2 (d) HBr, $Br_2 \& SO_2$
- 11. When NO_2^- ion is treated with dil HCl or H_2SO_4 , the gas evolved is
 - (a) NO (b) NO₂
 - (c) $NO + NO_2$ (d) none

 HNO_3 in the presence of $Mn(NO_3)_2$ produces a pink 12. coloured solution when treated with PbO₂ The pink colour is due to the formation of

(b) $Pb(NO_3)_2$ (a) $HMnO_4$

(c)
$$H_2MnO_4$$
 (d) none of these

13. Addition of KI to the solution of Pb(NO₃)₂ produces a yellow ppt. of

(a)	KNO3	(b)	PbI ₂
(c)	PbI ₄	(d)	none of these

MARYNOW	1. abcd	2. abcd	3. abcd	4. abcd	5. abcd
NIARK YOUR Response	6. abcd	7. abcd	8. abcd	9. abcd	10. abcd
	11. abcd	12. abcd	13. abcd		

9.

8.

14.	A scarlet compound (A) Pb_3O_4 gives a chocolate brown
	ppt. (B) and a colourless solution C with HNO ₃ . The brown
	ppt (B) is of

(a)	PbO_2	(b)	$2Pb(NO_3)_2$
(a)	DLO	(L)	

- (c) PbO (d) none
- 15. Black residue of NiS gives a green compound (A) in aquaregia, A is
 - (a) $Ni(NO_3)_2$ (b) SO_2
 - (c) NiCl₂ (d) none of these
- NiCl₂ solution on treatment with KCN produces 16.
 - (a) $K_2[Ni(CN)_4]$ (b) $Ni(CN)_2$
 - (c) $K_2[Ni(CN)_3]$ (d) none of these
- $K_2[Ni(CN)_4]$ solution on treatment with sodium hydroxide 17. and bromine water followed by heating gives a black residue (A). The compound A is
 - (a) NiO (b) NaCN
 - (d) none of these (c) Ni_2O_3
- 18. Addition of NaOH to Pb(NO₃)₂ gives a white precipitate of
 - (b) Na₂PbO₂ (a) NaPbO₂
 - (c) PbO (d) $Pb(OH)_2$
- 19. (A) on heating with concentrated H₂SO₄ and MnO₂ yields brown fumes. Then A contains
 - (a) Br (b) Cl⁻
 - (c) I⁻ (d) none of these
- 20. AgBr dissolves in Na₂S₂O₃ solution & produces
 - (a) Ag₂S (b) $Ag_2S_2O_3$
 - (c) Ag_2SO_4 (d) none of these
- AgBr dissolves in Na₂S₂O₃ solution and forms (A). On 21. boiling an aquous solution of (A), a ppt. (B) is obtained. The colour of B is
 - (a) Red (b) White
 - (c) Black (d) Colourless
- 22. When Sb₂O₃ is added to a solution of KIO₃ acidified with HCl, one of the products formed is
 - (a) SbCl₃ (b) SbCl₅
 - (c) $Sb(OH)_3$ (d) $HSb(OH)_6$
- One of the product formed, when Bi₂O₃ is added to an 23. alkaline solution of sodium hypochlorite, is
 - (a) NaBiO₃ (b)Na₂BiO₂ (c) BiCl₃ (d) none
- 24. When bismuth chloride is poured into large volume of water the white precipitate formed is of
 - (a) $Bi(OH)_3$ (b) Bi_2O_3 (c) BiOCl (d) Bi_2Cl_3

- In concentrated sodium thiosulfate solution, silver nitrate 25. gives
 - (a) white ppt. of $Ag_2S_2O_3$
 - (b) soluble complex of $Na_3[Ag(S_2O_3)_2]$
 - (c) black ppt. of Ag₂S
 - (d) black ppt of Ag
- 26. Which of the following anions is not easily removed from aqueous solution by precipitation?
 - (b) SO_4^{2-} (a) Cl
 - (d) CO_3^{2-} (c) NO_3^-
- 27. A salt on treatment with dil HCl gives a pungent smelling gas and a yellow ppt. The salt gives green flame when burnt. The salt solution gives a yellow ppt. with potassium chromate. The salt is
 - (a) BaS_2O_3 (b) PbS_2O_3
 - (c) $CuSO_4$ (d) NiSO₄
- 28. Which compound does not dissolve in hot dilute HNO₃?
 - (a) CuS (b) CdS
 - (c) HgS (d) PbS
- 29. A black sulphide is formed by the action of H₂S on
 - (a) CdCl₂ (b) CuCl₂
 - (c) NaCl (d) ZnCl₂
- 30. When a copper (II) sulphate solution is treated with excess of ammonia, it forms
 - (a) a red ppt.
 - (b) a white ppt. turning black
 - (c) a deep blue solution
 - (d) a black ppt.
- 31. A colourless solid on heating evolved carbon dioxide and also gave a white residue. The residue was soluble in water and evolved carbon dioxide when treated with dilute acid. The solid compound is
 - (a) calcium bicarbonate (b) sodium carbonate
 - (c) sodium bicarbonate (d) calcium carbonate
- 32. Starch iodide paper is used to test the presence of
 - (a) iodine (b) oxidising agent
 - (c) iodide ion (d)reducing agent
- 33. A white powder soluble in NH₄OH, but insoluble in water is
 - (a) $BaSO_4$ (b) $CuSO_4$ (c) PbSO₄
 - (d) AgCl

	14.abcd	15.@bcd	16. abcd	17. abcd	18. abcd
Mark Your	19.abcd	20. abcd	21. abcd	22. abcd	23. abcd
Response	24. abcd	25. abcd	26. abcd	27. abcd	28. abcd
	29. abcd	30. abcd	31. abcd	32. abcd	33. abcd

34. Which one of the following does not give borax bead test?

(a)	Pb ⁺⁺	(b)	Mn ⁺⁺
(c)	Cr ⁺⁺⁺	(d)	Cu ⁺⁺

35. Precipitate(s) soluble in aqua regia is

- (a) CoS (b) HgS
- (c) NiS (d) all of these
- Purple of cassius is 36.
 - (a) gold sol (b) silver sol (d) platinum sol
 - (c) $[Ag_2S_3]S^{--}$
- 37. Mercury (II) forms a complex with
 - (a) KI (b) H₂S (d) NaOH (c) $SnCl_2$
- 38. Ion present in Nessler's reagent is

(a)	Hg ⁺⁺	(b)	$HgI_4^{}$
(c)	HgI_	(d)	Hg2 ⁺⁺

- 39. Silver chloride dissolves in hypo solution to form a complex.
 - (a) $Na_2[Ag(S_2O_3)_2]$ (b) $Na_{5}[Ag(S_{2}O_{3})_{6}]$
 - (c) $Na_3[Ag(S_2O_3)_2]$ (d) $Na_{3}[Ag(S_{2}O_{3})_{4}]$
- When cuprous chloride is exposed to moist air, it turns 40. green due to the formation of
 - (a) CuCl₂ (b) CuCl₂.Cu(OH)₂
 - (c) $CuCl.Cu(OH)_2$ (d) Cu(OH)₂
- When H₂S is passed through an ammonical salt solution 41. X, a white ppt. is obtained, X can be
 - (a) Ni⁺⁺ solution (b) Zn^{++} solution
 - (c) Co^{++} solution (d) Mn^{++} solution
- 42. An aqueous solution of a substance gives a white ppt. on treatment with dilute hydrochloric acid which dissolves on heating. When hydrogen sulfide is passed through the hot acidic solution, a black ppt. is obtained. The substance is a
 - (a) Hg_2^{++} salt (b) Cu⁺⁺ salt
 - (d) Pb⁺⁺ salt (c) Ag⁺ salt
- 43. When MnO₂ is fused with KOH, a coloured compound is formed, the product and its colour is
 - (a) K_2MnO_4 , purple green (b) $KMnO_4$, purple
 - (c) Mn_2O_3 , brown (d) Mn₃O₄, black

44.	[X]	$+ H_2 SO_4 \rightarrow [Y], a \text{ colour}$	less g	gas with irritating smell
	[Y]	$+ K_2 Cr_2 O_7 + H_2 SO_4 \rightarrow gr$	een s	solution. [X] and [Y] are
	(a)	SO ₃ , SO ₂	(b)	Cl ⁻ ,HCl
	(c)	S , H ₂ S	(d)	CO ₃ , CO ₂
45.	Whi	ich of the following hydro	oxide	es dissolves in NaOH?
	(a)	Fe(OH) ₃	(b)	Cu(OH) ₂
	(c)	Al(OH) ₃	(d)	None of these
46.	Whi	ich of the following substa	ances	dissolves in aqua-regia
	and	ammonium hydroxide res	spect	ively?
	(a)	PbSO ₄ & HgS	(b)	PbSO ₄ & AgCl
	(c)	HgS & AgCl	(d)	HgS & PbSO ₄
47.	Whi	ich of the following acidic	radı	cals can not be detected
	by c	$\frac{1}{2}$	50 ₄ ?	T1 '1
	(a)	Sulphide	(b) (d)	Fluoride
19		horotory reagent imports	(u)	rounde
40.	heat	ing with solid K Cr.O. a	nd co	one H-SO, it evolves a
	red gas. Identify the reagent			5110: 11 <u>2</u> 504 11 0101105 u
	(a)	CaCl	(b)	BaCl
	(c)	CuCl ₂	(d)	None of these
49.	A la	boratory reagent on stron	gly h	eating gives two oxides
	ofsu	ılphur. On additon aq. Na	OH so	olution to its aq. solution
	a di	rty green precipitate is ob	otaine	ed. Identify the reagent
	(a)	FeSO ₄	(b)	CuSO ₄
	(c)	$Al_2(SO_4)_3$	(d)	None of these
50.	Whe	en dimethyl glyoxime sol	ution	is added to an aqueous
	solu	tion of nickel (11) chlori	de fo	ollowed by ammonium
	(a)	no procinitato is obtaino	A	
	(a)	a blue coloured ppt is o	u htair	ned
	(\mathbf{c})	a red coloured ppt. is of	taine	² d
	(d)	a black coloured ppt. is	obtai	ined
51.	Sod	a extract is prepared by		
	(a)	fusing soda and mixtur	e an	d then extracting with
	(-)	water		
	(b)	dissolving NaHCO3 and	mixt	ure in dil. HCl
	(c)	boiling Na ₂ CO ₃ and mix	ture i	n dil. HCl
	(d)	boiling Na_2CO_3 and mix	ture	in distilled water
		- 2 3		

