IDENTIFICATION OF AN ORGANIC COMPOUND

INTRODUCTION:

The aim for this investigation is to identify an unknown organic compound containing one of the following functional groups:

- Alkene
- Primary alcohol
- Tertiary alcohol
- Aldehyde
- Carboxylic acid
- Ketone
- Phenol
- Ester

To indentify I will take each of the functional group and test to see if the functional group is present in a unknown organic compound.

Safety:

- Safety goggles must be worn at all times in order to protect eyes from splashing chemicals or hot water.
- Empty the table before start doing an experiment so that no-one has any kind of accident- such as handling the glass apparatus because they are breakable and cause serious injure.
- Lab coat must be worn to avoid chemicals splash on your clothes

Chemical equipment Hazards Precautions

Bromine water Irritating ,toxic and high flammable Burn to skin and eyes

Potassium dichromate corrosive Severe eye damage

Zinc chloride corrosive Redness and pain

Hydrochloric acid Extremely corrosive Contact with skin cause serious permanent damage.

2, 4 dinitrophenylhydrazine Irritant Red skin, feel itchy

Sodium hydroxide Corrosive Contact with skin causes irritation or severe burn.

Silver nitrate Poisonous Contact with skin leaves silver stains on skin.

Hydroxylamine hydrochloride Corrosive, causes burn Causes skin irritation

Potassium hydroxide Corrosive Causes severe eye and skin burns

Iron (III) chloride Corrosive Causes severe eye and skin burns

Apparatus:

• Test tubes and a test tube holder

• Pipettes

• Spatula

• Water bath

• Potassium dichromate

• 2,4 dinitrophenylhydrazine

• Tollen's reagent

• Sodium Hydrogen Carbonate

• Limewater

• Sodium Metal

• Filter paper

• Iron(III)Chloride (FeCl3)

• Safety Glasses

• Gloves

• Lab coat

2, 4-dinitrophenylhydrazine (DNPH) Test (for presence of a carbonyl group)

Carbonyl compounds:

The carbonyl compounds is the presence of carbon - oxygen double bonds C=O. The functional group on aldehydes and ketones is a carbonyl group.

Carbonyl compounds can be tested with a reagent of 2, 4 dinitrophenylhydrazine. A positive test will show yellow precipitate.

Method:

• Add 5 drops of unknown compound into the test tube

• Add 5 drops of the DNPH reagent

• Shake the tube gently

If the solution turns into a yellow or orange precipitate then a carbonyl compound is present.

Equation:

Orange 2, 4-dinitrophenylhydrazine forms with the 2-propanone indicating the presence of an aldehyde or ketone.

(http://jchemed.chem.wisc.edu/jcesoft/cca/CCA5/MAIN/1ORGANIC/ORG12/TRAM12/B/0

380011/MOVIE.HTM)

The reaction is a condensation reaction as water is been eliminated in the formation of the carbon-nitrogen double bond in a hydrazone.

Tollen's reagent test (to distinguish between Aldehyde and Ketones):

Method:

• Put 2cm3 of silver nitrate in a test tube, add 3-4 drops of sodium hydroxide. This shows the gray precipitate of silver oxide

• Add few drops of ammonia solution and shake the test tube gently after each drop until the precipitate just dissolves.

• Rinse the test tube with sodium hydroxide and take 1 cm3 of Tollen's reagent, tilt the test tube and add the drops of unknown compound, letting it gently run into the solution.

• Heat the solution in water bath

A positive test will give a silver mirror on the inside of the test tube which indicates Aldehyde are present and a negative test will indicates that Ketone functional groups.

Equation:

RCHO + 2{Ag (NH3)} OH ◊ RCOO NH4 + 2Ag + H2O + 3NH3

This is a mixture of ammonia and silver nitrate, containing [Ag (NH3)] 2+ complex ions.

Silver (I) ions are reduced to Ag when the aldehyde is oxidised

Test for alkene (Bromine water):

Alkene contains C-C double bonds and reacts with hydrogen under the right condition, thus

alkene are said to be unsaturated due to double bond presence.

