

● Detection of elements organic compounds

Organic compound always possess carbon and hydrogen elements. Except these elements other elements are also present in organic compounds like oxygen, nitrogen, sulphur, halogen and phosphorous. Detection of elements like **C, N, P, S and X** easily done by **Lassaigne test**. Which indicated as below :

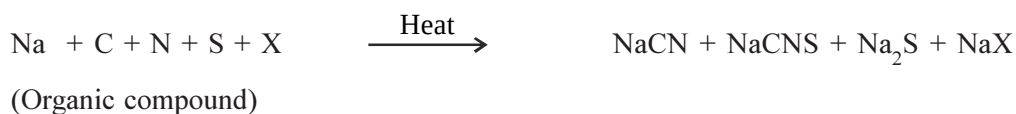
● Aim of Lassaigne test

Test of elements undergo most probably in ion form, but organic compounds are co-valent in nature, so its ionization is not possible. As a result elements present in organic compound fused with sodium metal to convert in ion form.

● Preparation of Lassaigne test :

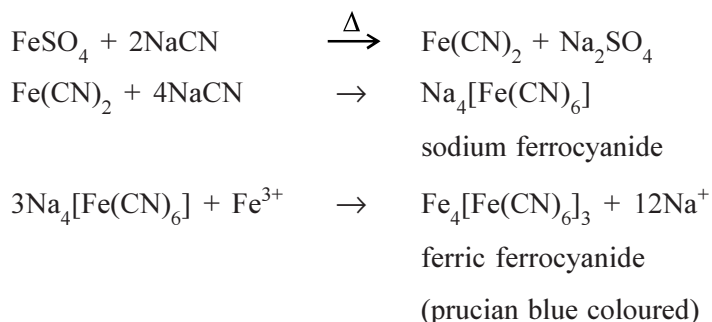
Take distilled water in a porcelein dish. Then heat small piece of sodium metal in small fusion tube. when sodium metal melts, add some organic compound and heat this mixture slowly, thereafter heated at high temperature till it becomes red hot. Then throw fusion tube in porcelein dish containing distilled water. Throw these types of two or three fusion tube in porcelien dish and boiled upto two minutes. Filter this boiled solution and obtained filterate solution is called **Lassaigne Solution**.

During fusion process, N, S and X in organic compound convert into NaCN, Na₂S and NaX.



● Detection of nitrogen

In one test tube heat lassigne solution and then add freshly prepared FeSO₄ solution to give sodium ferro cynide. If excess heated to this solution ferrous ion convert into ferric ion. Then neutralise this solution with dil. H₂SO₄. Here ferric ion reacts with ferrocyanide gives prucian blue coloured ferric - ferro cyanide, which indicates presence of nitrogen in organic compound.



When nitrogen and sulphur both are present, then due to ferric thiocyanate red colour like blood is obtained which indicates presence of N and S.

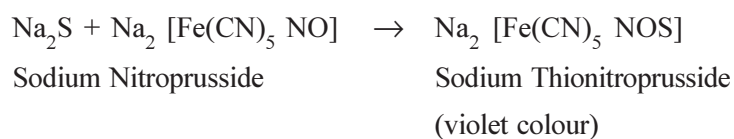


● **Detection of sulphur :**

Can be detected by following two tests :

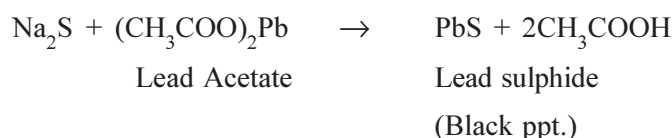
(a) **Sodium nitroprusside test :**

- In lassaigine solution add few drops of freshly prepared sodium thionitro having purple coloured which indicates presence of sulphur.



(b) **Lead acetate test :**

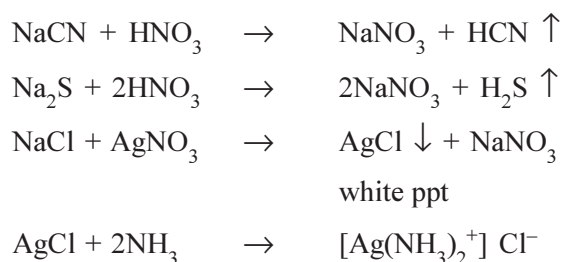
- In lassaigine solution add solution of acetic acid and lead acetate gives black precipitates which indicates sulphur.



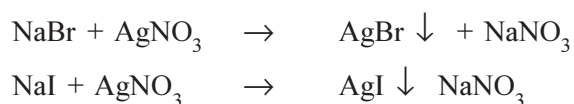
● **Detection of Halogen :**

- (a) If cyanide or sulphur are present in lassaigine solution, so it is necessary to remove them before lassaigine test of halogen. In lassaigine solution, add HNO_3 and heated then cyanide and sulphide ions are removed from solution in gaseous form of HCN and H_2S .

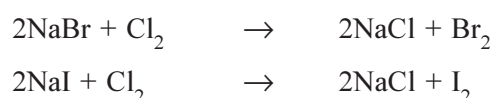
- After removal of CN and S , add AgNO_3 solution. In this solution and if white precipitate obtained and it is soluble in NH_4OH , then Cl is present



- If light yellow coloured precipitates obtained and it is difficult to dissolve in NH_4OH , so Br is present.
- If yellow coloured ppt obtained and it is insoluble in NH_4OH , so I is present.



- (b) Detection of halogen is also done by second test. In lassaigine solution add HNO_3 , then few drops of organic solvent like HNO_3 or CCl_4 add and shake well. So organic solvent becomes coloured in absorption of released halogen in organic solvent. If organic solvent remain colourless then Cl is present and brown colour is obtained then Br is present and if purple colour is obtained then I is present.



1. Which of the following halogen is inert towards bilstein test ?

- (A) F (B) Cl (C) Br (D) I
-

2. Which compound is not present in lassaingne's solution, when an organic compound containing nitrogen, sulphur and chlorine is reacted with excess sodium ?
 (A) Na_2S (B) NaCN (C) NaCl (D) NaCNS
3. Which compound give blood red colour with ferric ion in detection of excess elements in organic compound in lassaingne test ?
 (A) NaCN (B) Na_2S (C) NaCNS (D) NaCNO
4. Which of the following acidify lassaingne solution by lead acetate for detection of sulphur ?
 (A) dilute H_2SO_4 (B) dilute HCl (C) acetic acid (D) All above
5. Before carrying out halogen test, which is heated with lassaingne solution ?
 (A) dilute HCl (B) NaOH (C) con. HNO_3 (D) All above
6. Cl_2 gas is passed lassaingne solution containing CCl_4 . Which colour is obtained first on layer of CCl_4 when lassaingne solution contain NaBr and NaI ?
 (A) Purple (B) Brown (C) Green (D) Yellow
7. Which aq. solution of salt gives white ppt. with AgNO_3 which is soluble in excess NH_4OH ?
 (A) Cl^- (B) Br^- (C) I^- (D) NO_3^-
8. Due to which reason ferric ion gives prussian blue colour ?
 (A) $\text{K}_4[\text{Fe}(\text{CN})_6]$ (B) $\text{Fe}_4[\text{Fe}(\text{CN})_6]$ (C) KMnO_4 (D) $\text{Fe}(\text{OH})_3$
9. Which of the following organic compound, which gives positive test of nitrogen with lassaingne solution ?
 (A) $\text{Fe}_4[\text{Fe}(\text{CN})_6]_3$ (B) $\text{Na}_3[\text{Fe}(\text{CN})_6]$
 (C) $\text{Fe}(\text{CN})_3$ (D) $\text{Na}_4[\text{Fe}(\text{CN})_5\text{NOS}]$
10. Which of the following possess lassaingne solution when sulphanilic acid break with sodium metal ?
 (A) only NaCN (B) Na_2S
 (C) NaCN and Na_2S (D) NaCN , NaCNS and Na_2S

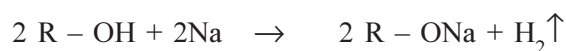
Answers : 1. (A), 2. (D), 3. (C), 4. (C), 5. (C), 6. (A), 7. (A), 8. (B), 9. (A), 10. (D)

● **Identification of following functional group of organic compounds - Hydroxyl (alcoholic and phenolic), carbonyl (aldehyde, and ketone), carboxyl and amino functional group.**

Test for identification of different functional group are as follow :

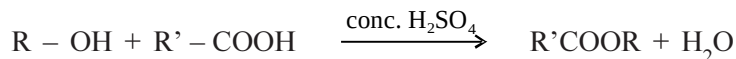
● **Reaction of alcoholic group**

- (a) **Sodium metal test :** Sodium metal reacts with alcohols and liberate hydrogen gas. A brisk effervescence due to evolution of hydrogen indicates the presence of an alcoholic hydroxyl group.

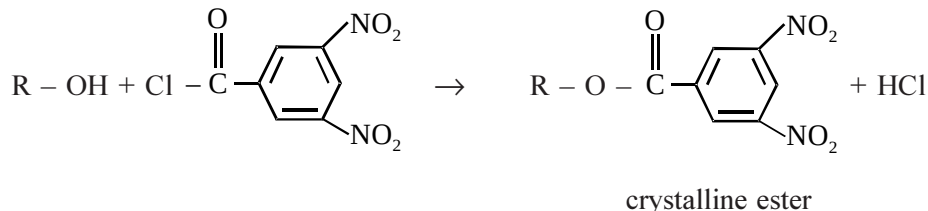


(b) Ester formation test :

- (i) Alcohols on heating with carboxylic acids in the presence of conc. H_2SO_4 form esters, which have sweet fruity odour.



