Exercise-1

Marked questions are recommended for Revision.

PART - I : SUBJECTIVE QUESTIONS

Section (A) : Heating in dry test tube

A-1. What is importance of dry tests and it is applicable to which kind of substances ?

A-2. Give the observation when each of the following is heated in a dry test tube. Also give balanced equations :
(a) $HgCO_3$ (b) NH_4NO_2
(c) (NH_4Cl + $NaNO_3$) mixture (d) $Pb(NO_3)_2$

Section (B) : Flame and borax bead test

B-1. Why compounds shows colours in flame test ?

B-2. Is intensity of colour in flame test, depends upon the concentration of metal present ?

B-3. Why is a green flame not obtained in the case of barium sulphate or barium phosphate ?

B-4. Colourless salt (A) $\xrightarrow[740°C]{\Delta}$ (B) + (C) $\xrightarrow{Cu^{2+},\Delta}$ blue coloured bead (D)
Identify the compound (A), (B), (C) and (D).

Section (C) : dil. HCl / dil. H_2SO_4 group

C-1. Why is sodium carbonate extract acidified before performing the confirmatory test for anions ?

C-2. Can sodium carbonate extract be used test for CO_3^{2-} ions ?

C-3. What will happen if a solution of $Ca(HCO_3)_2$, formed by passing the carbon dioxide through a milky solution of $CaCO_3$ for a longer time if, ammonia solution is added ?

C-4. What will happen if bromine water is added in a white precipitate of $BaSO_3$?

C-5. Salt (A) + lime water $\longrightarrow$ white precipitate $\downarrow$
white precipitate + prolong passage of gas (B) $\longrightarrow$ it forms soluble salt (C), gas (B) has burning sulphur smell Identify the anion of salt (A) and (C).

C-6. What will happen ? (Also write the chemical equations) .
(a) When a filter paper moistened with potassium iodate and starch solution is brought in contact with sulphur dioxide gas.
(b) When H_2S gas is made to react with sodium tetrahydroxidoplumbate(II) solution.
(c) When sulphite reacts with dilute H_2SO_4 in presence of zinc

C-7. A nitrite solution is added to a saturated solution of iron(II) acidified with dilute acetic acid or with dilute sulphuric acid. If any reactions occurs then write the name and chemical composition of the products formed. Also write the chemical equations involved.

Section (D) : Conc. H_2SO_4 group

D-1. Why is it necessary to test for the acid radicals first with dil. H_2SO_4 and then with conc. H_2SO_4?

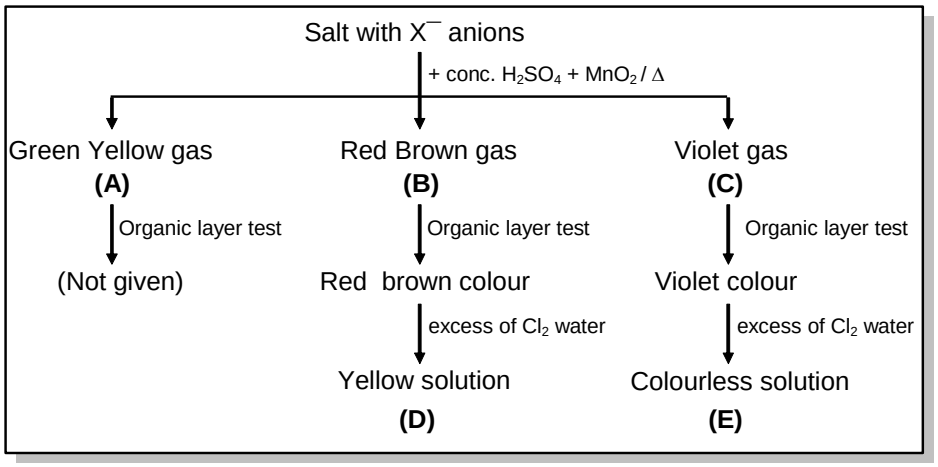
D-2. Why chromyl chloride test is carried out in a dry test tube ?

D-3. Why bromides and iodides do not respond to chromyl chloride test ?

D-4. NaCl on heating with conc. H_2SO_4 gives HCl where as NaBr and NaI give Br_2 and I_2 respetively, why?

D-5. Dilute Hydrochloric acid contains chloride ions but it doesnot give positive chromyl chloride test, why ?

D-6.



Identify the gas A, B and C.

D-7. Why heavy metal chlorides such as Hg_2Cl_2, AgCl, $PbCl_2$ etc. do not respond to chromyl chloride test.

D-8. Why is a freshly prepared solution of $FeSO_4$ used for the detection of nitrate and nitrite ?

Section (E) : Precipitation Reactions

E-1. Cu^{2+} and Ba^{2+} interfere in the flame test for borate, why ?

E-2. In which of the following reagents, the white precipitate of $PbSO_4$ is soluble ?
dilute HCl, hot concentrated H_2SO_4, ammonium acetate (6M), ammonium tartrate 6M in the presence of ammonia, sodium hydroxide solution.

E-3. How will you distinguish between sulphite and sulphate ions ?