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	34. abcd	35. abcd	36. abcd	37. abcd	38. abcd
Mark Your	39. abcd	40. abcd	41. abcd	42. abcd	43. abcd
Response	44. abcd	45. abcd	46. abcd	47. abcd	48. abcd
	49. abcd	50. abcd	51.abcd		

 $A + HCl \longrightarrow B_{(ppt.)} + HNO_3;$ 52. $B + KI \longrightarrow Yellow ppt.; Identify 'A'$ (a) $Pb(NO_3)_2$ (b) AgNO₃ (c) $Hg_2(NO_3)_2$ (d) None of these A + dil. HNO₃ \longrightarrow B + NO + S + H₂O; 53. $B + NH_4OH \longrightarrow Deep blue solution ; Identify 'B'$ (a) $Pb(NO_3)_2$ (b) $Bi(NO_3)_3$ (c) $Cu(NO_3)_2$ (d) $Cd(NO_3)_2$ 54. $X + HNO_3 \longrightarrow Y + NO_2 + H_2O + S;$ $Y + Ammonium Molybdate \longrightarrow Yellow ppt.;$ Identify 'X' (b) Sb₂S₅ (d) CdS (a) As_2S_5 (c) SnS_2 55. $X + NH_4OH \longrightarrow Gelatinous ppt.+ NH_4Cl;$ (\mathbf{Y}) $Y + NaOH \longrightarrow Soluble; Identify 'X'$ (a) FeCl₃ (b) CrCl₃ (c) $AlCl_3$ (d) SbCl₂ $A + CH_3COOH \longrightarrow B_{(so luble)} + CO_2 + H_2O;$ 56. $B + (NH_4)_2 C_2 O_4 \longrightarrow$ White ppt.; A and B may contain (a) Ni²⁺ (b) Ba²⁺

- (c) Sr^{2+} (d) Ca^{2+}
- **57.** Which of the following metals do not change colour during the borax bead test, when heated in the oxidising flame and in the reducing flame?
 - (a) Copper (b) Iron
 - (c) Chromium (d) Nickel
- **58.** Sulphuric acid is not used for preparing the original solution (O.S.) for cationic analysis because
 - (a) it is a strong oxidising agent
 - (b) it is a poor oxidising agent

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- (c) it is a powerful dehydrating agent
- (d) it precipitates Pb^{2+} , Ba^{2+} , Sr^{2+} and Ca^{2+} cations

- **59.** Sometimes yellow turbidity is observed when H_2S is passed through acidified O.S. even if group II cations are not present. This is because
 - (a) of the oxidation of H_2S by some acid radicals
 - (b) the group IV cations may get precipitated as sulphides
 - (c) sulphur is present as impurity
 - (d) none of these
- **60.** When the precipitate of Bi(OH)₃ is dissolved in dil HCl and solution is diluted with excess of water milkiness is observed. This milkiness is due to the formation of
 - (a) BiCl₃ (b) BiOCl
 - (c) $Bi(OH)_3$ (d) Bi_2O_3
- **61.** In Lake test for aluminium, the precipitate of $Al(OH)_3$ acquires blue colour due to
 - (a) absorption
 - (b) adsorption
 - (c) reaction of Al(OH)₃ with litmus
 - (d) adsorption and reaction of Al(OH)₃ with litmus to form a complex organic compound
- 62. Sodium carbonate can not be used in place of $(NH_4)_2CO_3$ for identification of the 5th group radicals. This is because the
 - (a) Na⁺ ion will interface in detection of group V radicals
 - (b) concentration of CO_3^{2-} ions will be very low
 - (c) Na⁺ will react with acid radicals
 - (d) Magnesium will be precipitated as $MgCO_3$
- **63.** Which of the following can be used in place of NH₄Cl for detection of group III cations ?
 - (a) NH_4NO_3 (b) $(NH_4)_2SO_4$
 - (c) $(NH_4)PO_4$ (d) none of these
- 64. A metal salt solution forms a yellow precipitate with potassium chromate in acetic acid, a white precipitate with dil H_2SO_4 , but gives no precipitate with NaCl. The white precipitate obtained when $(NH_4)_2CO_3$ is added to the metal, salt solution will consist of
 - (a) PbCO₃ (b) BaCO₃
 - (c) $MgCO_3$ (d) $CaCO_3$
- **65.** In brown **ring test** to confirm the presence of NO_3^- , the brown ring formed involves
 - (a) Fe^{2+} and NO (b) Fe^{3+} and NO (c) Fe^{2+} and NO (d) Fe^{2+} and $Fe^$
 - (c) NO and NO₂ (d) Fe^{2+} and NO₂

MARYVOUR	52.abcd	53. abcd	54. abcd	55. abcd	56. abcd
NIARK YOUR Response	57.abcd	58. abcd	59. abcd	60. abcd	61. abcd
	62. abcd	63. abcd	64. abcd	65. abcd	

66. A metal salt solution gives a yellow precipitate with AgNO₃(aq). The yellow precipitate dissolves in dil HNO₃. The yellow precipitate also dissolves in NH₄OH. The anion present in metal salt solution is

(a)
$$I^-$$
 (b) CrO_4^{2-}

- (c) PO_{A}^{3-} (d) Br⁻
- 67. The use of H₂S as a reagent for qualitation analysis of cations is based on the fact that
 - (a) H_2S form coloured sulphides
 - (b) H_2S is a weak acid and we can control the degree of ionisation of $\rm H_2S$ by adding HCl or $\rm NH_4OH$
 - (c) H_2S is a weak acid
 - (d) The colour of the metal sulphide precipitated depends upon the pH of the solution
- The most reliable confirmatory test for chloride ion is chromyl **68**. chloride test. Which of the following salts fails to respond to this test ?
 - (a) ZnCl₂ (b) MgCl₂
 - (c) CuCl₂ (d) HgCl₂
- 69. Select the pair that sublimes on heating.
 - (a) NH_4OH and NH_4Cl (b) HgCl₂ and Ag₂C
 - (c) $HgCl_2$ and NH_4Cl (d) none of these
- 70. A white solid "A" when heated gives off a colourless gas that turns lime water milky. The residue left behind is yellow when hot and white when cold. The solid "A" is
 - (a) K_2CO_3 (b) $ZnCO_3$
 - (c) CuCO₃ (d) CdCO₃
- 71. The composition of the soluble complex formed when Cd^{2+} ion react with excess of KCN is
 - (a) $K_4[Cd(CN)_6]$ (b) $K_3[Cd(CN)_6]$
 - (c) $K[Cd(CN)_2]$ (d) $K_2[Cd(CN)_4]$
- 72. For precipitating out group II cations, H_2S gas is passed through O.S. acidified with HCl, group II cations are completely removed before proceeding to analysis of group III cations. However sometimes a yellow precipitate is persistently formed even after repeatedly passing H₂S gas. This is due to
 - (a) CdS (b) As_2S_3
 - (c) AsO_4^{3-} (d) S
- 73. Fill in the blank.

(a)

$$Na_2B_4O_7.10H_2O \xrightarrow{acid} ? \xrightarrow{heat} B_2O_3 \xrightarrow{Mg \text{ or } Na} B_2O_3$$

$$H_3BO_4$$
 (b) H_3BO_3
 $H_2B_2O_4$ (d) None of these

(c) $H_2B_3O_4$

74. A colourless salt, colours a Bunsen flame violet and also turns moistened litmus paper blue. The salt is

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- (a) Na_2CO_3 (b) KNO₃
- (c) K_2CO_3 (d) $Cu(OH)_2$
- To clear solution 'X' of a compound a solution of $BaCl_2$ is 75. added when a heavy white precipitate is formed which does not dissolve in dil HCl. The compound in solution contains which anion ?

(a)
$$SO_4^{2-}$$
 (b) NO_3^{-}

(d)
$$CO_3^2$$

- 76. BO_3^{3-} can be identified using
 - (a) alcohol

(c) Br⁻

- (b) conc. H_2SO_4
- (c) alcohol and conc. H_2SO_4
- (d) none of these
- 77. On addition of aqueous NaOH to a salt solution, a white gelatinous precipitate is formed, which dissolves in excess of alkali. The salt solution contains
 - (b) Al³⁺ (a) Cr³⁺
 - (c) Ba^{2+} (d) Fe^{3+}
- 78. When excess of NH₄OH is added to CuSO₄ solution which of the following is formed ?
 - (a) $[Cu(NH_3)_4]SO_4$ (b) $[Cu(NH_4)_4]SO_4$
 - (c) $[Cu(NH_4)_3]SO_4$ (d) $[Cu(NH_3)_3]SO_4$
- White deposit often observed on laboratory window panes 79. is
 - (a) $AgNH_2Cl$ (b) NH₄Cl
 - (c) CaCN₂ (d) KNO₃
- 80. When HgS⁺ (black ppt in group II of cation) is dissolved in aqua regia, the function of HCl in the mixture (aqua regia is a mixture of HNO₃ and HCl) is to
 - (a) oxidise the sulphur (b) oxidise the mercury
 - (c) complex the sulphur (d) complex the mercury
- **81.** When SO₂ is passed through $K_2Cr_2O_7$ solution
 - (a) the solution is turned black
 - (b) the solution is decolourised
 - (c) SO_2 is reduced
 - (d) green $Cr_2(SO_4)_3$ is formed
- 82. Yellow ammonium sulphide is
 - (a) an oxidising agent
 - (b) a solvent for metal sulphides
 - (c) acidic in nature
 - (d) a solution of H_2S in aqueous NH_4Cl solution

	66. abcd	67. abcd	68. abcd	69. abcd	70. abcd
Mark Your	71.abcd	72. abcd	73. abcd	74. abcd	75. abcd
Response	76.@bcd	77. abcd	78. abcd	79. abcd	80. abcd
	81.abcd	82. abcd			

E Comprehension Type \equiv

B

This section contains groups of questions. Each group is followed by some multiple choice questions based on a paragraph. Each question has 4 choices (a), (b), (c) and (d) for its answer, out of which ONLY ONE is correct.

PASSAGE-1

Due to the fact that many cations form sparingly soluble salts, a method known as selective precipitation can be used to separate a mixture of cations. The process involves the addition of a soluble salt containing an anion which forms a sparingly soluble salt with one or more of the cations. If it forms a sparingly soluble salt with only one of the cations in solution, then that cation is effectively separated out of solution. However, this is not usually the case. More often than not a number of cations in solution will form sparingly soluble salts with the anion. Separation then depends on the magnitude of the K_{sp} value of the sparingly soluble salts that could be formed. The smaller the K_{sp} value for a salt, the earlier it will precipitate out of solution relative to the other salts. Thus the process is similar to a titration: the anion is added gradually in increasing amounts and precipitating each of the salts separately, then the precipitate is removed when all of that particular cation species has been extracted from solution. This is used extensively in the mining industry in the purification of various metal ores and in laboratories in the separation of ions from various bodily fluids.

