

## Identification of an organic unknown

### Aim

In this piece of coursework I will be outlining a sequence of simple chemical tests to use to identify 8 different functional groups.

These functional groups I will be finding are, Alkene, primary alcohol, tertiary alcohol, aldehyde, ketone, carboxylic acid, ester and phenol.

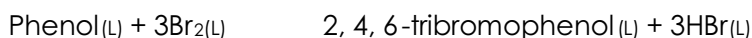
I will be explaining the tests, the observations and the safety of each test/functional group.

### Wet Tests

#### Bromine water

In the presence of an Alkene, the bromine water will turn the unknown from orange to colourless.  $C_2H_4(L) + Br_2(L) \rightarrow C_2H_4Br_2(L)$

In the presence of a phenol group, a white precipitate will be formed when bromine water is added.



Principal hazards	Bromine vapour is released from bromine water solutions when they are open to the air. This vapour is harmful if inhaled. Bromine water is harmful if you swallow it and can cause eye damage if splashed into the eyes. Prolonged contact with the skin may lead to burns.
Safe handling	Wear safety glasses. Work in a well ventilated area. Do not leave bromine water in the open laboratory, unless the solution is covered to prevent vaporization of bromine.
Emergency	<b>Eye contact:</b> Immediately flush the eye with water. If irritation persists, call for medical help. <b>Skin contact:</b> Wash off with soap and water. <b>If swallowed:</b> Call for medical help.
Disposal	Very small amounts can be flushed down the sink unless local rules prohibit this. Spills should be neutralised with soda ash.
Protective equipment	Safety glasses.

### 2, 4 DPNH/Brady's reagent

▲Add a few drops to Brady's reagent (2, 4-dinitrophenylhydrazine solution) to the unknown. Brady's reagent detects the carbonyl function of an aldehyde and ketone. Yellow/orange precipitate forms with aldehyde or ketone.

Principal hazards	2,4-DNPH is potentially explosive when dry and may decompose rapidly or explosively if heated or subject to shock. It is also very flammable. This material is harmful if you swallow it.
Safe handling	Wear safety glasses. Never allow the solid to dry out. Do not heat or grind it, since this might cause it to explode if it is dry. Do not use 2,4 -DNPH until you have been trained in how to handle potentially explosive material. Clean up spills - do not leave spilled material to dry out!
Emergency	<b>Eye contact:</b> Immediately flush the eye with water. If irritation persists, call for medical help. <b>Skin contact:</b> Wash off with soap and water. <b>If swallowed:</b> Call for medical help.
Disposal	Store wet for later disposal as solid waste. Ensure the container is suitably labelled with the identity of the contents, the hazards that it poses and the instruction that it must be kept damp at all times.
Protective equipment	Safety glasses

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### Tollens reagent

Warming tollens reagent with the organic unknown is a test for an aldehyde and ketone. Tollens reagent is an oxidising agent. When adding tollens reagent, an aldehyde will create a silver mirror on the side of the test tube.

In the presence of a ketone, no change will be made on the tollens reagent, as ketones cannot be oxidised.

Principal hazards	Tollens reagent contains ammonium hydroxide which is corrosive and harmful if you swallow it. It can also cause damage if splashed into the eyes. If spilt upon the skin, the silver ions in Tollens solution may, over the course of one or two days, produce a black stain on the skin. This is not likely to be harmful, nor will it be permanent, but may be unsightly. There is a small risk of forming explosive fulminating silver, if Tollens reagent is left unused for a period of time. To avoid this, neutralise unused reagent with a little nitric acid and discard.
Safe handling	Wear safety glasses. ▲void skin contact.
Emergency	<b>Eye contact:</b> Immediately flush the eye with water. If irritation persists, call for medical help. <b>Skin contact:</b> Wash off immediately with soap and water.

	If <b>swallowed</b> : Call for medical help if the amount swallowed is not trivial.
Disposal	Small amounts can be neutralised with nitric acid (test with pH paper) and then flushed down the sink if local rules permit. Do not store unwanted reagent for long periods.
Protective equipment	Safety glasses.

