Thurleigh & Kymbrook Federation

Calculation Policy

Progression in the written calculations of addition and subtraction

WRITTEN METHODS					
Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
read, write and interpret mathematical statements involving addition (+), subtraction (-) and equals (=) signs		add and subtract numbers with up to three digits, using formal written methods of columnar addition and subtraction	add and subtract numbers with up to 4 digits using the formal written methods of columnar addition and subtraction where appropriate	add and subtract whole numbers with more than 4 digits, including using formal written methods (columnar addition and subtraction)	solve addition and subtraction multi-step problems in contexts, deciding which operations and methods to use and why

MENTAL CALCULATION					
Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
add and subtract one-digit and two-digit numbers to 20, including zero	add and subtract numbers using concrete objects, pictorial representations, and mentally, including: * a two-digit number and ones * a two-digit number and tens * two two-digit numbers * adding three one-digit numbers	add and subtract numbers mentally, including: * a three-digit number and ones * a three-digit number and tens * a three-digit number and hundreds		add and subtract numbers mentally with increasingly large numbers	perform mental calculations, including with mixed operations and large numbers use their knowledge of the order of operations to carry out calculations involving the four operations

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Calculation Policy

Addition

Year 1

+ = signs and missing numbers

Children need to understand the concept of equality before using the '=' sign. Calculations should be written either side of the equality sign so that the sign is not just interpreted as 'the answer'.

2 = 1+ 1
2 + 3 = 4 + 1

3 + 4 = □	□ = 3 + 4
3 + □ = 7	7 = □ + 4
□ + 4 = 7	7 = 3 + □
□ + ∇ = 7	7 = □ + ∇

Promoting symbols in place of operations and numbers.

Hands on experience of counting and combining sets of objects

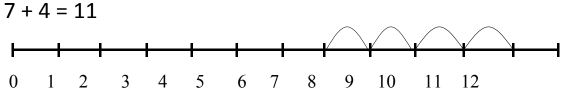
Combining two sets of objects (aggregation) which will progress onto adding on to a set (augmentation).

Informal jottings to aid mental calculations

Number lines

Using number lines to count on in ones, with jumps **above** the number lines.

7 + 4 = 11



Cubes and other practical resources can be used to model this method.

Year 2

+ = signs and missing numbers

Continue using a range of number sentences but with appropriate, larger numbers.

Extend to 14 + 5 = 10 + □

and adding three numbers 32 + □ + □ = 100

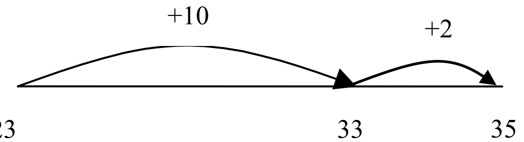
Informal jottings to aid mental calculations

Partition into tens and units and recombine

12 + 23 = 35 (This can be set out differently
10 + 20 =30 but still using the partitioning method)
2+ 3 =5

refine to partitioning the second number only:

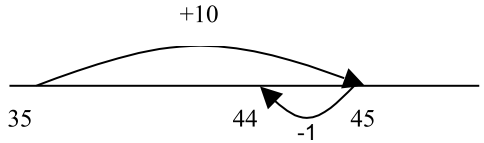
23 + 12 = 23 + 10 + 2
= 33 + 2
= 35



Using number lines to count on in tens then units, with jumps **above** the number lines.

Mental Method – adding 9 or 11 by adding 1 and adjusting

Add 9 or 11 by adding 10 and adjusting by 1 e.g. 35 + 9 = 44



with "counting back" jumps **below** the number lines.

Year 3

+ = signs and missing numbers

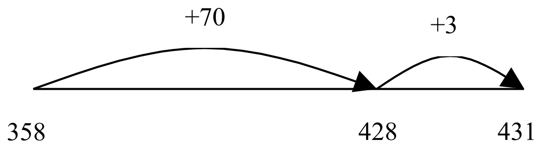
Continue using a range of number sentences with appropriate, larger numbers.

