QUALITATIVE TESTS FOR ESTERS

An ester is a chemical compound derived from an acid (organic or inorganic) in which at least one –OH hydroxyl group is replaced by an –O– alkyl (alkoxy) group.

Esters are also usually derived from carboxylic acids. It may also be obtained by reaction of acid anhydride or acid halides with alcohols or by the reaction of salts of carboxylic acids with alkyl halides.

Qualitative tests for esters:

1. Phenolphthalein test
2. Hydroxamic acid test

1. Phenolphthalein test:

- Dissolve 0.5ml of sample in 2ml of ethanol
- Add 2 drops of NaOH to the sample
- Add 2 drops of phenolphthalein indicator to the mixture
- Heat the mixture for few minutes

Note: Pink color disappears in the test tube

The color of the phenolphthalein is colorless. When it is contacted with a base NaOH it turns to pink color. On reaction with ester, the phenolphthalein molecule changes from its protonated form with a pink color to its deprotonated form where the pink color disappears.

2. Hydroxamic acid test (or) Feigl test:

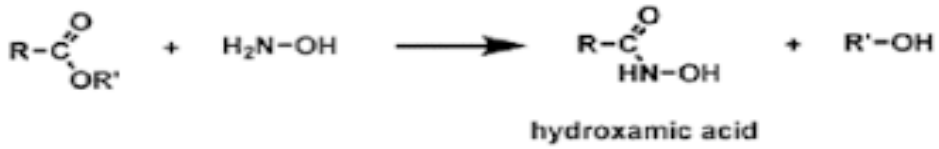
It is also called as Ferric Hydroxamate test. It is a confirmatory test for esters.

- Add 1ml of sample into a dry test tube
- To that add 0.1gm of hydroxylamine HCl in ethanol
- Add 1ml of 10% NaOH solution to the mixture and boil for 2 minutes.
- Cool and acidify with dil.HCl
- If the solution is cloudy, add 1-2ml of ethanol to make the solution clear.
- Add 2-3 drops of $FeCl_3$ solution

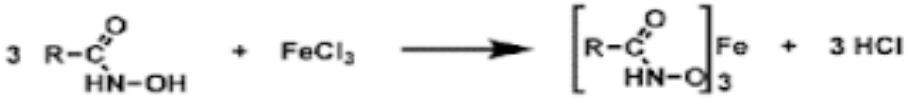
Note: Formation of red violet or magenta color is observed indicates the presence of esters.

Step1: Esters when heated with hydroxylamine produces Hydroxamic acid

Step2: Hydroxamic acid forms an intense colored complex with Fe^{3+} ions.



hydroxamic acid



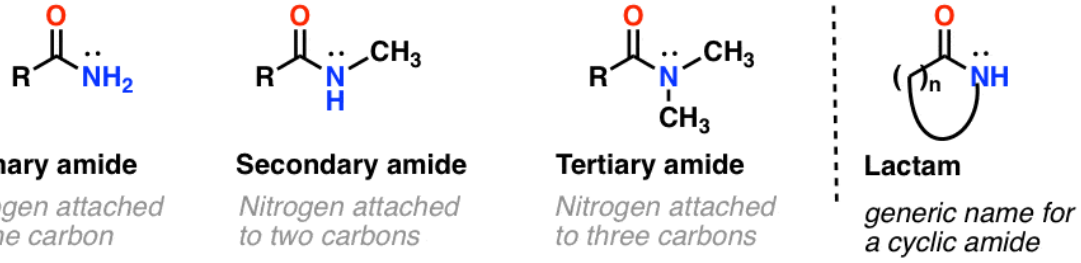
ferric hydroxamate

Note: Formation of red violet or magenta color indicates the presence of esters

QUALITATIVE TESTS FOR AMIDES

Amides are compounds that consist of a carbonyl functional group which is connected to both an amine group and a hydrocarbon group (or hydrogen atom). A carbonyl functional group consists of a carbon atom which is double-bonded with an oxygen atom.