- (ii) Alcohol reacts with 3, 5 dinitrobenzoic acid to give crystalline ester.



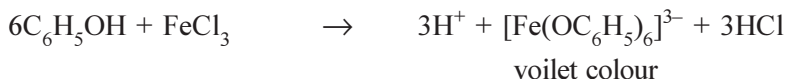
(c) Lucas test :

- This test is useful to detect primary (1°), secondary (2°) and tertiary (3°) alcohol in laboratory.
- In this test alcohol reacts with anhydrous zinc chloride and concentrated hydrochloric acid. Shake well this mixture and kept sometime after heating this mixture.
- If oily drops appears quickly on the surface of mixture, it must be 3° alcohol.
- If solution becomes milky after 5 minute, it must be 2° - alcohol.
- If solution remain as it is, it must be 1° - alcohol.

• Reaction of phenolic group

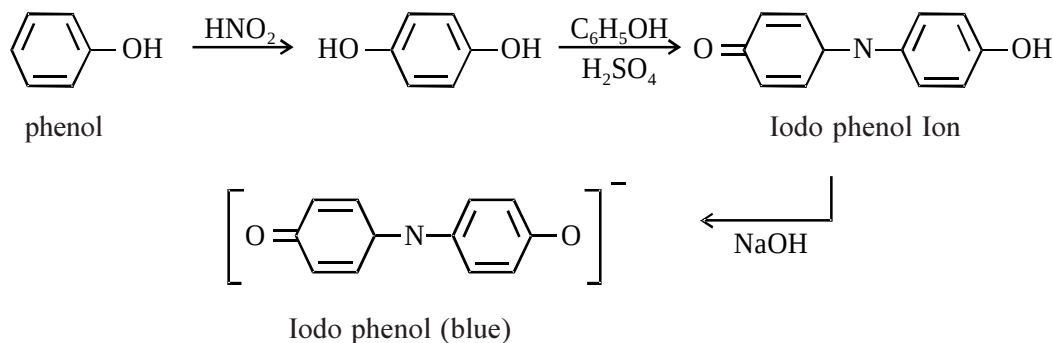
(a) Ferric chloride test :

- Neutral ferric chloride reacts with phenolic group to form ferric phenoxides which have characteristic colours depending upon the nature of phenolic compounds.



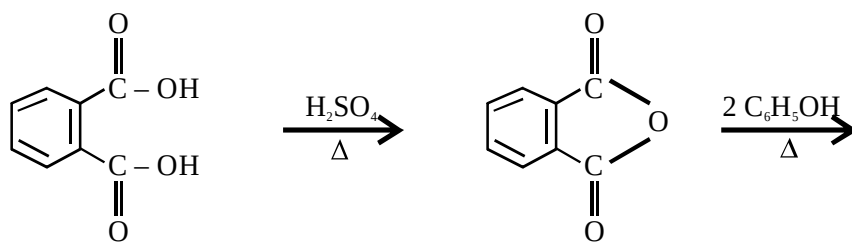
(b) Libermann Nitroso reaction :

- In a test tube containing crystal of NaNO_2 add small proportion of organic compound and cool down in which add 1 ml concentration H_2SO_4 produce greenish blue coloured. In which excess water is added red aqueous solution turns again dark green or blue. In this solution NaOH is added gives basic solution which indicates presence of phenol.



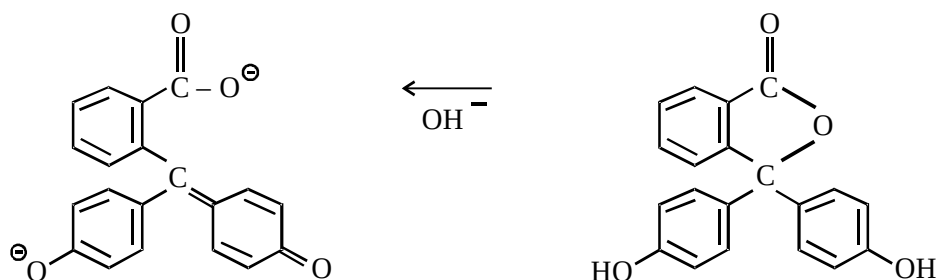
(c) Phthalein test :

- When phenol are heated with phthalic anhydride in the presence of conc H_2SO_4 they undergo condensation to form phthalein dyes which give characteristic colour in NaOH solution.



Phthalic acid

phthalic anhydride



Pink

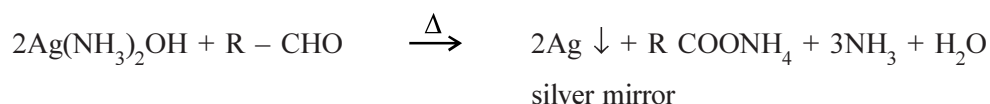
phenolphthalein (colourless)

- Phenolphthalein used as indicator in acid-base titration, which gives colourless in acidic medium and pink colour in basic medium.

● Aldehyde functional group

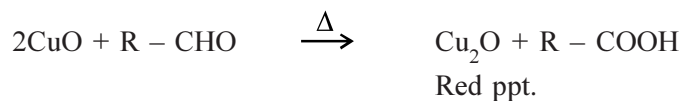
(a) Tollen's reagent test (silver mirror test)

- Tollen's reagent is ammoniacal solution of silver nitrate. The aldehyde reacts with freshly prepared Tollen's reagent to give silver mirror along the sides of the test tube.



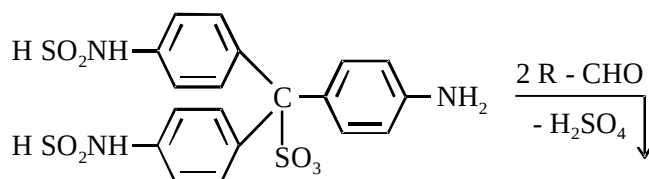
(b) Fehling solution test :

- Mixture of Fehling solution A and B forms a solution of $\text{Cu}(\text{OH})_2$ stabilised in solution by Rochelle salt (Sodium Potassium tetrates). Aldehyde reacts with Fehling's solution to give red ppt. due to copper (I) oxide.

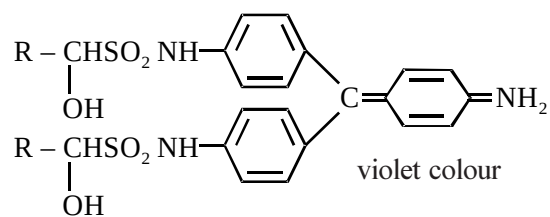


(c) Schiff's reagent test :

- When aldehydes are shaken with Schiff's reagent, a deep red or purple colour indicates the presence of aldehydes.



Schiff's reagent



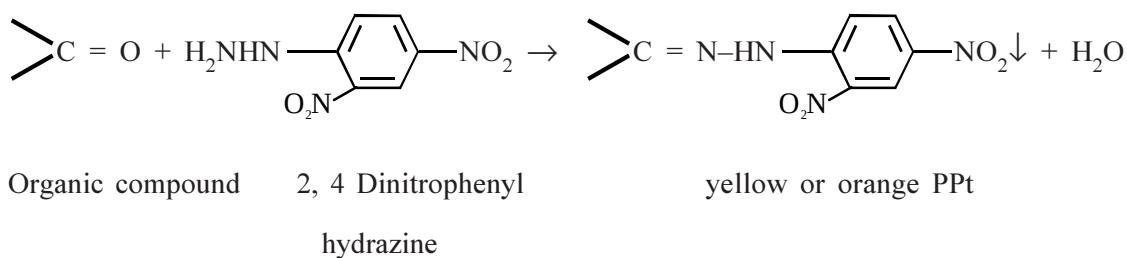
(d) Benedict's Test :

- Boil organic compound with 2-3 ml benedict's solution. After sometime red-yellow ppt obtained, which indicates presence of aldehyde group. This test is given by only aliphatic aldehyde.

● **Ketone group (>C=O)**

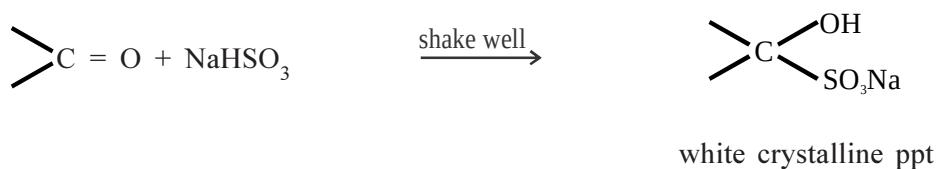
(a) 2, 4 Dinitro phenyl hydrazine test :

- Take few drops of organic compound in a test tube and add 2 ml reagent and one drop concentrated H_2SO_4 shake well and kept for 5 minutes. If organic compound contain carbonyl group, gives yellow or orange precipitates due to formation of hydrazone.



(b) Sodium bisulphite test :

- Aldehyde and ketones give white crystalline ppt with sodium bisulphite.



(c) Sodium Nitroprusside test :

- Add few organic compound in the solution of sodium nitroprusside ($\text{Na}_2[\text{Fe}(\text{CN})_5\text{NO}]$). 2-3 drop of NaOH is added to prepare basic solution. If red or purple colour is appeared ketone group then keto group must be present.