A mixture of bismuth (Bi³⁺), silver (Ag⁺), zinc (Zn²⁺) and copper (Cu²⁺) cations is to be separated using sodium sulfide (Na₂S).

$$K_{sp}(Bi_2S_3) = 1.0 \times 10^{-97}$$
; $K_{sp}(Ag_2S) = 2.0 \times 10^{-49}$; $K_{sp}(ZnS) = 1.0 \times 10^{-21}$; $K_{sp}(CuS) = 9.0 \times 10^{-36}$

1. Which cation will precipitate out of solution first on the addition of sodium sulfide?

(a)	Bi ³⁺	(b)	Ag^+
(c)	Zn^{2+}	(d)	Cu ²⁺

2. The K_{sp} expression for Bi_2S_3 is:

(a)
$$[Bi_2^{3+}][S_3^{2+}]$$
 (b) $[Bi^{3+}][S^{2-}]$

(c)
$$[Bi^{3+}]^2[S^{2-}]^3$$
 (d) $[Bi^{3+}]^3[S^{2-}]^2$

3 Cyanide ions (CN^{-}) could also have been used to precipitate the cations. If after all the cations have been precipitated, the concentration of CN^{-} is 0.02 M, calculate the pH of the solution given that :

 $CN^- + H_2O \longrightarrow HCN + OH^-$

$$K_b = 1.39 \times 10^{-5}; \log 5 = 0.5$$

(a) 4.9 (b)

(a) 4.9 (b) 5.4 (c) 7.7 (d) 10.7

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- 4. If in a solution containing only Zn^{2+} , the concentration of zinc ions is 5.0×10^{-3} M, what concentration of S^{2-} is required to just begin the precipitation of zinc sulfide?
 - (a) 5.0×10^{-24} M (b) 2.0×10^{-19} M (c) 3.2×10^{-11} M (d) 5.0×10^{-3} M
- 5. An unknown cation X^+ was added to the original solution of cations and was found to precipitate before Ag_2S but after Bi_2S_3 . Which of the following gives a plausible value for the solubility product of X_2S ?

(a)
$$3.4 \times 10^{-99}$$
 (b) 1.4×10^{-15}
(c) 8.0×10^{-28} (d) 4.0×10^{-53}

- 6. The CuS from the selective precipitation was collected, purified and equal weights of it placed into each of two beakers. Beaker 1 contained distilled water and beaker 2 contained a 0.01 M $Cu(NO_3)_2$ solution. Which of the following statements is true?
 - (a) More of the CuS will dissolve in beaker 1
 - (b) More of the CuS will dissolve in beaker 2
 - (c) Equal amounts of CuS will dissolve in both beakers
 - (d) No CuS will dissolve in either beaker.

PASSAGE-2

A series of chemical reactions was carried out to study the chemistry of lead.

Reaction 1	:	Initially, $15.0 \text{ mL of } 0.300M \text{ Pb}(\text{NO}_3)_{2(aq)}$ was
		mixed with 15.0mL of $0.300 \text{ M Na}_2\text{SO}_{4(aq)}$.
		All the $Pb(NO_3)_2$ reacted to form compound A, a white precipitate. Compound A was removed by filtration.
Reaction 2	:	Next 15.0 mL of 3.00 M KI _(aq) was added to
		Compound A. The mixture was agitated and some of compound A dissolved. In addition, a
		yellow precipitate of $PbI_{2(s)}$ was formed.

Reaction 3 : The $PbI_{2(s)}$ was separated and mixed with 15.0 mL of 0.300 *M* $Na_2CO_{3(aq)}$. A white precipitate of $PbCO_{3(s)}$ formed. All of the $PbI_{2(s)}$ was converted into $PbCO_{3(s)}$.

Mark Your	1. abcd	2. abcd	3. abcd	4. abcd	5. abcd
Response	6. abcd				

- **Reaction 4** : The PbCO_{3(s)} was removed by filtration and a small sample gave off a gas when treated with dilute HCl.
- 7. Which of the following reaction depicts the formation of the gas in Reaction 4?
 - (a) $PbCO_{3(s)} + 2HCl_{(aq)} \longrightarrow$

 $PbCl_{2(aq)} + CO_{2(g)} + H_2O_{(l)}$

(b)
$$\operatorname{Na_2CO_3(aq)} + 2\operatorname{HCl}_{(aq)} \longrightarrow$$

$$2$$
NaCl_(aq) + CO_{2(g)} + H₂O_(l)

(c) $PbCO_{3(s)} + 2HCl_{(aq)} \longrightarrow$

$$PbC_{2(s)} + Cl_{2(g)} + H_2O_{(l)}$$

- $(d) \quad PbI_{2(s)} + HCl_{(aq)} \longrightarrow PbCl_{2(s)} + HI_{(g)}$
- 8. The identity of Compound A is :
 - (a) $Pb(NO_3)_2$ (b) PbI_2
 - (c) $NaNO_3$ (d) $PbSO_4$
- 9. $Pb(OH)_{2(s)}$ is slightly soluble in water. How would the

amount of $Pb(OH)_{2(s)}$ that normally dissolves in 1 L of

water be affected if the pH were 9.0?

- (a) Less would dissolve
- (b) The same amount would dissolve
- (c) More would dissolve
- (d) There is no way to predict the effect of the change in pH of the water
- 10. A soluble form of Pb^{2+} can be carefully added to a solution to sequentially precipitate and separate anions present in the solution. When Pb^{2+} is added, in what order will the following anions be precipitate? (a)

$$SO_4^{2-}$$
 then I⁻ (b) CO_3^{2-} then I⁻

(c)
$$SO_4^{2-}$$
 then CO_3^{2-} (d) I⁻ then CO_3^{2-}

- How many moles of Na⁺ ions are there in the initial Na₂SO_{4(aq)} solution used in Reaction 1 ?
 - (a) 0.0018 mole (b) 0.009 mole
 - (c) 0.045 mole (d) 0.090 mole
 - 6

PASSAGE-3

An unknown solid mixture contains one or two of the following : $CaCO_3$, $BaCl_2$, $AgNO_3$, Na_2SO_4 , $ZnSO_4$ and NaOH. The mixture is completely soluble in water and the solution gives pink colour with phenolphthalein. When dilute hydrochloric acid is gradually added to the above solution, a precipitate is produced which dissolves with further addition of the acid. What is/are present in the solid? Give equations to explain the appearance of the precipitate and its dissolution.

12. What is /are present in the solid?

(a) $AgNO_3 \& NaOH$ (b) $BaCl_2 \& Na_2SO_4$

- (c) $ZnSO_4$ & NaOH (d) $CaCO_3$ & AgNO₃
- 13. In a separate analysis, if the mixture (as mentioned in the passage) gives a white precipitate with K_2SO_4 , then what is present in the mixture.
 - (a) $CaCO_3$ (b) $BaCl_2$
 - (c) AgNO₃ (d) None of these
- 14. The aqueous solution of the mixture gives a precipitate (A) with brine. (A) is soluble in ammonium hydroxide. What is present in the mixture.

(a)	BaCl ₂	(b)	AgNO ₃
(c)	$ZnSO_4$	(d)	CaCO ₃

PASSAGE-4

A salt 'A' when heated with $K_2Cr_2O_7$ and concentrated H_2SO_4 liberates a gas which turns NaOH solution yellow. This alkaline solution acidified with acetic acid results in yellow precipitate 'B' with lead acetate solution. When the compound 'A' is heated with solid KNO₃ and KOH, it produces a yellow mass 'C'. Aqueous solution of 'C' acidified with acetic acid gives yellow solution which gives yellow ppt 'D' with lead acetate. When the compound 'A' is heated with dil. H_2SO_4 and MnO_2 it liberates a gas 'E' which turns starch iodide paper blue. 'A' gives a precipitate with NH_4OH , the precipitate dissolves in dil HCl and is treated with Na_2O_2 till alkaline. This gives a yellow precipitate 'F' with lead acetate.

15. The anion present in the salt is

	(a)	SO_4^{2-}	(b)	SO ₃ ²⁻
	(c)	NO ₃ ⁻	(d)	Cl-
6.	The	cation present in the	salt is	
	(a)	Ba ²⁺	(b)	Cd^{2+}
	(c)	Fe ³⁺	(d)	Cr^{3+}

Mark Your	7. abcd	8. abcd	9. abcd	10. abcd	11. abcd
Response	12.abcd	13. abcd	14. abcd	15. abcd	16. abcd

1

- 17. Which of the following statements is true ?
 - (a) **Precipitates** B, D and F are three different compounds
 - (b) Precipitates B, D and F are identical

~

- (c) Precipitates B and D are identical but F is different
- (d) Precipitate B and F are identical but D is different

PASSAGE-5

A black solid 'X' when heated with KOH in presence of air changes to a green substance 'Y'. 'Y' on reaction with H_2SO_4 yields 'B' and 'C'. The colour of compound 'B' is purple and KI when treated with its alkaline solution gives a compound 'D'. The purple colour of 'B' disappears on treatment with acidic solution of FeSO₄. On reaction with cold conc. H_2SO_4 the compound 'B' gives 'E'. 'E' is explosive in nature and decomposes to yield 'F' and oxygen.