PART - II : ONLY ONE OPTION CORRECT TYPE

Section (A) : Heating in dry test tube

A-1. When a metal sulphate is heated in dry test tube, the colour changes from blue to white. Then metal sulphate may be :
(A) $BaSO_4$ (B) $CuSO_4.5H_2O$ (C) Na_2SO_4 (D) None of these

A-2. Which of the following can not evolve more than one gas (vapour) if heated in dry test tube.
(A) $NaNO_3(s)$ (B) $MgCO_3(s)$ (C) $FeSO_4(s)$ (D) $(NH_4)_2Cr_2O_7(s)$

A-3. On heating, a white amorphous inorganic compound becomes yellow and on cooling, turns white again.The salt may be
(A) $PbCO_3$ (B) $MgCO_3$ (C) $ZnCO_3$ (D) K_2CO_3

A-4. Which of the following metal carbonates liberate. $CO_2(g)$ on heating :
(A) Na_2CO_3 (B) K_2CO_3 (C) Rb_2CO_3 (D) Ag_2CO_3

A-5. In which of the following reactions a brown coloured gas is evolved ?
(A) KBr (s) + dil. $H_2SO_4 \longrightarrow$ (B) $NH_4NO_2 \xrightarrow{\Delta}$
(C) $NaNO_3 \xrightarrow[800\,^oC]{\Delta}$ (D) $AgNO_3(s)$ + conc. $H_2SO_4 \longrightarrow$

Section (B) : Flame and borax bead test

B-1. Why is concentrated HCl used to dissolve the given metal salt in the flame test ?
(A) strong acids produce better flame test.
(B) HCl is volatile
(C) Volatile metal chloride produce better flame test.
(D) sharper coloured are seen in the flame in presence of Cl^- ions.

B-2. The hottest part of the flame of a Bunsen burner is the
(A) Blue Zone (B) Zone of complete combustion
(C) Zone fo partial combustion (D) All parts of the flame are equally hot.

B-3. Metal **(M)** shows crimson red colour in flame test and its halide is deliquescent then metal **(M)** could be:
(A) Li (B) Mg (C) Ca (D) Ba

B-4. In Borax bead test, metal oxides react with B_2O_3 and form a coloured bead. This bead contains.
(A) orthoborate ion (B) metaborate ion (C) double oxide (D) tetraborate ion

B-5. Which one of the following ions does not give borax bead test :
(A) Cr^{3+} (B) Cu^{2+} (C) Mn^{2+} (D) Zn^{2+}

B-6. In the Borax bead test of Co^{2+}, the blue colour of bead is due to the formation of :
(A) B_2O_3 (B) Co_3B_2 (C) $Co(BO_2)_2$ (D) CoO

B-7. A salt gives white residue in charcoal cavity test but in cobalt nitrate test it gives pink mass. It represents:
(A) Zn^{+2} (B) Al^{+3} (C) Mg^{+2} (D) PO_4^{-3}

Section (C) : dil. HCl / dil. H_2SO_4 group

C-1. Which of the following anions are identified by dil. HCl :
(A) NO_2^-, NO_3^-, CO_3^{2-} (B) NO_2^-, NO_3^-, SO_3^{2-} (C) S^{2-}, SO_3^{2-}, NO_2^- (D) CH_3COO^-, I^-, CO_3^{2-}

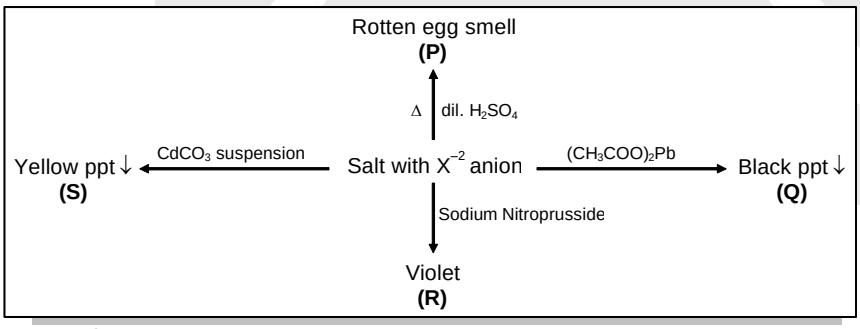
C-2. Two inorganic compounds **A** and **B** were heated in a dry test tube. **A** evolved a colourless gas which turned lead acetate paper black and **B** evolved a gas which turned lime water milky. The anions in **A** and **B** respectively are :
(A) SO_3^{2-}, CO_3^{2-} (B) S^{2-}, CO_3^{2-} (C) PO_4^{3-}, HSO_3^- (D) S^{2-}, NO_3^-

C-3. If addition of conc. H_2SO_4 is made to an unknown salt, a colourless and odourless gas is produced then which of the following can be present ?
(A) CO_3^{2-} (B) S^{2-} (C) Cl^- (D) NO_3^-

C-4. A gas turns lime water milky and acidified $K_2Cr_2O_7$ solution green then gas is :
(A) HCl (B) H_2S (C) SO_2 (D) CO_2

C-5. A gas has smell like rotten egg and turns lead acetate paper black. The gas is :
(A) NO_2 (B) H_2S (C) CO_2 (D) SO_2

C-6.



Anion (X^{2-}) is:
(A) CO_3^{2-} (B) SO_3^{2-} (C) S^{2-} (D) $S_2O_3^{2-}$

C-7. The acidic solution of a salt produces blue colour with KI starch solution. The reaction indicates the presence of :
(A) Sulphite (B) Bromide (C) Nitrite (D) Chloride

C-8. Sulphide ion reacts with $Na_2[Fe(CN)_5NO]$ to form a purple coloured compound (X). In this reaction oxidation state of iron.
(A) changes from +2 to +3 (B) changes from +3 to +2
(C) changes from +2 to +4 (D) does not change.