● **Carboxylic acid (–COOH) group**

(a) **Litmus solution test :**

- Carboxylic acids turn blue litmus solution red.

(b) **Sodium bicarbonate test :**

- Carboxylic acids react with 5% aqueous soln of NaHCO_3 and liberated CO_2 which gives effervescence.

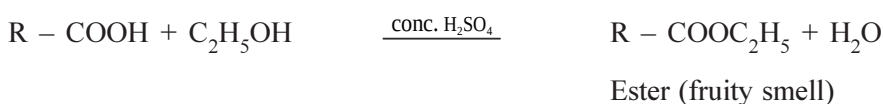


Benzoic acid

Sodium benzoate

(c) **Ester formation test :**

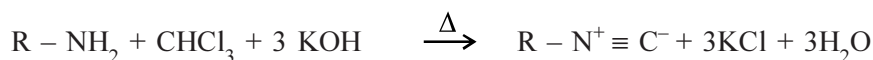
- In few amount of organic compound add ethyl alcohol and less proportion of concentrated H_2SO_4 , cool it and add vessel containing water to produce sweet smell like fruit due to formation of ester, which indicate presence of carboxylic acid. Carboxylic acids are converted to neutral solution of ammonium salts on treatment with ammonium hydroxide.



● **Primary amino (–NH₂) Group**

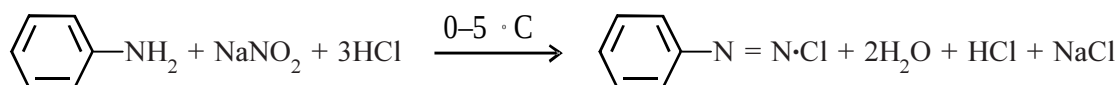
(a) **Carbylamine test :**

- Primary amines react with chloroform in the presence of alcoholic KOH to form isocyanide or carbyl amine which have very unpleasant (offensive) smell



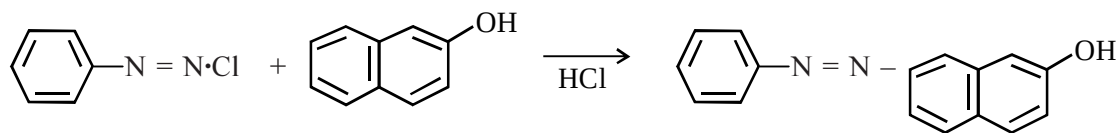
(b) **Dye-formation test :**

- Primary amines form benzene diazonium compounds with NaNO_2 and HCl at $0-5^\circ \text{C}$, which on treatment with ice cold alkaline soln of β naphthol form a brilliant orange or red dye.



Aniline

Benzene diazonium chloride

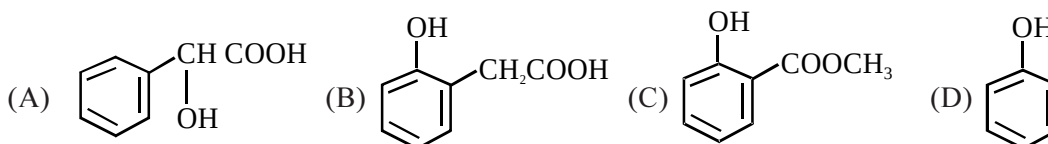


Benzene diazonium chloride β -naphthol

phenyl azo β -naphthol (red dye)

- Separation of primary (1°), secondary (2°) and tertiary (3°) can be done by nitrous acid test and Hinsberg's test.

11. Which group containing compound, release CO_2 gas when reacts with NaHCO_3 ?
 (A) $-\text{CHO}$ group (B) Phenolic $-\text{OH}$ group (C) $-\text{NH}_2$ group (D) $-\text{COOH}$ group
12. Which test is useful to distinguish acetone and α -hydroxy acetone ?
 (A) Tollens test (B) Iodoform test (C) Both A and B (D) None
13. Which of the following functional group is used to detect in reagent like 2, 4-dinitrophenyl hydrazine in organic analysis ?
 (A) alcohol (B) acid (C) aldehyde (D) amine
14. Which of the following compound, which gives positive iodo form test and tollen's test ?
 (A) $\text{CH}_3\text{CH}_2\text{OH}$ (B) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CHO}$ (C) CH_3CHO (D) CH_3COCH_3
15. Which of the following compound which release CO_2 gas with NaHCO_3 and give colour with neutral FeCl_3 ?



16. Which of the following detect alcoholic group in organic compound ?
 (A) ceric ammonium nitrate (B) Sodium metal
 (C) Ester formation test (D) All above
17. Which of the following organic compound which does not reduced with tollen's reagent or fehling solution but gives red colour with ceric ammonium nitrate solution ?
 (A) phenol (B) aldehyde (C) ketone (D) alcohol
18. Which statement is not correct for phenolphthalein ?
 (A) It is phthalein dye.
 (B) It is used in acid-base indicator.
 (C) It is obtained by condensation reaction of phenol with phthalic anhydride in presence of concentrated H_2SO_4 .
 (D) It is colourless in basic medium but pink in acidic medium
19. Obtained fruity smell when ...
 (A) Primary amine reacts with acetic anhydride.
 (B) alcohol reacts with glacial acetic acid in presence of concentrated H_2SO_4 .
 (C) aldehyde reacts with hydroxyl amine.
 (D) Carboxylic acid reacts with NaHCO_3 .
20. Which catalyst is used to separate acetophenone from benzaldehyde ?
 (A) Sodium bicarbonate (B) Sodium bisulphite (C) Sodium bisulphate (D) sodium sulphite

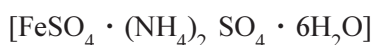
21. Which of the following statement is not correct ?
 (A) Fehling A solution contain CuSO_4 solution.
 (B) Fehling B solution is basic solution of roshell-salt.
 (C) Act of roshell salt keep stable of Cu^{2+} in basic medium.
 (D) Both type of aldehyde, aliphatic and aromatic gives red ppt of Cu_2O by redution of Fehling solution.
22. By whom can seprate acetaldehyde from acetone ?
 (A) NaHSO_3 (B) 2, 4-dinitro phenyl hydrazine
 (C) NaOI (D) $[\text{Ag}(\text{NH}_3)_2]^+\text{OH}^-$
23. What is an organic compound, which gives effervences with NaHCO_3 solution which dissolve in NaOH and add dil HCl to get ppt ?
 (A) Acetic acid (B) Benzoic acid (C) Oxalic acid (D) Formic acid
24. Which of the following compound when it is dissolved in dil HCl to give carbyl amine test ?
 (A) 1° - amine (B) 2° - amine (C) 3° - amine (D) carboxylic acid
25. Which organic compound is required to give azo-dye test ?
 (A) 1° - aliphatic amine and CHCl_3 (B) 1° - aromatic amine and 1-naphthol
 (C) 1° - aromatic amine and phenol (D) 3° - aliphatic amine and β -naphthol
26. Which test is used for present functional group in p-amino acetophenone ?
 (A) Azodye test and NaHCO_3 test (B) FeCl_3 test and azodye test
 (C) Carbyl amine test (D) Carbyl amine test and azo dye test
27. Which of the following gives red ppt. of Cu_2O with fehling solution ?
 (A) $\text{C}_6\text{H}_5\text{CH}_2\text{CHO}$ (B) $\text{C}_6\text{H}_5\text{CHO}$ (C) $\text{C}_6\text{H}_5\text{COCH}_3$ (D) $\text{CH}_3\text{CH}_2\text{COCH}_3$
28. Which of the following compound is prepared for very foul and poisonals smell in carbyl amine test ?
 (A) nityl (B) chlorocompound (C) nitrosoamine (D) iso cyanide

Answers : 11. (D), 12. (A), 13. (B), 14. (C), 15. (B), 16. (D), 17. (D), 18. (D), 19. (B), 20. (B), 21. (D), 22. (B), 23 (B),) 24 (A), 25 (B), 26. (C), 27 (A), 28 (D)

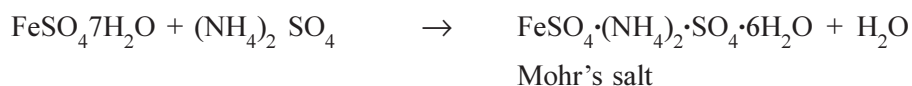
Chemistry involved in preparation of Inorganic compounds

● Inorganic compounds

(i) Mohr's salt or Ferrous amonium sulphate :



- When equimolar quantities of ferrous sulphate $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ and ammonium sulphate are dissolved in water and the solution is concentrated and allow to cool light green crystals of Mohr's salt seprate out.



- It is necessary to add less proportion of dilute H_2SO_4 in hot water, to prevent its hydrolysis during preparation of ferrous sulphate solution. i.e. ferrous sulphate prevent conversion in ferrous hydroxide.

(ii) **Potash alum** $[\text{K}\cdot\text{Al}(\text{SO}_4)_2\cdot 12\text{H}_2\text{O}]$:

- When equimolar quantities of potassium sulphate and aluminium sulphate are dissolved in water and the solution is concentrated to crystallization point by boiling and allowed to cool, colourless crystals of potash alum are formed.



