Longton Lane Primary School

A place to learn, a place to achieve, a place to enjoy

Calculation Policy

Rationale

Children should be able to choose an efficient method: mental or written appropriate to the given task. By the end of year 6, children working at age expected and exceeding level of attainment will have been taught, and be secure with, a compact standard method for each operation. Be secure in their ability to calculate using both formal written algorithms and mental strategies.

Purpose:

- To provide opportunities for children to use their knowledge of basic calculation concepts in real-life situations and other areas of the curriculum to understand the importance of mathematics in everyday life.
- To enable each child to confidently use a variety of mathematical tools, apparatus and strategies.
- To develop the correct use of mathematical vocabulary.
- To ensure that each child experiences a wide variety of mental strategies, so that they develop independence in selecting the most appropriate method for calculating.
- To develop fluency in their ability to calculate.
- To monitor the progress and development of mathematics teaching and learning.

Broad Guidelines

- At Longton Lane we use a variety of teaching and learning styles. The programme is based on identified learning objectives from the National Curriculum 2014 and is planned thoroughly to ensure high expectations and progression.
- Lessons will be taught using the sequence review, teach, practice and apply.
- Teaching, questioning and activities are all differentiated.
- Individual Mathematics targets are set using the school's progressive targets system.
- Children identified as having special educational needs in Mathematics will have targets set and reviewed on Individual Education Plans
- Calculation strategies are taught daily within CLIC sessions (Counting, Learn It, It's nothing new, Calculations)

Date of policy 28/6/16 Review due Summer 2018

Chair of Governors_____ Headteacher_____

Mental Strategies

For Addition & Subtraction

- Partitioning
- Reordering
- Near doubles
- Compensating/Adjusting
- Bridging
- Counting up to find a small difference
- Place value

For Multiplication & Division

- Partitioning
- Doubling and halving
- Multiplying and dividing by multiples of 10 and 100
- Factorising
- Adjusting/compensating

Calculation Guidance
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

Missing numbers need to be placed in all possible places.

3 + 4 = □ □ = 3 + 4

3 + □ = 7 7 = □ + 4

Counting and Combining sets of Objects

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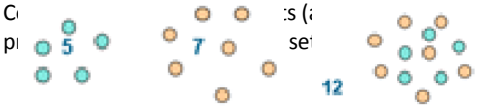
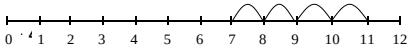


Understanding of counting on with a numbertrack.

Understanding of counting on with a numberline (supported by models and images).



Year 2

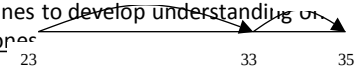
Missing number problems e.g 14 + 5 = 10 + □ 32 + □ + □ = 100

35 = 1 + □ + 5

It is valuable to use a range of represe +10 ns (also s +2

Continue to use numberlines to develop understandi

Counting on in tens and one



23 + 12 = 23 + 10 + 2

= 33 + 2

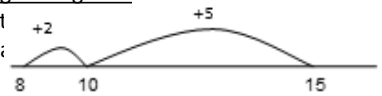
= 35

Partitioning and bridging through 10.

The steps in addition oft

e.g. Children should be a he

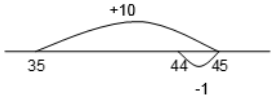
2 and then the 5.



8 + 7 = 15

Adding 9 or 11 by adding 10 an

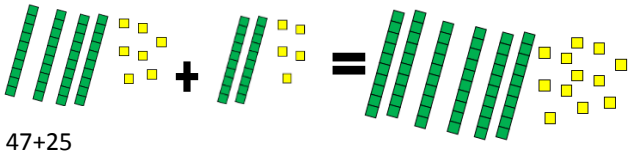
e.g. Add 9 by adding 10 and ad



35 + 9 = 44

Towards a Written Method

Partitioning in different ways and recombine

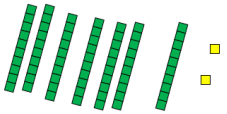


47+25

47 **25** **60 + 12**

Leading to exchanging:

72



40 + 7
+ 20 + 5
60 + 12 = 72

Year 3

Missing number problems using a range of equations as in Year 1 and 2 but with appropriate numbers.