Section (D) : Conc. H_2SO_4 group

D-1. Which of the following pair of anions are identified by conc. H_2SO_4.
(A) NO_3^-, CO_3^{2-} (B) Cl^-, NO_3^- (C) Br^-, CO_3^{2-} (D) CO_3^{2-}, CH_3COO^-

D-2. Which of the following anion behaves in a different manner than other on heating with conc. H_2SO_4?
(A) Cl^- (B) I^-
(C) Br^- (D) All behave in a similar manner

D-3. Which of the following reagents turns white precipitate of AgCl yellow ?
(A) $NaNO_3$ (B) Na_3AsO_3 (C) Na_3AsO_4 (D) NaCN

D-4. A Unknown salt **(S)** when heated with dil. H_2SO_4 does not evolve brown vapours but with conc. H_2SO_4 brown vapours are obtained. The vapours when brought in contact with $AgNO_3$ solution do not give any precipitate. The salt **(S)** contains.
(A) NO_2^- (B) NO_3^- (C) I^- (D) Br^-

D-5. When a mixture of solid NaCl and solid $K_2Cr_2O_7$ is heated with concentrated H_2SO_4, deep red vapours are obtained. This is due to the formation of :
(A) chromous chloride (B) chromyl chloride (C) chromic chloride (D) chromic sulphate

D-6. AgCl dissolves in ammonia solution giving :
(A) Ag^+, NH_4^+ and Cl^- (B) $[Ag(NH_3)]^+$ and Cl^-
(C) $[Ag_2(NH_3)]^{2+}$ and Cl^- (D) $[Ag(NH_3)_2]^+$ and Cl^-

D-7. A mixture upon adding conc. H_2SO_4 gives deep red fumes. Mixture may contain the anions pair :
(A) $Cr_2O_7^{2-}$ and Cl^- (B) Br^- and $Cr_2O_7^{2-}$ (C) NO_3^- and Cl^- (D) CrO_4^{2-} and NO_3^{2-}

D-8. A solution of a salt in concentrated H_2SO_4 produced a deep blue colour with starch iodide solution. The salt may contain :
(A) chloride (B) carbonate (C) acetate (D) bromide

D-9. A colourless solution of a compound gives a precipitate with $AgNO_3$ solution but no precipitate with a solution of Na_2CO_3. The action of concentrated H_2SO_4 on the compound liberates a suffocating reddish brown gas. The compound is :
(A) $Ba(CH_3COO)_2$ (B) $CaCl_2$ (C) NaI (D) NaBr

D-10. Which of the following gas turn starch iodide paper blue?
(A) CO_2 (B) SO_2 (C) NO_2 (D) H_2S

D-11. Nitrate is confirmed by ring test. The brown colour of the ring is due to formation of :
(A) ferrous nitrite (B) nitroso ferrous sulphate
(C) ferrous nitrate (D) $FeSO_4.NO_2$

Section (E) : Precipitation Reactions

E-1. When a mixture containing phosphate is heated with conc. HNO_3 and ammonium molybdate solution, a canary yellow precipitate is formed. The formula of the yellow precipitate is :
(A) $(NH_4)_3PO_4$ (B) $(NH_4)_3PO_4.12MoO_4$ (C) $(NH_4)_3PO_4.12MoO_3$ (D) $(NH_4)_3PO_4.(NH_4)_2MO_4$

E-2. A metal salt solution gives a yellow precipitate with silver nitrate. The precipitate dissolves in dil. Nitric acid as well as in ammonium hydroxide. The solution contains.
(A) Br^- (B) I^- (C) PO_4^{3-} (D) SO_4^{2-}

PART - III : MATCH THE COLUMN

1. Match the anions with the changes observed on qualitative analysis :

	Column-I		**Column-II**
(A)	SO_4^{2-}	(p)	Canary yellow ppt. with ammonium molybdate.
(B)	NO_3^-	(q)	Brown ring test.
(C)	NO_2^-	(r)	White ppt. with $BaCl_2$ solution.
(D)	PO_4^{3-}	(s)	Yellow ppt. with $AgNO_3$ solution.
		(t)	White ppt. with $AgNO_3$ solution.

2. Match the reagent which are used in qualitative analysis of given anions :

	Column-I		**Column-II**
(A)	$AgNO_3$ solution	(p)	CO_3^{2-}
(B)	$BaCl_2$ solution	(q)	Cl^-
(C)	$Pb(NO_3)_2$ solution	(r)	S^{2-}
(D)	Acidified $KMnO_4$ solution	(s)	NO_2^-

Exercise-2

Marked questions are recommended for Revision.

