With God, all things are possible

St. Margaret's Anfield Church of England Primary School

Jesus said, "Love one another as I have loved you" John 15:12. Therefore, by faith and work, we will be the change you want to see.

Calculation Policy

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Introduction.

Mathematics is essential to everyday life and critical to other aspects of the National Curriculum. It is necessary for financial literacy and most forms of employment. A high-quality mathematics education therefore provides a foundation for understanding the world, the ability to reason mathematically and a sense of enjoyment and curiosity about the subject.

Aims.

It is our aim at St Margaret's to ensure that all pupils:
become **fluent** in mathematics, including through a range of frequent practice that involves increasingly complex problems over time. It is our aim that pupils develop their understanding of the areas covered and are able to recall and apply knowledge rapidly and accurately.
reason mathematically by following a line of enquiry and are able to explain their ideas using mathematical language
can **solve problems** by applying their mathematics to a variety of problems with increasing sophistication, including breaking down problems into a series of simpler steps and persevering in seeking solutions.
Mathematics is an interconnected subject; pupils will be encouraged to make connections across mathematical ideas to develop fluency, mathematical reasoning and competence in solving increasingly difficult problems. They should also apply their mathematical knowledge to science and other subjects.

Spoken Language.

Pupils at St. Margaret's will be encouraged to use the correct mathematical vocabulary. It is our aim they will hear and speak this vocabulary, as these are key factors in developing their mathematical vocabulary and key to pupils being able to present a mathematical argument. They will be assisted in making their thinking clear to themselves as well as others to allow pupils to build secure foundations by using discussion to remedy their misconceptions.
It is important that children's mental methods of calculation are practised on a regular basis through and secured alongside their learning and use of written methods.
The aim at St. Margaret's is that children use mental methods when appropriate but for calculations that they cannot do in their heads they use a written method accurately and with confidence.
Children are taught and acquire secure mental methods of calculation and one written method of calculation for each operation (+ - ÷ x) that they know they can rely on when mental methods are not appropriate.
Our policy shows the possible stages of each written method and how each stage builds towards a more refined method.

Addition

Written methods for addition.

Key basic skills that children need to help with addition, which include:

- counting
- estimating
- recalling all addition **pairs** to 10, 20 and 100 (7 + 3 = 10, 17 + 3 = 20, 70 + 30 = 100)
- knowing number **facts** to 10 (6 + 2 = 8)
- adding mentally a series of one-digit numbers (5 + 8 + 4)
- adding multiples of 10 (60 + 70) or of 100 (600 + 700) using the related addition fact, 6 + 7 and their knowledge of place value
- partitioning two-digit and three-digit numbers into multiples of 100, 10 and 1 in different ways(432 into 400 + 30 + 2 and also into 300 + 120 + 12)
- understanding and using addition and subtraction as inverse operations

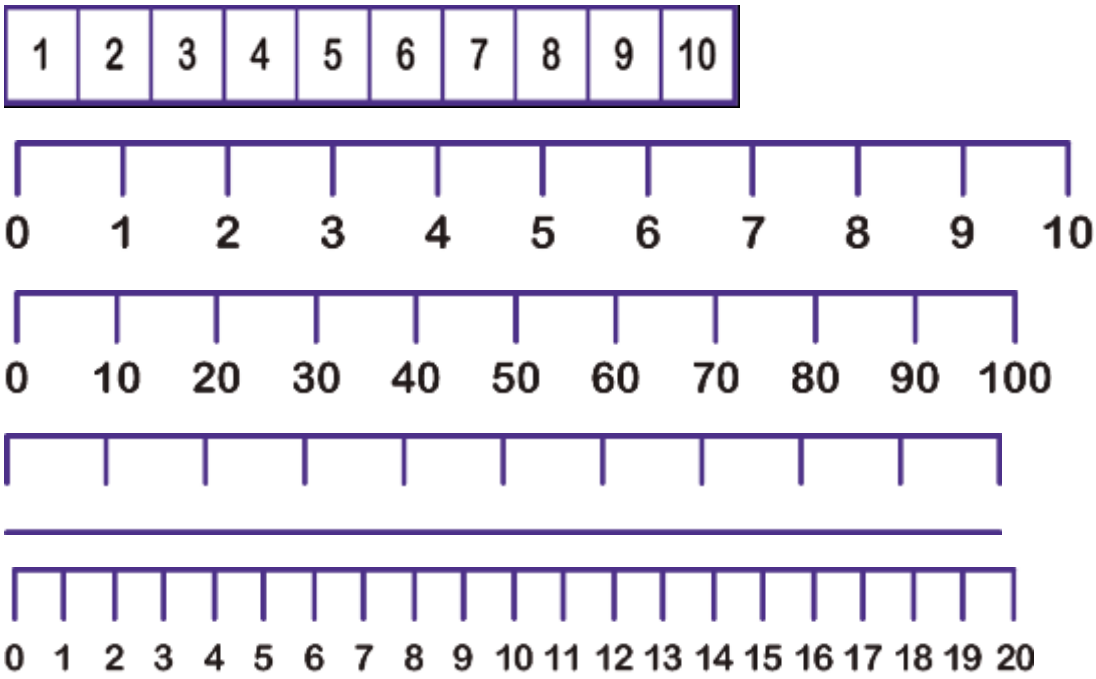
Using and applying is a key theme and one of the aims of National Curriculum. Before children move onto the next stage in written calculation it is important that their skills are broadened through their use and application in a range of contexts, these include:

- using inverse
- missing box questions
- using units of measure including money and time
- word problems
- open ended investigations

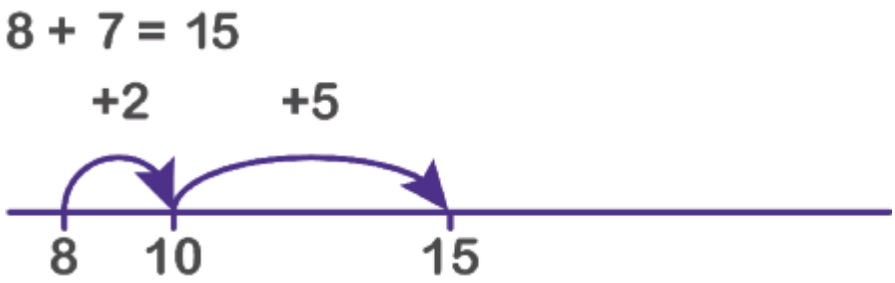
Stage 1: Practical (combining) and adding on (increasing)

Prior to recording addition steps on a number line, children will work practically with equipment where they are **combining** sets of objects. As they become more confident, this practical addition of sets of objects will be mirrored on a number line so that the two are being done together and children are **adding on**. This will prepare them for the abstract concept of adding numbers rather than objects.

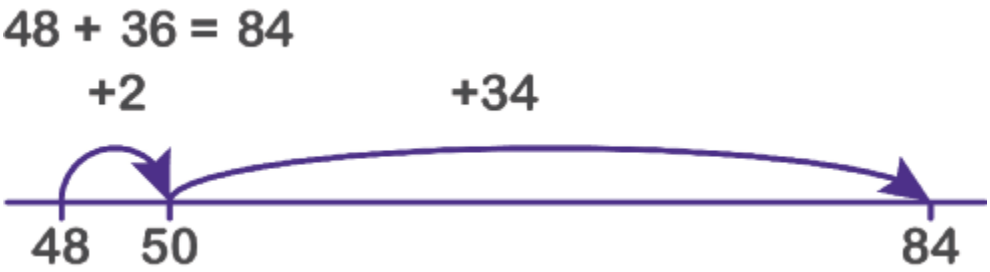
Stage 2: Number tracks and number lines



Steps in addition can be recorded on a number line. The steps often bridge through a multiple of 10 and this is more efficient if children know how to partition 2-digit numbers.



In this example, 7 has been partitioned into 2 and 5 which makes bridging through 10 more efficient.



or

In these examples, the 6 in 36 has been partitioned into 2 and 4 which makes bridging through 10 more efficient.

With practice, children will need to record fewer jumps.

Stage 3: Partitioning (expanded columnar method)

Partition both numbers into tens and units or hundreds, tens and units (using a grid makes this easier)

48 + 36 = 84

	40	8	
+	30	6	
	70	$^{1}4$	84

148 + 36 = 184

	100	40	8	
+		30	6	
	100	70	$^{1}4$	184

This builds on children's mental maths skills of partitioning and recombining.

40 + 30 = 70
8 + 6 = 14
48 + 36 = 84

Stage 4: Efficient (column method)

Children should be encouraged to estimate their answers first.

$$\begin{array}{r} 48 \\ +\ 36 \\ \hline 84 \\ \hline 1 \end{array} \qquad \begin{array}{r} 148 \\ +\ 36 \\ \hline 184 \\ \hline 1 \end{array} \qquad \begin{array}{r} 48.56 \\ +\ 32.23 \\ \hline 80.79 \\ \hline 1 \end{array}$$

Column addition remains efficient when used with larger whole numbers or decimals, and when adding more than two numbers, once learned, the method is quick and reliable.