- **18.** Choose the correct option :
 - (a) 'C' and 'F' are same compounds having same colour
 - (b) 'C' and 'F' are different compounds having same colour
 - (c) Compound 'B' forms similar compound 'E' with hot conc. H₂SO₄
 - (d) Compound '*Y*' does not give same type of reaction in acidic and neutral medium.
- **19.** Compound 'E' is a/an
 - (a) acidic oxide (b) basic oxides
 - (c) amphoteric oxide (d) neutral oxide
- **20.** The type of hybridization present in compound '*D*' is
 - (a) sp (b) sp^2
 - (c) sp^3 (d) sp^3d

ľ	Mark Your Response	17.abcd	18.@bcd	19.	abcd	20. abcd				
(REASE In the for question response (a) Bo (b) Bo (c) Sta (d) Sta	ONING TYPE ollowing questions has 4 choices (a), (the second sec	two Statement-1 (b), (c) and (d) for it options: tement-2 are true and tement-2 is false. atement-2 is true.	Asse ts ans d State d State	rtion) and Sta swer, out of w ement-2 is the co ement-2 is not th	atement-2 (Reason /hich ONLY ONE : orrect explanation of he correct explanatio) are provided. Each is correct. Mark your ⁷ Statement-1. nof Statement-1.			
1.	Statement-1	A very dilute acidic s Ni ²⁺ gives yellow pr passing hydrogen su	colution of Cd ²⁺ and ecipitate of CdS on lphide.	5.	Statement-1	: Boiling a solution I ⁻ with potassium brown vapours a	a containing Cl ⁻ , Br ⁻ and a persulphate, violet and ppear.			
	Statement-2	: Solubility product of of NiS.	CdS is more than that		Statement-2	: Br ⁻ and I ⁻ are ox Cl ⁻ is not oxidise	idised to Br_2 and I_2 but d.			
2.	Statement-1	Sulphate is estimated MgSO ₄ .	as BaSO ₄ and not as	6.	Statement-1	: First group basic as their chlorides	First group basic radicals are precipitated as their chlorides.			
	Statement-2	: Ionic radius of Mg ²⁺ of Ba ²⁺ .	is smaller than that		Statement-2	oduct of these chlorides				
3.	Statement-1	Borax bead test is coloured salts.	applicable only to	7.	Statement-1	other basic radica : Acidified K ₂ Cr	ll chlorides. O_7 solution is turned			
	Statement-2	In borax bead test, decomposed to give	coloured salts are ve coloured metal		Statement-2	green when SO_2 : SO_2 acts as an	is passed through it. oxidising agent in this			
4.	Statement-1	 cu²⁺ and Cd²⁺ are s other by first adding 	separated from each KCN solution and	8.	Statement-1	reaction. • V group basic rac their carbonates i	licals are precipitated as			
	Statement-2	 then passing H₂S gas KCN reduces Cu²⁺ to complex with it. 	s. to Cu ⁺ and forms a		Statement-2	• NH ₄ OH maintain basic.	as the pH of the solution			
	- <i>k</i> n									
		1	2 9000	3	ବ୍ୟତ୍ତ୍ତ୍ର	4	5 0000			
	MARK YOUR Response		7. abcd	<i>3</i> . 8.						

	Analytical Chi	EM	ISTRY				
9.	Statement-1	:	NH_4Cl is added in III group basic radicals to suppress the ionisation of NH_4OH .		Statement-2	:	NO_2 is acidic in nature and is a mixed anhydride of HNO_3 and HNO_2 .
	Statement-2	:	In the presence of high concentration of OH ⁻ ions, basic radicals of other groups	13.	Statement-1	:	Magnesium does not impart any characteristic colour to the flame.
10.	Statement-1	:	will also get precipitated in III group. Oxalate is removed as an interfering acid radical by boiling the filtrate obtained after group II with conc. HNO ₃ to dryness.		Statement-2	:	Due to its small size and a high effective nuclear charge, magnesium requires a large amount of energy for excitation of electrons.
	Statement-2	:	Oxalate is decomposed to CO_2 gas.	14.	Statement-1	:	Coloured salts form coloured metaborates
11.	Statement-1	:	Nessler's reagent gives a brown precipitate				in borax bead test.
	Statement-2	:	with NH ₃ . NH ₄ OH gives a brown precipitate with Fe^{3+} .		Statement-2	:	When heated borax gives a glassy transparent bead consisting of sodium metaborate only.
12.	Statement-1	:	NO_2 is a reddish brown gas which is produced by action of NO_3^- with acid	15.	Statement-1	:	A white precipitate of silver chloride gets dissolved in NH_4OH solution.
			when this gas is passed through alkalies it gives nitrites only.		Statement-2	:	NH ₃ reacts with AgCl and forms a soluble complex having the formula [Ag(NH ₂) ₂]Cl.

MARK YOUR	9. abcd	10.@bcd	11. abcd	12. abcd	13. abcd
Response	14.abcd	15.abcd			

MULTIPLE CORRECT CHOICE TYPE

Each of these questions has 4 choices (a), (b), (c) and (d) for its answer, out of which ONE OR MORE is/are correct.

5.

6.

- 1. Which of the following will give the ring test?
 - (a) PbNO₃ (b) NaNO₃
 - (c) $Bi(NO_3)_3$ (d) $Ba(NO_3)_2$
- 2. When borax is heated on the loop of Pt wire, it swells up due to loss of water of crystallisation. When it is further heated and, it melts to a liquid which solidifies to a transparant glassy mass. The glassy mass is of
 - (a) Na_2BO_2 (b) $NaBO_2$ (c) BO (d) B_2O_3
- 3. An aq. solution contains following ions

Hg₂⁺⁺, Hg⁺⁺, Pb⁺⁺, Cd⁺⁺. The additon of dil HCl precipitates

(a)
$$Hg_2Cl_2$$
 (b) $PbCl_2$

(c) $HgCl_2$ (d) $CdCl_2$

4. The ion that can be precipitated by HCl as well as H_2S is

- (a) Fe^{+++} (b) Zn^{++}
- (c) Pb^{++} (d) Cu^{++}
- 🖾 –

- Among the ions Zn^{++} , Ni^{++} , and Cr^{+++} , which are coloured (a) Zn^{++} (b) Ni^{++} (c) Cr^{+++} (d) None of these
- (c) Cr⁺⁺⁺ (d) None of these A gas 'X' is passed through water to form a saturated
- solution. The aqueous solution on treatment with silver nitrate gives a white ppt. The saturated aqueous solution also dissolves magnesium ribbon with evolution of a colourless gas 'Y'. Identify 'X' and 'Y'.

(a)
$$X = CO_2$$
 (b) $Y = CO_2$

(c)
$$X=Cl_2$$

Which of the following are true?

(a) Lime water is used for the test of carbonate radical

(d) $Y = H_2$

- (b) In Vth group, $K_2Cr_2O_7$ is used for the test of Barium ion
- (c) Ammonium Thiocyanate is used in the detection of CO^{2+} and Fe^{3+} ions
- (d) Ammonium sulphate can be used in place of ammonium chloride in third group

-					
Mark Your	1. abcd	2. abcd	3. abcd	4. abcd	5. abcd
Response	6. abcd	7. abcd			

7.

- 8. Which of the following is true?
 - (a) Cobalt can be tested with dimethyl glyoxime
 - (b) Sb_2S_3 is yellow in colour
 - (c) I_2 is liberated when an iodide is heated with conc. H_2SO_4
 - (d) HNO₃ need not be used in the 3rd group, if ferric compound is given in a mixture

9.
$$A(Black) \xrightarrow{H_2SO_4} B(gas) \xrightarrow{HNO_3} Colloidal Sulphur;$$

(White turbid)

$$B + D \xrightarrow{HCl} E_{(ppt.)} + H_2SO_4$$
; Identify A & E
(a) $A = FeS$ (b) $A = CuS$

(a)
$$A = FeS$$
 (b) $A = CuS$
(c) $E = CuS$ (d) $E = HgS$

10. $X + H_2S \xrightarrow{HCl} Y_{ppt.}$; $Y + (NH_4)_2S_2 \xrightarrow{} Soluble$; (yellow)

'X' may contain

- (a) As^{3+} (b) Sb^{3+} (c) Sn^{2+} (d) Cd^{2+}
- 11. During salt analysis, the third group filtrate is treated with H_2S when the sulphides of the fourth group are precipitated. The sulphide which is black and insoluble in conc. HCl is
 - (a) NiS(b) CoS(c) MnS(d) ZnS
- 12. The reagents, NH_4Cl and aqueous NH_3 will precipitate
 - (a) Ca^{2+} (b) Al^{3+} (c) Bi^{3+} (d) Mg^{2+}
- 13. Which of the following statement(s) is (are) correct when a mixture of NaCl and $K_2Cr_2O_7$ is gently warmed with conc. H_2SO_4 ?
 - (a) A deep red vapour is evolved
 - (b) The vapours when passed into NaOH solution gives a yellow solution of Na_2CrO_4
 - (c) Chlorine gas is evolved

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- (d) Chromyl chloride is formed
- 14. Which of the following statement(s) is (are) correct with reference to the ferrous and ferric ions?

- (a) Fe^{3+} gives brown colour with potassium ferricyanide.
- (b) Fe²⁺ gives blue precipitate with potassium ferricyanide.
- (c) Fe^{3+} gives red colour with potassium thiocyanate.
- (d) Fe^{2+} gives brown colour with ammonium thiocyanate.
- 15. Carbon dioxide (CO_2) when passed through lime water, it first turns milky and then becomes clear. The turbidity reappears if
 - (a) the clear solution is boiled
 - (b) more CO_2 gas is bubbled through it
 - (c) fresh lime water is added to it
 - (d) none of the above is correct
- **16.** A salt on heating with conc. HNO₃ and on addition of excess of ammonium molybdate forms a yellow precipitate. The acid radical(s) present in salt is/are

(a)
$$AsO_4^{3-}$$
 (b) PO_4^{3-}
(c) AsO_3^{3-} (d) BO_3^{3-}

17. A mixture of inorganic salts when treated with dil HCl gives out a colourless gas which turns lime water milky. It indicates the presence of the radical

(a)
$$CO_3^{2-}$$
 (b) HCO_3^{-}
(c) SO_3^{2-} (d) SO_4^{2-}

- **18.** Nitric acid used in the laboratory often acquires yellow colour. This yellow colour can be removed by
 - (a) adding little magnesium powder
 - (b) bubbling air through warm acid
 - (c) boiling the acid
 - (d) none of these
- **19.** The pair(s) of compounds which can not exist together in aqueous solution is/are
 - (a) NaH_2PO_4 and Na_2HPO_4
 - (b) NaH₂PO₄ and NaOH
 - (c) Na₂CO₃ and NaHCO₃
 - (d) NaHCO3 and NaOH
- **20.** An aqueous solution contains Hg_2^{2+} , Hg^{2+} , Pb^{2+} and Cd^{2+} . The addition of HCl (6 N) will precipitate
 - (a) Hg_2Cl_2 only (b) $PbCl_2$ only
 - (c) $PbCl_2$ and Hg_2Cl_2 (d) $PbCl_2$ and $HgCl_2$

-					
	8. abcd	9. abcd	10. abcd	11. abcd	12. abcd
MARK YOUR Response	13.abcd	14. abcd	15. abcd	16. abcd	17. abcd
	18.abcd	19. abcd	20. abcd		

