

Check-Up

18

Mental calculations, multiplication strategies

The QCA report on the 1998 Key Stage 3 mathematics National Curriculum assessment expressed concern about the fact that most pupils attempted the calculations below by using a standard multiplication written method. Very few responses indicated that pupils had used appropriate mental or informal strategies. How could they have done this?

- a) 46×8
- b) Audio cassettes cost £1.49 each. What is the cost of 4 cassettes?

Answers to check-up 18

The answers are (a) 368, and (b) £5.96. Possible methods are discussed below.

Discussion and explanation of check-up 18

When you are presented with a calculation, automatically turning to a standard procedure (like long multiplication) is an indication of a lack of confidence with number. Try to build up a range of informal strategies that you can use. These will be a combination of mental methods and informal written notes. Which strategies you use will depend on the actual numbers involved.

For example, many people find 'doubling' to be the easiest multiplication. So 46×8 could be tackled by doubling 46 (to get $46 \times 2 = 92$), doubling again (to get $46 \times 4 = 184$) and doubling again (to get $46 \times 8 = 368$). In fact, any multiplication with whole numbers can be done by using just doubling. For example, to find 27×19 , using repeated doubling we could jot down:

$$27 \times 1 = 27 \quad 27 \times 2 = 54 \quad 27 \times 4 = 108 \quad 27 \times 8 = 216 \quad 27 \times 16 = 432$$

Now, since $19 = 16 + 2 + 1$ for 27×19 we just add 432, 54 and 27, to get the answer, 513.

What we are doing here is to distribute the multiplication by 27 across the addition of 16, 2 and 1:

$$27 \times (16 + 2 + 1) = (27 \times 16) + (27 \times 2) + (27 \times 1)$$

An easier way of using the distributive law here would be to think of the 19 as $(20 - 1)$:

$$27 \times 19 = 27 \times (20 - 1) = (27 \times 20) - (27 \times 1) = 540 - 27 = 513$$

This is also how you might have done 46×8 and $4 \times £1.49$:

$$46 \times 8 = (40 + 5 + 1) \times 8 = (40 \times 8) + (5 \times 8) + (1 \times 8) = 320 + 40 + 8 = 368$$

$$4 \times £1.49 = 4 \times (£1.50 - £0.01) = (4 \times £1.50) - (4 \times £0.01) = £6.00 - £0.04 = £5.96$$

Of course, there's no need to write out all these steps in full like this. Just jot down what you need to remember to keep track of where you are in the mental calculation. The trick is to look for related calculations that are easier to do

mentally. You can do this by subtraction (like changing the £1.49 to £1.50 – £0.01) or by addition (like changing 46 into $40 + 5 + 1$), or a mixture of the two. You can also do it by spotting useful *factors*. For example, whenever I see 25 in a multiplication I want to multiply it by 4! So, if I had to calculate 25×36 , I would split the 36 into its factors (4×9) and change 25×36 to $25 \times 4 \times 9$, which is then just $100 \times 9 = 900$.

Summary of key ideas

- ◆ Many multiplications can be done by a combination of mental calculations and a few jottings to keep track of where you are.
- ◆ One strategy is to use doubling and to build up the number by which you are multiplying using a combination of 1, 2, 4, 8, 16 and so on.
- ◆ Look for easier, related multiplications, by changing one of the numbers into a sum of easier numbers (e.g. $28 = 25 + 2 + 1$) or a difference (e.g. $28 = 30 - 2$), and then using the distributive law.
- ◆ Try splitting up one of the numbers into factors that might make the multiplication easier.

Further practice

Use a range of informal strategies, combining mental calculations with whatever jottings are needed, to answer the following questions. These are the level of multiplication calculations that you should be able to do without using a calculator and without resorting to 'long multiplication'! The methods given in the answers are just some of many possibilities for appropriate strategies.

- 18.1** Find the cost of 24 computer discs at £4.95 each.
- 18.2** A primary school with 125 pupils is eligible for an additional grant of £48 per pupil for numeracy support. How much is this in total?
- 18.3** A pupil's text has about 240 words per page: approximately how many words in a text of 97 pages?
- 18.4** A school playing field is planned to be 45 metres long and 74 metres wide. What is the total area, in square metres? (Multiply the length by the width.) Would a field of 44 m by 75 m be larger, smaller or the same area?