Chemistry chart

Inorganic Qualitative Analysis

Name_____

Class_____

Div_____

Roll No_____

Batch No_____

PRELIMINARY TESTS:

TEST	OBSERVATION	INFERENCE
DRY TEST OF CATION (BASIC RADICALS)		
1. Colour	(a) Blue or Bluish green	Cu^{2+} or Ni^{2+} may be present
	(b) Green	Ni^{2+} may be present
	(c) Reddish Brown or Brown	Fe^{3+} may be present
	(d) Pink	Co^{2+} may be present
	(e) Light Pink, Flesh colour or earthy colour	Mn^{2+} may be present
	(f) Colourless (white)	Cu^{2+},Ni^{2+} ,Fe^{3+},Co^{2+}, Mn^{2+}may be absents. Pb^{2+}, Al^{3+},Zn^{2+},Ca^{2+},Sr^{2+}, Ba^{2+},Mg^{2+},K^{+},NH_4^{+} may be present
2. Heating in a dry test tube Little of compound heated in a dry heating tube **N.B** *(1) Observe the evolution Of gases also* *(2) If original compd is coloured then only a black residue obtained* *(3)Observe the changes by first slowly heating followed by strong heating*	(a) Decrepitation *(Crackling sound)*	$Pb(NO_3)_2$,KCl,$Ba(NO_3)_2$ KNO_3 may be present
	(b) Coloured residue *(including black)*	Cu^{2+}, Co^{2+},Ni^{2+},Fe^{3+} salts may be present
	(c) White infusible residue	Ba^{2+},Sr^{2+},Ca^{2+} may be present
	(d) White sublimate	.: Ammonium halides may be present
	(e) Yellow residue when hot which turns white when cold	Zn^{2+} may be present
	(f) White compd gives black residue on strong heating	.: $K_2C_2O_4$ may be present
	(g) **Evolution of gases**	
	(1) Colourless gas with Smell of Ammonia turning red litmus paper blue	.: NH_4^{+} may be present
	(2) Colourless gas turning blue litmus paper red	.:Cl^- , SO_4^{2-} , CH_3COO^- may be present
	(3) Colourless gas with having vinegar like smell	CH_3COO^- may be present

TEST	OBSERVATION	INFERENCE
	(4) Colourless gas turning lime water milky	$C_2O_4^{2-}$ may be present
	(5)Brown funes give out	NO_3^-,Br^- may be present
	(6)Greenish yellow gas turning starch iodide paper blue	$C1^-$ may be present
	(7)Reddish brown gas turning starch iodide paper orange yellow	Br^- may be present
	(8)Dark violet vapours gives out turning starch iodide paper blue	I^- may be present
3. Flame test *Clean the Pt.loop/Nichrome wire by dipping it in a t.t containing a little conc. HCl and placing it in the blue part of the flame. moisten a little compd on the watch glass with conc. HCl. Dip the Pt.loop/Nichrome wire in this mixture and hold it in the blue part of the flame. Observe the flame colour*	(1) Lilac or Violet flame	K^+ may be present
	(2) Bluish white flame	Pb^{2+} may be present
	(3) Bluish green flame	Cu^{2+} may be present
	(4) Apple green flame	Ba^{2+} may be present
	(5) Brick red (Dull red) flame	Ca^{2+} may be present
	(6) Crimson red (dark red) flame	Sr^{2+} may be present
	(7) No characteristic colour to the flame	K^+ Pb^{2+} Cu^{2+} Ba^{2+} Ca^{2+} Sr^{2+} May be absent.
4. Test for NH_4^+ Compound + dil NaOH. Warm	(1) Gas evolved with smell of ammonia forming dense white fumes with a glass rod dipped in conc. HCl.	.: NH_4^+ may be present
	(2) No smell of ammonia	.: NH_4^+ may be absent
DRY TEST FOR ANION (ACIDIC RADICALS) **5. Action of dil. HCl** Compd + dil HCl *(Observe without heating.)*	(1) Effervescence of a gas turning lime water milky	.: CO_3^{2-} may be present
	(2) No Effervescence	.: CO_3^{2-} may be Absent