	ANAL	YTICAL CHEMISTRY			
		MATRIX-MATCH TYPE			·
		Each question contains stateme	ents given in two columns, which ha	we to b	e matched. The pqrst
		statements in Column-I are lab	eled A, B, C and D, while the staten	nents in	n Column-II are
ΙT	7	labelled p, q, r, s and t. Any given	statement in Column -I can have corr	ect mat	tching with ONE
	2	OR MORE statement(s) in C	olumn-11. The appropriate bubbles	corre	sponding to the BPUUSU
		If the correct matches are A _{-n}	s and t. Ba and r. C-n and a. an	id D_s 1	then the correct $C \left[\bigcup_{i=1}^{n} \left(\prod_{j=1}^{n} \left(\prod_{i=1}^{n} \left(\prod_{j=1}^{n} $
		darkening of bubbles will look li	ke the given.	GID 5	
		8	0		
1.	Ma	atch the following reagents with the	eir respective basic radicals :		
		Column I			Column II
	(A)	H_2S in presence of dil. HCl		p.	Mg^{2+}
	(B)	H_4OH in presence of NH_4OH		q. r	$N1^{2+}$
	(C)	H_2S in presence of NH_4OH		I. S	Dh ²⁺
2.	(D) Ma	Θ_4 atch the following colour of the flan	ne with their respective metals	5.	10
	1,14	Column I	ie with then respective metals		Column II
	(A)	Golden Yellow		p.	Barium
	(B)	Brick Red		q.	Sodium
	(C)	Apple Green		r.	Potssium
	(D)	Violet		s.	Calcium
3.		Column I			Column II
	(A)) Pb^{2+}		р.	dil. HCl
	(B)	Hg_2^{2+}		q.	H_2S in presence of HCl
	(C) (D)	hg^{-1}		I.	solubility product equivalent to Sn^{+4}
4	(D)	Column I		5.	Column II
т.	(A)	HCl		n	common ion effect
	(B)	NH ₄ Cl		р. q.	decrease ionisation of H ₂ S
	(C)	NH₄OH		r.	increase ionisation of H_2^2 S
	(D)	HNO ₃		s.	oxidise Fe^{2+} to Fe^{3+}
		5		t.	Suppress ionisation of NH ₄ OH
5.		Column I			Column II
	(A)) Test of Fe ³⁺		p.	KCNS
	(B)	Separation of Co^{2+} and Ni^{2+}		q.	KCN K (Fra(CN) 1
	(C)	Separation of Cu ²⁺ and Cu ²⁺		I.	K ₄ [Fe(CN) ₆] H S
6.		Column - I		5.	Column - II
		heat			
	(A)	$\operatorname{Na}_2\operatorname{B}_4\operatorname{O}_7 \xrightarrow{\operatorname{near}} \rightarrow$		p.	NaBO ₂
	(B)	$Na_2B_4O_7 + NH_4Cl \longrightarrow$		q.	Na ₃ BO ₃
	(C)	$NaH + B_2O_3 \longrightarrow$		r.	B ₂ O ₃
	(D)	$B + NaOH \longrightarrow$		s.	$NaBH_4$
	Â.	K.			
	- <i>j</i> c	J			
		1 pqrs	p pqrs		2 pqrs
	_				
	MAR	RK YOUR			
	Res	SPONSE 4 pqrs	5 t = 5 - pqrs		$6. \frac{pqrs}{pqrs}$
		APPOR			A (P (T) S)
		R D O C	ାଡିମିଡ଼ିଷାଣ (ମିନ୍ଦୁ		вю́́щ́сі́
			ର୍ଚ୍ଚା ାଡ଼ିଉଁଡ଼ିଭା		ାଡିଭିତିତି
					D D D D D D D D D D D D D D D D D D D

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SINGLE CORRECT CHOICE TYPE

1.	d	2.	c	3.	c	4.	c	5.	d	6.	с	7.	а	8.	а	9.	с	10.	d
11.	с	12.	а	13.	b	14.	а	15.	c	16.	а	17.	c	18.	d	19.	а	20.	b
21	с	22	d	23	а	24	с	25	b	26	с	27	а	28	с	29	b	30	с
31	c	32	b	33	d	34	а	35	d	36	а	37	а	38	b	39	с	40	b
41	b	42	d	43	а	44	а	45	с	46	с	47	b	48	b	49	а	50	с
51	d	52	а	53	с	54	а	55	с	56	d	57	с	58.	d	59.	а	60.	b
61.	d	62.	d	63.	b	64.	b	65.	а	66.	а	67.	b	68.	d	69.	с	70.	b
71.	d	72.	с	73.	b	74.	с	75.	а	76.	с	77.	b	78.	а	79.	b	80.	d
81.	d	82.	а																

A

 \mathbf{B} \equiv Comprehension Type ==

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

 $C \equiv Reasoning Type =$

1	b	4	b	7	с	10	а	13	d
2	b	5	а	8	b	11	b	14	с
3	а	6	с	9	а	12	d	15	а

D

MULTIPLE CORRECT CHOICE TYPE

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

E

МАТRIX-МАТСН ТҮРЕ

- A -s; B-r; C-q; D-p 1.
- **3**. **A-p**, **q**, **s**; **B-p**; **C-q**, **s**; **D-q**, **r**, **s**
- 5.. A-p, r; B-r, s; C-q, s

- 2. A-q; B-s; C-p; D-r
- 4. A-p, q; B-p, t; C-r; D-s
- 6. A-p, r; B-r; C-p, s; D-q

$\mathbf{A} \equiv \mathbf{Single} \mathbf{Correct} \mathbf{Choice} \mathbf{Type} \equiv$

2. (c)
$$K_2Cr_2O_7 + 4KCl + 6H_2SO_4 \xrightarrow{\text{heat}}$$

 $2CrO_2Cl_2 + 6KHSO_4 + 3H_2O$ Chromyl chloride

- (c) In (c), sulphate ion is present outside the coordination sphere so it can form white ppt of BaSO₄ with BaCl₂ (aq.).
- 7. (a) $\text{LiNO}_3 \xrightarrow{\text{heat}} \text{LiO} + \text{NO}_2 \uparrow (\text{Reddish brown});$

 $NaNO_3 \xrightarrow{heat} NaNO_2 + O_2 \uparrow$

- 8. (a) In H_2SO_4 , oxidation number of S is + 6, so it cannot undergo further oxidation.
- 9. (c)
- (d) When Br⁻ reacts with conc. H₂SO₄, HBr is formed. Now HBr, being stronger reducing agent, reacts with conc. H₂SO₄, a stronger oxidizing agent, to form Br₂ and SO₂.
 MBr + H₂SO₄(conc.) → MHSO₄ + HBr;

 $2\text{HBr} + \text{H}_2\text{SO}_4(\text{conc.}) \longrightarrow \text{Br}_2 + \text{H}_2\text{O} + \text{SO}_2 \uparrow$

12. (a)
$$PbO_2 + Mn^{++} + HNO_3 \xrightarrow{heat} HMnO_4 + Pb^{++}$$

pink

14. (a) $Pb_3O_4 + 4HNO_3 -$ Scarlet compound (A)

$$\begin{array}{c} PbO_2 \downarrow + & 2Pb(NO_3)_2 + 2H_2O \\ Chocolate brown & Solution \\ (B) & (C) \end{array}$$

15. (c)
$$_{3NiS+6HCl+2HNO_3} \longrightarrow 3NiCl_2+3S+2NO+4H_2O$$
(A)

16. (a) $\operatorname{NiCl}_2 + 2\operatorname{KCN} \longrightarrow \operatorname{Ni}(\operatorname{CN})_2 + 2\operatorname{KCl}$;

 $Ni(CN)_2 + 2KCN \longrightarrow K_2[Ni(CN)_4]$

17. (c)
$$2 \operatorname{NaOH} + \operatorname{Br}_2 \longrightarrow 2 \operatorname{NaBr} + \operatorname{H}_2 \operatorname{O} + [O]$$

$$2K_2[Ni(CN)_4] + 4NaOH + [O] \longrightarrow$$

 $Ni_2O_3 + 4NaCN + 4KCN + 2H_2O$

18. (d) $Pb(NO_3)_2 + 2NaOH \longrightarrow Pb(OH)_2 \downarrow + 2NaNO_3$ White

21. (c)
$$2AgBr + Na_2S_2O_3 \longrightarrow Ag_2S_2O_3 + 2NaBr$$
;

$$Ag_2S_2O_3 \xrightarrow{Boil} Ag_2S + SO_3$$

Black ppt.

22. (d) $Sb_2O_3 + KIO_3 + 2HCl + 6H_2O \longrightarrow$

 $2HSb(OH)_6 + KCl + ICl$

23. (a)
$$Bi_2O_3 + 2NaOH + 2NaOCI$$

2NaBiO₃ + H₂O + 2NaCl

24. (c)
$$BiCl_3 + H_2O \longrightarrow BiOCl + 2HCl$$

25. (b) With a conc. solution of $Na_2 S_2O_3$, silver forms a soluble complex

$$2Ag + S_2O_3^{2-} \longrightarrow Ag_2S_2O_3;$$

$$Ag_2S_2O_3 + 3Na_2S_2O_3 \longrightarrow 2Na_3[Ag(S_2O_3)_2]$$

27. (a)
$$SO_2 \uparrow \xleftarrow{\text{dil. HCl}} BaS_2O_3 \xrightarrow{K_2CrO_4} BaCrO_4 \downarrow$$

yellow

29. (b)
$$CuCl_2 + H_2S \longrightarrow 2HCl + Cus_{(black)}$$

30. (c) This is because of the formation of tetramminocupric

ion.
$$Cu^{++} + 4NH_3 \longrightarrow [Cu(NH_3)_4]^{++}$$

(deep balck)

31. (c) $2NaHCO_3 \longrightarrow Na_2CO_3 + H_2O + CO_2$; white reside (soluble in water)

$$Na_2CO_3 + HCl \longrightarrow NaCl + H_2O + CO_2$$

32. (b) An oxidising agent (OA) will accept e⁻ from I⁻ ion and converts it into I₂ which gives blue colour with starch

Starch + KI + OA $\longrightarrow \underbrace{\text{Starch} + I_2}_{\text{blue colour}}$

- **33.** (d) AgCl is soluble in NH_4OH due to the formation of soluble complex $[Ag(NH_3)_2]Cl$ and AgCl is insoluble in water.
- 34. (a) Pb is *p*-block element. It does not form coloured metaborate.
- 36. (a) On reducing auric chloride by stannous chloride, the colloidal solution of gold is obtained, which is called purple of cassius.