Method:

Place 1cm3 of the organic compound in a test tube and add 3-4 drops of bromine water to it. Shake the test tube gently after each drop

If bromine water decolourise the solution, it means and alkenes compound is present. The colour will change from orange to colourless.

The equation for above reaction is:

(http://www.bbc.co.uk/schools/gcsebitesize/img/ch01008.gif)

However, the bromine water also decolourise phenols giving white precipitate. To confirm and distinguish phenols, a further test will be done by using Iron (iii) chloride ($FeCl_3$)

Phenol

http://www.wellesley.edu/Chemistry/chem211lab/Orgo_Lab_Manual/Appendix/ClassificationTests/phenol_amine_nitro.html

Method:

• Measure 5ml of an unknown compound in a measuring cylinder and place it into the test tube

• By using pipette add 3-4 drops of iron (III) chloride into the test tube

• If the colour changes to violet it will indicate the presence of phenol in unknown compound.

The Sodium hydrogen carbonate test (for presence of carboxylic acid):

Test for carboxylic acid to see if its present or not I will use sodium hydrogen carbonate. If the carbon dioxide is released and lime water is present this means there is a presence of carboxylic acid.

Equation:

CH3CH2COOH + NaHCO3 ----------> CH3COONA 2 + CO2 +H2

Method:

• Measure 5cm3 of an unknown compound in a measuring cylinder and place it into the test tube

• Add a spatula of NaHCO3 to aqueous unknown compound

If carbon dioxide gas is evolved, the gas can be tested by passing through lime water and if it turns the lime water milky, it means carboxylic acid group is present

Potassium dichromate test:

This test oxidise Primary alcohols to either aldehydes or carboxylic acids, if this is done by secondary alcohol then only Ketone forms. In each oxidation, the dichromate is reduced to Cr3 + (green) whereas tertiary alcohols does not oxidise by acidified sodium or potassium dichromate solution.

The equation for primary alcohols to oxides is:

CH3CH2OH +[O] ----------> CH3CHO + H2O

([O] Acts as an oxidising agent)

CH3CHO + O → CH3COOH

Method:

• Pipette 5 drops of unknown compound into a test tube

• Add 2 drops of potassium dichromate into a test tube

• Then add 10 drops of dilute sulphuric acid to the test tube and shake the test tube gently

• Place the test tube into the warm water for 5-10 mins

• If the colour change from orange to green it will identifies primary alcohol

Potassium Dichromate is a reagent, which oxidises alcohols when mixed with dilute sulphuric acid and warmed. The dichromate ion gives a colour change from orange to green.

Sodium Test (for presence of tertiary alcohols):

The sodium test will take place to find out if tertiary alcohols is present or not since Tertiary alcohols aren't oxidised by acidified sodium or potassium dichromate solution.

Method:

• Measure 2cm3 in a measuring cylinder and place it into a test tube

• Using forceps, take a small piece of sodium

• To remove the oil, dry the sodium onto a filter paper

• Put sodium in a test tube

• If sodium dissolves and evolve hydrogen gas

(Test the gas by putting the lighted splint into a test tube of hydrogen gas. Hydrogen will ignite with a pop sound when placed near a glowing splint)

This will indicate a positive test the presence of tertiary alcohols.

The negative test will indicate the ester functional group in the unknown compound

Fair test:

Doing a fair test is completely essential for achieving accurate and reliable results which would take a large part in the conclusion at the end, and also for avoiding errors and anomalous results. To make the experiment fair as much as possible, following things need to be considered:

• Relevant and accurate equipment with very small percentage errors.

• Washing and drying up the equipment thoroughly after each experiment ensuring that they are contamination-free.

• Taking measurements carefully as specified by the method.

• keeping a straight line of sight when reading measurements of solution in the measuring cylinder

• Always read the bottom of the meniscus of any solution when taking measurements and to make sure any inaccurate reading.