CASTLESIDE PRIMARY SCHOOL

This policy has been largely adapted from the White Rose Maths Hub Calculation Policy
It has been written in line with the aims of the National Curriculum.

The National Curriculum Aims

The National Curriculum for Mathematics aims to ensure that all pupils

- ✓ become **fluent** in the fundamentals of mathematics, including through **varied** and **frequent** practice with **increasingly complex problems** over time, so that pupils develop conceptual understanding and the ability to recall and apply knowledge rapidly and accurately.

- ✓ **reason mathematically** by following a line of enquiry, conjecturing relationships and generalisations, and developing an argument, justification or proof using mathematical language.

- ✓ can **solve problems** by applying their mathematics to a variety of routine and non-routine problems with increasing sophistication, including breaking down problems into a series of simpler steps and persevering in seeking solutions.

Each of the four operations build on a solid understanding of place-value, the connections between the four number operations and number sense: whether they are odd or even, whether they are near multiples of ten or near doubles, for example.

- Children should use correct mathematical language in context and be able to explain their calculation strategies.

- Children should make considered decisions as to the appropriate methods to make mathematics more functional. They should choose the most appropriate, fluent, accurate and efficient method to perform a particular calculation.

- Children should use concrete resources before they progress to pictorial and abstract representations. This CPA approach should be available to children throughout school, as and when necessary. Use of manipulatives helps reinforce understanding and provides support when calculating mentally, mentally with jottings, using expanded methods and formal written methods.

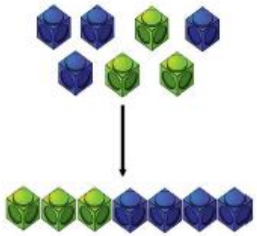
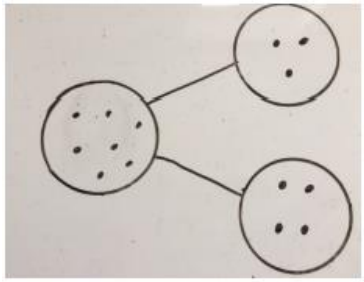
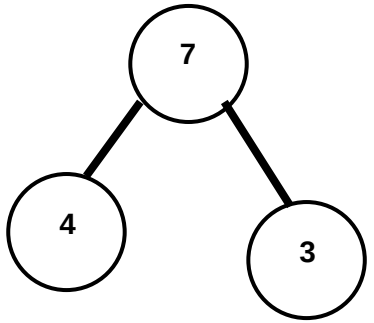
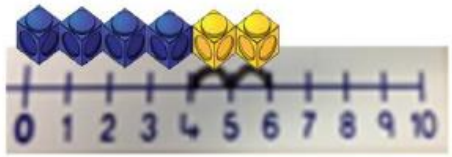
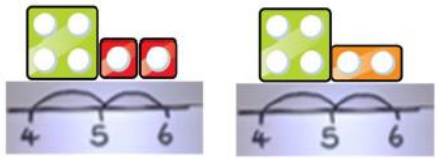
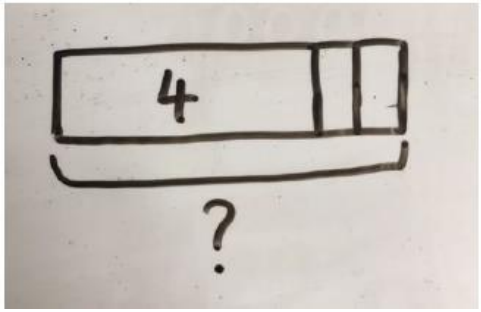
- Children should progress between the stages, working towards formal written methods once they are secure with each stage. However, they should not be rushed and, after the method has been taught, children should still be able to make their preferred choice of the most appropriate, accurate and efficient method for them. Previous stages may need to be revisited to consolidate understanding when introducing a new strategy.

