

Practical - 1

Date: _____

Aim: Qualitative analysis of given unknown inorganic substance [NH₄Cl]

[A] PHYSICAL PROPERTIES :-

No	Test	Observation	Inference
(1)	State	Crystalline	All soluble substance like K^+ , NH_4^+ , Cl^- , Br^- , I^- etc may be present.
(2)	Colour	White	Generally compounds of Al^{3+} , NH_4^+ , Zn^{2+} , Ca^{2+} , K^+ etc. may be present.
(3)	Odour	No particular odour	$(NH_4)_2CO_3$, NH_4OH , K_2S , etc may be present.
(4)	Solubility in water	Soluble	All soluble substance like K^+ , NH_4^+ , Cl^- , Br^- , I^- , NO_3^- etc may be present.
(5)	Action of litmus paper	Neutral	Salts of strong acid and strong base or salts of weak acid and weak base may be present.

[B] DRY TEST FOR POSITIVE RADICAL :-

No	Test	Observation	Inference
(1)	Heating in dry test tube	Sublimation takes place on the cooler part of the test tube	$\therefore NH_4^+$ may be present

change in colour

No change

$\therefore Al^{3+}, Ca^{2+}, Sr^{2+}, Ba^{2+}$, etc. may be present.

Evolution of a gas

Evolution of NH_3 gas recognized by smell, alkaline action on litmus, turmeric paper turns to brown and gives a white fumes with drop. of conc. HCl

$\therefore NH_4^+$ may be present. (1)

(2) Mixture test

Evolution of NH_3 gas recognized by smell.

$\therefore NH_4^+$ may be present. (E)

(3) charcoal cavity test

white infusible mass which glows when heated, sublimation take place

$\therefore Ca^{2+}, Sr^{2+}, Ba^{2+}$ etc may be present. $\therefore NH_4^+$ may be present.

(4) cobalt nitrate test

No particular colour

$\therefore Zn^{2+}, Al^{3+}, PO_4^{3-}, Mg^{2+}$ may be absent.

(5) Borax Bead Test: It can not be performed because given substance is white in colour.

(6) flame test

No	colour of flame without cobalt glass	colour of flame through cobalt glass
	violet (Pink)	rimson

$\therefore K^+$ may be absent.

7) Test for NH_4^+ :	Evolution of NH_3 gas recognized by smell.	NH_4^+ may be present.
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(C) DRY TEST FOR NEGATIVE RADICAL:-

(1) Test for CO_3^{2-} and S^{2-} :-		
(a) subst. + Dil. HCl	No effervescence of CO_2 gas	$\therefore \text{CO}_3^{2-}$ may be absent.
(b) subst. + Dil. HCl (Heat)	No evolution of gas	$\therefore \text{S}^{2-}$ may be absent.
(2) Test for Cl^- , Br^- , I^-	Evolution of colourless or greenish yellow gas having pungent smell and bleaches wet litmus paper.	$\therefore \text{Cl}^-$ may be present
(3) Test for NO_3^-	No evolution of reddish brown gas	$\therefore \text{NO}_3^-$ may be absent
4) Test for PO_4^{3-}	curry yellow No precipitates	$\therefore \text{PO}_4^{3-}$ may be absent
5) Test for CrO_4^{2-}	Given sol ⁿ is not yellow	$\therefore \text{CrO}_4^{2-}$ may be absent
6) Test for $\text{Cr}_2\text{O}_7^{2-}$	Given sol ⁿ is not orange	$\therefore \text{Cr}_2\text{O}_7^{2-}$ may be absent
7) Test for O^{2-}	Cl^- radical is found.	$\therefore \text{O}^{2-}$ may be absent.

[D] CONCLUSION FROM DRY TEST

- i) Probable Positive radical : NH_4^+
- ii) Probable Negative Radical : Cl^-

[E] PREPARATION OF ORIGINAL SOLUTION FOR WET TEST

(1) Subst. + Distilled H_2O	Soluble	(Possibility of Fe^{3+} , NH_4^+ , NO_3^- , SO_4^{2-} , Cl^- , Br^- , I^-)
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[F] WET TEST FOR POSITIVE RADICALS

