Lesson - Formal written multiplication and division

Year: Year 5

Hello, I am Otto! In Year 5 you learn the written methods that people have used for hundreds of years to multiply and divide big numbers. Written methods are fast, tidy and easy to check. You will multiply by 10, 100 and 1,000, use short and long multiplication, use short division and learn what to do with a remainder.

Starter activity

A school buys 28 boxes of pencils. There are 36 pencils in each box. Before you read on, make a quick guess: is the total nearer 600, 1,000 or 1,500? Round both numbers to find out: 28 is about 30 and 36 is about 40, and 30 × 40 = 1,200. So the answer should be a little less than 1,200. Now follow the lesson to find the exact answer, 1,008.

Multiplying and dividing by 10, 100 and 1,000

Rule: shifting digits

To multiply a whole number by 10, 100 or 1,000, move every digit 1, 2 or 3 places to the **left** and fill the gaps with zeros. To divide by 10, 100 or 1,000, move every digit 1, 2 or 3 places to the **right**. The digits move, the decimal point stays in the same place.

Number	× 10	× 100	× 1,000
47	470	4,700	47,000
308	3,080	30,800	308,000

Example 1

Work out 8,300 ÷ 100 and 56 × 1,000.

8,300 ÷ 100: move the digits two places right, 8,300 becomes **83**. 56 × 1,000: move the digits three places left and add zeros to get **56,000**.

Multiplying a 4-digit number by a 1-digit number

Method: short multiplication

1. Write the 4-digit number with the 1-digit number underneath, lining up the ones.
2. Multiply the ones digit first. If the answer is 10 or more, write the ones digit and **carry** the tens digit to the next column.

3. Multiply the next digit and add what you carried. Repeat for every column.
4. Read the answer and check it with an estimate.

Example 2

Work out 3,478 × 6.

Ones: 8 × 6 = 48, write 8 carry 4. Tens: 7 × 6 = 42, add 4 to get 46, write 6 carry 4. Hundreds: 4 × 6 = 24, add 4 to get 28, write 8 carry 2. Thousands: 3 × 6 = 18, add 2 to get 20, write 20. The answer is **20,868**. Estimate: 3,500 × 6 = 21,000, so it is sensible.

Long multiplication

Method: long multiplication with a two-digit number

1. Multiply the number by the ones digit of the second number.
2. Multiply the number by the tens digit. Write a zero place holder in the ones column first, because you are really multiplying by a multiple of ten.
3. Add the two partial answers.

Example 3

Work out 376 × 24.

The table shows the steps.

Step	Working	Result
Multiply by 4 (ones)	376 × 4	1,504
Multiply by 20 (tens)	376 × 20	7,520
Add the two answers	1,504 + 7,520	9,024

So 376 × 24 = **9,024**. Estimate: 400 × 20 = 8,000, close to 9,024.

Watch out

The most common mistake in long multiplication is to forget the zero place holder in the second line. When you multiply by the 2 in 24 you are multiplying by 20, not by 2, so the answer must end in 0. Check that your second line ends in a zero before you add.

Short division

Definition: dividend, divisor, quotient and remainder

In 756 ÷ 6 = 126, the **dividend** is 756 (the number being shared), the **divisor** is 6 (the number we divide by) and the **quotient** is 126 (the answer). A **remainder** is the amount left over when the divisor does not go into the dividend exactly.

Method: short division (the bus stop method)

1. Write the divisor outside the bus stop and the dividend inside.
2. Start at the left. Divide the first digit by the divisor. If it will not go, use the first two digits.
3. Write the answer on top and carry any remainder to the next digit as a small number in front of it.
4. Continue until you reach the ones digit. Write any final remainder as r.

Example 4

Work out 1,284 ÷ 4.

The digits of 1,284 are 1, 2, 8 and 4. The first digit, 1, is too small, so use the first two digits: 12 ÷ 4 = 3. Then 8 ÷ 4 = 2, and finally 4 ÷ 4 = 1. The answer is **321**. Check: 321 × 4 = 1,284.

Example 5

Work out 2,000 ÷ 7.

7 goes into 20 twice (14), remainder 6. Carry 6 to make 60 and 7 goes into 60 eight times (56), remainder 4. Carry 4 to make 40, and 7 goes into 40 five times (35), remainder 5. So 2,000 ÷ 7 = **285 remainder 5**. Check: 285 × 7 + 5 = 1,995 + 5 = 2,000.

Remainders in context

Rule: what to do with a remainder

The meaning of a remainder depends on the question. Sometimes you **round up** (how many buses are needed?). Sometimes you **round down** and ignore the remainder (how many whole packets can be filled?). Sometimes you **share the remainder** as a fraction or decimal (how much does each person get?). Always read the question again at the end.

Example 6

Eggs are packed in boxes of 6. A farmer has 100 eggs.

100 ÷ 6 = 16 remainder 4. (a) Full boxes: **16**, we round down. (b) Boxes needed for all the eggs: **17**, we round up because 4 eggs are left. (c) 100 ÷ 6 as a mixed number is 16 and 4/6, which simplifies to 16 and 2/3.

Estimating and checking

Always **estimate first** by rounding to one significant figure, and **check afterwards** using the inverse operation. Multiplication and division are inverses: if 321 × 4 = 1,284 then 1,284 ÷ 4 = 321. This is the quickest way to catch careless slips.

Did you know?

The long multiplication method we use today has been taught in schools for about 500 years. Before that, European merchants used an Arabic method called the grid or lattice method, which came from India. In the 1600s a Scottish mathematician named John Napier invented rods, called Napier's bones, to make multiplication faster.

Otto's tip

Say the times tables out loud and write the carried numbers small and neat. Most mistakes in written methods come from a messy carry or from forgetting the place holder zero, not from not knowing the method.