37. (a)
$$HgI_2 + 2KI \longrightarrow K_2[HgI_4]$$

Complex salt
(Potassium mercuric iodide)

38. (b) Ammonia gas turns Nessler's reagent (K₂HgI₄ + NaOH) into yellow brown colour

 $2K_2[HgI_4] + NaOH + NH_3 \xrightarrow{Brown ppt.}$

$$NH_2Hg_2I_3 + 4KI + NaI + H_2O$$

39. (c)
$$AgCl + 2Na_2S_2O_3 \longrightarrow Na_3[Ag(S_2O_3)_2] + NaCl$$

Hypo Sod. argentothiosulphate (colourless solution)

40. (b)
$$4\operatorname{CuCl} + 2\operatorname{H}_2O + O_2 \longrightarrow 2[\operatorname{CuCl}_2.\operatorname{Cu}(OH)_2]$$

air basic cupric chloride
(green colour)

41. (b) Under the given conditions, H₂S will pricipitate each one of these ions as their respective sulphides, but only ZnS is white in colour.

42. (d)
$$Pb^{++} + 2HCl \longrightarrow PbCl_2 \downarrow \xrightarrow{H_2S} PbS \downarrow$$

White ppt. Black ppt. dissolves on boiling

43. (a) Stable oxidation state of Mn in alkaline medium is +6.
 So, MnO₂ is oxidised to K₂MnO₄ by atmospheric oxygen in KOH medium.

 $2MnO_2 + 4KOH + O_2 \longrightarrow 2K_2MnO_4 + 2H_2O$

44. (a) SO₂ and H₂S both, being reducing agents, can turn acidified dichromate solution green; SO₂ can be obtained by the action of acid upon sulphite, while H₂S is evolved by the action of acid upon sulphide. However, SO₂ has a burning sulphur smell which is irritating, H₂S has rotten egg like smell.

45. (c)
$$Al(OH)_3 + NaOH \longrightarrow NaAlO_2 + 2H_2O$$

46. (c) AgCl is soluble in ammonium hydroxide.

 $AgCl + 2NH_4OH \longrightarrow Ag(NH_3)_2Cl + 2H_2O$

HgS is dissolved in aqua-regia.

 $3HgS + 2HNO_3 + 6HCl \longrightarrow 3HgCl_2$

 $+2NO+3S+4H_2O$

- 47. (b) Dilute H_2SO_4 is used to detect group I radicals whereas conc. H_2SO_4 is used to detect the group II radicals. Among the options given fluoride radicals are group III radicals hence cannot be detected by dilute or concentrated H_2SO_4 .
- 48. (b) The reagent is BaCl₂ which imparts green colour to flame. BaCl₂ forms chromyl chloride (which is red in colour), when treated with K₂Cr₂O₇ and conc. H₂SO₄.

$$2\text{BaCl}_2 + \text{K}_2\text{Cr}_2\text{O}_7 + 3\text{H}_2\text{SO}_4 \longrightarrow$$
$$\text{K}_2\text{SO}_4 + 2\text{BaSO}_4 + 2\text{CrO}_2\text{Cl}_2 + 3\text{H}_2\text{O}_4$$

49. (a) The reagent is FeSO₄ which give SO₂ and SO₃ on heating

$$\begin{array}{ccc} 2FeSO_4 & \longrightarrow Fe_2O_3 + SO_2 \uparrow + SO_3 \uparrow \\ Ferrous \ sulphate \end{array}$$

Ferrous sulphate gives dirty green $Fe(OH)_2$ with aqueous NaOH.

$$FeSO_4 + 2NaOH \longrightarrow Fe(OH)_2 + Na_2SO_4$$
(Dirty green)

50. (c) NiCl₂+2
$$\begin{array}{c} CH_3 \longrightarrow C = NOH \\ I \\ CH_3 \longrightarrow C = NOH \end{array}$$
 + 2 NH₄OH \longrightarrow



51. (d) Soda extract is prepared for the identification of acidic radicals. Mix a given solution with about 3 parts of sodium carbonate and nearly 10-15 ml. of distilled water. Heat the contents for 10-15 minutes and filter. The filtrate is known as soda extract.

52. (a) This is a typical Group I test of basic radicals

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

$$PbCl_2 + 2KI \longrightarrow PbI_2 + 2KCl$$
(Yellow ppt.)

53. (c) Test for II A group

 $3CuS + 8HNO_3 \longrightarrow 3Cu(NO_3)_2 + 2NO + 3S + 4H_2O$

 $Cu(NO_3)_2 + 4NH_4OH \longrightarrow [Cu(NH_3)_4](NO_3)_2 + 4H_2O$ Tetram min e cupric nitrate (deep blue solution)

54. (a) This is test for IIB groups for radicals arsenic, antmony and tin.

$$As_2S_5 + 10HNO_3 \longrightarrow 2H_3AsO_4$$

Arsenic acid

$$+10NO_2 + 2H_2O + 5S$$

$$H_3AsO_4 + 12(NH_4)_2MoO_4 + 21HNO_3 \longrightarrow$$

 $(NH_4)_3$ AsO₄.12MoO₃+21NH₄NO₃+12H₂O Yellow ppt.

55. (c) This is a test for Al^{3+} (Group III), hence X is $AlCl_3$

AlCl₃ + 3NH₄OH
$$\longrightarrow$$
 Al(OH)₃ \downarrow + 3NH₄Cl;
Gelatinous

$$\begin{array}{c} Al(OH)_3 + NaOH \longrightarrow NaAlO_2 + 2H_2O \\ (ppt) & Soluble \end{array}$$

56. (d) This is a Group V test

 $CaCO_3 + 2CH_3COOH \longrightarrow$ (CH₃COO)₂Ca + CO₂ + H₂O

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

$$CaC_{2}O_{4} + 2CH_{3}COONH_{4}$$
White ppt.

- 57. (c) The colour of chromium remains green during the test.
- 58. (d) Sulphuric acid is not used for preparing the original solution (O.S.) for cationic analysis because it precipitates Pb²⁺, Ba²⁺, Sr²⁺ and Ca²⁺ ions (these sulphates are insoluble).

59. (a)
$$H_2S+[O] \longrightarrow H_2O + S_{(collidal sulphur)} (yellow turbidity)$$

60. (b) The milkiness is due to formation of BiOCl (Bismuth oxychloride).

- **61.** (d) It is the correct answer.
- 62. (d) Due to higher concentration of CO_3^{2-} the K_{sp} of MgCO₃ will be exceeded and it will get precipitated in group V.
- 63. (b) $(NH_4)_2SO_4$ can be used in place of NH_4Cl .
- 64. (b) $BaCO_3$ forms a yellow ppt of Barium chromate. $BaCO_3$ forms a white precipitate of $BaSO_4$. $BaCl_2$ is soluble in water.
- 65. (a) The brown ring formed involves Fe²⁺ and NO (nitric oxide).

The brown ring formed is $[Fe(H_2O)_5NO]SO_4$.

- 66. (a) The precipitate of silver phosphate is yellow. It is soluble in dil HNO_3 as also in NH_4OH . The yellow precipitate of AgI is insoluble in NH_4OH .
- 67. (b) It is the correct answer.
 Addition of HCl suppresses the degree of ionisation of H₂S due to common ion effect (H⁺ is common ion) and only group II sulphides get precipitated.
- **68.** (d) $HgCl_2$ fails to respond to chromyl chloride test.
- **69.** (c) Both $HgCl_2$ and NH_4Cl are sublime substances.
- 70. (b) $ZnCO_3$ on heating leaves a residue that is yellow when hot and white when cold.

$$ZnCO_3 \longrightarrow ZnO + CO_2$$

- 71. (d) The composition of soluble complex formed is $K_2[Cd(CN)_4]$.
- 72. (c) This is due to presence of AsO_4^{3-} .
- **73.** (b) It is the correct answer.

75.

7

74. (c) K_2CO_3 gives violet flame due to K^+ ions. It turns moistened litmus paper blue as its solution is basic (solution of KNO₃ is neutral).

(a)
$$\operatorname{BaCl}_2 + \operatorname{SO}_4^{2-} \longrightarrow \operatorname{BaSO}_4 + 2\operatorname{Cl}^-$$

(white ppt)

White ppt (BaSO₄) does not dissolve in dil HCl.

76. (c) Borates (BO_3^{3-}) react with ethyl alcohol in presence of conc. H_2SO_4 to form volatile ethyl borate which burns with green edged flames.

$$BO_3^{3-} + 3H^+ + 3C_2H_5OH \longrightarrow (C_2H_5)_3BO_3 + 3H_2O$$
(volatile)

- 77. (b) $Al(OH)_3$, white gelatinous precipitate formed dissolves in excess of NaOH due to formation of soluble complex.
- **78.** (a) The blue complex $[Cu(NH_3)_4]SO_4$ is formed.
- **79.** (b) NH_4Cl is a sublime substance.
- 80. (d) It is the correct answer.
- 81. (d) $Cr_2(SO_4)_3$, green, is formed
- 82. (a) It is the correct answer.



\blacksquare Comprehension Type \equiv

(a) The stoichiometry of the salt often affects the solubility of the salt, so the least soluble salt is not necessarily the one with the smallest solubility constant. Simply for interest (!), let's derive the general formula :

For the equation : $A_x B_y = xA^{y+} + yB^{x-}$; p = solubility

of salt =
$$x + y \sqrt{\frac{K_{sp}}{x^x \times y^y}}$$

Therefore, solubility of Bi₂S₃= $\sqrt[5]{\frac{10^{-97}}{108}} = 10^{-20}$ approx.

Solubility of
$$Ag_2S = \sqrt[3]{\frac{2 \times 10^{-49}}{4}} = 10^{-16}$$
 approx.

Solubility of ZnS =
$$\sqrt[2]{\frac{1 \times 10^{-21}}{1}} = 10^{-10.5}$$
 approx.

Solubility of CuS =
$$\sqrt[2]{\frac{9 \times 10^{-36}}{1}} = 3.0 \times 10^{-18}$$

thus Bi_2S_3 has the lowest solubility which means that in solution Bi^{3+} would be the first cation to precipitate.