Informal jottings to aid mental calculations

Partition into hundreds, tens and units and recombine

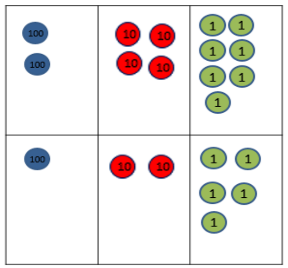
Either partition both numbers and recombine or partition the second number only e.g.

358 + 73 = 358 + 70 + 3
= 428 + 3
= 431

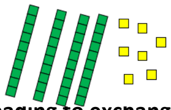
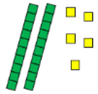
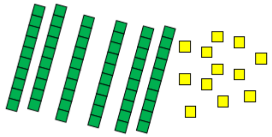
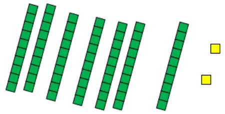
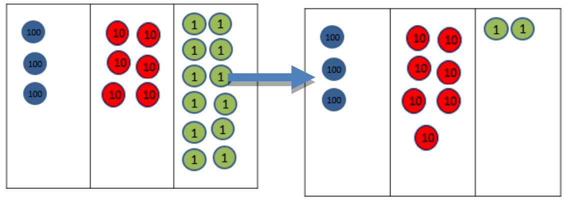


Towards a Written Method

Introduce expanded column addition modelled with place value counters (Dienes could be used for those who need a less abstract representation).



$$\begin{array}{r} 247 \\ +125 \\ \hline 12 \\ 60 \\ 300 \\ \hline 372 \end{array}$$

Year 1	Year 2 - continued	Year 3 - continued
	<u>Add a near multiple of 10 to a two-digit number</u> Understand that 35 + 19 is the same as 35 + 20 – 1. <u>Towards a Written Method</u> <u>Partitioning in different ways and recombine</u> **47+25** **47** **25** **60 + 12**    **Leading to exchanging:** **72**  **<u>Expanded written method</u>** 40 + 7 + 20 + 5 = 40+20 + 7 + 5 = 60 + 12 = 72	Leading to children understanding the exchange between tens and ones.  **<u>Partition into hundreds, tens and ones</u>** Partition both numbers and recombine. Count on by partitioning the second number only e.g. 247 + 125 = 247 + 100 + 20+ 5 = 347 + 20 + 5 = 367 + 5 = 372 Children need to be secure adding multiples of 100 and 10 to any three-digit number including those that are not multiples of 10. Some children will begin to use a formal columnar algorithm, initially introduced alongside the expanded method. **The formal method should be seen as a more streamlined version of the expanded method, not a new method.** 247 +125 372 10

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Calculation Policy

Addition

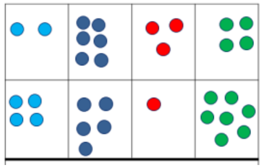
Year 4

Informal jottings to aid mental calculations

Continue to develop, supported by a range of models and images, including the number line and partitioning numbers as appropriate.

Written method (progressing to 4-digits)

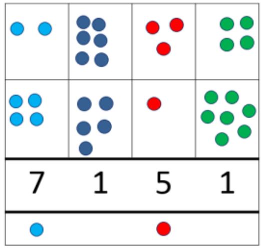
Expanded column addition modelled with place value counters, progressing to calculations with 4-digit numbers.



```
 2634
+4517
   11
   40
 1100
 6000
 7151
```

Compact written method

Extend to numbers with at least four digits.




```
 2634
+4517
 7151
 1 1
```

Children should be able to make the choice of reverting to expanded methods if experiencing any difficulty.

Extend to up to two places of decimals (same number of decimals places) and adding several numbers (with different numbers of digits).

```
  72.8
+ 54.6
 127.4
 1 1
```

Year 5

Informal jottings to aid mental calculations

Continue to develop, supported by a range of models and images, including the number line and partitioning numbers as appropriate. Children should practise with increasingly large numbers to aid fluency e.g. 12462 + 2300 = 14762

Formal written method (progressing to more than 4-digits)

As year 4, progressing when understanding of the expanded method is secure, children will move on to the formal columnar method for whole numbers and decimal numbers as an efficient written algorithm.

```
  172.83
+  54.68
  227.51
  1 1 1
```

Place value counters can be used alongside the columnar method to develop understanding of addition with decimal numbers.