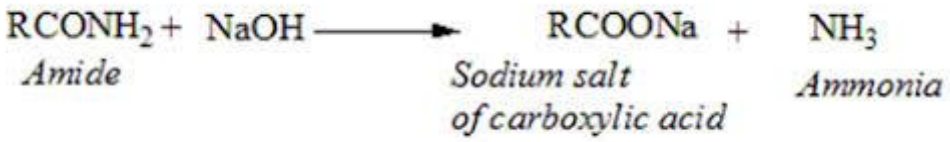
Nomenclature of Amides



1. NaOH test
2. Hydroxamic acid test
3. Nitrous acid test
4. Hydrogen peroxide test
5. Biuret test

1. **NaOH test (or) Alkaline hydrolysis of amide:**

Ethanamide is heated with sodium hydroxide solution then ammonia gas is evolved out and left with a solution containing sodium ethanoate.



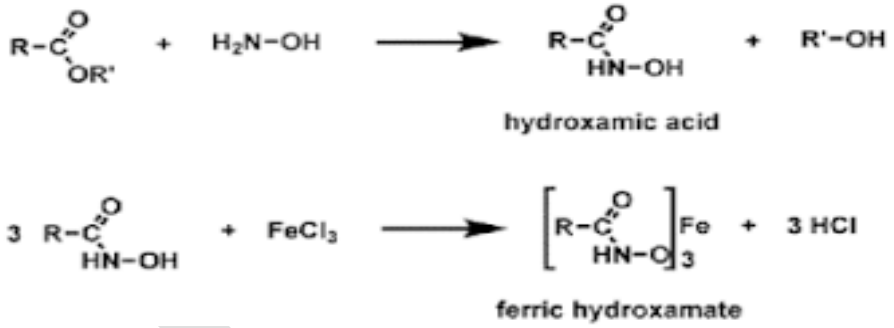
- Boil 0.5gm of the compound with 5ml of 10% sodium hydroxide solution.

Note: Ammonia gas is evolved i.e., it produces white fumes of ammonium chloride gas indicates the **Presence of Primary Amides.**

2. **Hydroxamic acid test:**

- Add 0.5gm of sample to a dry test tube
- Add 2ml of hydroxylamine HCl to the sample
- Boil the mixture for about 5mins
- Cool and add few drops of alcoholic $FeCl_3$ solution.

Note: Bluish red color solution is observed. It indicates the presence of **Aliphatic amide.**



3. **Nitrous acid test:**
    - Add 0.2gm of sample to a dry test tube
    - To the sample add 2ml of dilute. HCl
    - Add 2ml saturated solution of $NaNO_2$

Note: Brisk effervescence due to **Nitrogen (N_2) gas** is observed which indicates the **presence of aliphatic amides.**

Reactions of amides

2. With nitrous acid

- **Amides reacts with nitrous acid (HNO_2) to give carboxylic acid and N_2 gas.**
- **Nitrous acid (HNO_2) is unstable and is prepared in situ by the reaction of dilute HCl or dilute H_2SO_4 with sodium nitrite in the absence of heat.**

$$NaNO_2\ (s) + HCl\ (aq) \rightarrow NaCl\ (aq) + O{=}N{-}OH\ (aq)$$

nitrous acid

- $R\text{-}CONH_2 + HNO_2 \rightarrow R\text{-}COOH + N_2(evolved) + H_2O$

4. Hydrogen peroxide test:

- Take 0.2gm of sample in a dry test tube and add 1ml of water to the sample.
- Add 7-8 drops of H_2O_2 and boil the mixture in a water bath
- Cool and add few drops of $FeCl_3$ solution

Note: Bluish violet color is observed indicates the presence of **Aromatic amides**

$$ArCONH_2 + H_2O_2 \longrightarrow ArCONHOH + H_2O$$

Aromatic amide

$$3ArCONHOH + FeCl_3 \longrightarrow (ArCONHO)_3\,Fe + 3HCl$$

Ferric hydroxamate complex

Hydrogen peroxide reacts with aromatic primary amides to form the Hydroxamic acid which then reacts with ferric chloride to form ferric hydroxamate complex having bluish violet color indicates the presence of Aromatic amides.

5. Biuret test:

Composition: Hydrated copper sulphate, Sodium hydroxide, Rochelle's salt.

In the presence of alkali, when biuret is reacted with dilute $CuSO_4$, a purple colored substance is formed. The color is due to the formation of a chelate complex.

Cupric ions create a chelate complex of violet color; using oxygen atom in water and unshared electron pairs of nitrogen undergoes reduction reaction.

The solution appears violet, indicates the presence of diamide. This reaction takes place in compounds having two amide groups directly to the carbon atom.