2. (c)
$$Bi_2S_3 \longleftrightarrow 2Bi^{3+} + 3S^{2-}$$

 $K_{sp} = [Bi^{3+}]^2 [S^{2-}]^3$

3. **(d)** Using
$$K_b = \frac{[HCN][OH^-]}{[CN^-]}$$
;

Assuming that [HCN] = [OH⁻] approximately

$$K_{b} = \frac{[OH^{-}]^{2}}{[CN^{-}]};$$

Hence, $[OH^{-}]^2 = K_b \times [CN^{-}] = 1.39 \times 10^{-5} \times 0.02$ = $1.39 \times 10^{-5} \times 2 \times 10^{-2} = 2.78 \times 10^{-7}$ or $[OH^-] = approximately = 5 \times 10^{-4}$ Using pOH = $-log[OH^-]$ pOH = $-log(5 \times 10^{-4}) = -log(5) + [-log(10^{-4})]$ = -log(5) + 4pOH = 3.5 approximately Using pH + pOH = 14, pH = 14 - pOH = 14 - 3.5 approximately = 10.5 which is ≈ 10.7

(b)
$$ZnS \longleftrightarrow Zn^{2+} + S^{2-}$$

4.

5.

6.

Using
$$K_{sp} = [Zn^{2+}][S^{2-}]$$

 $1.0 \times 10^{-21} = (5.00 \times 10^{-3})[S^{2-}]$
 $[S^{2-}] = (1.0 \times 10^{-21})/(5.00 \times 10^{-3}) = 1/5 \times 10^{-18}$
 $= 0.2 \times 10^{-18} = 2.0 \times 10^{-19}$

(d) For X_2S to precipitate between Ag_2S & Bi_2S_3 its solubility should lie between 10^{-16} (solubility of Ag_2S) and 10^{-20} (solubility of Bi_2S_3)

> For a value, say 10^{-18} the K_{sp} of X₂S = $(10^{-18})^2 \times 10^{-18} = 10^{-54}$

which corresponds (very near) to the only one possible value of 4×10^{-53}

- (a) Due to the common ion effect, the CuS will dissolve to a lesser extent in the presence of copper (II) ions (or sulfide ions).
- 7. (a) *Reaction 4* is shown in the following equation, which is answer choice A.

 $PbCO_3(s) + 2 HCl(aq) \longrightarrow$

$$PbCl_2(aq) + CO_2(g) + H_2O(l)$$

Answers (b) and (d) do not show a reaction involving $PbCO_3(s)$, as required by Reaction 4. Answer (c) shows an implausible and unbalanced equation.

8. (d) *Reaction 1* is shown in the following equation.

$$Pb(NO_3)_2(aq) + Na_2SO_4(aq) \longrightarrow$$

 $PbSO_4(s) + 2 NaNO_3(aq)$

Compound A, the white solid, is $PbSO_4(s)$. Neither the reactant $Pb(NO_3)_2$ nor the product $NaNO_3$ can precipitate because all nitrates and sodium salts are water soluble. PbI_2 cannot precipitate because iodide is not present.

9. (a) The dissolution of Pb(OH)₂(s) is represented by the following equation.

 $Pb(OH)_2(s) \longrightarrow Pb^2(aq) + 2 OH^2(aq)$

At pH 9, the concentration of OH⁻(aq) is greater than the concentration of OH⁻(aq) at pH 7. According to Le Châtelier's principle, the additional common ion, OH⁻(aq), will shift the position of equilibrium to the left, and less Pb(OH)₂ will dissolve.

- 10. (b) The reactions described in the passage show that lead(II) is successively precipitated as PbSO₄, PbI₂, and PbCO₃. This sequence shows (assuming equal anion concentrations, as must be done here) that PbCO₃ is less soluble than PbI₂, and PbI₂ is less soluble than PbSO₄. The order in which the anions precipitate Pb²⁺ is: CO₃²⁻ then I⁻ then SO₄²⁻. When this sequence is applied to the question, answer choice (b) is in the correct order, and answers (a), (c), and (d) are all in the opposite order.
- 11. (b) The initial $Na_2SO_4(aq)$ solution in *Reaction 1* is 15 mL of 0.300 *M* $Na_2SO_4(aq)$.

 $\frac{(15.0 \text{ mL}) (1 \text{ L}) (0.300 \text{ mol } \text{Na}_2 \text{SO}_4) (2 \text{ mol } \text{Na}^+)}{(1000 \text{ mL}) (1 \text{ L} \text{ Na}_2 \text{SO}_4 (\text{aq}) (1 \text{ mol } \text{Na}_2 \text{SO}_4)}$

= 0.00900 mol

12. (c) (i) Since the mixture is soluble in water to give strong alkaline solution, it must contain NaOH as one of the constituents.

(ii) Since the aqueous solution gives precipitate with dil. HCl, which dissolves in excess of dil. HCl, it must contain zinc salt.

Thus the mixture consists of $ZnSO_4$ and NaOH which explains all the given reactions.

Reactions:

(i)
$$ZnSO_4 + 4NaOH \rightarrow Na_2ZnO_2 + Na_2SO_4 + 2H_2O$$

(ii)
$$Na_2ZnO_2 + 2HCl \rightarrow 2NaCl + Zn(OH)_2 \downarrow$$

 $Zn(OH)_2 + 2HCl \rightarrow ZnCl_2 + 2H_2O$
Soluble

823

13. (b) The mixture will contain BaCl₂ as it will only give a white precipitate with K₂SO₄.

$$BaCl_2 + K_2SO_4 \longrightarrow BaSO_4 \downarrow + 2KCl$$
(white ppt.)

14. (b) The mixture contains $AgNO_3$

AgNO₃ reacts with brine (NaCl) to give the precipitate of AgCl (A), which is soluble in NH_4OH .

$$AgCl + 2NH_4OH \longrightarrow [Ag(NH_3)_2]Cl + 2H_2O$$
(soluble)

- **15.** (d) It is chromyl chloride test.
- 16. (d) The yellow precipitate 'F' is due to PbCrO₄.
- 17. (b) 'B' is lead chromate'D' is lead chromate'F' is lead chromate

18. (a)
$$2MnO_2(s) + 4KOH + O_2 \longrightarrow 2K_2MnO_4 + 2H_2O$$

(Black) (Green)
(Green)

$$3MnO_4^{2-} + 4H^+ \longrightarrow 2MnO_4^- + MnO_2 + 2H_2O$$

'B' 'C'
(Purple)

- (i) $2KMnO_4 + H_2O + KI \longrightarrow 2KOH + 2MnO_2 + KIO_3$ 'D'
- (ii) $2KMnO_4 + 8H_2SO_4 + 10FeSO_4 \longrightarrow$

$$2\mathrm{MnSO}_4 + 5\mathrm{Fe}_2(\mathrm{SO}_4)_3 + \mathrm{K}_2\mathrm{SO}_4 + 8\mathrm{H}_2\mathrm{O}$$

(iii)

$$2\text{KMnO}_4 + \text{H}_2\text{SO}_4 \xrightarrow['E']{\text{cold}} \text{Mn}_2\text{O}_7 + \text{K}_2\text{SO}_4 + \text{H}_2\text{O}_{E'}$$

$$\operatorname{Mn}_{2}O_{7} \longrightarrow 2\operatorname{Mn}O_{2} + \frac{3}{2}O_{2}$$

19. (a) The compound 'E' is Mn_2O_7 . It is acidic.

20. (c) The compound 'C' is MnO_2 .

📄 Reasoning Type 🗏

- (b) Cd²⁺ is a 2nd group radical and Ni²⁺ is a 4th group radical. So solubility product of NiS has to be more than CdS. Further Cd²⁺ gives yellow colour of CdS with H₂S, but Ni²⁺ gives black colour of NiS with H₂S. So both assertion and statement are wrong. (d) is correct choice.
- (b) Sulphate is estimated as BaSO₄ because of its insolubility in water. BaSO₄ forms a white ppt. Reason is correct but do not explain the assertion.
- 3. (a) R is the correct explanation of A.
- (b) Correct explanation : KCN forms complexes with Cu⁺ and Cd²⁺ as K₃[Cu(CN)₄] and K₂[Cd(CN)₄] respectively. On passing H₂S, only Cd²⁺ complex is decomposed to give yellow CdS precipitate.
- 5. (a) R is the correct explanation of A.
- 6. (c) Correct R: The solubility product of the chlorides of first group basic radicals is less than the solubility product of all other chlorides.
- 7. (c) Correct \mathbf{R} : SO₂ acts as a reducing agent and $K_2Cr_2O_7$ is reduced to green $Cr_2(SO_4)_3$ compound.

- 8. (b) Correct explanation : NH_4OH converts NH_4HCO_3 present, if any into $(NH_4)_2CO_3$.
- 9. (a) **R** is the correct explanation of **A**.
- 10. (a) \mathbf{R} is the correct explanation of \mathbf{A} .
- (b) Correct explanation : Alkaline solution of K₂[HgI₄] (Nessler's reagent) gives a brown precipitate of Millon's base H₂N.HgO.HgI with NH₃.
- 12. (d) Assertion is false because NO_2 when passed through alkalies produces nitrates and nitrites.

2NaOH + 2NO₂ \longrightarrow NaNO₂ + NaNO₃ + H₂O

Reason is true because NO_2 is acidic in nature and it is a mixed anhydride of HNO_2 and HNO_3 .

- 13. (d) Both assertion and reason are correct and reason is correct explanation of assertion.
- 14. (c) Assertion is correct, reason is incorrect. The bead is B_2O_3 .
- 15. (a) Both assertion and reason are correct and reason is correct explanation of assertion.

D MULTIPLE CORRECT CHOICE TYPE

1. (c) Ring test is done with H_2SO_4 and $FeSO_4$. So any nitrate which reacts with H_2SO_4 to give an insoluble ppt. of metalic sulfate will not respond to the test, Pb and Ba form insoluble sulfates so their nitrates will not respond to the test.

2. **(b,d)** Na₂B₄O₇.10H₂O
$$\xrightarrow{\text{heat}}$$
 Na₂B₄O₇ + 10H₂O;

$$Na_2B_4O_7 \xrightarrow{740^{\circ}C} 2NaBO_2 + B_2O_3$$

Glassy mass, called borax bead

4. (c) Because $PbCl_2$ & PbS are insoluble

5. (b, c) Because Zn^{++} is not having unpaired *d*-electron, while Ni⁺⁺ & Cr⁺⁺⁺ are having unpaired de^{-} .

$$(\mathbf{c}, \mathbf{d}) \qquad \mathrm{Cl}_2 + \mathrm{H}_2\mathrm{O} \longrightarrow \mathrm{HOCl} + \mathrm{HCl}$$

6.

8.

$$2\text{HCl} + \text{Mg} \longrightarrow \text{MgCl}_2 + \text{H}_2 \uparrow$$

- (a, b, c) (d) is false because sulphates of Vth group radicals will be precipitated.
 - (c) In second group ferric salts are reduced by H₂S. Hence it is always necessary to use HNO₃ in third group. Sb₂S₃ is orange in colour. Nickel can be tested with dimethyl glyoxime.