Year 6

Informal jottings to aid mental calculations

Continue to develop, supported by a range of models and images, including the number line and partitioning numbers as appropriate. Children should practise with increasingly large numbers to aid fluency e.g. 12462 + 2300 = 14762

Formal written method

As year 5, progressing to larger numbers, aiming for both conceptual understanding and procedural fluency with columnar method to be secured.

Continue calculating with decimals, including those with different numbers of decimal places

124.9 + 117.25 = 242.15

```
  1 2 4 . 9 0    add zero as a place holder
+ 1 1 7 . 2 5
  2 4 2 . 1 5
   1 1
```

Problem Solving

Teachers should ensure that pupils have the opportunity to apply their knowledge in a variety of contexts and problems (exploring cross curricular links) to deepen their understanding.

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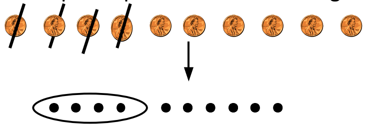
Calculation Policy

Subtraction

Year 1

Pictures / marks

Sam spent 4p. What was his change from 10p?



- = signs and missing numbers

7 - 3 = □	□ = 7 - 3
7 - □ = 4	4 = □ - 3
□ - 3 = 4	4 = 7 - □
□ - ∇ = 4	4 = □ - ∇

Visual / practical activities

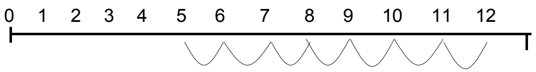
Use practical resources to model "taking away"

Informal jottings to aid mental calculations

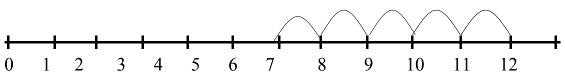
Number lines (empty)

Use number lines to **count back** in ones, using jumps **below** the number lines

E.g. 12 – 7 = 5



Use number lines to find the difference between 7 and 12 by **counting on** in ones, using jumps **above** the number lines



Year 2

- = signs and missing numbers

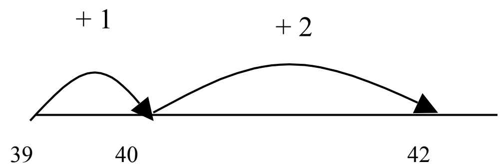
Extend to 14 + 5 = 20 - □

Informal jottings to aid mental calculations

Find a small difference by counting up

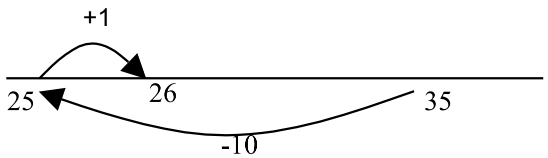
Teach children to recognise "small differences" between numbers

E.g. 42 – 39 = 3



Subtract 9 or 11 by subtracting 10 and adjusting by 1

e.g. 35 – 9 = 26

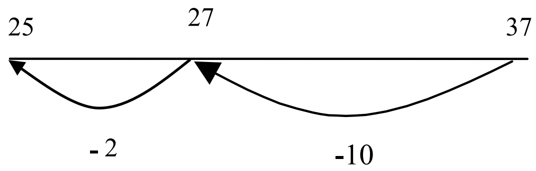


Use known number facts and place value to subtract Partition second number only

37 – 12 = 37 – 10 – 2

= 27 – 2

= 25



Year 3

- = signs and missing numbers

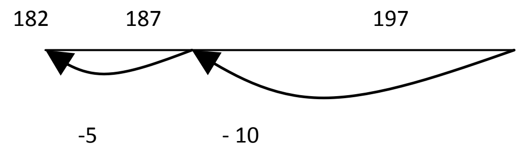
Missing number problems e.g. □ = 43 – 27; 145 – □ = 138; 274 – 30 = □; 245 – □ = 195; 532 – 200 = □; 364 – 153 = □

Informal jottings to aid mental calculations

Counting back

Continue to develop, supported by a range of models and images, including the number line. Children should make choices about whether to use complementary addition or counting back, depending on the numbers involved.