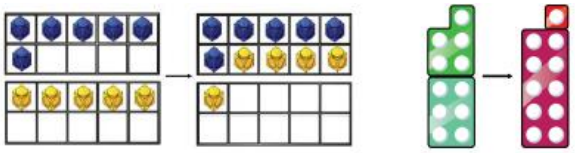
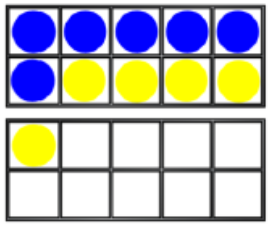
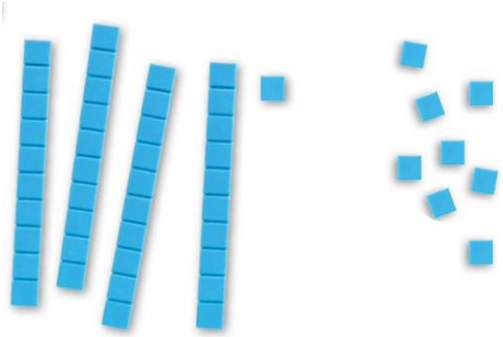
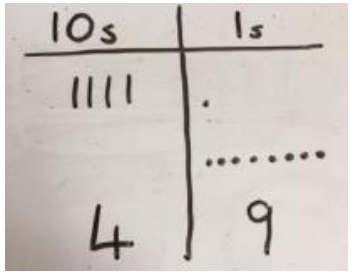
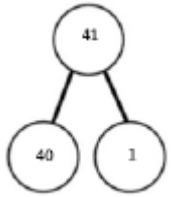
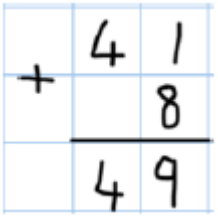
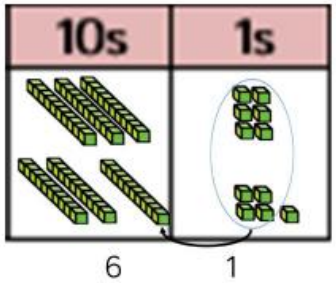
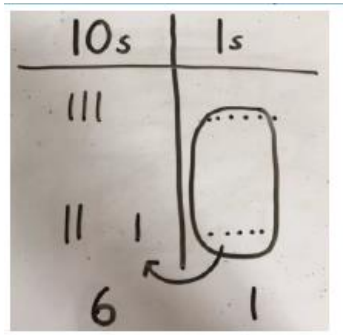
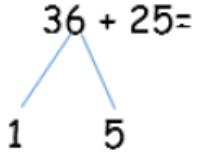
As new methods of calculation are introduced, children should be given the opportunity to examine them alongside the method they have consolidated in order to make connections between them and establish similarities and differences.

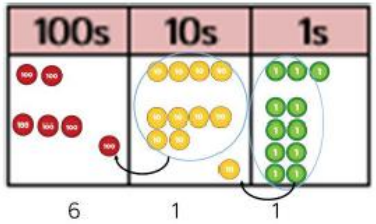
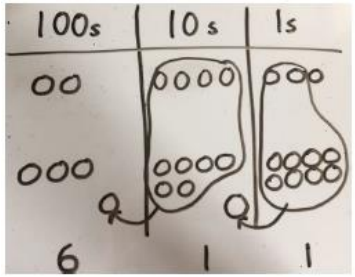
This policy includes sections for the four operations. It outlines a progression in teaching from mental through to formal written methods. It also includes appropriate mathematical language as well as conceptual variation.

Calculation Policy: Addition

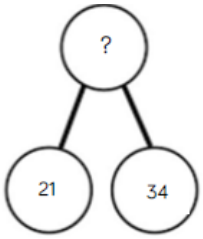
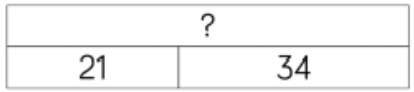
Key language: sum, total, parts and wholes, plus, add, altogether, more, ‘is equal to’, ‘is the same as’

Concrete	Pictorial	Abstract
Combining two parts to make a whole (Use other resources too: eggs, shells, Teddy Bears, cars etc) 	Children to represent the manipulative used with dots or crosses. They could also use a part-whole model. 	4 + 3 = 7 4 is a part, 3 is a part and the whole is 7 
Counting on using number lines with cubes, number tracks, Numicon, or counters  	A bar model, which encourages the children to count on, rather than count all. 	The abstract number line: What is 2 more than 4? What is the sum of 2 and 4? What is the total of 4 and 2? 4 + 2 

Regrouping to make 10 using tens frames and counters/cubes or Numicon. Can also use straw bundles or bead strings. 6 + 5 	Children to draw the ten frame and counters/cubes. 	Children to develop an understanding of equality e.g. 6 + □ = 11 6 + 5 = 6 + □ 6 + 5 = □ + 4
TO + O using base 10. Continue to develop understanding of partitioning and place value. 41 + 8 	Children to represent the base 10 e.g. lines for tens and dot/crosses for ones. 	41 + 8 1 + 8 = 9 40 + 9 = 49  
TO + TO using base 10. Continue to develop understanding of partitioning and place value. 36 + 25 	Children to represent the base 10 in a place value chart. 	Looking for ways to make 10.  30 + 20 = 50 5 + 5 = 10 50 + 10 + 1 = 61 ***Formal method*** 3 6 + 2 5 1 6 1