PART - I : ONLY ONE OPTION CORRECT TYPE

1. The compound formed in the borax bead test of Cu^{2+} ion in oxidising flame is :
(A) Cu (B) $CuBO_2$ (C) $Cu(BO_2)_2$ (D) None of these

2. A fire work gave bright crimson red light. It probably contained a salt of :
(A) Ca (B) Sr (C) Ba (D) Mg

3. Alkali metal salt "X" gives a pale violet colour in flame test "X" is :
(A) NaCl (B) LiCl (C) KCl (D) None of these

4. Borax bead is responded generally by :
(A) Alkali metal salt (B) Alkaline earth metals
(C) p-block metal salt (D) d-block metal salt

5. Salt of Anion A
- $\xrightarrow{\text{dil. } H_2SO_4}$ Colourless gas with brick effervescence
- $\xrightarrow{AgNO_3}$ White ppt $\xrightarrow{\text{boil}}$ Turns black
- $\xrightarrow[K_2Cr_2O_7]{\text{Acidic}}$ Green colour

Shape of anion A will be :
(A) Tetrahedral (B) Trigonal planer
(C) Trigonal pyramidal (D) Linear

6. Which of the following anions are producing same gas on treatment with (Zn + dil. H_2SO_4).
I : SO_3^{2-} II : HSO_3^- III : S^{2-} IV : Cl^-
(A) I and II only (B) I, II and III only
(C) I, II, III and IV (D) I, III and IV only

7. Consider the following reaction; Nitrite + Acetic acid + Thiourea $\longrightarrow N_2\uparrow$ + HSCN + $2H_2O$. Formation of the product in the above reaction can be identified by :
(A) $FeCl_3$ / dilute HCl, when blood red colour appears.
(B) $FeCl_3$ / dilute HCl, when blue colour appears.
(C) $K_2Cr_2O_7$ / HCl, when green colour appears.
(D) $KMnO_4$ / HCl, when colourless solution is formed.

8. 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 obtained which does not dissolve in dil. HNO_3. The anion could be :
(A) CO_3^{2-} (B) Cl^- (C) SO_3^{2-} (D) S^{2-}

9. A salt solution of Cd^{2+} in dilute HCl, on treatment with a solution of $BaCl_2$ gives a white precipitate, which is insoluble in concentrated HNO_3. Anion in the salt may be :
(A) SO_4^{2-} (B) CO_3^{2-} (C) NO_2^- (D) S^{2-}

10. $Na_2SO_4 + BaCl_2 \longrightarrow$ White precipitate $\xrightarrow{\text{Fuse this precipitate on charcoal with } Na_2CO_3 \text{ and extract the soluble substance with } H_2O}$ Aqueous solution.

Add dil H_2SO_4 and heat the solution ↓

Gas 'G' is evolved

The gas 'G' will show which of the following property ?
(A) It turns lead acetate filter paper black.
(B) It turns acidified $K_2Cr_2O_7$ filter paper green.
(C) It produces purple colouration on filter paper moistened with sodium nitroprusside already made alkaline with sodium hydroxide.
(D) All of these

11. Sodium borate on reaction with conc. H_2SO_4 and C_2H_5OH gives a compound **(A)** which burns with a green edged flame. The compound **(A)** is :
(A) $H_2B_4O_7$ (B) $(C_2H_5)_2B_4O_7$ (C) H_3BO_3 (D) $(C_2H_5)_3BO_3$

PART - II : SINGLE AND DOUBLE VALUE INTEGER TYPE

1. How many compounds liberate NH_3 on heating from the following?
(i) $(NH_4)_2SO_4$ (ii) $(NH_4)_2CO_3$ (iii) NH_4Cl
(iv) NH_4NO_3 (v) $(NH_4)_2Cr_2O_7$

2. How many of following metals impart a characteristic colour to the Bunsen flame ?
(i) Na (ii) Li (iii) K (iv) Ba
(v) Sr (vi) Mg (vii) Rb (viii) Cs
(ix) Be (x) Ca (xi) Cu

3. Number of ions which are identified by dil. HCl from the following.
(i) SO_4^{2-} (ii) CO_3^{2-} (iii) SO_3^{2-} (iv) HCO_3^-
(v) NO_2^- (vi) NO_3^- (vii) CH_3COO^- (viii) PO_4^{3-}

4. Find the total number of acidic radical which produce volatile product with dil HCl :
(i) SO_4^{2-} (ii) I^- (iii) NO_2^- (iv) NO_3^-
(v) SO_3^{2-} (vi) HCO_3^-

5. $Na_2S + Na_2[Fe(CN)_5NO] \longrightarrow$ "X" (Violet colour)
The total number of possible isomers for complex "X" is, provided the ambident behaviour of CN^- is not considered.

6. NaCl + Solid $K_2Cr_2O_7$ + Conc. $H_2SO_4 \longrightarrow$ "X" (reddish brown fumes)
How many axial-d-orbital are involved in hybridization of "X" ?

7. $Fe^{2+} + NO_3^- + H_2SO_4$(conc.) $\rightarrow$ 'X' (Brown ring complex)
The magnetic moment of complex 'X' to its nearest integer is :

8. How many anions evolve brownish gas when treated with dil./conc. HCl ?
(i) CO_3^{2-} (ii) SO_3^{2-} (iii) NO_2^- (iv) Cl^-
(v) Br^- (vi) NO_3^- (vii) CH_3COO^-

9. Na_2CO_3, NaCl, $NaNO_2$, Na_2SO_3, NaBr, CH_3COONa are separately treated with $AgNO_3$ solution. In How many cases white precipitate is/are obtained.

10. BO_3^{3-} + conc. H_2SO_4 + CH_3CH_2–OH $\xrightarrow{\text{ignite}}$ 'A' (green flame)
What is the oxidation number of central atom in Compound 'A' that is responsible for green flame ?