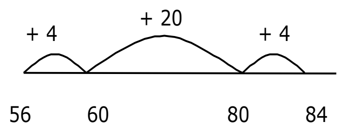
e.g. 197 – 15 = 182



Counting on (complementary addition)

Use a number line to **count on**, using jumps **above** the number lines

E.g. 84 – 56 = 28



20 + 4 + 4 = 28

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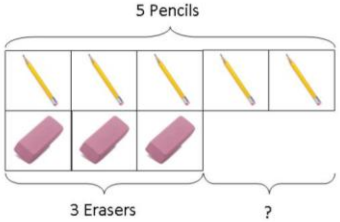
Calculation Policy

Year 1 - continued

Record subtraction by drawing jumps on prepared number lines and constructing own number lines. To reinforce concept use practical strategies to see 'difference':



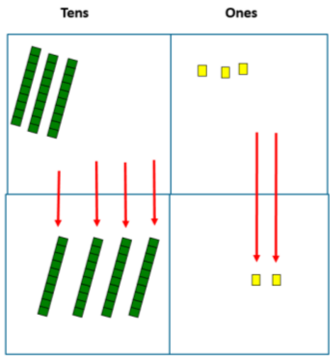
The above model would be introduced with concrete objects which children can move (including cards with pictures) before progressing to pictorial representation.
The use of other images is also valuable for modelling subtraction e.g. Numicon, bundles of straws, Dienes apparatus, multi-link cubes, bead strings

Teachers to model jottings appropriate for larger numbers.

Year 2 - continued

Towards written methods

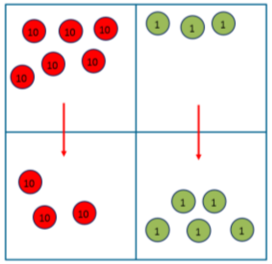
Using Dienes apparatus to support the understanding of the quantity aspect of place value and prepare for efficient written methods with larger numbers.
E.g. 75 – 42



Year 3 - continued

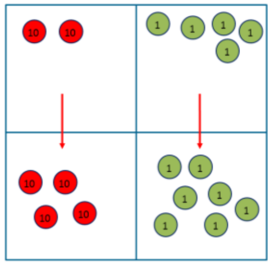
Written methods (progressing to 3-digits)

Introduce expanded column subtraction, modelled with place value counters (Dienes could be used for those who need a less abstract representation).



$$\begin{array}{r} 98 \\ -\ 35 \\ \hline 63 \end{array}$$

For some children this will lead to exchanging, modelled using place value counters (or Dienes).



$$\begin{array}{r} {}^{6}\cancel{7}{}^{1}2 \\ -\ 47 \\ \hline 25 \end{array}$$

A number line and expanded column method may be compared next to each other.

Some children may begin to use a formal column method, initially introduced alongside the expanded method. The formal method should be seen as a more streamlined version of the expanded method, not a new method.

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Calculation Policy

Subtraction

Year 4

Missing number/digit problems:

456 + □ = 710; 60 + 99 + □ = 340; 200 – 90 – 80 = □; 225 - □ = 150; □ – 25 = 67; 3450 – 1000 = □; □ - 2000 = 900

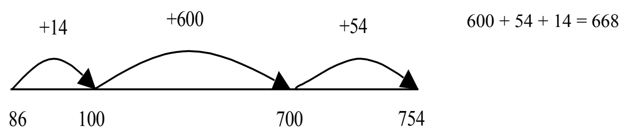
Mental methods should continue to develop, supported by a range of models and images, including the number line.

