Doing the maths – Ohm's Law

Introduction

When learners have difficulty using Ohm's Law, they may be challenged in several different ways. Transposing equations and working with different units of measurement can often be a sticking point. **Doing the maths** is a collaborative group activity that offers a way of assessing their skills in these areas. It can be used as part of an assessment for learning strategy.

Each triangular card carries part of a calculation that has to be matched with the solution on the edge of another card. If all the cards are put together correctly, they form a hexagon.

The activity is designed to reveal common misconceptions which can then be explored and resolved through discussion in small groups. It draws on the work of Malcolm Swann, University of Nottingham, who wrote Improving learning in mathematics: challenges and strategies. You can download a copy from the website of the National Centre for the Excellence in Teaching Mathematics www.ncetm.org.uk and the **Teaching and learning materials** section at QIA's Excellence Gateway http://excellence.qia.org.uk.

To see learners engaging with the activity, go to Challenging topics/Doing the maths – Ohm's Law.

Learning outcomes

By the end of the activity, learners will have:

- deepened their knowledge of units of measurement and revised their skills in transposing equations
- identified where they need to develop greater understanding.

Resources required

- **Card set: Doing the maths,** one set per small group; 24 triangles per set.

Starting points

To complete the activity successfully, learners need:

- to recognise the symbols for the units of voltage, current and resistance
- a knowledge of the Ohm's Law equation and the ability to rearrange it to make either voltage, current or resistance the subject of the equation
- knowledge and understanding of the symbols used to represent multiples and submultiples of the three basic units
- the skills necessary to use them to obtain a correct numerical answer when substituted into the rearranged equation.

Some common limitations and errors that the activity will bring to the surface are:

- not recognising the unit associated with a given quantity (as in confusing voltage and current)
- rearranging the equation incorrectly (for example, using I = R/V instead of I = V/R
- not understanding the meaning of submultiples (not knowing that the unit milliamp represents one thousandth or that microamp represents one millionth)
- being unable to represent these quantities in scientific notation
- struggling to use them in calculations done mentally or with a calculator.

Suggested approach

Allocate learners to groups of three.

Provide each group with one set of cards.

Explain that the task is to make a hexagon out of the cards. Those that form the perimeter of the completed hexagon have the quantities needed to perform a calculation on one edge; the other two edges are blank. The triangles that form the central part of the hexagon have answers to the adjacent calculations on two edges and a calculation on the third.

The calculations involve deriving the value of one parameter of Ohm's Law (such as resistance) from two other parameters from Ohm's Law (such as voltage and current).

Listen in as learners talk among themselves. Your role is to ensure that learners:

- explore every calculation methodically and explain their thinking to one another even when one or more of them thinks the answer is obvious
- challenge each other if they disagree and to explain the reason for their challenge
- explore ways of checking their answers.

When you see where their misconceptions lie, ask questions to help learners think rather than providing them with answers. You might, for example, ask "What's the difference between this unit and that one?" or "How did you arrive at that answer?" or "What would happen if you…?".

Some teachers want to warn learners about common misconceptions on the grounds that prevention is better than cure. However, Malcolm Swan points out that this medical metaphor is unhelpful. Misconceptions are the result of alternative ways of thinking. Exploring these leads to deeper and longer term learning than approaches that try to avoid mistakes by explaining the right way to see things from the start.

Alternative approaches

You could put learners in the role of 'examiner' by giving them some 'test papers' to mark.

When you construct these test papers, include answers that show interesting and significant errors, illustrating common mistakes and misconceptions. You could draw on real answers that you have collected from previous tests and make them anonymous.

The learners' task is to assess the accuracy of the answers and to provide guidance to the 'candidate'. This strategy provides a non-threatening environment in which to discuss the errors and misconceptions.

Differentiation to meet individual needs

A simpler set of cards would use only integer values and thus require no knowledge of multiples and submultiples. This would enable learners to practise recognising the symbols and rearranging the equation without the added complexity of dealing with the more difficult arithmetic of large and small numbers.

Embedding literacy, language and numeracy (LLN)

In terms of the Adult Literacy Core Curriculum, the main aspects of LLN in this activity are **Speaking and listening**, a description of which can be found at the website below.

www.dfes.gov.uk/curriculum_literacy/tree/speaklisten/engagediscuss

In the context of the activity, though, discussion takes on a very specific flavour. It is about articulating thoughts using mathematical terminology which means that learners need to understand the units used and talk about them with precision. One of the contributions that teachers can make is to reflect back to learners what they have said and to coax them into making more scientific and mathematically accurate statements.