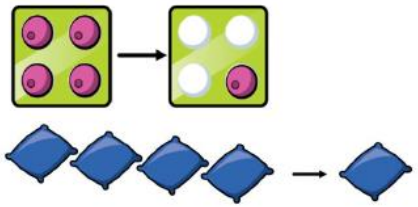
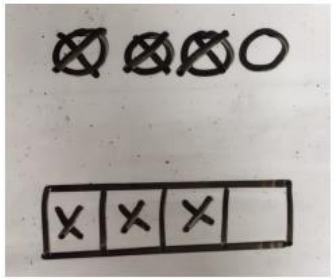
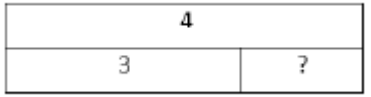
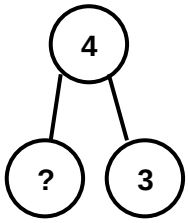
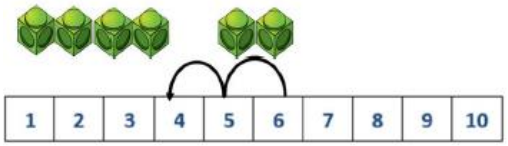
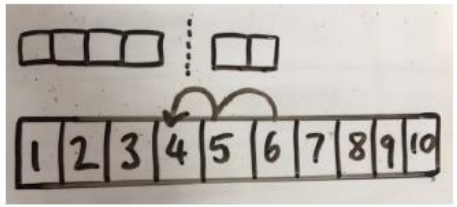
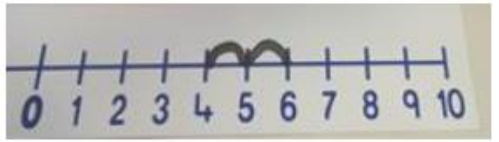
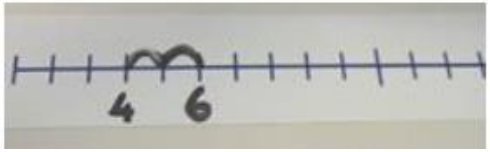
Use of place value counters to add HTO + TO, HTO + HTO etc. When there are 10 ones in the 1s column- we exchange for 1 ten, when there are 10 tens in the 10s column- we exchange for 1 hundred. 	Chidren to represent the counters in a place value chart, circling when they make an exchange. 	Formal written method 2 4 3 + 3 6 8 1 1 6 1 1

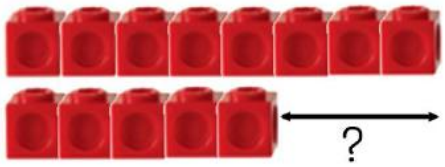
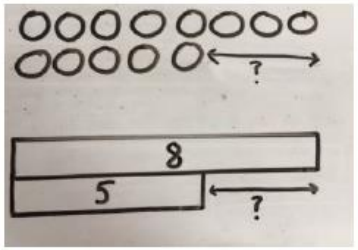
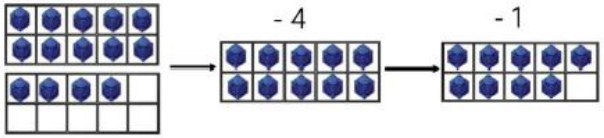
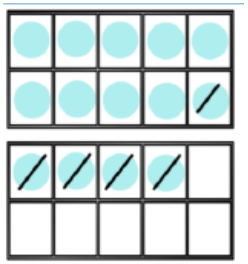
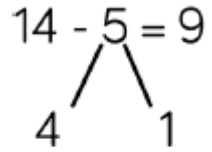
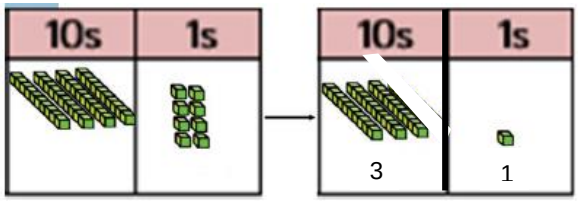
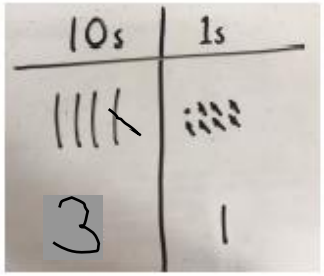
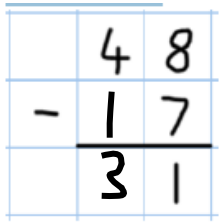
Conceptual variation: different ways to ask children to solve 21+ 34