(1) 0.5 + dil. HCl	No precipitates	I st group is absent. e.g. Ag^+ , Hg^+ , Pb^{2+} is absent
2) 0.5 + dil. HCl + H_2S 50% (excess) + H_2O	No precipitates	II nd group is absent. e.g. Cu^{2+} , Sb^{3+} , Cd^{2+} is absent
3) 0.5 + NH_4Cl + 50% NH_4OH till 50% become alkaline	No precipitates	III-A group is absent. e.g. Al^{3+} , Fe^{3+} , Fe^{2+} is absent
4) 0.5 + NH_4Cl + 50% NH_4OH + H_2S 50%	No precipitates	III-B group is absent. e.g. Mn^{2+} , Zn^{2+} , Ni^{2+} is absent

5)	o.s. + NH_4Cl + 50% NH_4OH + $(\text{NH}_4)_2\text{CO}_3$ excess	No white precipitates	N group is absent. e.g. $\therefore \text{Ca}^{2+}, \text{Sr}^{2+}, \text{Ba}^{2+}$ is absent.
6)	o.s. + NH_4Cl + 50% NH_4OH + Na_2HPO_4	No white precipitates	V-A group is absent. e.g. Mg^{2+} is absent.
7)	Test for V^{th} B group.	All above groups are found to be absent and also given subst. is soluble in H_2O .	V-B group is present. e.g. $\therefore \text{K}^+, \text{NH}_4^+$ is present.

(4) SEPERATION of CATION IN TO GROUPS - (~~V-B~~ group)
[Group ~~V~~ B]

Seperation of K^+ and NH_4^+ (~~V-B~~ group)

1)	o.s. + Freshly prepared sodium cobalt nitrite	yellow precipitates	$\therefore \text{K}^+$ or NH_4^+ is present
2)	o.s. + NaOH (heat)	Evolution of NH_3 gas recognized by smell.	$\therefore \text{NH}_4^+$ is present
3)	o.s. + Nessler's reagent	Reddish brown ppt	$\therefore \text{NH}_4^+$ is present

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[H] Insoluble Phosphate ~~Scheme~~ ^{scheme:-}

→ Given substance is soluble in H_2O ∴ phosphate is not applicable.

[I] CONFIRMATIVE TEST FOR POSITIVE RADICALS $[NH_4^+]$

1) O.S. + Nessler's reagent	Reddish-brown precipitates	∴ NH_4^+ is confirmed
2) O.S. + NaOH (heat)	Evolution of NH_3 gas recognized by smell.	∴ NH_4^+ is confirmed

[J] WET TEST FOR NEGATIVE RADICALS :-

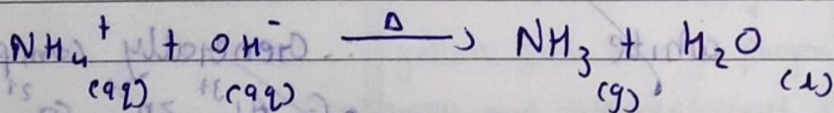
1) O.S. + $AgNO_3$	white precipitates insoluble in dil. HNO_3 Take small qty of above white ppt. + NH_4OH	∴ Cl^- , Br^- , I^- is present
	i) white precipitates soluble in NH_4OH	∴ Cl^- is present

Phosphoric acid

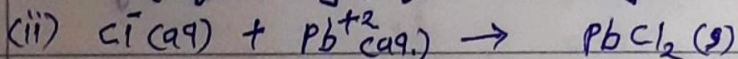
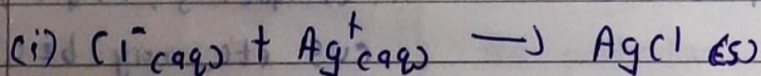
[K] CONFIRMATORY TEST FOR NEGATIVE RADICALS:-

1) o.s. + lead acetate	white ppt. soluble on heating and ppt. on cooling.	$\therefore \text{Cl}^-$ is confirmed
2) Subst. + MnO_2 + conc. H_2SO_4 and heat.	Evolution of greenish yellow gas having pungent smell bleaches the litmus paper	$\therefore \text{Cl}^-$ is confirmed

[L] EQUATION FOR CATION:-



[L] EQUATION FOR ANION



[M] FINAL CONCLUSION

~~Answer~~ The given unknown substance contains:-

Positive radical $\doteq \text{NH}_4^+$

Negative radical $\doteq \text{Cl}^-$

Formula of substance $\doteq \text{NH}_4\text{Cl}$

Name of substance \doteq Ammonium chloride.