TEST	OBSERVATION	INFERENCE
6. **Action of Conc.H_2SO_4** Compd + Conc.H_2SO_4 **NB**: *Test for $C1^-$ in cold. If Cl^- absent, warm and observe*	(1) Colourless fumes of HCl given out forming dense white fumes with a glass rod dipped in NH_4OH.	.: Cl^- may be present
	(2)Colourless vapours given out on warming, having the smell of vinegar.	.: CH_3COO^- may be present
	(3) Reddish brown or yellowish brown vapour given out on warming the test tube.	.: Br^-,NO_2^-, NO_3^- may be present
	(4) Brownish fumes obtained above (3) increases on addition of Cu foil.	.: Br^- may be absent NO_2^-, NO_3^- may be present
	(5) Violet vapours given out on warming the test tube.	.: I^- may be present
	(6) No characteristic fumes / vapours	Cl^-, Br^-, I^-, NO_3^-, CH_3COO^- may be absent
7.Test for PO_4^{3-} Compd.+ Conc HNo_3 *(Boil to drive out any coloured fumes if given.)* Add excess of ammonium molybdate soln	1) Canary yellow ppt	.: PO_4^{3-} may be present
	2) No Canary yellow ppt	.: PO_4^{3-} absent.
8. **Test for $C_2O_4^{2-}$ ($KMnO_4$ Test)** Compd. + 2 mldil.H_2SO_4 Boil off any gas evolved, add little more dil.H_2SO_4 and then $KMnO_4$ soln dropwise.	$KMnO_4$ Soln is decolourised	.: $C_2O_4^{2-}$ may be present
	$KMnO_4$ Soln is not decolourised	.: $C_2O_4^{2-}$ absent.

NB: *If the tests (5) ,(6),(7) and (8) do not give positive results ,the compound may contain SO_4^{2-} anion.*

PREPARATION OF SOLUTION (W.E)

Take a 10 ml (approx) of distilled water in a 25 ml beaker, warm and add pinch by pinch the compound , stir till it dissolves, then add more . Solution obtained is (W.E) **Water Extract** (*Use this solution to perform the wet tests for cation and anion).*

1. TEST FOR HALIDES (Cl^-, Br^-, I^-)		
W.E + $AgNO_3$	No ppt or Ppt soluble in dil HNO_3	Halides absent.
	Ppt insoluble in dil HNO_3	Halides (Cl^-, Br^-, I^-) are present
DETECTION OF HALIDES (Cl^-, Br^-, I^-)		
Note the colour of the appt obtained above in	(a) White ppt soluble in NH_4OH	Cl^- is present
	(b) Pale yellow ppt	Br^- is present
	(c) Yellow ppt	I^- is present
C.T FOR Cl^- /Br^- / I^-		
(i) W.E + Conc H_2SO_4 + MnO_2. Warm gently	(a) Faint greenish yellow fumes turning moist blue litmus paper red and finally bleaches it	Cl^- is confirmed
	(b) Reddish brown fumes	Br^- is confirmed
	(c) Violet fumes	I- is confirmed
ii) W.E + dil. H_2SO_4 + CCl_4 or $CHCl_3$ + excess of strong chlorine water. Shake well and allow to stand	(a) Colourless CCl_4 /$CHCl_3$ layer	Cl^- is confirmed
	(b) Reddish yellow CCl_4 / $CHCl_3$ layer	Br^- is confirmed
	(c)Violet CCl_4 /$CHCl_3$ layer	I^- is confirmed
2. TEST FOR CARBONATE (CO_3^{2-})		
W. E + $CaCl_2$	White ppt soluble in dil HNO_3 with effervescence.	
C.T for CO_3^{2-}		
(i) W.E + dil HCl	Effervescence of a gas turning lime water milky.	CO_3^{2-} is present
		CO_3^{2-} is confirmed
(ii) W.E + phenolphthalein	Pink colour	CO_3^{2-} is confirmed
3. TEST FOR SULPHATE (SO_4^{2-})		
W.E + di.l HNO_3 + $Ba(NO_3)_2$	White ppt	
C. T FOR SULPHATE		SO_4^{2-} is present
W.E + Pb $(CH_3COO)_2$	White ppt insoluble in dil. HNO_3	SO_4^{2-} is confirmed