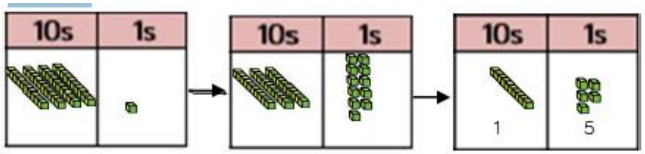
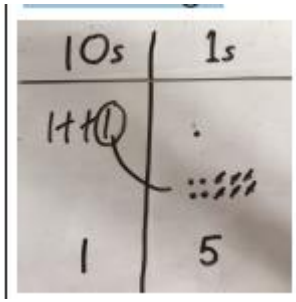
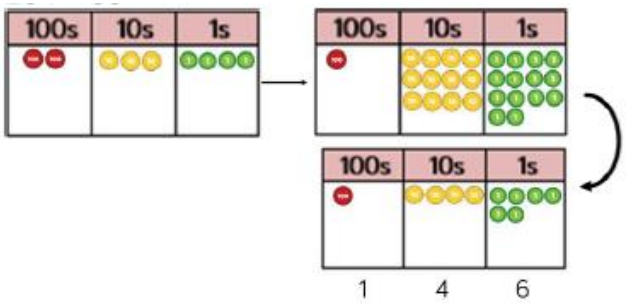
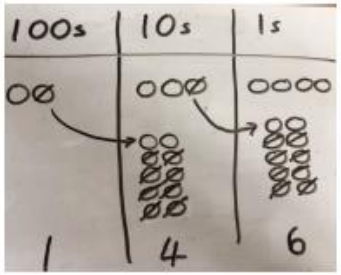
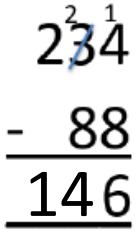
 	**Word problems:** In year 3, there are 21 children and in year 4, there are 34 children. How many children in total? 21 + 34 = 55. Prove it	21 +34 ____ 21 + 34 = □ = 21 + 34 Calculate the sum of 21 and 34	Missing digit problems 

Calculation Policy: Subtraction

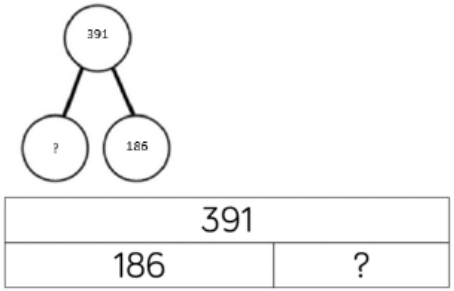
Key language: take away, less than, the difference, subtract, minus, fewer, decrease.

Concrete	Pictorial	Abstract
Physically taking away and removing objects from a whole (ten frames, Numicon, cubes and other items such as beanbags could be used). 4 – 3 = 1 	Children to draw the concrete resources they are using and cross out the correct amount. The bar model can also be used. 	4 - 3 = ? □ = 4 - 3  
Counting back (using number lines or number tracks) children start with 6 and count back 2. 6 – 2 = 4 	Children to represent what they see pictorially e.g. 	Children to represent the calculation on a number line or number track and show their jumps. Encourage children to use an empty number line  

Finding the difference (using cubes, Numicon or Cuisenaire rods, other objects can also be used). Calculate the difference between 8 and 5. 	Children to draw the cubes/other concrete objects which they have used or use the bar model to illustrate what they need to calculate. 	Find the difference between 8 and 5. 8 – 5, the difference is ☐ Children to explore why 9 and 6, 8 and 5, and 7 and 4 have the same difference.
Making 10 using ten frames. 14 – 5 	Children to present the ten frame pictorially and discuss what they did to make 10. 	Children to show how they can make 10 by flexible partitioning.  14 – 4 = 10 10 – 1 = 9
Column method using base 10 to subtract 2 digits from 2 digits. 48-17 	Children to represent the base 10 pictorially. 	Column method 

Column method using base 10 with exchange (decomposition) 41 – 26 	Represent the base 10 pictorially, remembering to show the exchange. 	Formal written method. Children must understand what has happened when they have crossed out digits and use the language ‘exchange’. 
Column method using place value counters with exchange (decomposition). 234 – 88 	Represent the place value counters pictorially; remembering to show what has been exchanged. 	Formal column method. Children must understand what has happened when they have crossed out digits and use the language ‘exchange’ 

Conceptual variation: different ways to ask children to solve 391 - 136

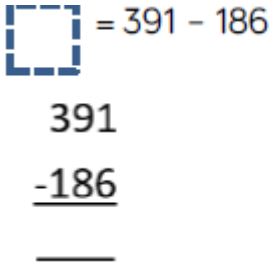


Word problems:

Raj spent £391, Timmy spent £186.

How much more did Raj spend?

Calculate the difference between 391 and 186.