Partition into tens and ones

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.

Towards a Written Method

Introduce expanded column addition modelled with place value counters or dienes

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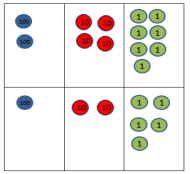
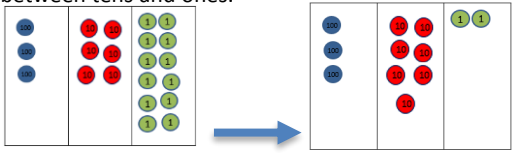


200 + 40 + 7
100 + 20 + 5
300 + 60 +12 = 372

247
+125
12
60
300
372

Leading to children understanding the exchange between tens and ones.



Some children may 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.

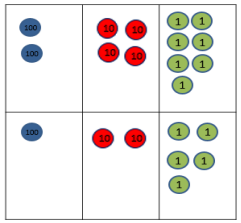
247
+125
372
10

Year 4

Missing number/digit problems as appropriate for year group

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

Written methods (progressing to 4-digits)
Expanded column addition modelled with place value counters, progressing to calculations with 4-digit numbers.



247
+ 125

Compact written method
Extend to numbers with at least four digits.

2634
+4517

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

Missing number/digit problems as appropriate for year group

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

Written methods (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.

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.

Year 6

Missing number/digit problems as appropriate for year group

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

Written methods
As year 5, 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

Extend to numbers with any number of digits and decimals with 1 and 2 d.p.
e.g.124.9 + 117.25 = 242.15

	1	2	4	.	9	0
+	1	1	7	.	2	5
	2	4	2	.	1	5
		1	1			

.

Calculation Guidance
Subtraction

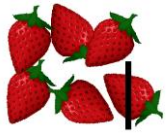
Year 1

Missing number problems e.g. 7 = □ - 9; 20 - □ = 9; 15 – 9 = □; □ - □ = 11; 16 – 0 = □

Use concrete objects and pictorial representations. If appropriate, progress from using number lines with every number shown to number lines with significant numbers shown.

Understand subtraction as take-away:

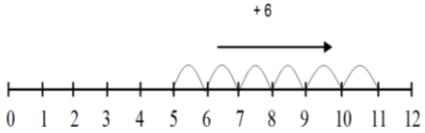
6-1 = 5



Use a numbered number line 6 – 2 =

0 1 2 3 4 5 6

Understand subtraction as finding the difference:
The difference between 5 and 11 = 6.



The use of resources is also valuable for modelling subtraction e.g. place value counters, bundles of straws, Dienes apparatus, multi-link cubes, bead strings

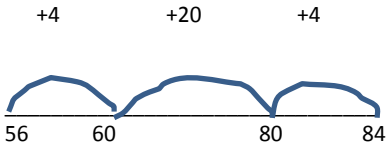
Year 2

Missing number problems e.g. 52 – 8 = □; □ – 20 = 25; 22 = □ – 21; 6 + □ + 3 = 11

It is valuable to use a range of representations (also see Y1).

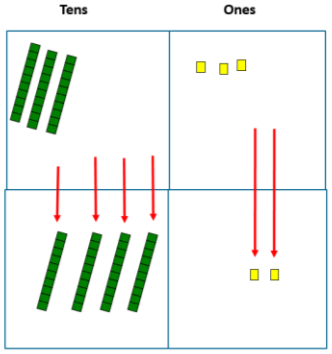
Continue to use number lines to model take-away and difference.

