NUMBER — **Number operations**

Pupils should learn to:

Consolidate understanding of the operations of multiplication and division, their relationship to each other and to addition and subtraction; know how to use the laws of arithmetic

As outcomes, Year 7 pupils should, for example:

Use, read and write, spelling correctly:
operation, commutative, inverse, add, subtract, multiply, divide, sum, total, difference, product, multiple, factor, quotient, divisor, remainder…

Understand addition, subtraction, multiplication and division as they apply to whole numbers and decimals.

Multiplication

Understand that:

- Multiplication is equivalent to and is more efficient than repeated addition.
- Because multiplication involves fewer calculations than addition, it is likely to be carried out more accurately.

Compare methods and accuracy in examples such as:

- Find the cost of 38 items at £1.99 each.

Conclude it is easier to calculate £2 × 38 then compensate by 38p than to add £1.99 a total of 38 times, or calculate 1.99 × 38.

Understand the effect of multiplying by 0 and 1.

Division

Recognise that:

- 910 ÷ 13 can be interpreted as 'How many 13s in 910?', and calculated by repeatedly subtracting 13 from 910, or convenient multiples of 13.
- Division by 0 is not allowed.
- A quotient (the result obtained after division) can be expressed as a remainder, a fraction or as a decimal, e.g.
  90 ÷ 13 = 6 R 12
  or 90 ÷ 13 = $6\frac{12}{13}$
  or 90 ÷ 13 = 6.92 (rounded to two decimal places)
  The context often determines which of these is most appropriate.

Decide in the context of a problem how to express and interpret a quotient – that is:

- whether to express it with a remainder, or as a fraction, or as a decimal;
- whether to round it up or down;
- what degree of accuracy is required.

For example:

- Four small cars cost a total of £48 623. What should a newspaper quote as a typical cost of a small car?
  An appropriate answer is rounded: about £12 000 each.
- 107 pupils and staff need to be taken to the theatre. How many 15-seater minibuses should be ordered?
  $7\frac{2}{15}$ minibuses is not an appropriate answer for this example. To round $7\frac{2}{15}$ down to 7 would leave 2 people without transport. 8 minibuses is the appropriate answer.
- How many boxes of 60 nails can be filled with 340 nails?
  340 ÷ 60 = 5 R 40 or $5\frac{2}{3}$, but the appropriate answer is obtained by rounding down to 5, ignoring the remainder.

NUMBER

Number operations

As outcomes, Year 8 pupils should, for example:

Use vocabulary from previous year and extend to:
associative, distributive… partition…

Understand the operations of addition, subtraction, multiplication and division as they apply to positive and negative numbers.

Link to integers (pages 48–51).

Understand the operations of addition and subtraction as they apply to fractions.

Link to fractions (pages 66–9).

Understand that multiplying does not always make a number larger and that division does not always make a number smaller.

Recognise that:

- 9.1 ÷ 0.1 can be interpreted as 'How many 0.1s (or tenths) in 9.1?'
- 9.1 ÷ 0.01 can be interpreted as 'How many 0.01s (or hundredths) in 9.1?'

Link to multiplying and dividing by 0.1 and 0.01 (pages 38–9).

As outcomes, Year 9 pupils should, for example:

Use vocabulary from previous years and extend to:
reciprocal…

Understand the effect of multiplying and dividing by numbers between 0 and 1.

Understand the operations of multiplication and division as they apply to fractions.

Link to fractions (pages 66–9).

Understand that multiplying a positive number by a number between 0 and 1 makes it smaller and that dividing it by a number between 0 and 1 makes it larger. Use this to check calculations and to estimate the order of magnitude of an answer.

Generalise inequalities such as:

if $p > 1$ and $q > 1$, then $pq > p$.

Know the effect on inequalities of multiplying and dividing each side by the same negative number.

Know and understand that division by zero has no meaning. For example, explore dividing a number by successively smaller positive decimals approaching zero, then negative decimals approaching zero.

Link to multiplying and dividing by any integer power of 10 (pages 38–9), checking results (pages 110–11), and inequalities (page 4-131).

NUMBER | **Number operations**

Pupils should learn to:	As outcomes, Year 7 pupils should, for example:

Consolidate understanding of the operations of multiplication and division, their relationship to each other and to addition and subtraction; know how to use the laws of arithmetic (continued)

When dividing using a **calculator**, interpret the quotient in the context of a problem involving money, metric measures or time.