Informal jottings to aid mental calculations

Using a number line to count on (complementary addition)

Use a number line to **count on**, using jumps **above** the number lines

E.g. 754 – 86 = 668



Formal written methods (progressing to 4-digits)

932 – 457 becomes

$$\begin{array}{cccc} & {}^{8} & {}^{12} & {}^{1} \\ & \cancel{9} & \cancel{3} & 2 \\ - & 4 & 5 & 7 \\ \hline & 4 & 7 & 5 \\ \hline \end{array}$$

Answer: 475

Year 5

Missing number/digit problems:

6.45 = 6 + 0.4 + □; 119 - □ = 86; 1 000 000 - □ = 999 000;
600 000 + □ + 1000 = 671 000; 12 462 – 2 300 = □

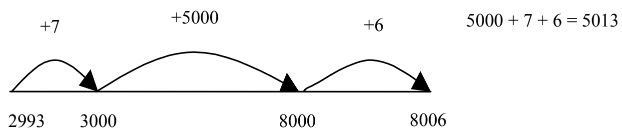
Mental methods should continue to develop, supported by a range of models and images, including the number line.

Informal jottings to aid mental calculations

Using a number line to count on (complementary addition)

Use a number line to **count on**, using jumps **above** the number lines

E.g. 8006 – 2993 = 5013



Formal written methods (progressing to more than 4-digits)

Progress to calculating with decimals, including those with different numbers of decimal places.

$$\begin{array}{rl} & {}^{2}\cancel{3}\,{}^{14}\cancel{5}\,{}^{1}2.4 \\ - & 178.2 \\ \hline & 174.2 \end{array}$$

Year 6

Missing number/digit problems:

□ and # each stand for a different number. # = 34. # + # = □ + □ + #. What is the value of □? What if # = 28? What if # = 21

10 000 000 = 9 000 100 + □ 7 – 2 x 3 = □;
(7 – 2) x 3 = □; (□ - 2) x 3 = 15

Mental methods should continue to develop, supported by a range of models and images, including the number line.

Formal written methods

As year 5, progressing to larger numbers, aiming for both conceptual understanding and procedural fluency with decomposition to be secured.

Teachers may also choose to introduce children to other efficient written layouts which help develop conceptual understanding. For example: Continue calculating with decimals, including those with different numbers of decimal places.

Progression in the written calculations of multiplication and division

WRITTEN METHODS					
Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
solve one-step problems involving multiplication by calculating the answer using concrete objects, pictorial representations and arrays with the support of the teacher	calculate mathematical statements for multiplication and division within the multiplication tables and write them using the multiplication (×), division (÷) and equals (=) signs	write and calculate mathematical statements for multiplication and division using the multiplication tables that they know, including for two-digit numbers times one-digit numbers, using mental and progressing to formal written methods	multiply two-digit and three-digit numbers by a one-digit number using formal written layout	multiply numbers up to 4 digits by a one- or two-digit number using a formal written method, including long multiplication for two-digit numbers divide numbers up to 4 digits by a one-digit number using the formal written method of short division and interpret remainders appropriately for the context	multiply multi-digit numbers up to 4 digits by a two-digit whole number using the formal written method of long multiplication divide numbers up to 4-digits by a two-digit whole number using the formal written method of short division where appropriate for the context divide numbers up to 4 digits by a two-digit whole number using the formal written method of long division, and interpret remainders as whole number remainders, fractions, or by rounding, as appropriate for the context use written division methods in cases where the answer has up to two decimal places

MENTAL CALCULATION AND KNOWN FACTS					
Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
make connections between arrays, number patterns, and counting in twos, fives and tens.	recall and use multiplication and division facts for the 2, 5 and 10 multiplication tables,	recall and use multiplication and division facts for the 3, 4 and 8 multiplication tables use known multiplication, including for two-digit numbers times one-digit numbers to mentally calculate multiplication and division statements	recall multiplication and division facts for multiplication tables up to 12 × 12 use place value, known and derived facts to multiply and divide mentally, including: multiplying by 0 and 1; dividing by 1; multiplying together three numbers	multiply and divide numbers mentally drawing upon known facts multiply and divide whole numbers and those involving decimals by 10, 100 and 1000	perform mental calculations, including with mixed operations and large numbers

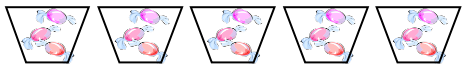
Multiplication

Year 1

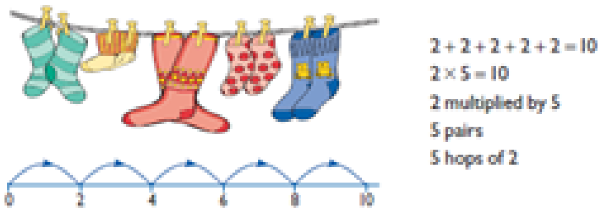
Pictures, symbols and practical resources

Use pictures, symbols and practical resources as a model for multiplication. Understand multiplication is related to doubling and combing groups of the same size (repeated addition).