Subtraction.

Written methods for Subtraction.

It is important that children's mental methods of calculation are practiced on a regular basis and secured alongside their learning and use of written methods of subtraction.
The aim is that children use mental methods when appropriate, but for calculations that they cannot do in their heads they use a written method accurately and with confidence.
Children are taught and acquire secure methods of calculation and one written method of calculation for subtraction which they know they can rely on when mental methods are not appropriate.
This policy shows the possible stages of each written method for subtraction, each stage building towards a more refined method.
There are some key basic skills that children need to help with subtraction, which include:

- Counting
- Estimating
- Recalling all addition **pairs** to 10, 20 and 100 along with their inverses (7 + 3 = 10, 10 – 3 = 7, 17 + 3 = 20, 20 – 3 =17, 70 + 30 = 100, 100 – 30 = 70)
- Knowing number **facts** to 10 and their inverses (6 + 2 = 8, 8 – 2 = 6)
- Subtracting multiples of 10 (160 – 70) using related subtraction fact, 16 – 7, and their knowledge of place value
- Partitioning two-digit and three-digit numbers into multiples of 100, 10 and 1 in different ways (432 into 400 + 30 + 2 and also 300 + 120 + 12)
- Understanding and using subtraction and addition as inverse operations

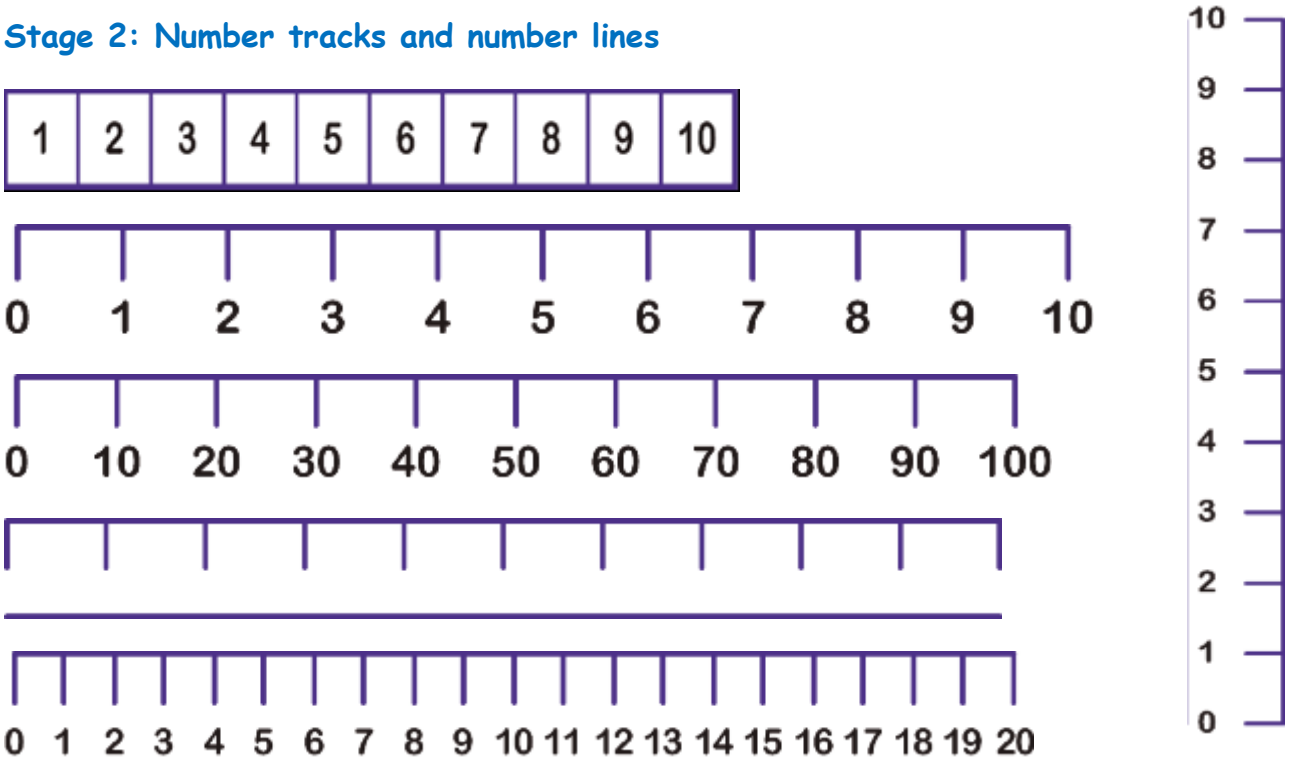
Using and applying is a key theme and one of the aims of National Curriculum. Before children move onto the next stage in written calculation it is important that their skills are broadened through their use and application in a range of contexts, these include:

- Using inverse
- Missing box questions
- Using units of measure including money and time
- Word problems
- Open ended investigations

Stage 1: Practical (taking away)

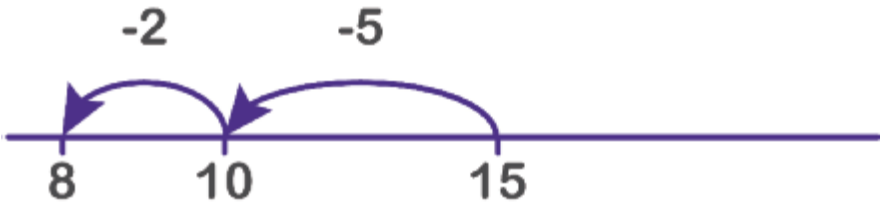
Prior to recording subtraction steps on a number line, children will work practically with equipment where they are 'taking away' a small group from a larger set of objects. As they become more confident, this practical subtraction will be mirrored on a number line so that the two are being done together. This will prepare them for the abstract concept of subtracting numbers rather than objects.

Stage 2: Number tracks and number lines



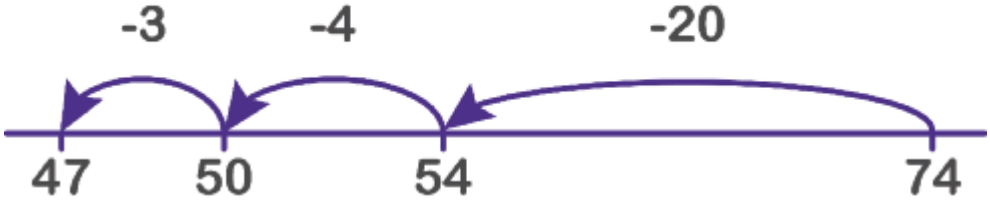
Counting back (to be introduced before counting up)
Steps in subtraction can be recorded from right to left on a number line. The steps often bridge through a multiple of 10 and, this is more efficient if children know how to partition 2-digit numbers.

15 - 7 = 8



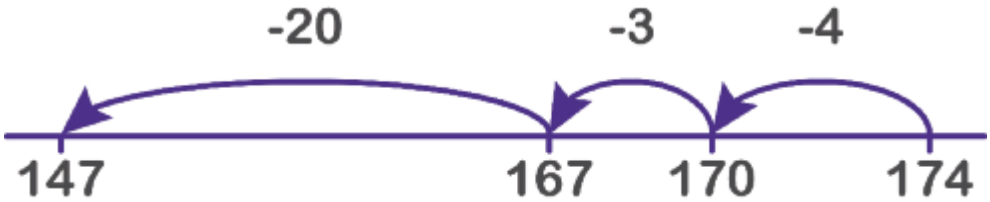
In this example, 7 has been partitioned into 2 and 5 which makes bridging through 10 more efficient

74 - 27 = 47



or

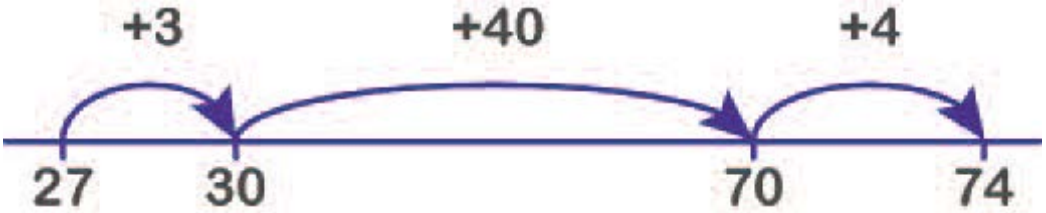
174 - 27 = 147



In these examples, 27 has been partitioned into tens and units then the 7 in 27 has been partitioned into 3 and 4 which makes bridging
through 10 more efficient.

With practice, children will need to record fewer jumps.

Counting up (to be introduced after counting back)
Steps in subtraction can be recorded from left to right on a number line. The steps often bridge through a multiple of 10.