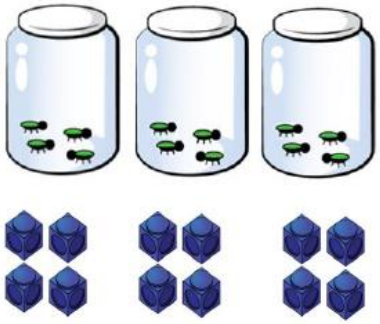
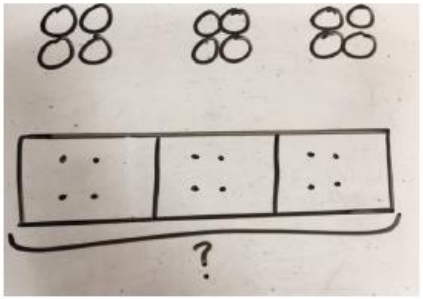
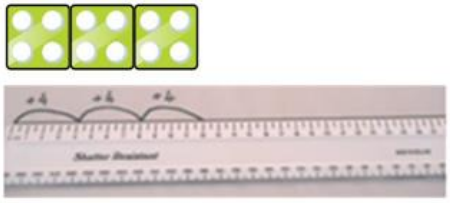
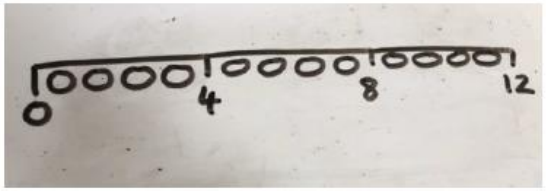
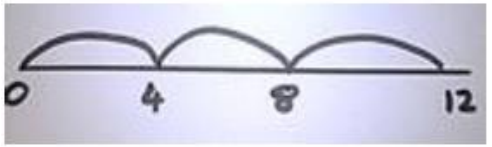


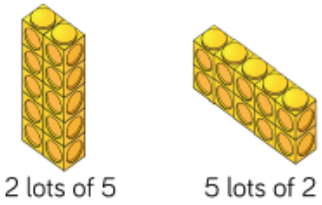
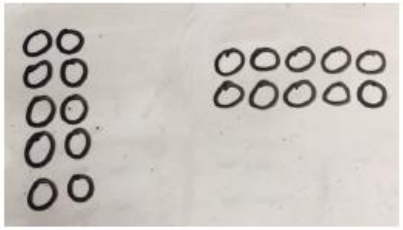
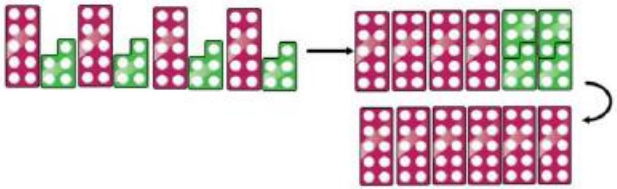
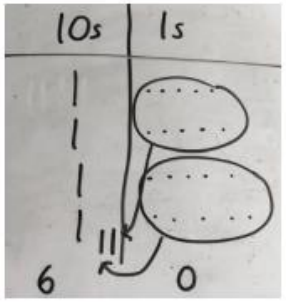
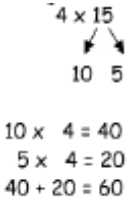
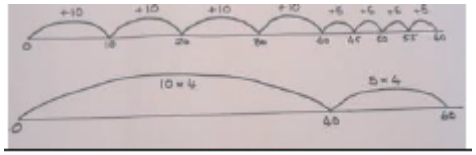
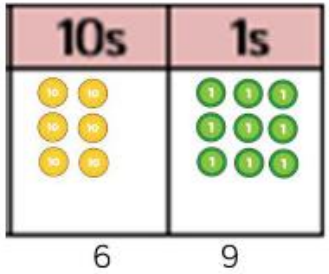
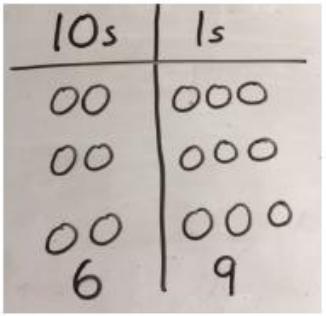
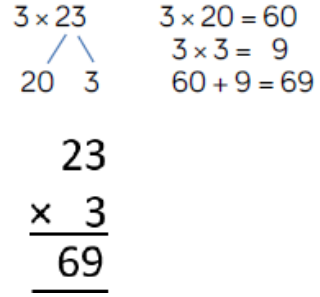
What is 186 less than 391?