3.05

For example, depending on the context:

- A display of '3.05' could mean £3.05, 3 kilograms and 50 grams, or 3 hours and 3 minutes.
- A display of '5.2' could mean £5.20, 5 metres and 20 centimetres, or 5 hours and 12 minutes.

Relate division to fractions. Understand that:

- $\frac{1}{4}$ of 3.6 is equivalent to $3.6 \div 4$.
- $7 \div 8$ is equivalent to $\frac{7}{8}$.
- $\frac{50}{3}$ is equivalent to $50 \div 3$.

Link to finding fractions of numbers (pages 66–7).

Know how to use the laws of arithmetic to support efficient and accurate mental and written calculations, and calculations with a **calculator**.

Examples of commutative law

$4 \times 7 \times 5 = 4 \times 5 \times 7 = 20 \times 7 = 140$
or $= 7 \times 5 \times 4 = 35 \times 4 = 140$

To find the area of a triangle, base 5 cm and height 6 cm:
area $= \frac{1}{2} \times 5 \times 6 = \frac{1}{2} \times 6 \times 5 = 3 \times 5 = 15\,\text{cm}^2$

Example of associative law

$15 \times 33 = (5 \times 3) \times 33$ or $5 \times (3 \times 33) = 5 \times 99 = 495$

Example of distributive law

$$\begin{aligned} 3.7 \times 99 &= 3.7 \times (100 - 1) \\ &= (3.7 \times 100) - (3.7 \times 1) \\ &= 370 - 3.7 \\ &= 366.3 \end{aligned}$$

Link to algebraic operations (pages 114–17), and mental calculations (pages 92–7).

Inverses

Understand that addition is the inverse of subtraction, and multiplication is the inverse of division. For example:

- Put a number in a **calculator**. Add 472 (or multiply by 26). What single operation will get you back to your starting number?
- Fill in the missing number: $(\square \times 4) \div 8 = 5$.

Use inverses to check results. For example:

- $703 \div 19 = 37$ appears to be about right, because $36 \times 20 = 720$.

Link to inverse operations in algebra (pages 114–15), and checking results (pages 110–11).

NUMBER **Number operations**

As outcomes, Year 8 pupils should, for example:

Continue to use the **laws of arithmetic** to support efficient and accurate mental and written calculations, and calculations with a **calculator**.

For example, use mental or informal written methods to calculate:

- $484 \times 25 = 484 \times 100 \div 4 = 48\,400 \div 4 = 12\,100$
- $3.15 \times 25 = 3.15 \times 100 \div 4 = 315 \div 4 = 78.75$
- $28 \times 5 = 28 \times 10 \div 2 = 280 \div 2 = 140$
- $15 \times 8 = 15 \times 2 \times 2 \times 2 = 120$
- $6785 \div 25 = 6785 \div 5 \div 5 = 1357 \div 5 = 271.4$

Recognise the application of the distributive law when multiplying a single term over a bracket in number and in algebra.

Link to algebraic operations (pages 114–17), and mental calculations (pages 92–7).

Inverses

Use inverse operations. For example:

- Put a number in your **calculator**.
  Add 46, then multiply by 17.
  What must you do to get back to the starting number?
- Fill in the missing number:
  $\square^2 \div 4 = 16$

Use inverses to check results. For example:

- $6603 \div 18.6 = 355$ appears to be about right, because $350 \times 20 = 7000$.

Link to inverse operations in algebra (pages 114–15), and checking results (pages 110–11).

As outcomes, Year 9 pupils should, for example:

Continue to use the **laws of arithmetic** to support efficient and accurate mental and written calculations, and calculations with a **calculator**.

Recognise the application of the distributive law when expanding the product of two linear expressions in algebra.

Link to algebraic operations (pages 114 to 4-121), and mental calculations (pages 92–7).

Inverses

Use inverse operations. For example:

- Put a number in your **calculator**. Cube it.
  What must you do to get back to the starting number?
- Put a number in your **calculator**. Find the square root. What must you do to get back to the starting number?

Explain why it may not be possible to get back exactly to the starting numbers using a calculator.

Use inverses to check results of calculations.

Link to algebraic operations (pages 114 to 4-121), and checking results (pages 110–11).