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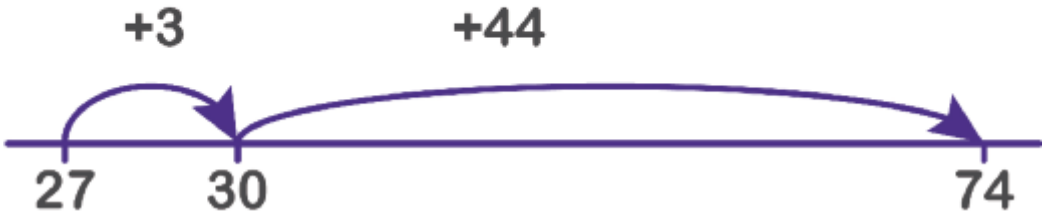


When carrying out money calculations that involve finding change or when calculating time duration, children should use this
Method.

With practice, children will need to record fewer jumps. They will decide whether to count back or forwards, seeing both as 'finding the difference'. It is useful to ask children whether counting up or back is the more efficient for calculations such as 57 – 12 or 86 – 77.

Stage 3: Partitioning (expanded columnar method)

Partition both numbers into tens and units or hundreds, tens and units (using a grid makes this easier).

	60 ~~7~~0	1 4	
-	20	7	
	40	7	47

	100	60 ~~7~~0	1 4	
		20	7	
	100	40	7	147

Stage 4: Efficient (column method)

6 1 ~~7~~4	6 1 1~~7~~4	48.56
- 27	- 27	- 32.23
47	147	16.33

Children should be encouraged to estimate their answers first.

Column subtraction remains efficient when used with larger whole numbers or decimals, once learned, the
method is quick and reliable.

Multiplication.

Written methods for Multiplication.

It is important that children's mental methods of calculation are practised on a regular basis and secured alongside their learning and use of written methods of multiplication.
The aim is that children use mental methods when appropriate, but for calculations that they cannot do in their heads they use a written method accurately and with confidence.
Children are taught and acquire secure mental methods of calculation and one written method of calculation for multiplication which they know they can rely on when mental methods are not appropriate.
This policy shows the possible stages of each written method for multiplication, each stage building towards a more refined method.

There are some key basic skills that children need to help with multiplication, which include:

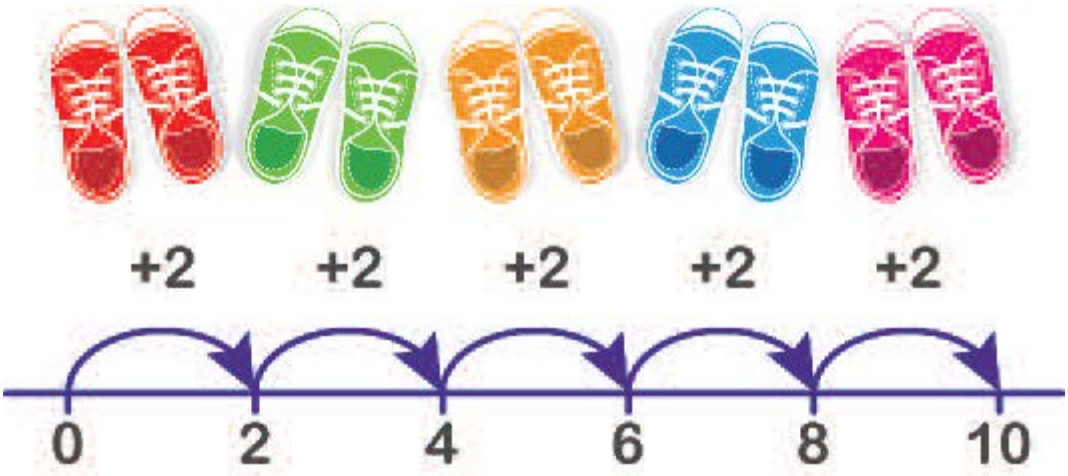
- Counting
- Estimation
- Understanding multiplication as repeated addition
- Recalling all multiplication facts to 12 x 12
- Partitioning numbers into multiples of one hundred, ten and one
- Working out products (70 x 5, 70 x 50, 700 x 5, 700 x 50) using the related fact 7 x 5 and their knowledge of place value
- Adding two or more single-digit numbers mentally
- Adding multiples of 10(60+70) or of 100(600+700) using the related addition fact, 6+7, and their knowledge of place value
- Adding combinations of whole numbers
- Understanding and using division and multiplication and inverse operations

Using and applying is a key theme and one of the aims of National Curriculum. Before children move onto the next stage in written calculation it is important that their skills are broadened through their use and application in a range of contexts, these include:

- Using inverse
- Missing box questions
- Using units of measure including money and time
- Word problems
- Open ended investigations

Stage 1: Practical (repeated addition)

Children will work practically with equipment grouping objects to see multiplication as repeated addition. As they become more confident, this practical grouping of objects will be mirrored on a number line using the vocabulary 'lots of', 'groups of', 'how many lots', 'how many times' so that the two are being done together. This will prepare them for the abstract concept of multiplying numbers rather than objects.