4. TEST FOR NITRATE (NO_3^-) W.E Conc H_2SO_4 +Cu filings. *Warm Carefully.*	Brown fumes of NO_2 and Bluish green soln	NO_3^- is present
C.T For NO_3^- W.E + Conc H_2SO_4 Cool under tap. then add freshly prepared saturated $FeSO_4$ soln Carefully along the sides of the test tube .	Brown ring (of $FeSO_4.NO$) at the junction of the two solutions	NO_3^- is confirmed
5.TEST FOR PHOSPHATE (PO_4^{3-}) W.E + Conc. HNO_3 boil gently. Add ammonium Molybdate in excess and warm again.	Canary yellow ppt	PO_4^{3-} is present
C.T For PO_4^{3-} W.E + NH_4Cl + NH_4OH + Mg SO_4 solution	White crystalline ppt of Magnesium ammonium phosphate	PO_4^{3-} is confirmed
6.TEST FOR ACETATE (CH_3COO^-) W.E + neutral $FeCl_3$ soln	Reddish coloured ppt or soln	CH_3COO^- is present
C.T for CH_3COO^- To the decanted solution from above add dil HCl	Reddish colour disappears and a white ppt is formed in a yellow coloured solution	CH_3COO^- is confirmed
(2) ESTER TEST W.E + Conc. H_2SO_4 (2ml) Heat. Add ethyl alcohol (1ml). Shake warm pour this soln into a beaker containing water.	Pleasant fruity smell of ester.	CH_3COO^- is confirmed.
7. TEST FOR OXALATE ($C_2O_4^{2-}$) W.E + dil CH_3COOH. Boil to remove CO_2. Add $CaCl_2$ soln.	White ppt formed that dissolves on adding dil HNO_3 and warming.	$C_2O_4^{2-}$ is present.
C.T FOR $C_2O_4^{2-}$ W.E + dil H_2SO_4 warm. Add 2-3 drops of $KMnO_4$	Pink colour of $KMnO_4$ is decolourised with the evolution of CO_2 gas.	$C_2O_4^{2-}$ is confirmed

WET TEST FOR CATION
DETECTION OF CATION OF GROUP ZERO (NH_4^+)

TEST	OBSERVATION	INFERENCE
W.E + 2ml dil NaOH shake well and warm gently	(1) No smell of Ammonia/ NH_3 gas not evolved	.: Group O is absent .: NH_4^+ is absent
	(2)NH_3 gas evolved recognized by its smell turning most red litmus paper blue **or** moist Turmeric Paper brown **or** Evolution of dense white fumes when a glass rod dipped in conc.HCl is held over the mouth of the test tube	.: Group O is Present .: NH_4^+ is Present
C.T. for NH_4^+ 1ml of Nessler's reagent + 2 drops of W.E	Brown ppt or Colouration	.: NH_4^+ is confirmed

SEPARATION OF CATIONS INTO GROUPS (I – VI)

TEST	OBSERVATION	INFERENCE
1)W.E + dil. HCl	White ppt	Group I is present .: Pb^{2+} is present *(Refer table No 2)*
	No white ppt	Group I is absent
2)W.E + dil. HCl + warm and add H_2S water.	Black ppt	.: Group II is present .: Cu^{2+} is present *(Refer Table No 3)*
	No black ppt	Group II is absent
3) W.E + Solid NH_4Cl + NH_4OH till alkaline	Coloured ppt *(white or Brown)*	.: Group III is present .: Al^{3+}, Fe^{3+}, Mn^{2+} are present *(Refer Table No 4)*
	No coloured ppt	.: Group III is absent .

4) W.E + solid NH_4Cl +NH_4OH till alkaline + H_2S gas / H_2S water	Coloured ppt *(Black, White,Pink)*	Group IV is present Co^{2+}, Ni^{2+}, Zn^{2+} and Mn^{2+} are present *(Refer Table No 5)*
	No coloured ppt	.: Group IV is absent
5) W. E + Solid NH_4Cl + NH_4OH till alkaline + $(NH_4)_2 CO_3$. Warm	White ppt	Group V is present .: Ba^{2+}, Sr^{2+}, Ca^{2+} are present *(Refer Table No 6)*
	No white ppt	.: Group V is absent .: Group VI is present .: K^+,or Mg^{2+} may be present *(Refer Table No 7.)*

TABLE NO. 2

Analysis of Group I (Pb^{2+})

The colour of the group I ppt ($PbCl_2$) is white

.: Pb^{2+} is present.

C.T. for Pb^{2+}

TEST	OBSERVATION	INFERENCE
1) W.E + $^1/_2$ ml KI	Yellow ppt of $Pb I_2$	.: Pb^{2+} is confirmed
2) W.E + ½ ml K_2CrO_4	Yellow ppt	.: Pb^{2+} is confirmed
3) W.E + ½ ml dil H_2SO_4	White ppt of $PbSO_4$	.: Pb^{2+} is confirmed

TABLE NO 3

Analysis of Group II (Cu^{2+})

The colour of the group II ppt (CuS) is black .: Cu^{2+} is present.