● **Organic compounds**

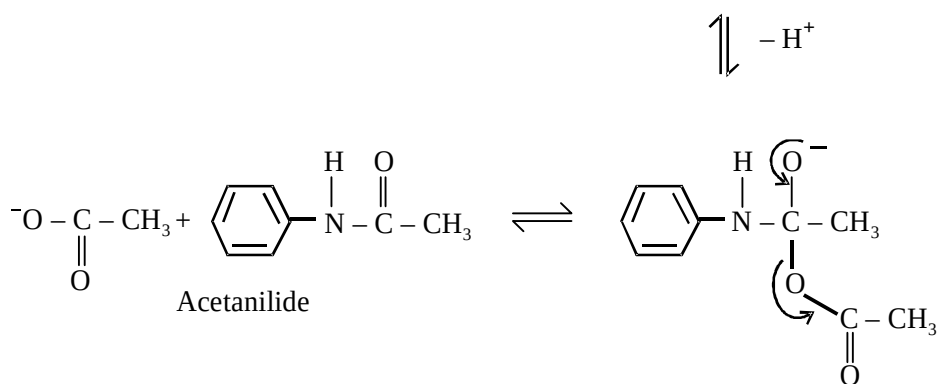
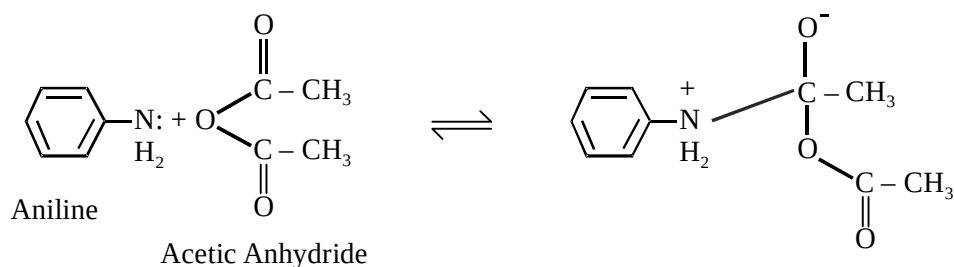
(i) **Acetanilide** $\text{C}_6\text{H}_5\text{NHCOCH}_3$:



- Acetanilide is prepared by acetylation of aniline. It is carried out by refluxing aniline with acetic anhydride or with glacial acetic acid and anhydrous zinc chloride. The reaction mixture is decomposed with cold water and crystallised from hot water containing a few drop of alcohol.
- Amine containing $-\text{NH}_2$ or $-\text{NH}$ group undergo direct acetylation. Substitution of active hydrogen in it by acetyl group $(-\text{COCH}_3)$ gives derivatives like $\text{R} - \text{NHCOCH}_3$ and R_2NCOCH_3 .

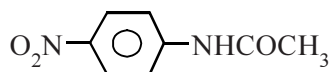


● **Mechanisms :**

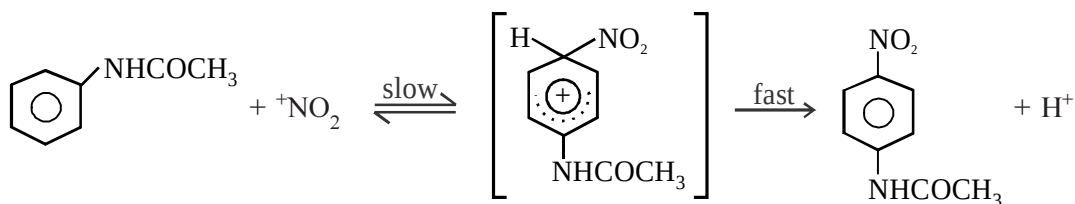


It is necessary to add less proportion of zinc to prevent oxidation of aniline and do the reduction of colourless impurities present in it.

(ii) **P-nitro acetanillide :**

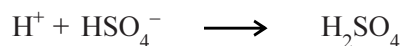


● It can be prepared by the nitration of acetanilide with a mix of conc. H_2SO_4 and conc. HNO_3 . The reaction mixture is decomposed with crushed ice. The solid product is separated by filtration and crystallised from rectified spirit.

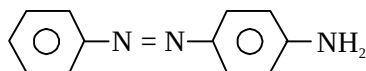


Acetanilide

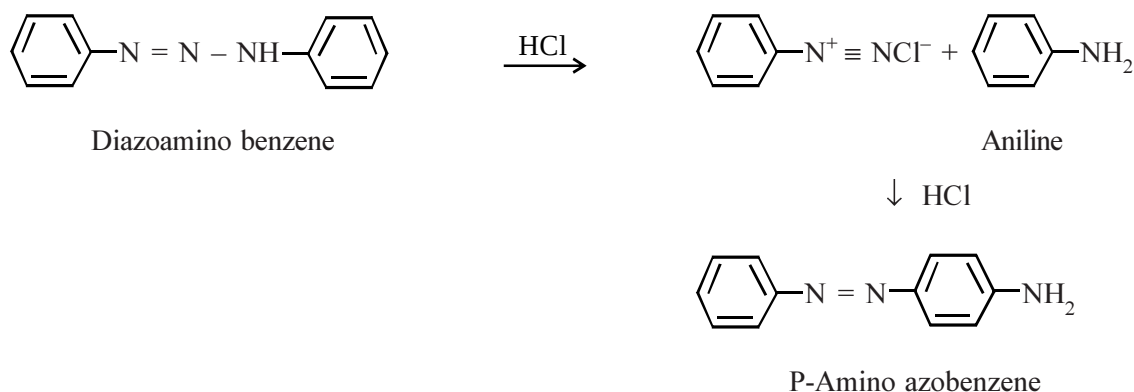
P-nitro acetanilide



(iii) **Aniline yellow/p-Amino Azobenzene :**

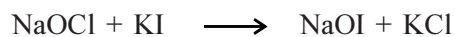


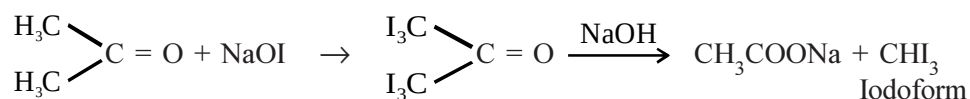
● Aniline is heated with dil. HCl to form aniline hydrochloride which is soluble in water. The water solution of aniline hydrochloride is cooled in crushed ice ($0-5^\circ\text{C}$) and treated with ice cold soln of NaNO_2 . Benzene diazonium compound is formed which on coupling with aniline gives aniline yellow.

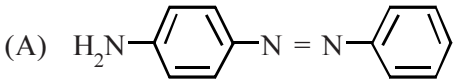
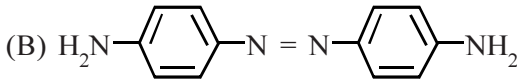
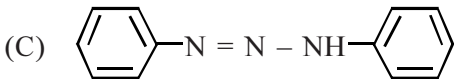
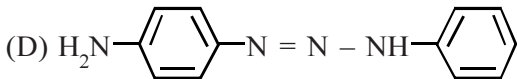


(iv) **Iodoform (CHI_3) :**

● Iodoform may be prepared by heating Ethanol or propanone (acetone) with Iodine in the presence of NaOCl solution.





29. What is the ratio of aluro contain aqueous monovalent positive ion $[\text{M}(\text{H}_2\text{O})]^+$, trivalent positive ion $[\text{M}(\text{H}_2\text{O})_6]^{3+}$ and SO_4^{2-} ?
 (A) 1 : 1 : 1 (B) 1 : 2 : 3 (C) 1 : 3 : 2 (D) 1 : 1 : 2
30. Which of the following is obtained when aniline hydrochloride reacts with diazo amino benzene at 40°C ?
 (A) aniline yellow (B) Hydruso compound (C) azo benzene (D) No reaction
31. During preparation of acetanilide from aniline some proportion of zinc is added to reaction mixture because ...
 (A) Zinc increases in precipitatzaton.
 (B) Zn prevent reduction of aniline during reaction.
 (C) Zn prevent oxidation of aniline during reaction as well as reduced colourless impurities in aniline.
 (D) Zinc gives white crystallised complex with aniline.
32. Which compound is not useful in preparation of iodoform test ?
 (A) CH_3CHO (B) CH_3COCH_3 (C) HCHO (D) Propan-1-ol
33. Which statement is wrong for aniline yellow ?
 (A) It is carcinogenic. (B) It is also known as P-amino azobenzene.
 (C) It is acid dye. (D) It is also known as 4-phenylazoaniline.
34. Which compound is not useful in preparation of Mohr's salt ?
 (A) Ferrous sulphate (B) Ammonium sulphate (C) $\text{Dil H}_2\text{SO}_4$ (D) All are useful
35. Which method is useful for preparation of P-nitro acetanilide ?
 (A) nitration of aniline by $\text{Con. HNO}_3 + \text{H}_2\text{SO}_4$ then acetylation by acetic anhydride.
 (B) Friedel craft reaction of nitrobenzene with acetic anhydride.
 (C) Acetylation of aniline by acetic anhydride.
 (D) None of this.
36. Which structural formula of diazo amino benzene obtained from preparation of aniline yellow ?
 (A)  (B) 
 (C)  (D) 
37. What is used in preparation of iodoform from acetone ?
 (A) KI (B) KI_3 (C) KOI (D) KIO_3

38. Which statement is incorrect for aniline yellow ?
- (A) It is azo dye.
 (B) It is basic dye
 (C) Its preparation is done by diazo amino benzene heated with aniline and aniline hydrochloride.
 (D) Its preparation is done in basic medium by conjugation progress with phenol and diazonium chloride.
39. Which reagent is used to separate aniline from mixture of aniline and nitrobenzene ?
- (A) Ether (B) aqueous HCl (C) aqueous NaOH (D) aqueous NaHCO_3
40. Why dil H_2SO_4 is added in preparation of mohr's salt ?
- (A) To stop hydrolysis of ferrous sulphate. (B) To increase in solubility of salt.
 (C) To stop precipitation of metal carbonate. (D) To neutralization of ammonium salt.
41. In which form of potash alum crystal crystallizes ?
- (A) Monoclinic shape (B) Octahedral shape (C) Tetragonal shape (D) Tetrahedral shape
42. Which substance is not used in preparation of iodoform as starting reagent substance ?
- (A) $\text{CH}_3\text{CHOHCH}_3$ (B) $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$ (C) $\text{CH}_3\text{COCH}_2\text{CH}_3$ (D) $\text{C}_6\text{H}_5\text{COCH}_3$

Answers : 29. (D), 30. (A), 31. (C), 32. (C), 33. (C), 34. (D), 35. (C), 36. (C),
 37. (C), 38. (D), 39. (C), 40. (A), 41. (B), 42. (B)

● Titration

In volumetric analysis of definite volume of substance having unknown concentration required for complete reaction what volume of substance having known concentration. It can be determined by process known as titration.