11. $NaCl\ (s) \xrightarrow{MnO_2 / Conc.H_2SO_4} X\ (g)$

$NaCl\ (s) \xrightarrow{K_2Cr_2O_7 / Conc.\ H_2SO_4} Y\ (g)$

a = difference in the oxidation number of Cl in the product X and product Y, respectively
b = total number of atom in X and Y
c = total number of lone pair in X
then calculate a + b + c = ?

PART - III : ONE OR MORE THAN ONE OPTION CORRECT TYPE

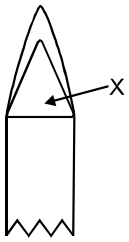
1. Which of the following salt liberates a colourless gas on acidification with dil. H_2SO_4 ?
(A) KNO_2 (B) Na_2CO_3 (C) $NaNO_2$ (D) $NaHCO_3$

2. Which of the following salts release reddish brown gas when heated in a dry test tube?
(A) $LiNO_3$ (B) KNO_3 (C) $Pb(NO_3)_2$ (D) $AgNO_3$

3. Which of the following can decompose on heating to give CO_2?
(A) Li_2CO_3 (B) Na_2CO_3 (C) $KHCO_3$ (D) $BaCO_3$

4. Metals which do not give flame test?
(A) Be (B) Li (C) Mg (D) Ba

5. In the following diagram bunsen flame the (X) represent.



(A) Oxidising zone
(B) Reducing zone
(C) Lower temperature zone
(D) Hottest portion of flame

6. Metal salts, which respond to Borax bead test?
(A) Nickel salts (B) Copper salts (C) Cobalt salts (D) Aluminium salts

7. Which of the following gases turn lime water milky when passed throught it.
(A) SO_2 (B) CO_2 (C) HCl (D) H_2S

8. A (mixture of two anions) $\xrightarrow{AgNO_3\ solutions}$ "B" (White crystalline precipitate)

A (mixture of two anions) $\xrightarrow{Zn+dil/H_2SO_4}$ C (g) $\xrightarrow{(CH_3COO)_2Pb}$ "D" (Black ppt.)

Then A may have :
(A) CO_3^{2-}, Br^- (B) Br^-, S^{2-} (C) CH_3COO^-, S^{2-} (D) CH_3COO^-, SO_3^{2-}

9. S^{2-} and SO_3^{2-} can be distinguished by :
(A) $(CH_3COO)_2Pb$
(B) $Cr_2O_7^{2-}$ / H^+
(C) $Na_2[Fe(CN)_5NO]$
(D) Zn + dil. H_2SO_4 followed by $(CH_3COO)_2Pb$

10. Which statements is/ are correct about **sodium nitroprusside** test?
(A) This test is used for detection of S^{2-} anion.
(B) H_2S also gives positive test.
(C) Formation of $Na_2[Fe(H_2O)_5NOS]$ complex confirm the presence of S^{2-} anion.
(D) Iron has +2 oxidation state in sodiumthionitroprusside complex.

11. Which statement(s) is/are correct about **Brown ring test** ?
(A) This test is given by NO_2^-, NO_3^- anions.
(B) Brown ring test depend upon the reduction of NO_2^- and NO_3^- to Nitric oxide.
(C) Brown ring is formed due to formation of $[Fe(H_2O)_5NO]_2(SO_4)_3$
(D) Charge on NO in brown ring complex is +1.

12. Which of the following metal chloride will give chromyl chloride test ?
(A) NaCl (B) KCl (C) AgCl (D) $SbCl_3$

13. Which of the following will be completely or partially dissolved in NH_4OH ?
(A) AgCl (B) AgBr (C) AgI (D) $BaSO_4$

14. Reddish-brown gas is obtained when the following are treated with conc. H_2SO_4?
(A) Br^- (B) NO_2^- (C) NO_3^- (D) SO_3^{2-}

15. Each of these are added to a mixture of aqueous solutions of iodide and $CHCl_3$ separately. Which will give a positive test for iodine when the solutions are vigorously mixed?
(A) NaCl solution (B) NaBr solution (C) Chlorine water (D) Bromine water

16. $\underset{\text{(mixture of two anions)}}{\mathbf{A}} \xrightarrow[\text{excess of } BaCl_2]{\text{Cold}} \text{white ppt.} \xrightarrow{\text{filtered}} \text{(Filtrate)} \xrightarrow{\text{boil}} \text{White ppt} \downarrow .$

Anion of **(A)** could be :
(A) SO_3^{2-}, HSO_3^- (B) CO_3^{2-}, SO_3^{2-} (C) SO_3^{2-}, HCO_3^- (D) None of these

PART - IV : COMPREHENSION

*** Marked Questions may have more than one correct option.**
Read the following passage carefully and answer the questions.

