

The Chemical Detective



You have just started work as a chemical analyst working for a water authority. One of your jobs is to note down exact observations about the appearance of unknown solutions, which you have taken from the waste output pipes of several factories. You will do tests to detect certain substances, such as poisonous metals and carbonates.



Eye protection must be worn

It is very important to work **carefully** and **cleanly**. Do **not** muddle solutions (especially by using unwashed test pipettes).

Apparatus

Goggles

Bench mat

Test tube rack

2 x test tubes

Test pipette

Sample solutions to test

Dilute hydrochloric acid

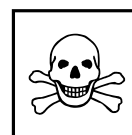
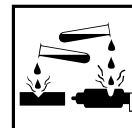
Dilute nitric acid

Sodium hydroxide solution

Ammonia solution

Silver nitrate solution

Barium chloride solution



Methods

For each test, pour one of the test solutions into a test-tube until the tube is approximately $\frac{1}{4}$ full.

Make sure you record **all** your observations, including any where there seems to be **no change**.

When each test has been done, pour the contents of the test tube into the sink, then carefully rinse it out.

If necessary, use a test tube brush to remove stubborn remains of precipitates before doing the next test.

Test for chloride ions, Cl^-

Add a few drops of nitric acid, then a few drops of silver nitrate solution.

If a white precipitate is formed, the sample contains chloride ions.

Test for sulphate ions, SO_4^{2-}

Add a few drops of nitric acid, then a few drops of barium chloride solution.

If a white precipitate is formed, the sample contains sulphate ions.

Test for carbonate ions, CO_3^{2-}

Add dilute hydrochloric acid. If bubbles of gas are given off, the sample contains carbonate ions.

Test for iron(II) ions, Fe^{2+}

Add sodium hydroxide solution. If the sample contains Fe^{2+} ions, a pale green jelly-like precipitate forms.

Test for iron(III) ions, Fe^{3+}

Add sodium hydroxide solution. If the sample contains Fe^{3+} ions, a brown jelly-like precipitate forms.

Test for copper(II) ions, Cu^{2+}

Add ammonia solution. If the sample contains copper(II) ions, a pale blue precipitate forms.

If more ammonia solution is added, the precipitate dissolves to form a deep blue solution.