Missing digit calculations

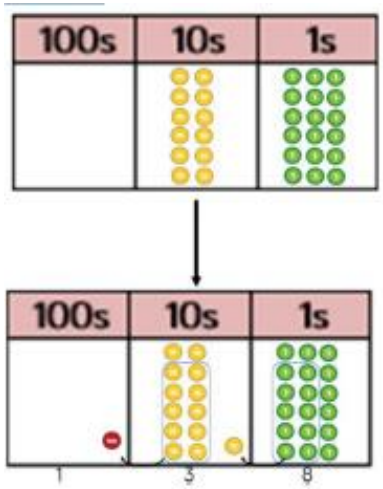
Calculation Policy: Multiplication

Key language: double, times, multiplied by, the product of, groups of, lots of, equal groups

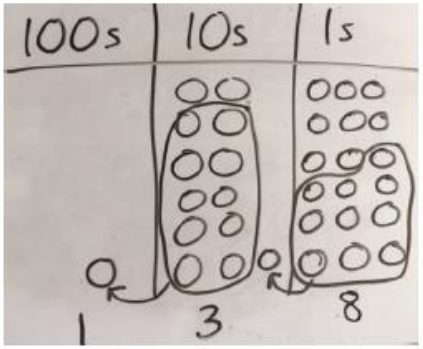
Concrete	Pictorial	Abstract
Repeated grouping/repeated addition 3 × 4 4 + 4 + 4 There are 3 equal groups, with 4 in each group. 	Children to represent the practical resources in a picture and use a bar model. 	3 × 4 = 12 4 + 4 + 4 = 12
Number lines and Numicon to show repeated groups (Cuisenaire may also be used as well as groups of counters/objects 3 × 4 	Represent this pictorially alongside a number line e.g.: 	Abstract number line showing three jumps of four. 3 × 4 = 12 

Use arrays to illustrate commutativity counters and other objects can also be used. 2 × 5 = 5 × 2  	Children to represent the arrays pictorially 	Children to be able to use an array to write a range of calculations e.g. 10 = 2 × 5 5 × 2 = 10 2 + 2 + 2 + 2 + 2 = 10 10 = 5 + 5
Partition to multiply using Numicon, base 10 or Cuisenaire rods. 4 × 15 	Children to represent the concrete manipulatives pictorially.  	Children to be encouraged to show the steps they have taken. e.g.  A number line may also be used 
Formal column method with place value counters (base 10 can also be used.) 3 × 23  	Children to represent the counters pictorially.  	Children to record what it is they are doing to show understanding. 

Formal column method with place value counters.
6 x 23



Children to represent the counters/base 10, pictorially e.g.



Formal written method

$$\begin{array}{r} 6 \times 23 = \\ 23 \\ \times \overset{1}{6} \\ \hline 138 \end{array}$$

When children start to multiply 3d × 3d and 4d × 2d etc, they should be confident with the abstract: e.g. 124 x 26

.
To get 2480 they have solved 20 × 124.
To get 744 children have solved 6 × 124

Begin with grid method then move onto formal written method.

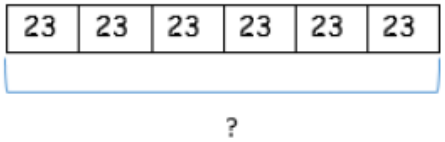
X	100	20	4	
20	2000	400	80	= 2480
6	600	120	24	= 744

(Grid method may also be modelled with place value counters

$$\begin{array}{r} 2480 \\ + \overset{1}{7}\overset{1}{4}4 \\ \hline 3224 \end{array}$$

$$\begin{array}{r} 124 \\ \times \overset{1}{2}\overset{2}{6} \\ \hline 744 \\ 2\overset{1}{4}\overset{1}{8}0 \\ \hline 3224 \end{array}$$

Conceptual variation: different ways to ask children to solve 6 x 23



Word problems:
Mai had to swim 23 lengths, 6 times a week.
How many lengths did she swim in one week?