● Standard solution

In volumetric analysis, method, one or more standard solutions are used as reagent whose concentration is known. In acid-base titration most of standard solution is used as strong acid and strong base. eg. HCl , H_2SO_4 , NaOH , KOH and $\text{Ba}(\text{OH})_2$ etc. Base is not always used for standard solution like acid because when they comes in contact with air, absorb CO_2 gas.

● Acid base Titration using Acid-Base Indicator

Acid-base titration is one of the method from different practical methods to determine concentration of solutions.

In this method reagent present in definite volume of solution reacts with what volume of another reagent in its equivalent proportion required, it should be determined.

In titration method, two solutions are used and concentration of second solution can be determined based on known concentration of first solution.

In acid-base titration definite volume of aqueous solution of acid and bases taken by pipette in conical flask, add solution of second reagent from burette slowly added till the reaction is completed.

To determine the completion of reaction, two-three drops of substance is added to definite volume of solution to colour-change at proper time. This substance is called indicator.

Success of acid-base titration depends on proper indicator.

Selection of indicator is depended on quickly change in pH in last step of titration.

Phenolphthalein and methyl orange are important indicators used in acid-base titrations.

● **pH range and colour of some indicators**

No	Indicator	pH range	colour in acidic sol.	colour in base solution
1.	Thymol blue	1.2-2.8	Red	Yellow
2.	Bromophenol blue	3.1-4.6	Yellow	Purple
3.	Methyl orange	3.1-4.5	Red	Yellow
4.	Methyl red	4.2-6.3	Red	Yellow
5.	Bromothymol blue	6.0-7.5	orange	Blue
6.	Phenol red	6.4-8.2	yellow	Red
7.	Thymol blue (Base)	8.1-9.6	Yellow	Blue
8.	Phenolphthalein	8.0-9.8	colourless	pink
9.	Thymolphthalein	9.3-10.5	colourless	Blue
10.	Aizarine yellow R	10.1-12.1	Yellow	Green

● **Indicators used in acid-base titrations**

No	Acid-base titration	Indicators
1.	Strong acid-strong Base	Bromothymol blue, phenolphthalein, Methyl orange, Thymolphthalein
2.	Strong acid-weak base	Methyl orange, methyl red, bromo cesol green
3.	Weak base-strong acid	phenolphthalein, Thymolphthalein
4.	Weak acid weak base	Phenol red

● **Information of terms used in volumetric analysis**

Normality : When 1 gm equivalent weight of solute dissolve in 1 litre solution known as 1 normal solution and its normality is 1.

$$\text{Normality (N)} = \frac{\text{gm/litre}}{\text{equivalent weight}}$$

$$= \frac{\text{gram}}{\text{eq. wt} \times \text{vol. of solution (litre)}}$$

- Equivalent weight of acid = $\frac{\text{Atomic weight of acid (gm/mol)}}{\text{Basicity of acid}}$

- Equivalent weight of base = $\frac{\text{Atomic weight of base (gm/mol)}}{\text{Acidity of Base}}$

● Molarity (M)

When 1 gm molecular weight of solute dissolve in 1 litre solution known as 1 molar solution and its molarity is 1.

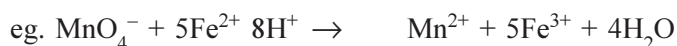
$$\text{Molarity (M)} = \frac{\text{gm/litre}}{\text{molecular weight}}$$

$$= \frac{(\text{weight of solution in gram})}{\text{Molecular mass} \times \text{volume of solution in litre}}$$

OR
$$\text{Molarity} = \frac{\text{Normality} \times \text{Equivalent weight}}{\text{Molecular weight}}$$

● Redox Titrations

Oxidising agent like KMnO_4 and $\text{K}_2\text{Cr}_2\text{O}_7$ titrate with reducing agent like Fe, Fe^{2+} , H_2O_2 , CaCl_2 and MnO_2 in acidic, basic or neutral medium, known as redox titration. In this type of titration oxidation and reduction both are included.



MnO_4^- reduced to Mn^{2+} in this reaction. Oxidizing agent is reduced. So, MnO_4^- is known as oxidizing agent.

Fe^{2+} oxidized to Fe^{3+} in the reaction. Reducing agent is oxidized. So, Fe^{2+} is called reducing agent.

In all cases $N_1V_1 = N_2V_2$ but $M_1V_1 \neq M_2V_2$

● Important Examples of some redox titrations

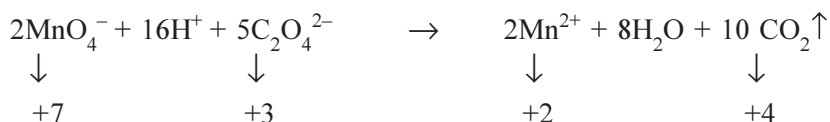
(i) $\text{KMnO}_4 \rightarrow$ oxalic acid titration :

It is the example of redox titration, in which reducing agent (oxalic acid) titrate with standard solution of oxidizing agent (KMnO_4). This reaction is depended on change in valency of ions. In this type of titration oxidation and reduction both occurs i.e. one undergo oxidation and other undergo reduction.



OR

Ionic Equation :



In this redox reaction KMnO_4 undergo reduction and $\text{H}_2\text{C}_2\text{O}_4$ undergo oxidation. In this titration KMnO_4 act as self indicator. This titration can be possible in presence of HCl or H_2SO_4 but impossible with HNO_3 because it is oxidising agent and resist in oxidation reaction of KMnO_4 .

In this titration, solution of oxalic acid heated with dil H_2SO_4 at $70-80^\circ\text{C}$ temperature.

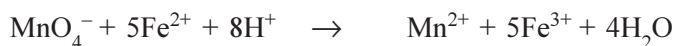
(ii) Titration : $\text{KMnO}_4 \rightarrow$ Mohr salt $[\text{FeSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot 6\text{H}_2\text{O}]$:

In this titration, ferrous ammonium sulphate present as ferrous sulphate form which oxidised to ferric sulphate by acidic KMnO_4 .



OR

● **Ionic Equation**



KMnO_4 itself indicator.

Occurs at room temperature, because mohr salt oxidised only by air.

If H_2SO_4 is in excess, brown ppt of MnO_2 obtained.

-
43. Oxalic acid is present in vegetables and many shrubs. What is percentage weight of $(\text{H}_2\text{C}_2\text{O}_4)$ in sample when 24 ml 0.01 M KMnO_4 required at the end point for titration of 100 gm $\text{H}_2\text{C}_2\text{O}_4$?
(A) 0.54 % (B) 5.4 % (C) 1.54 % (D) 0.054 %
44. How KMnO_4 act as in titration of KMnO_4 versus oxalic acid ?
(A) Outer indicator (B) Self indicator (C) Reducing agent (D) Both B and C
45. What amount of mohr salt is required to prepare 250 ml N/20 mohr's salt ?
(A) 9.8 gm (B) 4.9 gm (C) 19.6 gm (D) 3.2 gm
46. 0.5 gm mixture of $\text{K}_2\text{Cr}_2\text{O}_7$ and KMnO_4 reacts with excess KI in acidic medium. What percentage of $\text{K}_2\text{Cr}_2\text{O}_7$ in mixture, when 100 cm^3 0.15 N Na_2SO_4 solution is required for titration of release I_2 from mixture ?
(A) 85.36 % (B) 14.64 % (C) 58.63 % (D) 26.14 %
47. Which of the following is equivalent to 50 ml 0.04 m KMnO_4 solution, when KMnO_4 reacts with oxalate in acidic medium MnO_4^- reduced to Mn^{2+} and $\text{C}_2\text{O}_4^{2-}$ oxidized to CO_2 ?
(A) 100 ml 0.1 M $\text{H}_2\text{C}_2\text{O}_4$ solution (B) 50 ml 0.2 M $\text{H}_2\text{C}_2\text{O}_4$ solution
(C) 25 ml 0.1 M $\text{H}_2\text{C}_2\text{O}_4$ solution (D) 50 ml 0.1 M $\text{H}_2\text{C}_2\text{O}_4$ solution
-