Comprehension # 1

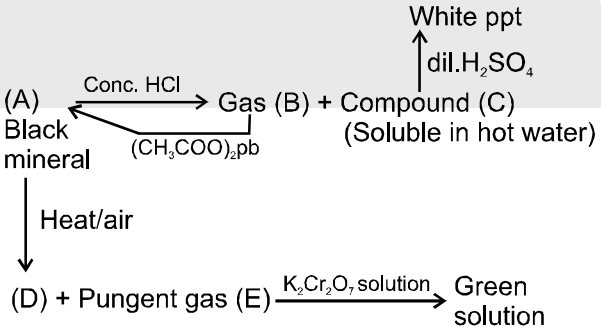
$$\underset{\text{(chlorides salt)}}{A} \xrightarrow[\text{conc. } H_2SO_4]{K_2Cr_2O_7} B \xrightarrow[\text{dil NaOH solution}]{\text{passed through}} C \xrightarrow[\& Pb(CH_3COO)_2 \text{ is added}]{\text{acidified with } CH_3COOH} D$$

Step-I **Step-II** **Step-III**

1. 'A' can be :
(A) $PbCl_2$ (B) $SbCl_3$ (C) $SnCl_2$ (D) RbCl

2.* In step-III if $Pb(CH_3COO)_2$ is added without acidifying the solution with CH_3COOH then possible product may be:
(A) $PbCrO_4$ (B) $Na_2Cr_2O_7$ (C) Na_2CrO_4 (D) Na_2PbO_2

Comprehension # 2



3. Gas (B) on passing through cadmium acetate solution will give :
(A) Black ppt (B) Yellow ppt (C) Orange ppt (D) White ppt

4. Gas (B) and (E) are respectively :
(A) H_2S, NH_3 (B) H_2S, SO_2 (C) SO_2, H_2S (D) H_2S, CO_2

Comprehension # 3

Answer Q.5, Q.6 and Q.7 by appropriately matching the information given in the three columns of the following table.

In the following three tables, information regarding Qualitative analysis of anion is given					
Column-1		**Column-2**		**Column-3**	
(I)	SO_3^{2-}	(i)	Reaction with $AgNO_3$	(P)	Precipitate is obtained
(II)	Cl^-	(ii)	Pungent smelling product with conc. H_2SO_4	(Q)	Product is coloured gas.
(III)	NO_2^-	(iii)	Form X_2 with $K_2Cr_2O_7$(s) + conc. H_2SO_4	(R)	Product formed is soluble in excess NH_3.
(IV)	Br^-	(iv)	Reaction with $Pb(NO_3)_2$(aq)	(S)	Product gives blue colour with starch iodide solution.

5. Select the only correct option.
(A) (I) (i) (P) (B) (II) (ii) (Q) (C) (I) (ii) (S) (D) (II) (iii) (Q)

6. Select the only incorrect option.
(A) (III) (i) (P) (B) (I) (ii) (Q) (C) (IV) (i) (R) (D) (IV) (ii) (Q)

7. Select the only incorrect option.
(A) (III) (ii) (Q) (B) (IV) (ii) (S) (C) (II) (iv) (P) (D) (II) (ii) (S)

Exercise-3

*** Marked Questions may have more than one correct option.**

PART - I : JEE (ADVANCED) / IIT-JEE PROBLEMS (PREVIOUS YEARS)

1. The acidic aqueous solution of Ferrous ion forms a brown complex in the presence of NO_3^- by the following two steps : **[JEE 1993]**
$[Fe(H_2O)_6]^{2+} + NO_3^- + H^+ \longrightarrow$ ..... + $[Fe(H_2O)_6]^{3+} + H_2O$
$[Fe(H_2O)_6]^{2+}$ + ... + H_2O
Complete and balance the equations.

2. In nitroprusside ion the iron and NO exist. They exist as Fe^{II} and NO^+ rather than Fe^{III} and NO. These forms can be differentiated by : **[JEE 1998]**
(A) estimating the concentration of Iron.
(B) measuring the concentration of CN.
(C) measuring the solid state magnetic moment.
(D) thermally decomposing the compound.

3. **Assertion :** Sulphate is estimated as $BaSO_4$ and not as $MgSO_4$.
Reason : Ionic radius of Mg^{2+} is smaller than that of Ba^{2+}. **[JEE 1998]**
(A) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.
(B) Both Assertion and Reason are true but Reason is not correct explanation of Assertion.
(C) Assertion is true but Reason is false.
(D) Assertion is false but Reason is true.

4. A gas 'X' is passed through water to form a saturated solution. The aqueous solution on treatment with silver nitrate gives a white precipitate. The saturated aqueous solution also dissolves magnesium ribbon with evolution of a colourless gas 'Y'. Identify 'X' and 'Y'? **[JEE 2002(S), 3/90]**
(A) X = CO_2, Y = Cl_2 (B) X = Cl_2, Y = CO_2 (C) X = Cl_2, Y = H_2 (D) X = H_2, Y = Cl_2

5. [X] + $H_2SO_4 \longrightarrow$ [Y] a colourless gas with irritating smell;
[Y] + $K_2Cr_2O_7$ + $H_2SO_4 \longrightarrow$ green solution.
[X] and [Y] is : **[JEE 2003(S), 3/84]**
(A) SO_3^{2-}, SO_2 (B) Cl^-, HCl (C) S^{2-}, H_2S (D) CO_3^{2-}, CO_2

6. A dilute aqueous solution of a sodium salt forms white precipitate with $MgCl_2$, only after boiling. The anion of the sodium salt is : **[JEE 2004(S), 3/84]**
(A) HCO_3^- (B) CO_3^{2-} (C) NO_3^- (D) SO_4^{2-}

7. The species present in solution when CO_2 is dissolved in water are : **[JEE 2006, 5/184]**
(A) CO_2, H_2CO_3, HCO_3^-, CO_3^{2-} (B) HCO_3^-, CO_3^{2-}
(C) CO_3^{2-}, HCO_3^- (D) CO_2, H_2CO_3