Finding the difference
84-56 = 28



Towards written methods

Recording addition and subtraction in expanded columns can support understanding of the quantity aspect of place value and prepare for efficient written methods with larger numbers. The numbers may be represented with Dienes apparatus. E.g. 75 – 42



$$\begin{array}{r} 70\ \ 5 \\ -\ 40\ \ 2 \\ \hline 30\ \ 3 \end{array}$$

Year 3

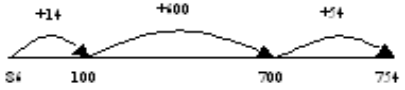
Missing number problems e.g. □ = 43 – 27; 145 – □ = 138; 274 – 30 = □; 245 – □ = 195; 532 – 200 = □; 364 – 153 = □

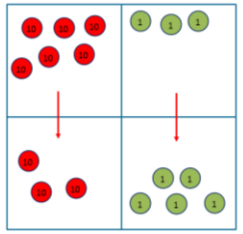
Mental methods should continue to develop, supported by a range of models and images, including the number line. Children should make choices about whether to use complementary addition or counting back, depending on the numbers involved.

Written methods (progressing to 3-digits)

Review Finding the difference. Introduce expanded column subtraction with no decomposition, modelled with place value counters (Dienes could be used for those who need a less abstract representation)

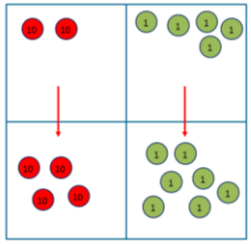
Finding the difference
754 - 86 = 668





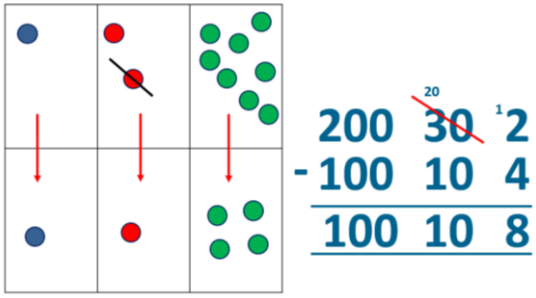
$$\begin{array}{r} 90\ \ 8 \\ -\ 30\ \ 5 \\ \hline 60\ \ 3 \end{array}$$

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



$$\begin{array}{r} {}^{60}\cancel{70}\ {}^{1}2 \\ -\ 40\ \ 7 \\ \hline 20\ \ 5 \end{array}$$

Some children may 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.

Year 4	Year 5	Year 6
Missing number/digit problems: 456 + □ = 710; 1□7 + 6□ = 200; 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. **Written methods (progressing to 4-digits)** Expanded column subtraction with decomposition, modelled with place value counters, progressing to calculations with 4-digit numbers.  200 30 2 - 100 10 4 100 10 8 If understanding of the expanded method is secure, children will move on to the formal method of decomposition, which again can be initially modelled with place value counters. 232 -114	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. **Written methods (progressing to more than 4-digits)** When understanding of the expanded method is secure, children will move on to the formal method of decomposition, which can be initially modelled with place value counters. 6232 - 4814 Progress to calculating with decimals, including those with different numbers of decimal places.	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. The bar model should continue to be used to help with problem solving. **Written methods** As year 5, progressing to larger numbers, aiming for both conceptual understanding and procedural fluency with decomposition to be secured. Continue calculating with decimals, including those with different numbers of decimal places.

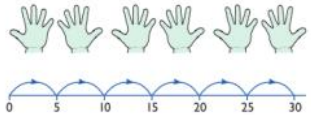
Calculation Guidance
Multiplication

Year 1

Understand multiplication is related to doubling and combing groups of the same size (repeated addition)

Washing line, and other practical resources for counting. Concrete objects., bundles of straws, bead strings

2 + 2 + 2 + 2 + 2 = 10
2 × 5 = 10
2 multiplied by 5
5 pairs
5 hops of 2

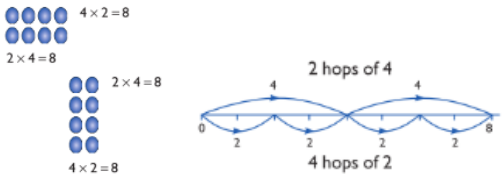


5 + 5 + 5 + 5 + 5 + 5 = 30
5 × 6 = 30
5 multiplied by 6
6 groups of 5
6 hops of 5

Problem solving with concrete objects (including money and measures

Develop the vocabulary relating to 'times' – Pick up five, 4 times

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



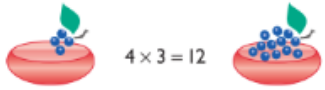
Year 2

Expressing multiplication as a number sentence using x
Using understanding of the inverse and practical resources to solve missing number problems. Link to counting in 2's, 5's 10's.