48. Which of the following oxidized of 126 gm oxalic acid ($\text{H}_2\text{C}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$) in acidic medium ?
 (A) $\frac{1}{3}$ mole $\text{K}_2\text{Cr}_2\text{O}_7$ (B) 2 mole $\text{K}_2\text{Cr}_2\text{O}_7$ (C) $\frac{1}{3}$ mole KMnO_4 (D) $\frac{5}{2}$ mole KMnO_4
49. What is percentage of purity of sample when complete reaction of 3.92 gm ferrous ammonium sulphate (mohr's salt) with 50 m $\frac{\text{N}}{10}$ KMnO_4 ?
 (A) 50 (B) 78.4 (C) 80 (D) 39.2
50. Which of the following statement is wrong ?
 (A) Acidic solution of $\text{K}_2\text{Cr}_2\text{O}_7$ release iodine from iodide.
 (B) In acidic solution dichromate ions convert into chromate ion.
 (C) Heating of $(\text{NH}_4)_2\text{Cr}_2\text{O}_7$ gives Cr_2O_3 by exothermic decomposition.
 (D) Potassium dichromate is used as titrant for estimation of Fe^{2+} ion.
51. Aqueous solution of 6.3 gm oxalic acid of 250 ml is prepared. What volume of 0.1 N NaOH is required for neutralisation of 10 ml oxalic acid solution ?
 (A) 40 ml (B) 20 ml (C) 10 ml (D) 4 ml
52. What is the reason for brown ppt of aq. MnO_2 in titration of KMnO_4 ?
 (A) In complete reduction of KMnO_4 due to less proportion of dil. H_2SO_4 .
 (B) Due to excess heating of solution.
 (C) Add KMnO_4 dropwise with stirring.
 (D) Addition of HCl.
53. Which of the following statement is not correct ?
 (A) It is not heated before titration of mohr's salt solution with KMnO_4 .
 (B) Reaction between KMnO_4 and mohr salt can possible in cold solution.
 (C) Heating of ferrous sulphate present in mohr's salt, it oxidised in ferric sulphate by air.
 (D) In titration of mohr's salt by KMnO_4 heated at $60^\circ\text{--}70^\circ$ temperature gives acute result.
54. In titration of KMnO_4 , dil HCl can't be used in place of dil. H_2SO_4 because...
 (A) KMnO_4 reacts with HCl to produce Cl_2 gas.
 (B) Reaction with HCl some KMnO_4 is used.
 (C) Require excess KMnO_4 than require necessary.
 (D) HCl does not react with KMnO_4 .
55. Which of the following statement is wrong for given aqueous solution ?

$$\text{KI} + \text{K}_3[\text{Fe}(\text{CN})_6] \xrightarrow{\text{dil. H}_2\text{SO}_4} \text{Brownish yellow solution}$$

$$\downarrow \text{ZnSO}_4$$
 colourless solution $\leftarrow$ Brownish yellow filtrate + white ppt
 (A) First reaction is a redox reaction.
 (B) White ppt is of $\text{Zn}_3[\text{Fe}(\text{CN})_6]_2$.
 (C) Add starch solution in filtrate gives yellow colour.
 (D) White ppt. dissolve in NaOH solution.

56. What mass of crystal of $K_2Cr_2O_7$ required for oxidation of 750 cm^3 0.6 M mohr's salt solution ?
(mol mass of $K_2Cr_2O_7 = 294$; Mohar's salt = 392)
(A) 0.49 gm (B) 0.45 gm (C) 22.05 gm (D) 2.2 gm
57. What volume of 0.02 M MnO_4^- solution is required for oxidation of 0.1 M 40 ml Fe^{2+} ion solution ?
(A) 200 ml (B) 100 ml (C) 40 ml (D) 20 ml
58. When $KMnO_4$ solution is added to oxalic acid solution, initially its colour slowly disappear but after sometime it disappear quickly because...
(A) CO_2 produced as a product. (B) reaction is exothermic.
(C) MnO_4^- catalysation reaction. (D) Mn^{2+} acts as self catalyst.

Answers : 43. (B), 44. (B), 45. (B), 46. (B), 47. (C), 48. (A), 49. (A), 50. (B), 51. (A), 52. (A), 53 (D), 54. (D), 55. (B), 56. (C), 57. (C), 58, (D)

● Qualitative Analysis

“Identification or checking of different species (ions) present in compound known as quantitative analysis.”

e.g. zinc blende contain Zn^{2+} and S^{-2} ion.

Systematic qualitative analysis depends on three steps :

(1) Primary tests (2) Wet test of positive ions (3) Wet test of negative ions.

(1) Primary test :

(a) colour :

No.	observation	Inference
(1)	Blue, Its solution is also blue	Cu^{2+} ion
(2)	Green, Its solution also green	Ni^{2+} ion
(3)	Dark green colour	Cr^{2+} ion
(4)	Violet-pink, solution is pink	Co^{2+} ion
(5)	light pink, solution is colourless	Mn^{2+} , Mn^{3+} ion
(6)	Brownish red	Fe_2O_3
(7)	Red	HgO , HgI_2 , Pb_3O_4 , Cu_2O
(8)	Black	CuO , NiO , SnO , FeS , CuS , HgS , PbS , CoS , FeO , CuS
(9)	Orange red	Sb_2S_3
(10)	Yellow	As_2S_3 , CdS , Bi_2O_3 , As_2S_5
(11)	Yellow-Green	Fe^{2+} salt
(12)	Yellow-Brown	Fe^{3+} salt
(13)	Purple	Cr^{3+} salt

(b) Effect of Heat :

Heat given substance in dry and clean test tube slowly and then more heated gives following observations :

No.	Observations	Inference
(1)	Substance melts	Salt of metals (alkali) chlorides of Hg, Ag and Pb
(2)	Substance cracks	$\text{Pb}(\text{NO}_3)_2$, $\text{Ba}(\text{NO}_3)_2$, NaCl and KI
(3)	Swells	Alumn, phosphate and Borates salts.
(4)	Sublimation of substance and its colour is white.	HgCl_2 , As_2O_3 , Hg_2Cl_2 , AlCl_3 , Sb_2O_3
	yellow	Halide of NH_3
	Black	As_2S_3 and HgI_2
	Blue, yellow or violet vapour	(Hg, Sb and As)'s sulphide
	gray (garlic colour)	Iodide
(5)	After heating colour of residue white	oxide of Ca, Ba, Sr, Mg, Zn and Al
	red-brown	Fe_2O_3
	yellowish brown	SnO_2
	when hot but brown when cool	
	black	NiO , MnO_2 and CuO
	Dark orange-red	HgO
	White after heated yellow	ZnO
	Blue or green after heating white	$\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$
(6)	Observation of Evolution gas	
	Supporter combustion O_2	nitrate of Na and K.
	CO_2 gas which gives milky of lime water	Carbonate and oxalate
	H_2S -bad smelling gas like rotten egg	sulphide
	White fumes with HCl gas	aqueous chlorine salt
	NH_3 -gas red litums turns blue	ammonium salt
	SO_2 -smell like burnt sulphur	sulphide and thiosulphate
	Cl_2 -yellow-green gas	chloride
	I_2 -violet gas	Iodide
	Br_2 -red brown gas	Bromide
	NO_2 -brown gas	nitrate and nitrite of heavy metal.

(c) Smell of compound :

It also give the idea of present radical.

smell	Inference
Ammoniacal	salt of NH_4^+
vinegar	acetate
like Cl_2	Hypochlorite

(d) Solubility of salt :

Types of salt	observation
Nitrate or nitrite	all metallic salt dissolve in water
Acetate	all metallic acetate dissolve in water
Chloride	All chloride except AgCl , Hg_2Cl_2 and PbCl_2 dissolve in water
Bromide	all bromide except AgBr , Hg_2Br_2 and PbBr_2 dissolve in water
Iodide	all iodides except Hg_2I_2 , HgI_2 and PbI_2 dissolve in water
Sulphide	all sulphide except metal of group-I and group-II and ammonium ion, dissolve in water.
carbonate	all carbonate except carbonate of group-I and $(\text{NH}_4)_2\text{CO}_3$ dissolve in water.
Sulphate	All sulphate are soluble in water but PbSO_4 , Hg_2SO_4 , BaSO_4 , CaSO_4 and Ag_2SO_4 sparingly soluble in water
Phosphate	All sulphate except group-I and $(\text{NH}_4)_3\text{PO}_4$ dissolve in water.
Hydroxide	All hydroxide except group-I, $\text{Ba}(\text{OH})_2$, $\text{Sr}(\text{OH})_2$ and $\text{Ca}(\text{OH})_2$ dissolve in water.

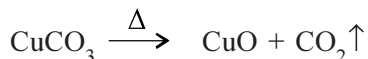
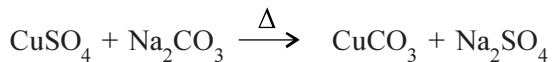
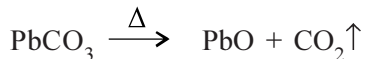
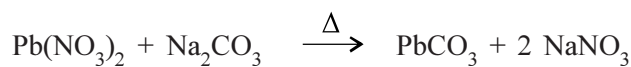
(e) Flame Test :

Prepare a paste of the substance in a minimum quantity of con. HCl and perform flame test in oxidising flame (blue flame). General radical of Gr. (IV) (Ca^{2+} , Ba^{2+} , Sr^{2+}) can be detected by this test.