8.* The reagent(s) that can selectively precipitate S^{2-} from a mixture of S^{2-} and SO_4^{2-} in aqueous solution is(are) **[JEE(Advanced) 2016, 4/120]**
(A) $CuCl_2$ (B) $BaCl_2$ (C) $Pb(OOCCH_3)_2$ (D) $Na_2[Fe(CN)_5NO]$

9. The green colour produced in the borax bead test of a chromium (III) salt is due to **[JEE(Advanced) 2019, 3/124]**
(1) CrB (2) Cr_2O_3 (3) $Cr(BO_2)_3$ (4) $Cr_2(B_4O_7)_3$

PART - II : JEE (MAIN) / AIEEE PROBLEMS (PREVIOUS YEARS)

JEE(MAIN) ONLINE PROBLEMS

1. Sodium extract is heated with concentrated HNO_3 before testing for halogens because : **[JEE(Main) 2016 Online (10-04-16), 4/120]**
(1) Ag reacts faster with halides in acidic medium.
(2) Silver halides are totally insoluble in nitric acid.
(3) Ag_2S and AgCN are soluble in acidic medium.
(4) S^{2-} and CN^-, if present, are decomposed by conc. HNO_3 and hence do not interfere in the test.

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 aforementioned solution, a white precipitate is obtained which does not dissolve in dilute nitric acid. The anion is : **[JEE(Main) 2018 Online (15-04-18), 4/120]**
(1) CO_3^{2-} (2) SO_4^{2-} (3) S^{2-} (4) Cl^-

Answers

EXERCISE - 1

PART - I

A-1. The dry test give information in short time and also provides a clue about the presence or absence of certain substances so wet analysis may be modified and shortened.
It is applicable to solid substances.

A-2. (a) $HgCO_3 \xrightarrow{\Delta} Hg + CO_2\uparrow + \frac{1}{2}O_2\uparrow$

(b) $NH_4NO_2 \xrightarrow{\Delta} N_2\uparrow + 2H_2O\uparrow$ (no solid residue)

(c) $NH_4Cl + NaNO_3$ (mixture) $\xrightarrow{\Delta} NaCl + N_2O\uparrow + 2H_2O\uparrow$

(d) $Pb(NO_3)_2 \xrightarrow{\Delta} PbO + 2NO_2\uparrow + \frac{1}{2}O_2\uparrow$

B-1. When compound is heated, the electrons gain energy and can jump into the empty orbitals at higher level. Higher levels are energetically unstable so electrons tend to fall back and transmit the light as characteristic colour.

B-2. Yes, because intensity of the absorbed light is proportional to the concentration of element in the flame.

B-3. Both barium sulphate and barium phosphate are insoluble and cannot be easily converted into chlorides.Therefore, the green flame is either indistinct or visible with difficulty.

B-4. $Na_2B_4O_7.10H_2O \xrightarrow[740°C]{\Delta} 2NaBO_2 + B_2O_3 \xrightarrow{Cu^{2+},\Delta} Cu(BO_2)_2$

(A) (B+C) (Blue bead) (D)

C-1. Sodium carbonate extract in addition to the sodium salts of anions contain carbonate also. On heating with the test reagent carbonates of certain metals precipitate which interfere in the detection of acid redicals. Because of this, Na_2CO_3 is decomposed by adding HCl, HNO_3, H_2SO_4, depending upon the nature of test.

C-2. No, because it already contains CO_3^{2-} ions.

C-3. White precipitate of $CaCO_3$ is formed.
$Ca(HCO_3)_2 + 2\,NH_3 \longrightarrow (NH_4)_2CO_3 + CaCO_3\downarrow$

C-4. Colour of bromine water is discharged according to the following reaction.
$BaSO_3 + Br_2 + H_2O \longrightarrow BaSO_4\downarrow$ (white) $+ 2HBr$

C-5. (A) = SO_3^{-2} (C) = HSO_3^- (Lime water test)

C-6. **(a)** Blue colouration develops due to the formation of iodine gas.

$5\,SO_2 + 2IO_3^- + 4\,H_2O \longrightarrow I_2 + 5\,SO_4^{2-} + 2\,H^+$

I_2 + Starch $\longrightarrow$ Blue (starch iodine adsorption complex)

(b) Black precipitate is formed owing to the formation of PbS.

$[Pb(OH)_4]]^{2-} + H_2S \longrightarrow PbS\downarrow + 2OH^- + 2\,H_2O$

(c) $SO_3^{2-} + 3\,Zn + 8\,H^+ \longrightarrow H_2S + 3\,Zn^{2+} + 3\,H_2O$

C-7. $NO_2^- + CH_3COOH \longrightarrow HNO_2 + CH_3COO^-$

$3\,HNO_2 \longrightarrow H_2O + HNO_3 + 2\,NO\uparrow$

$NO\uparrow + Fe^{2+} + SO_4^{2-} \longrightarrow [FeNO]SO_4$ (Nitroso ferrous sulphate)

D-1. There are some ions like, SO_3^{2-}, S^{2-}, NO_2^- and CH_3COO^- which can react with dilute/conc. H_2SO_4 whereas ions like Cl^- , Br^-, I^- , $NO_3^{\ominus}$, etc. react only with con. H_2SO_4.
Now if conc. H_2SO_4 is used first then the anions of both the types will react. Hence, it is desired to test acid radicals first with dilute H_2SO_4 and then with conc. H_2SO_4.