With the counters, prove that 6 x 23 = 138

Find the product of 6 and 23

$6 \times 23 =$

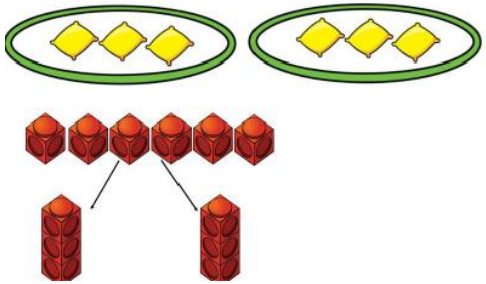
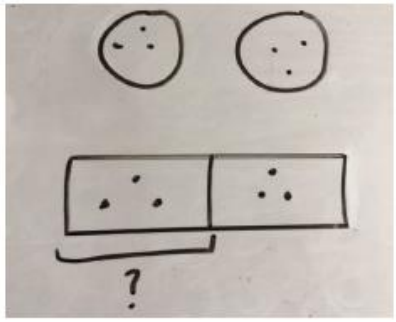
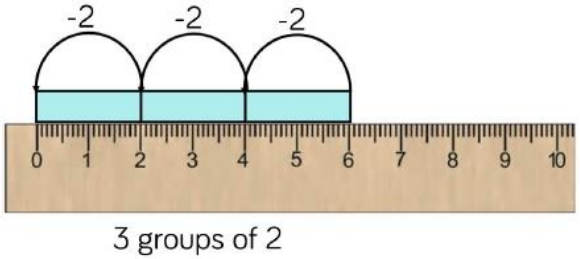
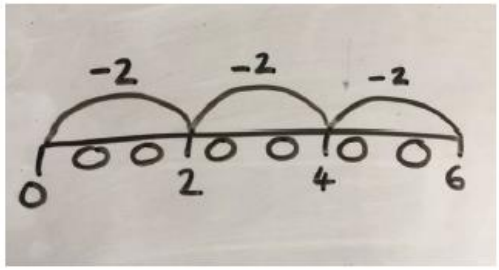
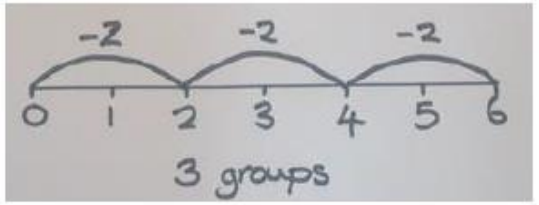
$\square = 6 \times 23$

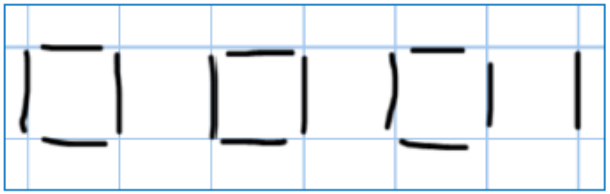
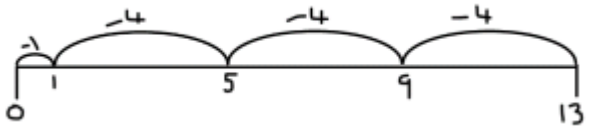
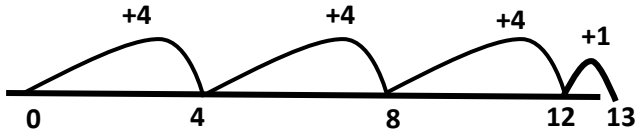
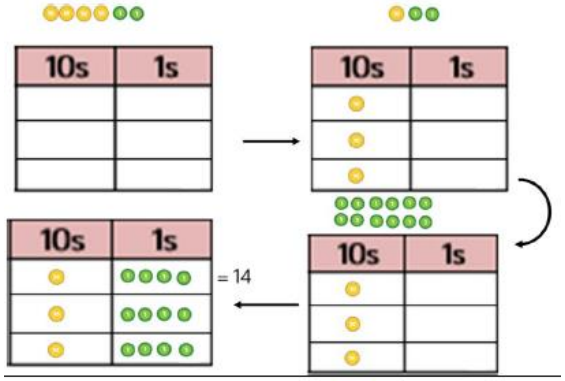
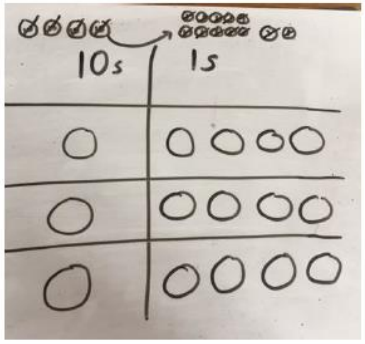
$$\begin{array}{r} 6 \\ \times\ 23 \\ \hline \\ \hline \end{array} \qquad \begin{array}{r} 23 \\ \times\ 6 \\ \hline \\ \hline \end{array}$$

What is the calculation?
What is the product?

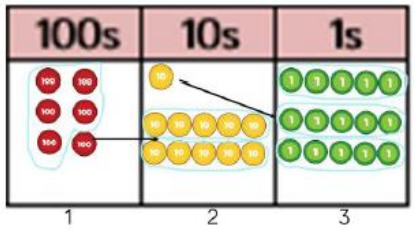
Calculation Policy: Division

Key language: shared, group, divide, divided by, half, quotient

Concrete	Pictorial	Abstract
Sharing using a range of objects. 6 ÷ 2. 	Represent the sharing pictorially. 	6 ÷ 2 = 3  Children should also be encouraged to use their 2 times tables facts.
Repeated subtraction using Cuisenaire rods above a ruler.(Numicon could also be used) 6 ÷ 2 	Children to represent repeated subtraction pictorially. 	Abstract number line to represent the equal groups that have been subtracted. 