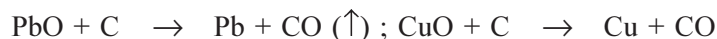
Colour	+ve ion (Radically)
Golden yellow	Na^+
Violet (pink)	K^+
Reddish brown	Li^+
Brick red	Ca^{2+}
Green like apple	Ba^{2+} , Mg^{2+}
Greenish blue	Cu^{2+} , BO_3^{3-} , Ti^{3+}
Crimson red	Sr^{2+}
Blue	Cu^{2+} , As^{3+} , Sb^{3+} , Bi^{3+}

(f) Charecoal cavity test :

Make a cavity in the charcoal and moisten it with a drop of water. Put the mixture of substance + Na_2CO_3 ‘+’ cha dust (mix well seperately) in the cavity. Again put a drop of water on the mixture and heat it with blow pipe in the reducing flame for 8-10 minutes.)



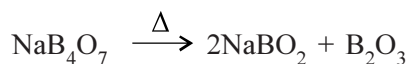
This metal oxide reduced in metal by carbon from reducing flame and form bead after cool.

**● Colour in charcoal cavity test :**

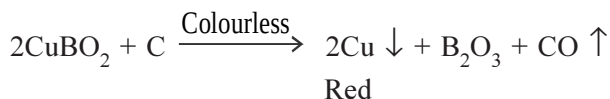
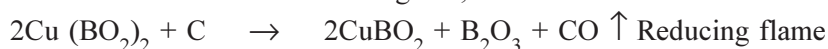
No.	Bead	Cryst (layer)	observation
(1)	White soft bead which marking on paper.	brown-yellow after cool.	Pb^{2+}
(2)	Flexible white bead	—	Ag^+
(3)	White-brown bead	Orange-After cool become yellow	Bi^{3+}
(4)	Fumes of garlic smell No bead form.	—	As^{3+}
(5)	—	Brown	Cd^{2+}
(6)	Smell of ammonia	Red	NH_4^+
(7)	—	White ppt	$\text{Fe}^{3+}, \text{Co}^{2+}, \text{Mn}^{2+}$

(g) Borax Bead Test :

If borax ($\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$) is heated on pt-wire, it gives bead of sodium metaborate (NaBO_2) and boric anhydride like transparent and colourless glass.



Above colourless bead produces different colour with salt of Cu, Fe, Cr, Mn, Co and Ni. Colour of bead depends on it is heated on which type of flame.



● **Colour in Borax Bead Test**

No	Oxidizing flame		Reducing flame		Bead
	Hot	cool	Hot	cool	
(1)	Green	Blue	Colourless	Red-brown	Cu
(2)	Yellowish brown	Yellow	Green	Green	Fe
(3)	Yellow	Green	Green	Green	Cr
(4)	Violet	Anethyst	Colourless	Colourless	Mn
(5)	Blue	Blue	Blue	Blue	Co
(6)	Violet	Brownish red	Gray	Gray	Ni
(7)	Yellow	Colourless	Brown	Brown	Mo
(8)	Violet (pink)	Violet (pink)	Red	Violet	Au
(9)	yellow	Colourless	Yellow	Yellowish brown	W
(10)	Yellow	Light yellow	Green	Green like bottle	U
(11)	Yellow	Green-yellow	Brown	Green	V
(12)	Yellow	Colourless	Gray	Light violet	Ti
(13)	Orange-red	Colourless	Colourless	Colourless	Ce

PbSO_4 is insoluble in water but soluble in sulphate of Cu^{2+} .

(2) Wet test for positive radicals :

Conformative tests, for positive ions or basic ions.

General positive ions are clasified into six groups in qualitative analysis. It is differernt from each other. Every group of positive ion is precipitated by any definite reagent, which is called group reagent.

● **First Group (Silver Group)**

- Three basic ions : Pb^{2+} , Ag^+ and Hg_2^{2+} .
- Dilute HCl is group reagent.
- These ions group precipitated as chloride form. PbCl_2 is dissolved in hot water, while insoluble in cold water. Same as AgCl and Hg_2Cl_2 both are insoluble in water.
- PbCl_2 reacts with K_2CrO_4 and KI gives yellow precipitates due to formation of PbCrO_4 and PbI_2 respectively.
- AgCl gives $(\text{Ag}(\text{NH}_3)_2\text{Cl})$ complex with NH_4OH . If salt soluble in cold and dil. HCl, So Pb^{+2} is absent.
- If salt dissolve in cold and dilute HCl, so Pb^{2+} is absent.

● **Second Group (Copper Group)**

- Five Basic ions : Hg^{2+} , Pb^{2+} , Bi^{3+} , Cu^{2+} .

- II-A Copper group, II-B As^{3+} , Sb^{3+} and Sn^{2+} or Sn^{4+}
- Group reagent : dil $\text{HCl} + \text{H}_2\text{S}$. Ions precipitated with sulphide form.

● Colour of Basic ions of Group II

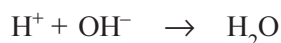
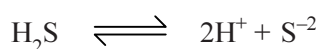
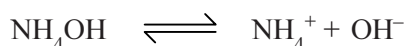
PbS and $\text{CuS} \rightarrow$ Black

CdS , Ag_2S and $\text{SnS}_2 \rightarrow$ Yellow

$\text{Sb}_2\text{S}_3 \rightarrow$ Orange,

$\text{SnS} \rightarrow$ brown

- Sulphide of Pb^{2+} , Cu^{2+} and Cd^{2+} are soluble with 50 % HNO_3 due to formation of nitrate.
- Ammonium hydroxide increase in ionisation of H_2S by removal of H^+ from H_2S and form water which do not ionized.



In this situation S^{2-} are in more proportion, so it can be precipitated in group-IV.

● Third Group (Iron Group)

- Three basic ions : Fe^{3+} , Al^{3+} , Cr^{3+} .
- Group reagent : $\text{NH}_4\text{Cl} + \text{NH}_4\text{OH}$. These ions of group are precipitated as their hydroxides due to their solubility product is very high.

$\text{Fe}(\text{OH})_3 \rightarrow$ Reddish brown precipitates

$\text{Al}(\text{OH})_3 \rightarrow$ Gelateneous white precipitates

$\text{Cr}(\text{OH})_3 \rightarrow$ Green precipitates like dirty.

- During analysis of this group, first NH_4Cl is added then after NH_4OH is added due to common ion effect.
- Here, $(\text{NH}_4)_2\text{SO}_4$ and NH_4NO_3 Can't be used in place of NH_4Cl because SO_4^{2-} ions precipitated as BaSO_4 with Ba^{2+} ions.
- Precipitate of $\text{Al}(\text{OH})_3$ dissolve in excess NaOH while precipitates of $\text{Fe}(\text{OH})_3$ and $\text{Cr}(\text{OH})_3$ are insoluble.
- Fe^{3+} ions gives red colour like blood with potassium thiocyanate (KCNS) due to formation of $\text{Fe}(\text{CNS})_3$ or $[\text{Fe}(\text{SCN})_6]^{3-}$ ions, white with potassium ferrocyanide $[\text{K}_4(\text{Fe}(\text{CN})_6)]$ gives percuin blue colour due to formation of ferro-ferricyanide ($\text{Fe}_4[\text{Fe}(\text{CN})_6]$).

● Fourth Group (Zinc Group)

- Four Basic groups : Co^{+} , Ni^{2+} , Mn^{2+} and Zn^{2+} .
- Group reagent : $\text{H}_2\text{S} + \text{NH}_4\text{OH}$. These ions precipitated as sulphide form which is insoluble in NH_4OH .

CoS , $\text{NiS} \rightarrow$ Black ppt

$\text{MnS} \rightarrow$ light pink ppt

$\text{ZnS} \rightarrow$ light white ppt

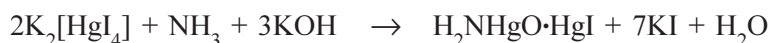
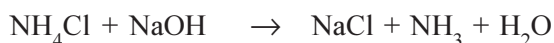
- In this group NH_4Cl is present before addition of H_2S .
- ZnS is soluble in cold and dil. HCl due to formation of chloride while NiS is insoluble.

● Fifth Group (Calcium Group)

- Three Basic ions : Ba^{2+} , Sr^{2+} and Ca^{2+} .
- Group reagent $\text{NH}_4\text{Cl} + \text{NH}_4\text{OH} + [(\text{NH}_4)_2\text{CO}_3]$. Basic ions insoluble in NH_4OH dissolve in $(\text{NH}_4)_2\text{CO}_3$.
- Carbonate of Ba^{2+} , Sr^{2+} and Ca^{2+} form equivalent acetate so soluble in CH_3COOH . While only Barium chromate (BaCrO_4) insoluble in CH_3COOH gives yellow ppt of potassium chromate.
- CaSO_4 is soluble in $(\text{NH}_4)_2\text{SO}_4$ due to formation of $(\text{NH}_4)_2(\text{CaSO}_4)_2$ complex.
- In calcium complex if ammonium oxalate's solution is added then it gives white ppt of calcium oxalate. This ppt dissolves in dil. HCl and this solution becomes colourless to KMnO_4 solution due to reduction of H_2SO_4 .

● Sixth Group (Alkali Group)

- Four basic ions : Mg^{2+} , Na^+ , K^+ and NH_4^+ .
- No group reagent, so detection is done by independent method. (separately)
- Ammonium solution of Mg^{2+} ammonium phosphate is added. Then white ppt of MgNH_4PO_4 is obtained.
- Ammonium salt is heated with NaOH produces NH_3 which gives white fumes with con. HCl and NH_4Cl .
- NH_3 gas is passed through Nessler's reagent, brown ppt. will be obtained.