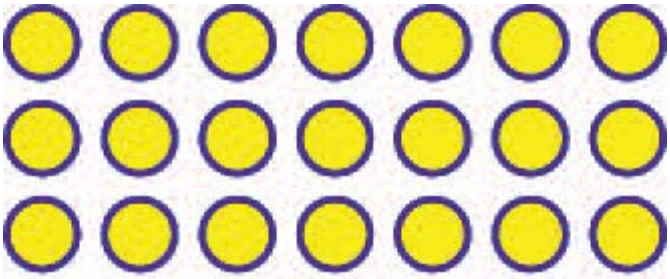


This image can be expressed as:

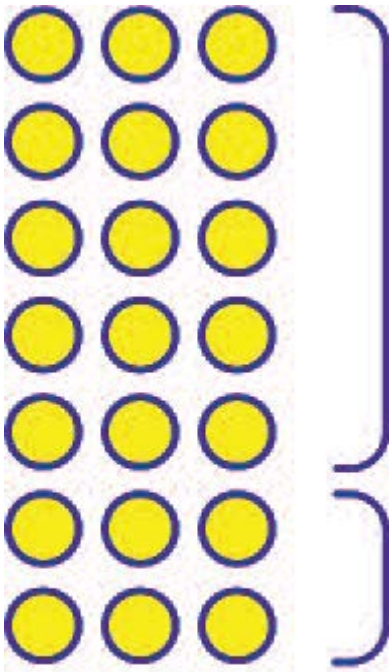
- 2 multiplied by 5
- Two, five times
- 5 groups of 2
- 5 lots of 2
- 5 jumps of 2 on a number line

Stage 2: Practical and pictorial arrays (towards grid method)

Children use arrays to demonstrate their understanding of commutativity for multiplication facts



7 x 3 = 21



3 x 7 = 21

Children use their knowledge of known multiplication tables
This 3 x 7 array can also be seen as 3 x 5 add 3 x 2.

Stage 3: Partitioning (grid method)

24 x 3 = 72

x	20	4	
3	60	12	72

24 x 32 = 768

x	20	4	
30	600	120	720
2	40	8	48
			768

Stage 4: Short (column)

$24 \times 3 = 72$

$$\begin{array}{r} 24 \\ \times\ \ 3 \\ \hline 72 \\ \hline 1 \end{array}$$

$1241 \times 3 = 3723$

$$\begin{array}{r} 1241 \\ \times\ \ \ \ 3 \\ \hline 3723 \\ \hline 1 \end{array}$$

Stage 5: Long (column)

$24 \times 32 = 768$

$$\begin{array}{r} 24 \\ \times\ 32 \\ \hline 48 \\ 720 \\ \hline 1\ \ \\ 765 \end{array}$$

1245×13

$$\begin{array}{r} 1245 \\ \times\ \ \ \ 13 \\ \hline 3735 \\ 12450 \\ \hline 16185 \end{array}$$

In the examples given, it is also correct to multiply starting with the tens digit (ie multiplying by the most significant digit first)

Division.

Written methods for Division.

It is important that children's mental methods of calculation are practised on a regular basis and secured alongside their learning and use of written methods of division.
The aim is that children use mental methods when appropriate, but for calculations that they cannot do in their heads they use a written method accurately and with confidence.
Children are taught and acquire secure mental methods of calculation and one written method of calculation for division which they know they can rely on when mental methods are not appropriate.
This policy shows the possible stages of each written method for division, each stage building towards a more refined method.

There are some key basic skills that children need to help with division, which include:

- Counting
- Estimating
- Understanding division as repeated subtraction
- Partitioning two-digit and three-digit numbers into multiples of 100, 10 and 1 in different ways (432 into 400 + 30 + 2 and also into 300 +120 +12)
- Recalling multiplication and division facts to 12 x 12
- Recognising multiples of one-digit numbers and dividing multiples of 10 or 100 by a single-digit number using their knowledge of division facts and place value
- Knowing how to find a remainder working mentally, for example, find the remainder when 48 is divided by 5
- Understanding and using division and multiplication as inverse operations

Using and applying is a key theme and one of the aims of National Curriculum. Before children move onto the next stage in written calculation it is important that their skills are broadened through their use and application in a range of contexts, these include:

- Using inverse
- Missing box questions
- Using units of measure including money and time
- Word problems
- Open ended investigations

Stage 1: Practical (sharing)