E.g. There are 3 sweets in one bag. How many sweets are there in 5 bags?

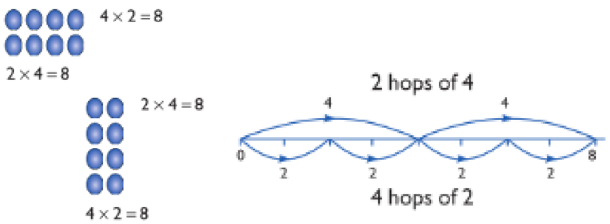


Teacher to model how to record this on a number line when solving problems.



Problem solving with concrete objects (including money and measures.

Use arrays to understand multiplication can be done in any order (commutative):



Year 2

x = signs and missing numbers

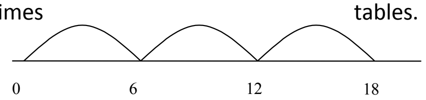
Expressing multiplication as a number sentence using x

Using understanding of the inverse and practical resources to solve missing number problems.

7 x 2 = □	□ = 2 x 7	□ x 2 = 14
7 x □ = 14	14 = □ x 7	14 = □ x ∇
14 = 2 x □	□ x ∇ = 14	

Developing use of arrays and number lines

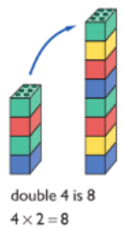
Develop understanding of multiplication using array and number lines (see Year 1). Include multiplications not in the 2, 5 or 10 times tables.



E.g. 6 x 3 = 18

Doubling multiples of 5 up to 50

Use knowledge of doubling to double multiples of 5 up to 50. Record this using partitioning.

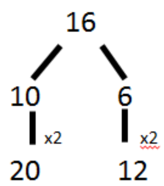


E.g. 15 x 2 = 30

15 x 2 = 10 x 2 + 5 x 2
= 20 + 10
= 30

Begin to develop understanding of multiplication as scaling (3 times bigger/taller).

Doubling numbers up to 10 + 10. Using known doubles to work out double 2d numbers (double 15 = double 10 + double 5)



Towards written methods - Use jottings to develop an understanding of doubling two digit numbers.

Year 3

x = signs and missing numbers

Continue using a range of equations as in Year 2 but with appropriate numbers.

Informal jottings to aid mental calculations

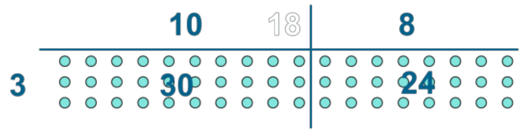
Using partitioning

Doubling 2 digit numbers using partitioning. Demonstrating multiplication on a number line – jumping in larger groups of amounts 13 x 4 = 10 groups 4 + 3 groups of 4

Towards a formal written methods

Partition 2-digit numbers and then use the grid method to record multiplication Developing written methods using understanding of visual images

Develop onto the grid method



Give children opportunities for children to explore this and deepen understanding using Dienes apparatus and place value counters

	10	8
3	30	24

Progressing to a standard written method (two-digit by a one-digit)

24 × 6 becomes

$$\begin{array}{r} 2\ 4 \\ \times\quad 6 \\ \hline 1\ 4\ 4 \\ \hline {}_{2}\ \ \end{array}$$

Answer: 144

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Calculation Policy

Multiplication

Year 4

Missing number/digit problems:

Continue with a range of equations with appropriate numbers.
Also include equations with missing digits
☐2 x 5 = 160

Mental methods

Counting in multiples of 6, 7, 9, 25 and 1000, and steps of 1/100.