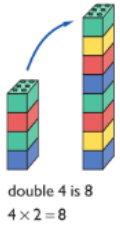
7 x 2 = □ □ = 2 x 7
7 x □ = 14 14 = □ x 7
□ x 2 = 14 14 = 2 x □
□ x ◯ = 14 14 = □ x ◯

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

Abstract, pictorial, concrete representations
4 x 3 = 12



Doubling numbers up to 10 + 10
Link with understanding scaling
Using known doubles to work out double 2d numbers
(double 15 = double 10 + double 5)



Use jottings to develop an understanding of doubling two digit numbers.

16

10 6
x2 x2
20 12

Year 3

Missing number problems
Continue with a range of equations as in Year 2 but with appropriate numbers.

Mental methods
Doubling 2 digit numbers using partitioning

Demonstrating multiplication on a number line – jumping in larger groups of amounts.

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

13 x 4 =(10 groups 4) + (3 groups of 4)

Written methods (progressing to 2d x 1d)
Place value counters can help children's understanding

1. **13 x 4**
   3 x 4 =
   10 x 4 =

2. 13
   x 4
   12
   40

3. Formal method

Place value counters can help children's understanding.

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

Year 4

Continue with a range of equations but 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?)

Written methods

Children to embed and deepen their Ensure this is still linked back to their understanding of arrays and place value counters.

Short Multiplication

24 × 6 becomes

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

Answer: 144

342 × 7 becomes

$$\begin{array}{r} 3\ 4\ 2 \\ \times\ \ \ \ 7 \\ \hline 2\ 3\ 9\ 4 \\ \hline \ \ 2\ \ 1 \end{array}$$

Answer: 2394

2741 × 6 becomes

$$\begin{array}{r} 2\ 7\ 4\ 1 \\ \times\ \ \ \ \ \ 6 \\ \hline 1\ 6\ 4\ 4\ 6 \\ \hline \ \ 4\ \ 2 \end{array}$$

Answer: 16 446

Year 5

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

Mental methods

X by 10, 100, 1000 using moving digits ITP

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

Written methods (progressing to 4d x 2d)

Continue to refine short multiplication. (Examples in Year 4)Long multiplication using place value counters

Children to explore how the grid method supports an understanding of long multiplication (for 2d x 2d)

Long Multiplication

24 × 16 becomes

$$\begin{array}{r} \overset{2}{} \\ 2\ 4 \\ \times\ 1\ 6 \\ \hline 2\ 4\ 0 \\ 1\ 4\ 4 \\ \hline 3\ 8\ 4 \end{array}$$

Answer: 384

124 × 26 becomes

$$\begin{array}{r} \overset{1\ 2}{} \\ 1\ 2\ 4 \\ \times\ \ 2\ 6 \\ \hline \ \ 7\ 4\ 4 \\ 2\ 4\ 8\ 0 \\ \hline 3\ 2\ 2\ 4 \\ \hline 1\ 1 \end{array}$$

Answer: 3224

Also incorporate

4 x 1 and 4 x 2

Progress onto multiplying with decimals

Year 6

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

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

Mental methods

Identifying common factors and multiples of given numbers

Solving practical problems where children need to scale up. Relate to known number facts.

Written methods

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

$$\begin{array}{r} \overset{2\ 3\ 1}{} \\ 1\ 3\ 4\ 2 \\ x\ \ \ \ 1\ 8 \\ \hline 1\ 3\ 4\ 2\ 0 \\ 1\ 0\ 7\ 3\ 6 \\ \hline 2\ 4\ 1\ 5\ 6 \\ \hline \ \ 1 \end{array}$$

Progress onto multiplying with decimals

Calculation Guidance
Division

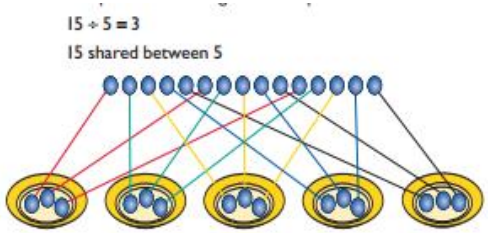
Year 1

Children must have secure counting skills- being able to confidently count in 2s, 5s and 10s.
Children should be given opportunities to reason about what they notice in number patterns.