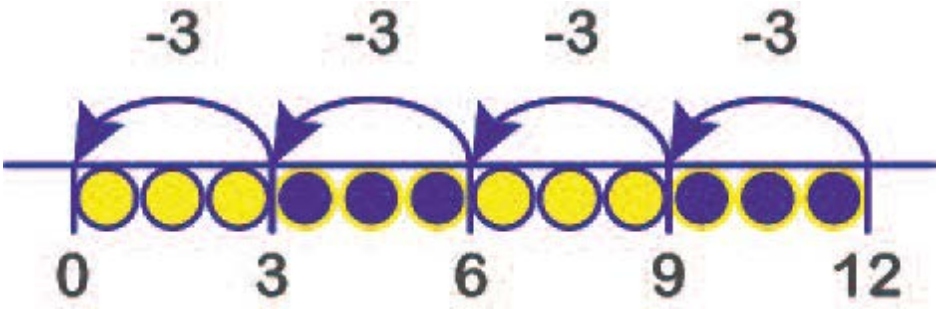
Children will work practically with equipment sharing objects one to one.

12 cakes are shared equally between 3 people.

Stage 2: Number lines (grouping)

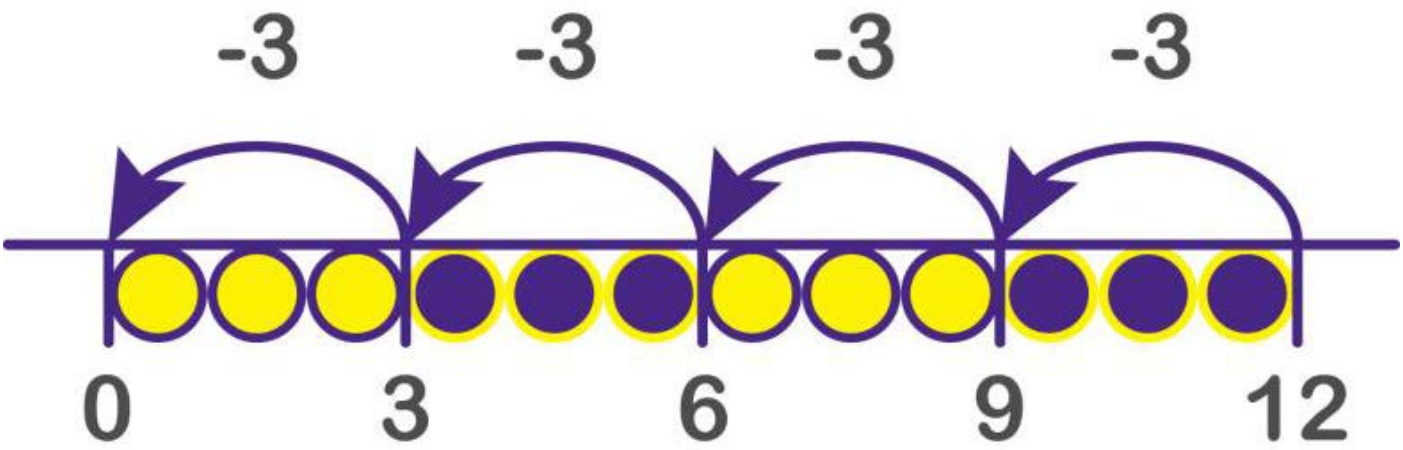
Children will move from sharing objects practically to grouping them, this will be mirrored on a number line, working from right to left so that they see division as repeated subtraction. This will prepare them for the abstract concept of dividing numbers rather than objects.

Each cake box holds 3 cakes, if I have 12 cakes, how many cake boxes will I need?



How many times can I subtract 3 from 12?

Using their knowledge of the inverse relationship between multiplication and division, children can use their multiplication tables when grouping on a number line, working from left to right.



How many groups of 3 are there in 12?

First without and then with remainders and ensuring that divisors offer an appropriate level of challenge.

Stage 3: Short division

372 ÷ 3 = 124

$$\begin{array}{r} 124 \\ 3\,\overline{)\,37^{1}2} \end{array}$$

432 ÷ 15 = 28 r12

$$\begin{array}{r} 28_{r12} \\ 15\,\overline{)\,43^{13}2} \end{array}$$

$$\begin{array}{r} 28\tfrac{12}{15} \\ 15\,\overline{)\,43^{13}2} \end{array}$$

remainder as a fraction

$$\begin{array}{r} 28\tfrac{4}{5} \\ 15\,\overline{)\,43^{13}2} \end{array}$$

$$\begin{array}{r} 28.8 \\ 15\,\overline{)\,43^{13}2} \end{array}$$

remainder as a decimal

Stage 4: Long division.

