Analysing organic unknowns

Organic tests and observations

Preliminary tests

Preliminary observations and tests provide a general introduction to the characteristics of an organic compound. They can include:

* the state and appearance of the compound at room temperature
* the solubility of the compound in cold and hot water, and the pH of any solution that forms
* the effect of heating the compound and the appearance of the flame if the sample burns.

Specific tests

There are specific tests that help to identify the functional groups in compounds. You should be familiar with reactions that can be used in tests for the functional groups in alkanes, alkenes, alcohols and halogenoalkanes as described in Chapters 6.1, 6.2 and 6.3 in Student Book 1. These tests are summarised in the data sheet ‘Characteristic reactions of organic functional groups’, which you can access via the QR code for Chapter 7 on page 313 of Student Book 1.

Observations

The main types of changes looked for in organic chemistry include:

* mixing of liquids – many organic liquids do not mix with water; shaking an immiscible liquid with water can produce a cloudy emulsion.
* solids dissolving – whether or not a solid is soluble in water, acid or alkali can be very significant. First check to see if a solid dissolves in water and whether or not it affects the pH of the water, then test separate small samples with acid and then with alkali.
* colour changes – colour changes may be due to changes in the colour of the solution, the formation of a coloured precipitate or a combination of the two.
* formation of a precipitate – in organic chemistry the appearance of a precipitate and its colour can be significant.
* evolution of a gas – you are only likely to come across a limited range of gases when testing organic chemicals, including carbon dioxide, hydrogen and hydrogen chloride.
* rate of change – whereas most inorganic reactions between ions are fast, reactions between organic molecules can be slow. Noting the rate of change can provide significant information about the chemicals under test.

**TIP**

Develop a language for describing common organic smells such as sharp, sweet, fruity, like an antiseptic and so on

Carrying out observation exercises on organic compounds

Following instructions

* You may be asked to carry out a test that you have not practised before. If so, carry out the test exactly as specified. When you have tried the test, check the instructions again to check that you have not missed out an essential step.
* You may have to use a simple test to check that you really have carried out a procedure as instructed. If, for example, you are told to acidify a solution you should mix well after addition of acid and then transfer a drop of the solution to a small piece of blue litmus paper to check whether or not you have added enough acid.
* If you are not sure whether a colour change is a change in the solution or due to the formation of a coloured precipitate, then you should separate some of the solid from the solution with the help of a centrifuge or by filtering.
* If you are not sure whether or not an added reagent has caused a change, then repeat the test using pure water instead. The test with distilled water acts as a control. It is sometimes easier to look for differences.

Quantities

Always start by adding small quantities of chemicals. Never add more of a solid or solution than stated in the instructions.

If you find it hard to judge volumes, then use a measuring cylinder and marker pen to make a 1 cm3 and a 5 cm3 mark on one of the test tubes you are using.

If you add too much, you may miss important clues. If a solid dissolves in excess acid you will fail to spot this if you add so much solid to the acid in a test tube that an excess of solid obscures an important observation.

Recording observations

* Your notes should be concise, yet complete. Look out for unusual changes and write down everything that you observe even if you do not understand all that is going on.
* Be careful to distinguish your observations from their interpretation. Suppose you add some sodium carbonate to a solution of a unknown compound. What you see is that the mixture fizzes. The colourless gas turns limewater cloudy white. These are the points that you record as your observations.

Analysing results and drawing conclusions

* *Making deductions from your observations* – You have to use your knowledge of chemistry to decide what your observations mean. If a solution of an organic chemical reacts with sodium carbonate to produce a colourless gas that turns limewater milky, you can infer that the gas is carbon dioxide. From this you can conclude that the unknown compound is acidic and might be a carboxylic acid.
* *Drawing conclusions* – You will not be able to draw definite conclusions from every test that you do. Sometimes, you may not be asked for any inferences at all. Keep an open mind until you have carried out the complete series of tests. Bear in mind that you may be testing a chemical that you have never studied before. Your teacher knows that this is the situation. The aim is to see whether or not you can make accurate observations and then suggest sensible interpretations based on your general chemical knowledge.
* *Using spectra to aid your interpretation* – You are expected to be able to interpret simple mass spectra and infrared spectra. You may be given spectra to analyse alongside the results of chemical tests. You will need to be able to refer to tables that give data which correlates infrared absorption wavenumbers with molecular structure.

**TIP**

Do not get carried away and come to conclusions that you cannot justify from the evidence of your observations.