C.T. for Cu^{2+}

Test	OBSERVATION	INFERENCE
1. W.E + KI soln	Brown ppt of CuI_2	.: Cu^{2+} is confirmed
2. W.E + dil NaoH	Blue ppt of $Cu(OH)_2$ turning black on heating	.: Cu^{2+} is confirmed

TABLE NO. 4

Analysis of Group III (Al^{3+}, Fe^{3+}, Mn^{2+})

The colour of the ppt of Group III hydroxides is white / Reddish brown

<table>
<tr><td rowspan="4">White gelatinous ppt.
.: Al^{3+} is present.

<u>C.T. for Al^{3+}:</u>
1) W.E + NaOH soln dropwise → gelatinous white ppt soluble in excess of NaOH.
2) W.E +Na_2CO_3 solution →white ppt.
3) W.E + ammonium acetate soln.→No ppt in cold but on boiling a white gelatinous ppt.

Al^{3+} is confirmed.</td><td colspan="2">Reddish brown or brown or pink ppts
. :Fe^{3+} or Mn^{2+} are present.</td></tr>
<tr><td colspan="2">: W.E +$K_4Fe(CN)_6$→ Deep blue ppt / no deep blue ppt.</td></tr>
<tr><td>Deep blue ppt or colouration

Fe^{3+} is present.</td><td>No deep blue ppt

Mn^{2+} is present</td></tr>
<tr><td>C.T for Fe^{3+}
W.E. + KSCN/NH_4CN → Blood red colouration.

Fe^{3+} is confirmed</td><td>C.T for Mn^{2+}
1) W.E.+ NH_4OH till alkaline →white ppt turning brown on heating
2) W.E +5ml of dil HNO_3 +pinch of solid Sodium bismuthate. Shake, allow to stand →violet colouration.
Mn^{2+} is confirmed</td></tr>
</table>

*Note: With concentrated W.E the Mn^{2+} is precipitated In Group III as $Mn(OH)_2$ (brown or buff ppt) Otherwise Mn^{2+} will be precipitated as MnS (Pinkish ppt) in Group IV. Thus, Mn can analysed either in **Group III** or in **Group IV**.*

TABLE NO 5

Analysis of Group IV (Co^{2+}, Ni^{2+}, Zn^{2+}, Mn^{2+})

The colour of the ppt.of Group IV sulphides is Black / White / Pinkish

<table>
<tr>
<td colspan="2">Black ppt.
: Co^{2+} or Ni^{2+} are present</td>
<td rowspan="2">White ppt.

Zn^{2+} is present.

<u>C.T for Zn^{2+}:</u>
1) W.E. + $K_4Fe(CN)_6$ → White ppt.

2) W.E.+NaOH soln. dropwise → White ppt. Soluble in excess of NaOH and is reppt. as ZnS on addition of H_2S gas.

.: Zn^{2+} is confirmed</td>
<td rowspan="2">Pinkish ppt.
.
: Mn^{2+} is present.

<u>C.T. for Mn^{2+}:</u>
1) W.E + NH_4OH → White ppt.turning brown on heating.
2) W.E +5ml dil HNO_3 pinch of sodium bismuthate. Shake and allow to stand → Violet colouration.
3) W.E + PbO_2 (0.1g) +1/2 ml of dil.(1:1) HNO_3; boil and allow to settle → Violet colouration.

.:Mn^{2+} is confirmed

.</td>
</tr>
<tr>
<td colspan="2">W.E + equal volume acetone + NH_4SCN → Blue colour / no blue colour</td>
</tr>
<tr>
<td><u>Blue colour</u>
Co^{2+} is present.
<u>C. T. for Co^{2+}</u>
1) W.E.+1ml of a-nitroso β- napthol →Brown ppt.

2) W.E.+NaOH →blue ppt changing to brown on heating.

3) W.E.+ NH_4Cl+NH_4OH till alkaline +$K_4Fe(CN)_6$→ Red soln. Warm →Reddish brown ppt.

.:Co^{2+} is confirmed
.</td>
<td><u>No Blue colour</u>
Ni^{2+} is present.
<u>C.T. for Ni^{2+}</u>
1) W.E. + NH_4Cl +NH_4OH till alkaline + dimethyl glyoxime. →Scarlet red ppt.

2) W.E. + NH_4OH in excess. → Pale green ppt. soluble in excess giving blue soln.