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### ▲Acidified potassium dichromate (VI)

Strong oxidising agent. Distil organic unknown with potassium dichromate (VI). If colour change happens from orange to green, the functional group has allowed the primary alcohol in the unknown to be oxidised. 4

Principal hazards	Potassium dichromate is toxic if swallowed, inhaled or absorbed through the skin. It is corrosive and may produce severe eye damage. Chromium (VI) compounds are carcinogens. Potassium dichromate may act as a sensitizer. This material is a strong oxidizing agent and reacts vigorously or explosively with a wide variety of reducing agents.
Safe handling	Wear safety glasses and gloves. Work in a well ventilated area, preferably using a fume cupboard. Ensure that any spills are cleaned up without delay. "Chromic acid" baths, which were once widely used for cleaning glassware, should not be used unless (a) there is no alternative available for cleaning, and (b) a suitable procedure has been determined BEFORE work starts for disposing of waste. Note that, since chromium (VI) is a carcinogen, used chromic acid cannot be disposed of down the drains. Chromic acid is, in any case, a very dangerous material and should not be used unless it is absolutely necessary.
Emergency	<b>Eye contact</b> : Immediately flush the eye with water. Call for medical help. <b>Skin contact</b> : Wash off with soap and water. <b>If swallowed</b> : Call for medical help.
Disposal	Store for later disposal as solid waste. Ensure that the container is marked both with the name of the chemical and a statement that it is a strong oxidizer and a carcinogen.
Protective equipment	Safety glasses, gloves.

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### Phosphorus Pentachloride

PCL<sub>5</sub> is a test for an –OH group

▲Adding PCL<sub>5</sub> to a carboxylic acid will turn it into an acyl chloride. This will give off white fumes as the HCL is given off as gas,



▲Adding PCL<sub>5</sub> to any alcohol will do the same. R = any R group



Principal hazards	Phosphorus pentachloride reacts very readily with water or moisture to produce hydrochloric acid, which is a strong acid and very corrosive. Therefore, if you get this material on damp skin it can cause burns, and if you inhale it you might suffer serious respiratory problems.
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	If phosphorus pentachloride is stored in damp conditions pressure may build up in the container. Store under a dry atmosphere. The reaction of phosphorus pentachloride with water is very vigorous, so care should be taken if you need to carry out a procedure in which this material comes into contact with water.
Safe handling	Wear safety glasses. It is important that you do not inhale phosphorus pentachloride, so work in a well-ventilated area, preferably using a fume cupboard. Clean up any spills immediately.
Emergency	<b>Eye contact:</b> Immediately flush the eye with water. If irritation persists, call for medical help. <b>Skin contact:</b> Wash off immediately with water; seek first aid if the skin appears red or damaged. <b>If swallowed or inhaled:</b> Call for immediate medical help.
Disposal	Store, properly labelled, for later disposal as solid waste or destruction.
Protective equipment	Safety glasses.

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### Sodium Carbonate

Sodium carbonate added to an acid will neutralize the acid, and form carbonic acid, which is not stable and so decomposes to form CO<sub>2</sub> which is then given off.

The overall reaction is:



▲ Adding sodium carbonate to an ester creates a fruity smell. No observable change formed.

▲ Acid + alcohol → ester + water

Principal hazards	** Sodium carbonate powder may irritate the lungs if you breathe it in.
Safe handling	Wear safety glasses if required by local rules.
Emergency	<b>Eye contact:</b> Immediately flush the eye with water. If irritation persists, call for medical help. <b>Skin contact:</b> Wash off with water. <b>If swallowed:</b> Call for medical help if the amount swallowed is large.
Disposal	Small amounts of sodium carbonate can be flushed down the sink unless local rules prohibit this.
Protective equipment	Safety glasses if required.

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### References

- 1 = [http://cartwright.chem.ox.ac.uk/hsci/chemicals/bromine\\_water.html](http://cartwright.chem.ox.ac.uk/hsci/chemicals/bromine_water.html)
- 2 = <http://cartwright.chem.ox.ac.uk/hsci/chemicals/2,4-dinitrophenylhydrazine.html>
- 3 = [http://cartwright.chem.ox.ac.uk/hsci/chemicals/tollens\\_reagent.html](http://cartwright.chem.ox.ac.uk/hsci/chemicals/tollens_reagent.html)
- 4 = <http://www.chemguide.co.uk/organicprops/alcohols/oxidation.html>
- 5 = [http://cartwright.chem.ox.ac.uk/hsci/chemicals/potassium\\_dichromate.html](http://cartwright.chem.ox.ac.uk/hsci/chemicals/potassium_dichromate.html)
- 6 = [http://cartwright.chem.ox.ac.uk/hsci/chemicals/phosphorus\\_pentachloride.html](http://cartwright.chem.ox.ac.uk/hsci/chemicals/phosphorus_pentachloride.html)
- 7 = <http://www.chemguide.co.uk/organicprops/phenol/ring.html>
- 8 = [http://cartwright.chem.ox.ac.uk/hsci/chemicals/sodium\\_carbonate.html](http://cartwright.chem.ox.ac.uk/hsci/chemicals/sodium_carbonate.html)