$560 \div 24 = 23\ r8$

```
      23 r8
24 | 560
     48
     ---
      80
      72
     ---
       8
```

$432 \div 15 = 28\ r12$

```
      28 r12
15 | 432
     300      15x20
     ---
     132
     120      15x8
     ---
      12
```

```
      28.8
15 | 432.0
     30
     ---
     132
     120
     ---
      12 0
      12 0
     ----
         0
```

$(12 \div 15 = 0.8)$

remainder as a decimal

```
      28 4/5
15 | 432
     30
     ---
     132
     120
     ---
      12
      12
```

$(0.8 = \frac{4}{5})$

remainder as a fraction

With long division, there is the opportunity to teach an expanded method (ie chunking)

The Calculation Sequence – applying the skills.

The Sequence	Prompts	Planning
Provide an estimate for the calculation	Using the knowledge of number and the number system, rounding and approximating, make a reasonable estimate.	
Teach the calculation skill	What is the objective you are teaching? Include example questions, increasing in complexity, for both operations.	
Ensure you have taught the inverse	Plan example questions, increasing in complexity. Ensure methods used are in line with school calculation policy. Check that children understand that inverse can also be used to check calculations.	
Devise similar calculations but include units.	Which units do you need to include? Check the measures applicable to your year group for length, weight, capacity, money and time.	
Complete missing box questions	Include units in these questions as above. The box may cover single digits or an entire number. Vary the position of the missing box with the calculation.	
Complete word problems, 1 and 2 step, including units	Write problems, ensuring the numbers are sized correctly in line with the objective and that units are also used.	
Provide opportunities for open ended investigations	Plan example questions and investigations. Ensure children are working with the correct operations, appropriate size of number and use of units for context.	

Progression across the year groups.

Addition.

	Typical calculations	Suitable methods
Year 1	U+U TU+U (up to 20 including 0)	Practical Number line
Year 2	TU+U TU+ multiples of 10 TU+TU U+U+U	Practical Number line Expanded columnar
Year 3	HTU+U HTU+TU HTU+HTU	Number Line Expanded columnar Column
Year 4	THTU+HTU THTU+THTU	Expanded columnar Column
Year 5	THTU.t+THTU.t THTU.th+THTU.th	Expanded columnar Column
Year 6	THTU.tht+THTU.tht	Column

Progression across the year groups.

Subtraction.

	Typical calculations	Suitable methods
Year 1	U-U TU-U (to 20 including zero)	Practical Number line
Year 2	TU-U TU-multiples of 10 TU-TU U-U-U	Practical Number line Expanded columnar
Year 3	HTU-U HTU-TU HTU-HTU	Number line Expanded columnar Column
Year 4	THTU-HTU THTU-THTU	Expanded columnar Column
Year 5	THTU-HTU THTU-THTU	Expanded columnar Column
Year 6	THTU.tht - THTU.tht	Column

Progression across the year groups.

Multiplication.

	Typical calculations	Suitable methods
Year 1	U x U	Practical (repeated addition) Practical and pictorial arrays
Year 2	U x U	Practical (repeated addition) Practical and pictorial arrays
Year 3	TU x U	Grouping on a number line progressing into Expanded (grid) and into short
Year 4	TU x U HTU x U	Expanded (grid) progressing into Short
Year 5	HTU x U THTU x U TU x TU	Expanded (grid) progressing into Short
Year 6	THTU x U TU x TU HTU x TU THTU x TU U.t x U U.th x U U.t x TU	Short Expanded (grid) progressing into Long Long Expanded (grid) progressing into Short Expanded (grid) progressing into Long

Progression across the year groups.

Division.

	Typical calculations	Suitable methods
Year 1	U ÷ U TU ÷ U	Practical sharing Number-line grouping
Year 2	U ÷ U TU ÷ U	Practical sharing Number-line grouping
Year 3	TU ÷ U	Grouping on a number line progressing into Short
Year 4	TU ÷ U HTU ÷ U	Grouping on a number line progressing into Short Short (remainders to be expressed as r)
Year 5	HTU ÷ U THTU ÷ U	Short (remainders to be expressed as r, then as a fraction and as a decimal)
Year 6	THTU ÷ U HTU ÷ TU THTU ÷ TU U.th ÷ U TU.th ÷ U HTU.th ÷ U THTU.th ÷ U	Short (remainders to be expressed as r, then as a fraction and as a decimal) Long (remainders to be expressed as r, then as a fraction and as a decimal) Short (remainder to be expressed as a decimal)