D-2. Because in presence of water, chromyl chloride forms the chromic acid.
$CrO_2Cl_2 + 2H_2O \longrightarrow H_2CrO_4 + 2HCl$

D-3. Because chromyl bromide (CrO_2Br_2) and chromyl iodide. (CrO_2I_2) compounds are unstable and are not formed. In such case bromine and iodine are evolved

D-4. HBr and HI are reducing agent where as H_2SO_4 is oxidizing agent and thus Br_2 and I_2 are formed.
$NaCl + H_2SO_4 \rightarrow NaHSO_4 + HCl$
$NaBr / NaI + H_2SO_4 \rightarrow NaHSO_4 + HBr/HI$
$HBr/HI + H_2SO_4 \rightarrow Br_2/I_2 + SO_2 + 2H_2O$

D-5. Because in presence of water chromic acid is obtained in place of chromyl chloride.

D-6. A = Cl_2 ; B = Br_2 ; C = I_2

D-7. Because heavy metal chlorides are partially dissociated. This test is given generally by Ionic chloride.

D-8. This is because Fe^{2+} ions on long standing are oxidised to Fe^{3+} ions which are not used for the detection of nitrate and nitrite.

E-1. Because they also impart green colour to flame.

E-2. Not in dilute HCl but dissolves in all other reagents.
$PbSO_4 \downarrow + H_2SO_4 \longrightarrow Pb^{2+} + 2\ HSO_4^-$; $PbSO_4 \downarrow + 4\ CH_3COO^- \longrightarrow [Pb(CH_3COO)_4]^{2-} + SO_4^{2-}$
$PbSO_4 \downarrow + 2\ C_6H_4O_6^{2-} \longrightarrow [Pb(C_6H_4O_6)_2]^{2-} + SO_4^{2-}$
$PbSO_4 \downarrow + 4\ OH^- \longrightarrow [Pb(OH)_4]^{2-} + SO_4^{2-}$

E-3. $BaCl_2$ gives a white precipitate. with both sulphite and sulphate ions.
$BaSO_3$ is soluble in conc.HCl whereas $BaSO_4$ is insoluble in conc.HCl.
$SO_3^{2-} + MnO_4^- + H^+ \longrightarrow Mn^{2+}$ (colourless)
$SO_4^{2-} + MnO_4^- + H^+ \longrightarrow$ (No colour change)

PART - II

A-1.	(B)	**A-2.**	(B)	**A-3.**	(C)	**A-4.**	(D)	**A-5.**	(D)
B-1.	(C)	**B-2.**	(B)	**B-3.**	(A)	**B-4.**	(B)	**B-5.**	(D)
B-6.	(C)	**B-7.**	(C)	**C-1.**	(C)	**C-2.**	(B)	**C-3.**	(A)
C-4.	(C)	**C-5.**	(B)	**C-6.**	(C)	**C-7.**	(C)	**C-8.**	(D)
D-1.	(B)	**D-2.**	(A)	**D-3.**	(B)	**D-4.**	(B)	**D-5.**	(B)
D-6.	(D)	**D-7.**	(A)	**D-8.**	(D)	**D-9.**	(D)	**D-10.**	(C)
D-11.	(B)	**E-1.**	(C)	**E-2.**	(C)				

PART - III

1. (A) - (r,t); (B) - (q); (C) - (q,t); (D) - (p,r,s)

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

EXERCISE - 2

PART - I

1.	(C)	**2.**	(B)	**3.**	(C)	**4.**	(D)	**5.**	(C)
6.	(B)	**7.**	(A)	**8.**	(B)	**9.**	(A)	**10.**	(D)
11.	(D)								

PART - II

1.	3 (i, ii, iii)	**2.**	9 (All, except vi and ix)			**3.**	5 (ii, iii, iv, v, vii)
4.	3 (iii, v, vi)	**5.**	3	**6.**	0	**7.**	4
8.	1 (only iii)	**9.**	5 (All except NaBr)			**10.**	3
11.	14 (a = 1, b = 7, c = 6)						

PART - III

1.	(BD)	**2.**	(ACD)	**3.**	(ACD)	**4.**	(AC)	**5.**	(BC)
6.	(ABC)	**7.**	(AB)	**8.**	(D)	**9.**	(ABC)	**10.**	(AD)
11.	(ABD)	**12.**	(AB)	**13.**	(ABC)	**14.**	(ABC)	**15.**	(CD)
16.	(AC)								

PART - IV

1.	(D)	**2.**	(AD)	**3.**	(B)	**4.**	(B)	**5._**	(A)
6._	(B)	**7._**	(D)						

EXERCISE - 3

PART - I

1. $3[Fe(H_2O)_6]^{2+} + NO_3^- + H^+ \longrightarrow NO + 3[Fe(H_2O)_6]^{3+}$

$[Fe(H_2O)_6]^{2+} + NO \longrightarrow [Fe(H_2O)_5NO]^{2+} + H_2O$

2.	(C)	**3.**	(B)	**4.**	(C)	**5.**	(A)	**6.**	(A)
7.	(A)	**8.***	(A or AC)	**9.**	(3)				

PART - II

JEE(MAIN) ONLINE PROBLEMS

1.	(4)	**2.**	(4)