Pesticides and agricultural productivity calculations

This resource accompanies the article **Bugs beware** in *Education in Chemistry* which can be viewed at: rsc.li/46mxJtY. The article covers developments in pest control, from insect pheromones to essential oils, and food security.

Learning objectives

1 Calculate yields, percentage yields and atom economies and apply these to reactions involving alternatives to agrochemicals.

2 Describe that the actual yield of a reaction is usually less than the theoretical yield and this is due to incomplete reactions, practical losses and side reactions.

3 Handle data in a variety of chemistry contexts.

Introduction and scaffolding

This resource provides learners with the opportunity to understand more about pesticides and their alternatives while linking this to yield, percentage yield and atom economy. The *Education in Chemistry* article **Bugs beware** is a great opportunity for learners to develop their literacy skills and read around an incredibly important topic. The article is more suitable for learners with a higher reading age due to the difficulty of some of the key words. Provide learners with the full article so they can develop their understanding of the topic and experience reading more scientific texts. Alternatively, the question sheet itself explains the key concepts and is more suitable for learners with lower reading ages. The content covers yield and atom economy. The comprehension and calculations would work well as a revision task or homework for learners aged 14–16 and as a starter task for 16–18 year-olds.

There is a student support sheet, indicated by a single star in the header, to provide scaffolding for learners who find it difficult to lay out the calculations and remember key words. Download the interactive support sheet with cloze questions or the printable version. Delete the calculation prompts or key words for the fill-in-the-gaps questions to reduce the level of support as appropriate. The unscaffolded sheet has two stars in the student sheet header.

Answers

1. If learners find this task hard, direct them to the learning objectives for ideas. At least one of:
   - Incomplete reactions or alternative reactions taking place.
   - Loss of product during the reaction for example during filtering or pouring.
   - Errors weighing the chemicals.

2. Percentage yield:

$$\frac{8.6}{14.5} = 0.59 \times 100 = 59\%$$

3. 61.5%

4. 61.46%

5. 61%

6. 61.5%

7. $C_{16}H_{30}O_2 = (12 \times 16) + (1 \times 30) + (16 \times 2) = 254$

   The atom economy is 100% as there is only one product and the symbol equation is balanced.

8. $\text{Mr } C_{10}H_{14}O = (12 \times 10) + (1 \times 14) + (16 \times 1) = 150$

   $\text{Mr } C_7H_8O + C_3H_6 = (12 \times 7) + (1 \times 8) + 16 + (12 \times 3) + (1 \times 6) = 150$

   Atom economy $= \frac{150}{150} \times 100 = 100\%$

9.
   - Fewer waste products.
   - Less waste to landfill.
   - Fewer resources needed.

Extension task

This task may require laptops or other devices and you can utilise the task as a research project if there is enough time. It also provides a useful opportunity for learners to improve their presentation or oracy skills by having a presentation or Q and A activity for them to share their findings. There aren't many useful links to share with learners due to the complexity of the literature, however the support sheet contains some questions for learners to consider which link nicely into these calculations.