9. (a, c) FeS
$$H_2SO_4 \longrightarrow FeSO_4 + H_2S;$$

A (Black) B

$$\begin{array}{c} H_2S+2HNO_3 \longrightarrow 2NO_2 + 2H_2O + S \\ (B) \\ (B) \\ (Colloidal \\ sulphur) \end{array}$$

$$\underbrace{\operatorname{CuSO}_4}_{(D)} + \underbrace{\operatorname{H}_2S}_{(B)} \xrightarrow{\operatorname{HCl}} \underbrace{\operatorname{CuS}}_{(E)} + \underbrace{\operatorname{H}_2SO_4}_{(E)}$$

10. (a,b,c,d) This is a typical test for the presence of Group II A or II B salts.

The ppt. Y is a sulphide and as it dissolves in $(NH_4)_2S_2$ it shows X contains IIB group radical, i.e. As^{3+} , Sb^{3+} or Sn^{2+} .

$$As_2S_3 + 5(NH_4)_2S_2 \longrightarrow 2(NH_4)_3AsS_4$$
;
Ammonium thioarsenate

$$Sb_2S_3 + 5(NH_4)_2S_2 \longrightarrow 2(NH_4)_3SbS_4$$

Ammonium thioantimonate

 $SnS + (NH_4)_2S_2 \rightarrow thio complex$

- (a,b) NiS & CoS are black & insoluble in HCl whereas MnS (buff coloured) and ZnS (colourless) are soluble in conc. HCl.
- 12. (a,b) Al^{3+} (third group radical) and Ca^{2+} (fifth group radical) precipitate out as their hydroxide with NH₄Cl and aq. NH₃ (NH₄OH) which are the group reagents.
- 13. (a, b & d) The reactions are

$$4 \text{NaCl} + \text{K}_2 \text{Cr}_2 \text{O}_7 + 6\text{H}_2 \text{SO}_4$$

$$\rightarrow 2 \text{CrO}_2 \text{Cl}_2 + 4 \text{NaHSO}_4 + 2 \text{KHSO}_4 + 3\text{H}_2 \text{O}$$
(Red variance)

(Red vapours)

$$CrO_2Cl_2 + 4NaOH \rightarrow Na_2CrO_4 + 2NaCl + 2H_2O$$

Chromyl chloride yellow solution

14. (b & c) The blue precipitate of Fe^{2+} ions with potassium ferricyanide is due to formation of Turnbull's blue $KFe^{ll} [Fe^{lll} (CN)_6]$

 $\operatorname{Fe}^{3+}+\operatorname{K}_{3}[\operatorname{Fe}(\operatorname{CN})_{6}] \rightarrow \operatorname{K}.\operatorname{Fe}^{ll}[\operatorname{Fe}^{lll}(\operatorname{CN})_{6}]+2\operatorname{K}^{+}$

Potassium ferro ferricyanide

825

The red colouration of Fe^{3+} ions with potassium thiocyanate is due to the formation of $[Fe(CNS)_3]$

$$Fe^{3+} + 3KCNS \longrightarrow [Fe(CNS)_3] + 3K^+$$
Ferric thiocyanate
red colour

- **15.** (a,c) The turbidity reappears if the clear solution is boiled or fresh lime water is added to it.
- 16. (a,b) Both AsO_4^{3-} and PO_4^{3-} give yellow ppt on being heated with conc. HNO₃ and then addition of excess ammonium molybdate.

$$Na_2HPO_4 + 12(NH_4)_2MoO_4 + 23HNO_3 \longrightarrow$$

- $(\mathrm{NH}_4)_3[\mathrm{PMo}_{12}\mathrm{O}_{40}] + 2\mathrm{NaNO}_3 + 12\mathrm{NH}_4\mathrm{NO}_3 + 12\mathrm{H}_2\mathrm{O}_{(\text{yellow ppt)}}$
- 17. (a,b,c) All these (i.e., CO_3^{2-} , HCO_3^{-} and SO_3^{2-}) are indicated.
- **18.** (b) It is the most commonly used method.

19.

(b,d)
$$NaH_2PO_4 + NaOH \longrightarrow Na_3PO_4 + H_2O$$

 $NaHCO_3 + NaOH \longrightarrow Na_2CO_3 + H_2O$

20. (c) At this concentration of HCl, the chlorides of basic radicals of group I will get precipitated.

🚍 МАТКІХ-МАТСН ТУРЕ 💻

1. A -s; B-r; C-q; D-p

The reagents provided in the left side are the group reagents for group II, III, IV and VI respectively and hence have been matched with their basic radicals.

2. A-q; B-s; C-p; D-r

Alkali and alkaline earth metals give characteristic colour when introduced in Bunsen flame-

Na - Golden yellow; Ca - Brick Red; Ba - Apple Green; K - Violet.

3. **A-p**, **q**, **s**; **B-p**; **C-q**, **s**; **D-q**, **r**, **s**

dil. HCl is the reagent for first group which contains Ag^+ , Pb^{2+} and Hg_2^{2+} (ous).

The second group reagent is H_2S in presence of HCl and Pb^{2+} , Hg^{2+} and As^{3+} are the second group radicals. Again Sn^{4+} is a second group radical, so the solubility product of Hg^{2+} and As^{3+} is equivalent to that of Sn^{4+} . Note the solubility product Pb^{2+} and Cd^{2+} is more than other second group radical and that's why they are precipitated first. Again II A (Pb^{2+} , Hg^{2+}) and II B (As^{3+}) radicals are separated by yellow ammonium sulphide, (NH_4)₂ S_x , in which II-B radicals are soluble.

4. **A-p, q; B-p, t; C-r; D-s**

Function of HCl is to decrease ionisation of H_2S (due to common ion effect) so that only the solubility product of sulphides of II group radicals is overpowered and not that of III, IV and V group.

Conc. HNO_3 is used to oxidise Fe^{2+} ion into Fe^{3+} because the solubility product of $Fe(OH)_2$ is very high as compared to $Fe(OH)_3$ and in presence of NH_4Cl (group reagent), the ionisation of NH_4OH is suppressed and thus only the solubility product of $Fe(OH)_3$ is reached.

Function of NH_4Cl is to suppress the ionisation of NH_4OH so that only the III group radicals are precipitated because the solubility product of III group hydroxides is less than that of IV and VI group hydroxides.

Function of ammonium hydroxide is to increase the ionisation of H_2S by removing H^+ of H_2S as unionised water.

$$H_2S \Longrightarrow 2H^+ + S^{2-}; \qquad H^+ + OH^- \longrightarrow H_2O$$

Thus excess of sulphide ions will be available and hence the ionic product of IV group sulphides exceeds their solubility product and precipitate will be obtained.

5.. A-p, r; B-r, s; C-q, s

(A) Tests of
$$Fe^{3+}$$
. (i)
FeCl₃ + 3KCNS \longrightarrow Fe(CNS)₃ + 3KCl
Ferric thiocyanate
(blood red colour)

(ii)
$$4\text{FeCl}_3 + 3K_4[\text{Fe}(\text{CN})_6] \longrightarrow \text{Fe}_4[\text{Fe}(\text{CN})_6]_3 + 12K\text{Cl}$$

Ferric ferrocyanide
(prussian blue)

(C) Complex of copper decomposes by acetic acid to form copper sulphate which gives red brown ppt. of cupric ferrocyanide with potassium ferrocyanide.

$$[Cu(NH_3)_4]SO_4 + 4CH_3COOH \longrightarrow CuSO_4 + 4CH_3COONH_4$$

$$2\text{CuSO}_4 + \text{K}_4[\text{Fe}(\text{CN})_6] \longrightarrow \begin{array}{c} \text{Cu}_2[\text{Fe}(\text{CN})_6] & \downarrow + 2\text{K}_2\text{SO}_4\\ \text{red brown ppt.}\\ \text{or chocolate red ppt.} \end{array}$$

Cadmium complex decomposes by H_2S to give yellow ppt. of CdS.

$$[Cd(NH_3)_4]SO_4 + H_2S \longrightarrow CdS \downarrow + (NH_4)_2SO_4 + 2NH_3$$

Cu and Cd separation is based upon the fact that in presence of KCN, only Cd is precipitated as sulphide on passing H₂S.

 $[Cu(NH_3)_4]SO_4 + 10KCN + 8H_2O \longrightarrow$

$$2K_3[Cu(CN)_4] + 2K_2SO_4 + 8NH_4OH + (CN)_2$$

 $[Cd(NH_3)_4]SO_4 + 4KCN + 4H_2O \longrightarrow$

$$K_2[Cd(CN)_4] + K_2SO_4 + 4NH_4OH$$

Since second ionisation of pot. cadmicyanide is higher than that of pot. cuprocyanide, sufficient Cd^{2+} ions are present in solution and hence only CdS is precipitated on passing H_2S gas.

(B) Cobalt and nickel chlorides form soluble complexes with KCN.

(a)
$$\operatorname{CoCl}_2 + 2\operatorname{KCN} \longrightarrow \operatorname{Co}(\operatorname{CN})_2 + 2\operatorname{KCl}$$

(buff coloured)
 $\operatorname{Co}(\operatorname{CN})_2 + 4\operatorname{KCN} \longrightarrow \operatorname{K}_4[\operatorname{Co}(\operatorname{CN})_6]$
Pot. cobaltocyanide
(b) $\operatorname{NiCl}_2 + 2\operatorname{KCN} \longrightarrow \operatorname{Ni}(\operatorname{CN})_2 + 2\operatorname{KCl}$
 $\operatorname{Ni}(\operatorname{CN})_2 + 2\operatorname{KCN} \longrightarrow \operatorname{K}_2[\operatorname{Ni}(\operatorname{CN})_4]$
Pot. nickelocyanide

When treated with NaOH solution and Br_2 water, pot. cobaltocyanide is oxidised to very stable complex, pot. cobaLticyanide which thus does not give any Co^{2+} ion. On the other hand, nickel complex decomposes forming black nickelic oxide. (a) $2NaOH + Br_2 \longrightarrow NaBr + NaOBr + H_2O$

 $NaOBr \longrightarrow NaBr + O$

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 $2K_4[Co(CN)_6] + O + H_2O \longrightarrow 2K_3[Co(CN)_6] + 2KOH$

(b) $2K_2[Ni(CN)_4] + 4NaOH + O \longrightarrow$

$$Ni_2O_3 \downarrow + 4NaCN + 4KCN + 2H_2O$$

(Black)