Solving practical problems where children need to scale up. Relate to known number facts. (e.g. how tall would a 25cm sunflower be if it grew 6 times taller?)

Consolidation of multiplying two two-digit numbers

Children to embed and deepen their understanding of the grid method to multiply up 2d x 2d. Ensure this is still linked back to their understanding of arrays and place value counters. Model how to find approximate answers to encourage pupils to estimate first.

Formal written method (two-digit and three-digit by one-digit)

First using the expanded method:

346		
x 9		
54	6 x 9	Multiply the ones first!
360	40 x 9	
2700	300 x 9	
3114		

Moving towards the compact method:

342 × 7 becomes

	3	4	2
×			7
2	3	9	4
	2	1	

Answer: 2394

Year 5

Missing number/digit problems:

Continue with a range of equations with appropriate numbers.
Also include equations with missing digits

Mental methods

X by 10, 100, 1000 using moving digits
Use practical resources and jottings to explore equivalent statements (e.g. 4 x 35 = 2 x 2 x 35)

Recall of prime numbers up 19 and identify prime numbers up to 100 (with reasoning). Solving practical problems where children need to scale up. Relate to known number facts. Identify factor pairs for numbers.

Formal written methods including long multiplication up to four-digit by two-digit numbers

Long multiplication using place value counters
Children to explore how the grid method supports an understanding of long multiplication.
Four-digit by two-digit:

	2	3	1	
	1	3	4	2
x			1	8
1	3	4	2	0
1	0	7	3	6
2	4	1	5	6
	1			

X	1000	300	40	2
10	10000	3000	400	20
8	8000	2400	320	16

124 × 26 becomes

	1	2	
	1	2	4
×		2	6
	7	4	4
2	4	8	0
3	2	2	4
1	1		

Answer: 3224

Year 6

Missing number/digit problems:

Continue with a range of equations with appropriate numbers.
Also include equations with missing digits

Mental methods

Identifying common factors and multiples of given numbers.
Solving practical problems where children need to scale up. Relate to known number facts.

Formal written methods

Continue to refine and deepen understanding of written methods including fluency for using long multiplication.

Extend to decimals with up to two decimal places (multiplied by one or two digit whole numbers)

Use written division methods in cases where the answer has up to two decimal places.

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Calculation Policy

Division

Year 1

Mental calculation:

Children must have secure counting skills- being able to confidently count in 2s, 5s and 10s.

Using pictures, marks and symbols

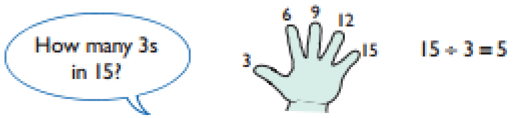
Use pictures, symbols and practical resources as a model for division. **Group AND share small quantities- understanding the difference between the two concepts.**

Sharing

Develops importance of one-to-one correspondence.
Children should be taught to share using concrete apparatus. E.g. sharing marbles between a group of friends.

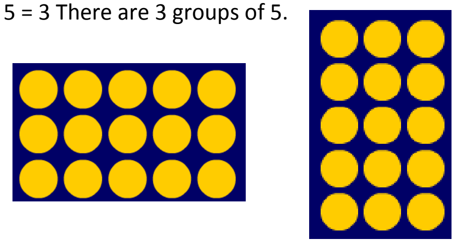
Grouping

Children should apply their counting skills to develop some understanding of grouping.



Use of arrays as a pictorial representation for division. 15 ÷ 3 = 5 There are 5 groups of 3.

15 ÷ 5 = 3 There are 3 groups of 5.



Children should be able to find ½ and ¼ and simple fractions of objects, numbers and quantities.

Year 2

÷ = signs and missing numbers

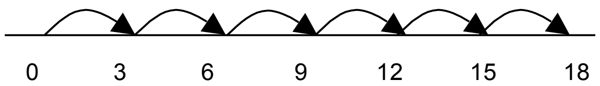
6 ÷ 2 = □	□ = 6 ÷ 2
6 ÷ □ = 3	3 = 6 ÷ □
□ ÷ 2 = 3	3 = □ ÷ 2
□ ÷ ∇ = 3	3 = □ ÷ ∇

Understand division as sharing and grouping

Use the sharing and grouping models of division practically and then using pictures, marks or symbols, before progressing to division on a number line.