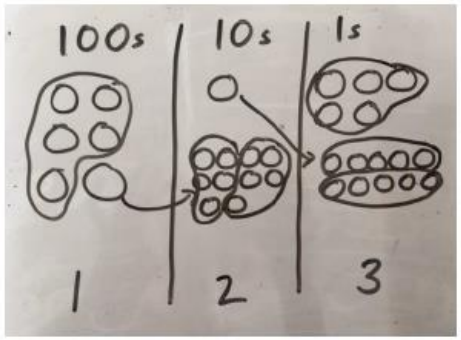
2d ÷ 1d with remainders using lollipop sticks. Cuisenaire rods, above a ruler can also be used. 13 ÷ 4 Use of lollipop sticks to form wholes- squares are made because we are dividing by 4.  There are 3 whole squares, with 1 left over.	Children to represent the lollipop sticks pictorially.  There are 3 whole squares with 1 left over	13 ÷ 4 = 3 remainder 1 Children should be encouraged to use their times table facts; they could also represent repeated addition on a number line. '3 groups of 4, with 1 left over'  
Sharing using place value counters. 42 ÷ 3 = 14 	Children to represent the place value counters pictorially. 	Children to be able to make sense of the place value counters and write calculations to show the process. 42 ÷ 3 42 = 30 + 12 30 ÷ 3 = 10 12 ÷ 3 = 4 10 + 4 = 14

Short division using place value counters to group.
61



1. Make 615 with place value counters.
2. How many groups of 5 hundreds can you make with 6 hundred counters?
3. Exchange 1 hundred for 10 tens.
4. How many groups of 5 tens can you make with 11 ten counters?
5. Exchange 1 ten for 10 ones.
6. How many groups of 5 ones can you make with 15 ones?

Represent the place value counters pictorially.

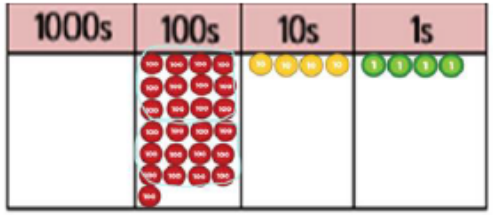


Children to complete the calculation using the standard written method for short division

$$5\overline{)615} = 123$$

Long division Any use of place value counters should be used alongside a formal written method

We can't group 2 thousands into groups of 12 so will exchange them.

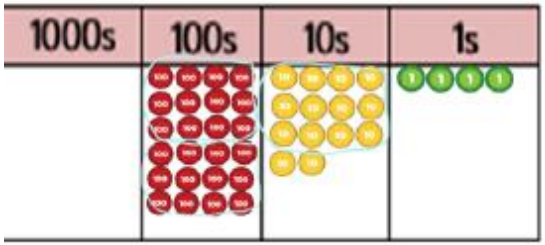


We can group 24 hundreds into groups of 12 which leaves with 1 hundred.

$$12\overline{)2544} = 02$$

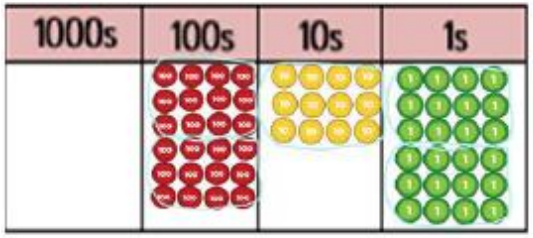
24

1



After exchanging the hundred, we have 14 tens. We can group 12 tens into a group of 12, which leaves 2 tens.

$$\begin{array}{r} 021 \\ 12\overline{)2544} \\ 24 \\ \hline 14 \\ 12 \\ \hline 2 \end{array}$$



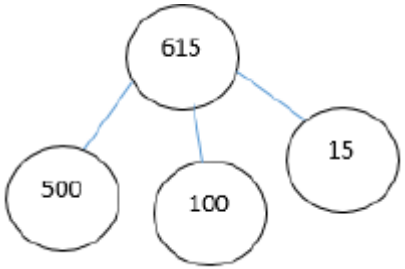
After exchanging the 2 tens, we have 24 ones. We can group 24 ones into 2 group of 12, which leaves no remainder.

$$\begin{array}{r} 0212 \\ 12\overline{)2544} \\ 24 \\ \hline 14 \\ 12 \\ \hline 24 \\ 24 \\ \hline 0 \end{array}$$

Factorisation and short division may also be used to solve long division calculations

Conceptual variation: different ways to ask children to solve 615 ÷ 5

Using the part whole model below, how can you divide 615 by 5 without using short division?



Word problems:
I have £615 and share it equally between 5 bank accounts. How much will be in each account?
615 pupils need to be put into 5 groups. How many will be in each group?

$$5\overline{)615}$$

$615 \div 5 =$

$\square = 615 \div 5$

What is the calculation?
What is the quotient?