Group AND **share small quantities- understanding the difference between the two concepts.**

Sharing

Develops importance of one-to-one correspondence.

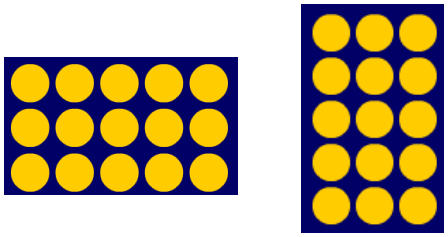


Children should be taught to share using concrete apparatus.

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 = □ ÷ ∇

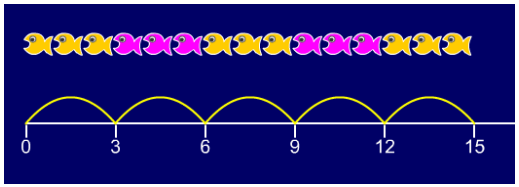
Know and understand sharing and grouping- introducing children to the ÷ sign.

Children should continue to use grouping and sharing for division using practical apparatus, arrays and pictorial representations.

Grouping using a number line

'how many groups of 3 are there in 15?'.

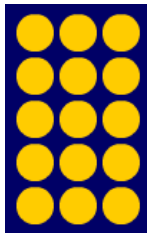
15 ÷ 3 = 5



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

Record

5 x 3 = 15
3 x 5 = 15
15 ÷ 3 = 5
15 ÷ 5 = 3



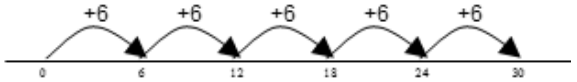
Year 3

÷ = signs and missing numbers

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

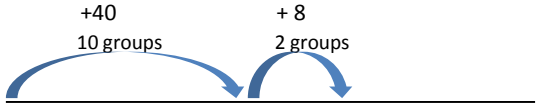
Grouping

How many 6's are in 30?
30 ÷ 6 can be modelled as:

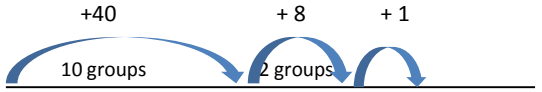


Becoming more efficient using a numberline

Children need to be able to partition in different ways.
48 **÷ 4 = 12**



40 ÷ 4 = 10
8 ÷ 4 = 2



Remainders
49 ÷ 4 = 12 r1

Sharing – 49 shared between 4. How many left over?
Grouping – How many 4s make 49. How many are 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?

Year 4

÷ = signs and missing numbers

Continue using a range of equations as in year 3 but with appropriate numbers.

Sharing, Grouping and using a number line

Children will continue to explore division as sharing and grouping, and to represent calculations on a number line until they have a secure understanding. Children should progress in their use of written division calculations:

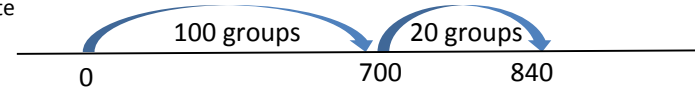
- Using tables facts with which they are fluent
- Experiencing a logical progression in the numbers they use, for example:

1. Dividend just over 10x the divisor, e.g. 84 ÷ 7
2. Dividend just over 10x the divisor when the divisor is a teen number, e.g. 173 ÷ 15 (learning sensible strategies for calculations such as 102 ÷ 17)
3. Dividend over 100x the divisor, e.g. 840 ÷ 7
4. Dividend over 20x the divisor, e.g. 168 ÷ 7