Nessler's reagent

Brown ppt

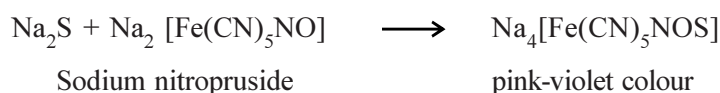
(3) Wet tests of negative ions :

(a) Tests of carbonates and bicarbonates :

- Carbonate and bicarbonate evolved CO_2 gas with dil. H_2SO_4 which turns lime water milky.
- $(\text{NH}_4)_2\text{CO}_3$ which is a soluble solute reacts with MgSO_4 gives white ppt due to formation of magnesium carbonate.

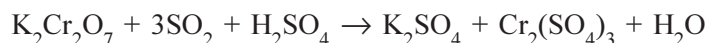
(b) Tests of sulphide :

- Sulphide reacts with dil. H_2SO_4 evolved H_2S gas which turns lead acetate paper black.
- Soluble sulphide gives pink-violet colour with sodium nitroprusside.



(c) Tests of sulphite :

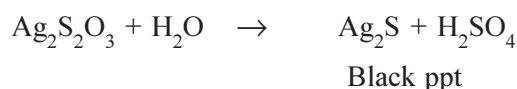
- (i) Sulphite evolved SO_2 gas with dil. H_2SO_4 which turns acidic solution of $\text{K}_2\text{Cr}_2\text{O}_7$ green because dicromate reduced to chromium sulphate which is green.



- (ii) Sulphite reacts with solution of BaCl_2 gives white precipitate of Barium sulphide, which evolved SO_2 gas, soluble in dil. HCl .

(d) Tests of thiosulphate :

- (i) Thiosulphate reacts with dil. H_2SO_4 to evolve SO_2 gas and colloidal sulphur.
- (ii) Thiosulphate reacts with solution of silver nitrate gives white precipitate of silver thiosulphate which on decomposes gives slowly yellow, orange, brown and at last turns to black due to formation of silver sulphide.



(e) Tests of nitrite :

- (i) Nitrite reacts with dil. H_2SO_4 gives nitrous acid, which decomposes gives brown colour of NO_2 gas.

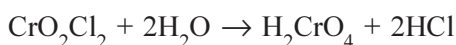


- This gas reacts with ferrous sulphate gives black solution due to formation of complex having $\text{FeSO}_4 \cdot \text{NO}$ or $[\text{Fe}(\text{H}_2\text{O})_5\text{NO}]\text{SO}_4$ formula.
- (ii) Nitrite reacts with dil. H_2SO_4 gives nitrous acid which reacts with KI produce I_2 which turns starch solution into blue-purple coloured solution.

(f) Tests of chloride :

- (i) Chloride reacts with Con. H_2SO_4 produce HCl gas which gives white ppt of AgCl with AgNO_3 solution.
- (ii) Chloride reacts with $\text{K}_2\text{Cr}_2\text{O}_7$ or con. H_2SO_4 and heated gives reddish gas of $(\text{CrO}_2\text{Cl}_2)$ (Chromile chloride). This gas reacts with NaOH gives yellow solution of sodium chromate.

Note : In chromile chloride test only dry test is used otherwise if water is present then hydrolysis of cromile chloride occurs.



(g) Tests of Bromide :

- (i) When bromide reacts with con. H_2SO_4 gives reddish brown colour of bromine which turns starch iodide paper into blue.
- (ii) Bromide reacts with Cl_2 water produce Bromine which remove brown colour on CS_2 layer.

(h) Test of iodide

- (i) When iodine reacts with Con. H_2SO_4 gives purple iodine gas which turns starch paper into blue.
- (ii) I_2 solution stirr with Cl_2 water liberate I_2 which turns purple on CS_2 layer.

Note : To prepare easily Cl_2 water, in KMnO_4 solution, con. HCl added dropwise till the purple colour of KMnO_4 remove.

(i) Test of nitrate :

- (i) When nitrate reacts with con. H_2SO_4 gives HNO_3 which gives vapour of brown coloured NO_2 gas with powdered Cu.
- (ii) **Ring Test :** When nitrate reacts with freshly prepared FeSO_4 solution in presence of concentrate H_2SO_4 brown coloured ring form at which both liquid meet due to formation of $[\text{Fe}(\text{H}_2\text{O})_5\text{NO}]\text{SO}_4$ complex.

(j) Tests of Sulphate :

- (i) Soluble sulphate gives white ppt of BaSO_4 with BaCl_2 solution, which is insoluble in acid.

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59. Which of the following compound is obtained in borax bead test ?
(A) metaborate (B) tetraborate (C) orthoborate (D) All of three
60. Which of the following salt give white ppt. with AgNO_3 and dil. H_2SO_4 as well as gives green flame in flame test ?
(A) CuCl_2 (B) BaCl_2 (C) PbCl_2 (D) $\text{Cu}(\text{NO}_3)_2$
61. Which of the following colour of ppt. obtained when phosphate ion reacts with ammonium molybdenum ?
(A) violet (B) pink (C) yellow (D) Green
62. Which ion remove colour of acidic KMnO_4 ?
(A) SO_4^{2-} (B) S_2^{2-} (C) NO_3^- (D) CH_3COO^-
63. Which reagent give test of presence of Fe^{2+} ion ?
(A) H_2S (B) NH_4CNS (C) $\text{K}_4[\text{Fe}(\text{CN})_6]$ (D) $\text{K}_3[\text{Fe}(\text{CN})_6]$
64. In test of NO_3^- brown coloured ring is obtained due to formation of nitroso sulphate. This test depends on which of the following ?
(A) By reduction of nitrate into nitric oxide.
(B) By oxidation of nitric oxide into nitrogen dioxide.
(C) By reduction of ferrous sulphate into iron.
(D) Oxidising capacity of H_2SO_4 .
65. Which principle is included in classification of basic free radical ?
(A) Common ion effect (B) solubility product (C) valency of ions (D) strength of salt
66. Which of the following product obtained which is colourless when KCN is added to CuSO_4 solution ?
(A) $[\text{Cu}(\text{CN})_4]^{2-}$ (B) $[\text{Cu}(\text{CN})_4]^{3-}$ (C) $\text{Cu}(\text{CN})_2$ (D) CuCN
67. Chloride salt is added to con. H_2SO_4 produce colourless smoke but incase of iodide salt produce violet smoke because...
(A) H_2SO_4 is reduced HI to I_2 . (B) HI is violet coloured.
(C) Due to oxidation of HI into I_2 . (D) HI is transfer into KIO_3 .
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68. Why HCl can't be used in preparation of acidic medium in oxidation reaction of KMnO_4 ?
 (A) HCl and KMnO_4 act as oxidising agent.
 (B) KMnO_4 is oxidised HCl to Cl_2 but it is oxidising agent.
 (C) KMnO_4 is weak oxidising agent than HCl.
 (D) KMnO_4 act as reducing agent in presence of HCl.
69. Which element detect by sodium nitropruside $[\text{Na}_2(\text{Fe}(\text{CN})_5\text{NO})]$? Which compound is prepared ?
 (A) Sulphur, $\text{Na}_4[\text{Fe}(\text{CN})_5\text{NOS}]$ (B) Nitrogen, $\text{Na}_4[\text{Fe}(\text{CN})_6]$
 (C) Sulphur, $\text{Na}_2[\text{Fe}(\text{CN})_4\text{NOS}]$ (D) Sulphur, $\text{Na}_2[\text{Fe}(\text{CN})\text{NOS}]$
70. What volume of 0.02 M 0.1 M MnO_4^- solution is required for oxidation of 40 ml 0.1 M Fe^{2+} ion solution ?
 (A) 200 ml (B) 100 ml (C) 40 ml (D) 20 ml
71. Which element detect by Nessler's reagent ?
 (A) CrO_4^{2-} (B) PO_4^{3-} (C) MnO_4^- (D) NH_4^+
72. Which of the following metal oxide, which is yellow when it is hot and white when it is cold ?
 (A) ZnO (B) CuO (C) PbO (D) All above
73. Which salt gives dark blue coloured when acidic solution of salt with solution of starch iodide ?
 (A) Chloride (B) nitrite (C) acetate (D) bromide
74. Position of lead in group-1 and group-2 both because...
 (A) It possess +1 and +2 valency (B) It produce insoluble PbCl_2 .
 (C) It produce lead sulphide. (D) Its chloride are partially dissolve in water.
75. Which of the following is used in place of NH_4Cl for analysis of group III ions ?
 (A) NH_4NO_3 (B) $(\text{NH}_4)_2\text{SO}_4$ (C) $(\text{NH}_4)_2\text{CO}_3$ (D) NaCl
76. Identify correct order of solubility in aqueous medium of Na_2S , CuS and ZnS :
 (A) $\text{CuS} > \text{ZnS} > \text{Na}_2\text{S}$ (B) $\text{ZnS} > \text{Na}_2\text{S} > \text{CuS}$
 (C) $\text{Na}_2\text{S} > \text{CuS} > \text{ZnS}$ (D) $\text{Na}_2\text{S} > \text{ZnS} > \text{CuS}$

Answers : 59. (A), 60. (B), 61. (C), 62. (B), 63. (D), 64. (A), 65. (B), 66. (B), 67. (C), 68. (B), 69. (A), 70. (C), 71. (D), 72. (A), 73. (B), 74. (D), 75. (A), 76. (D).