.:Ni^{2+} is confirmed</td>
</tr>
</table>

TABLE NO 6

Analysis of Group V (Ba^{2+}, Sr^{2+}, Ca^{2+})

The colour of the ppt. of Group V carbonates is white therefore Ba^{2+}/. Sr^{2+} or Ca^{2+} are present

W.E +Acetic acid+ K_2CrO_4 → yellow ppt / no yellow ppt.

Yellow ppt. Ba^{2+} is present.	No yellow ppt. Sr^{2+} or Ca^{2+} are present . W.E +Acetic acid + NH_4OH till alkaline + solid $(NH_4)_2SO_4$ + boil → white ppt. / No white ppt	
C.T.for Ba^{2+}: 1) W.E +Acetic acid.+ ammonium oxalate soln. → White ppt. insoluble in acetic acid. 2) W.E +Acetic acid. + dil. H_2SO_4 → White ppt. 3) Flame test → Apple green flame. .:Ba^{2+} is confirmed.	**White ppt.** Sr^{2+} is present **.C.T.for Sr^{2+}:** 1) W.E +Acetic acid Ammonium oxalate →White ppt. Insolube in acetic acid. 2) W.E +Acetic acid.+ dil. H_2SO_4 → White ppt. 3) Flame test → Crimson red flame. .:Sr^{2+} is confirmed.	**No white ppt** Ca^{2+} is present **.C.T. for Ca^{2+}** 1) W.E +Acetic acid.+ $CaSO_4$ → No ppt. 2) W.E +Acetic acid.+ $(NH_4)_2C_2O_4$ → White ppt. Insoluble in acetic acid. 3) Flame test → Brick red Flame. .:Ca^{2+} is confirmed.

TABLE NO 7

Analyses of Group VI (Mg^{2+}, K^+)

TEST FOR K^+ W.E + 1-2ml of fresh and clear solution of sodium cobaltinitrite. → Yellow ppt .: K^+ is present. **C. T for K^+** (1) W.E + picric acid → yellow ppt. .: K^+ is confirmed Note:-If K^+ is absent test for **Mg^{2+}**	**TEST FOR Mg^{2+}** W.E add NH_4Cl and NH_4OH till alkaline (in slight excess) and then add ammonium phosphate solution. Scratch the inner side of the test tube with a glass rod→ 1. white crystalline ppt .: Mg^{2+} is present 2. No white ppt .: Mg^{2+} is Absent **C.T for Mg^{2+}** W.E + NaOH solution → White ppt soluble in NH_4Cl solution .: Mg^{2+} is confirmed

Result:-

a. Cation_____

b. Anion_____

c. Formula_____

d. Name of the Compound_____

Instructions:

1. Always be in time for your practical's.
2. Always corne prepared for the experiment. This will help in understanding the experiment better.
3. Always listen to the teacher's instructions carefully and note down the important points and precautions to be followed.
4. Do only the experiments assigned, unallotted experiments should not be done.
5. Do your experiment honestly without caring for the final result. Record the observations on a rough note-book instead of writing on pieces of paper.
6. Be economical with the reagents. Only small quantities of the reagent are to be used.
7. Handle the glass apparatus very carefully. In case of any breakage, report it to your teacher at once.
8. Dispose of all waste liquids in the sink and allow the water to run for sometime by opening the water tap.
9. Keep your work place clean. If an acid or other corrosive chemical is spilled, wash it off with water.
10. In case of any injury or accident or breakage of the apparatus, report it to the teacher immediately.
11. Wash your hands with soap after the experiment.

Precautions:

1. Do not touch any chemical with the hand as some of them may be corrosive.
2. Never taste a chemical. It may be poisonous.
3. Do not place the chemical on the palm of your hand.
4. Do not keep the reagent bottles open.
5. Do not roam here and there in the laboratory uselessly.
6. Do not put any object into the reagent bottle.
7. Do not bring inflammable liquids such as alcohol or ether near the flame.
8. Do not take the reagent from the shelf to your work place.
9. Do not disturb the arrangement of the reagents placed on the shelf.
10. Do not use cracked glass apparatus such as beakers for heating purposes.
11. Do not keep the water tap running when not required.
12. Do not throw solid waste materials like pieces of filter paper, broken test-tubes, etc in the sink. Throw them in the waste box only.
13. Do not heat beakers or a china dish directly on a flame. Always make use of wire gauze.

Always wear: 1.Safety gloves 2.Safety glasses 3.Gas masks and 4.Lab coat *(Apron)* in the Lab

*******************Work Safely*********************