Sharing – 18 sweets are shared between 3 people. How many do they have each?

Grouping - There are 18 sweets. How many people can have 3 each? (How many 3s make 18?)



Using arrays

Continue work on arrays. Support children to understand how multiplication and division are inverse. Look at an array – what do you see?

Year 3

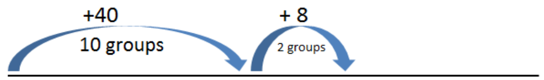
÷ = signs and missing numbers

Continue using a range of equations as in Year 2 but with appropriate numbers.

Becoming more efficient using a number line

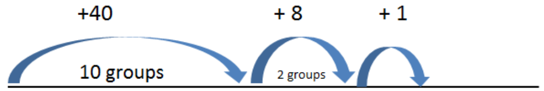
Children need to be able to partition the dividend in different ways.

48 ÷ 4 = 12



Remainders

49 ÷ 4 = 12 r1



Sharing – 49 shared between 4. How many left over?

Place value counters can be used to support children apply their knowledge of grouping.

For example:
60 ÷ 10 = How many groups of 10 in 60?
600 ÷ 100 = How many groups of 100 in 600?

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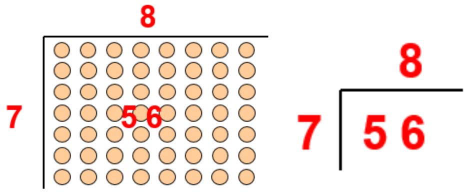
Calculation Policy

Division

Year 4

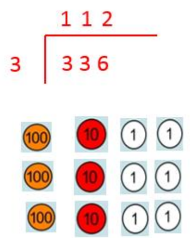
÷ = signs and missing numbers
Continue using a range of equations with appropriate numbers.

Towards a formal written method
Alongside pictorial representations and the use of models and images, children should progress onto short division.



Place value counters can be used to support children apply their knowledge of grouping. Reference should be made to the value of each digit in the dividend.

Formal written method for short division
Use place value counters to understand the written method.



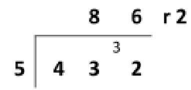
When children have conceptual understanding and fluency using this method without remainders, they can then progress onto ‘moving’ their remainder across to the next digit.

Year 5

÷ = signs and missing numbers
Continue using a range of equations with appropriate numbers.

Formal written methods of short division (up to 4 digits by a one-digit number)

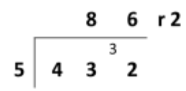
432 ÷ 5 becomes



Answer: 86 remainder 2

Division with remainders
Interpret remainders appropriately for the context

432 ÷ 5 becomes



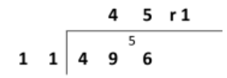
Answer: 86 remainder 2

Year 6

÷ = signs and missing numbers
Continue using a range of equations with appropriate numbers.

Formal written method of short division(up to 4 digits by a two-digit number where appropriate).

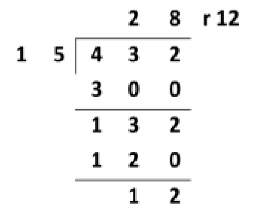
496 ÷ 11 becomes



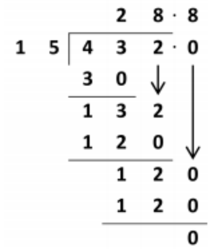
Answer: $45\frac{1}{11}$

Formal written method of long division(up to 4 digits by a two-digit number where appropriate)

432 ÷ 15 becomes



432 ÷ 15 becomes



Answer: 28·8

Division with remainders
Interpret remainders as whole number remainders, fractions, or by rounding, as appropriate for the context. Begin to express quotients as fractions or decimal fractions

E.g. 61 ÷ 4 = 15 r 1 would be expressed as 15 ¼ or 15.25
E.g. 79 ÷ 4 = 19 r 3 would be expressed as 19 ¾ or 19.75