All of the above stages should include calculations with remainders as well as without.
Remainders should be interpreted according to the context. (i.e. rounded up or down to relate to the answer to the problem)

e.g. 840 ÷ 7 = 120
700 ÷ 7=
140 ÷ 7 =

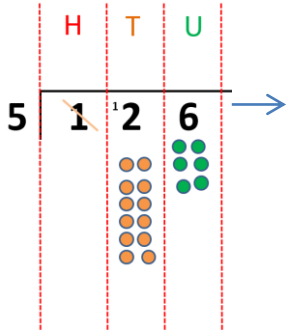
Jottings
7 x 100 = 700
7 x 10 = 70
7 x 20 = 140



Formal Written Methods

Formal short division should only be introduced once children have a good understanding of division, its links with multiplication and the idea of 'chunking up' to find a target number (see use of number lines above)

Short division to be modelled for understanding using place value counters as shown below. Calculations with 2 and 3-digit dividends. E.g. fig 1



98 ÷ 7 becomes

$$\begin{array}{r} 1\ 4 \\ 7\overline{)\ 9\ 8} \end{array}$$

(2 above the 9)

Answer: 14

Year 5

Formal Written Methods

Continued as shown in Year 4, leading to the efficient use of a formal method. The language of grouping to be used (see link from fig. 1 in Year 4)

98 ÷ 7 becomes

$$\begin{array}{r} 1\ 4 \\ 7\overline{)\ 9\ 8} \end{array}$$

(2 above the 9)

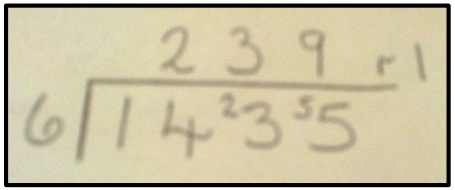
Answer: 14

432 ÷ 5 becomes

$$\begin{array}{r} 8\ \ 6\ \ r\,2 \\ 5\overline{)\ 4\ 3\ \ 2} \end{array}$$

(3 above the 3)

Answer: 86 remainder 2



Children begin to practically develop their understanding of how express the remainder as a decimal or a fraction e.g. what could I do with this remaining 1? How could I share this between 6 as well?

Year 6

÷ = signs and missing numbers

Continue using a range of equations but with appropriate numbers

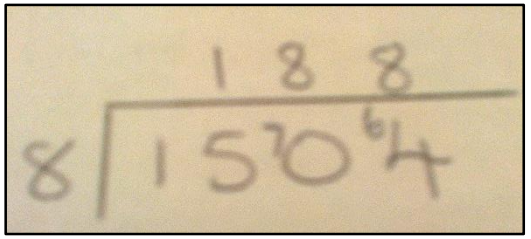
Sharing and Grouping and using a number line

Children will continue to explore division as sharing and grouping, and to represent calculations on a number line as appropriate.

Quotients should be expressed as decimals and fractions

Formal Written Methods – long and short division

E.g. 1504 ÷ 8



496 ÷ 11 becomes

$$\begin{array}{r} 4\ \ 5\ \ r\,1 \\ 1\ 1\overline{)\ 4\ 9\ \ 6} \end{array}$$

(5 above the 9)

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

432 ÷ 15 becomes

$$\begin{array}{r} \ \ 2\ \ 8 \\ 1\ 5\overline{)\ 4\ 3\ \ 2} \\ \ \ 3\ \ 0\ \ 0 \quad 15\times20 \\ \hline \ \ 1\ \ 3\ \ 2 \\ \ \ 1\ \ 2\ \ 0 \quad 15\times8 \\ \hline \ \ \ \ 1\ \ 2 \end{array}$$

$\frac{12}{15} = \frac{4}{5}$

Answer: $28\frac{4}{5}$

432 ÷ 15 becomes

$$\begin{array}{r} \ \ 2\ \ 8\cdot 8 \\ 1\ 5\overline{)\ 4\ 3\ \ 2\cdot 0} \\ \ \ 3\ \ 0 \\ \hline \ \ 1\ \ 3\ \ 2 \\ \ \ 1\ \ 2\ \ 0 \\ \hline \ \ \ \ 1\ \ 2\ \ 0 \\ \ \ \ \ 1\ \ 2\ \ 0 \\ \hline \ \ \ \ \ \ \ \ 0 \end{array}$$

Answer: 28·8