Shellingford CE (A) Primary School

Headteacher: Miss Judith Terrell

"Inspiring hearts and minds"

WRITTEN CALCULATION POLICY

Introduction

As a school we recognise the important link between mental, practical and written methods to support the development of children's understanding. Children are introduced to the processes of calculation through practical, oral and mental activities.

As they begin to understand the underlying ideas, they develop ways of recording to support their thinking and calculation methods, so that they develop both conceptual understanding and fluency in the fundamentals of mathematics. Whilst interpreting signs and symbols involved with calculation, orally in the first instance, children use models and images to support their mental and written methods of calculation. As children's mental methods are strengthened and refined they begin to work more efficiently, which will support them with using succinct written calculation strategies as they are developed. By the time children leave Shellingford CE (A) Primary School they will be equipped with efficient mental and written calculation methods, which they use with fluency. Decisions about when to progress should always be based on the security of pupils' understanding and their readiness to progress to the next stage. At whatever stage in their learning, and whatever method is being used, children's strategies must still be underpinned by a secure understanding and knowledge of number facts that can be recalled fluently.

The overall aims are that when children leave Shellingford CE (A) Primary School they:

- Are able to recall number facts with fluency, having developed conceptual understanding through being able to visualise key ideas, such as those related to place value, through experience with practical equipment and visual representation.
- Make use of diagrams and informal notes to help record steps and part answers when using mental methods that generate more information than can be kept in their heads.
- Have an efficient, reliable, written method of calculation for each number operation that they can apply with confidence when undertaking calculations that they cannot carry out mentally.

- Are able to make connections between all four number operations, understanding how they relate to one another, as well as how the rules and laws of arithmetic can be applied.

Mental Methods of Calculation (see Mental Calculation Policy)

Oral and mental work in mathematics is essential, particularly so in calculation. Early practical, oral and mental work must lay the foundations by providing children with a good understanding of how the four operations build on efficient counting strategies and a secure knowledge of place value and number facts. Later work must ensure that children recognise how the operations relate to one another and how the rules and laws of arithmetic are to be used and applied. On-going oral and mental work provides practice and consolidation of these ideas. It must give children the opportunity to apply what they have learned to particular cases, exemplifying how the rules and laws work, and to general cases where children make decisions and choices for themselves. The ability to calculate mentally forms the basis of all methods of calculation and has to be maintained and refined in order to develop fluency. A good knowledge of numbers or a 'feel' for numbers is the product of structured practice and repetition. It requires an understanding of number patterns and relationships developed through directed enquiry, use of models and images and the application of acquired number knowledge and skills.

Written Methods of Calculation

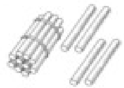
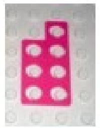
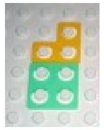
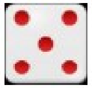
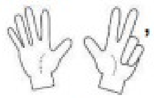
In line with the National Curriculum 2014, our emphasis is on ensuring that pupils progress quickly towards efficient methods. This guidance promotes the use of what are commonly known as 'formal' written methods – methods that are efficient and work for any calculations, including those that involve whole numbers or decimals. They are compact and consequently help children to keep track of their recorded steps. Being able to use these written methods gives children an efficient set of tools they can use when they are unable to carry out the calculation in their heads or do not have access to a calculator. We want children to know that they have a reliable and efficient written method to apply to calculations. In setting out these aims, the intention is that we adopt greater consistency in our approach to calculation. The challenge is for our teachers to determine when their children should move on to a refinement in the method and know when it is best to use a mental, written or calculator method based on the knowledge that they are in control of this choice as they are able to carry out all three methods with confidence. We value the communication between teachers and pupils and pupils and their peers. When children feel confident to communicate their ideas and discuss their findings openly this improves their level of understanding. It has been proved that children will remember 70% of what they have been learning if they have taken an active part in the lesson, compared to a passive learner who will only retain 20% of what has been taught.

Choosing the Appropriate Strategy

Recording in mathematics, and in calculation in particular is an important tool both for furthering the understanding of ideas and for communicating those ideas to others. An efficient written method is one that helps children carry out a calculation and can be understood by others. Written methods are complementary to mental methods and should not be seen as separate from them. The aim is that children use mental methods when appropriate, but for calculations that they cannot do in their heads they use an efficient written method accurately and with confidence. It is important children acquire secure mental methods of calculation and fluency in using and applying efficient written methods of calculation for addition, subtraction, multiplication and division.

First Experiences/Building Blocks:

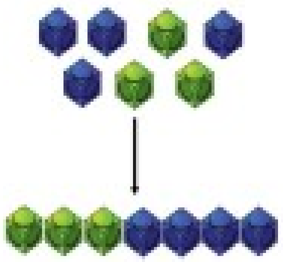
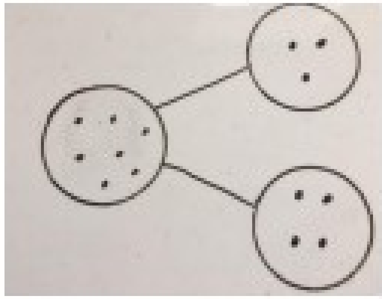
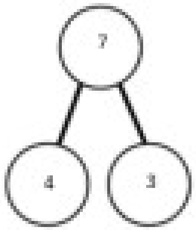
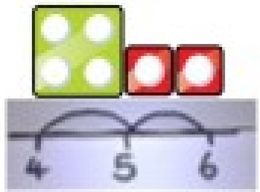
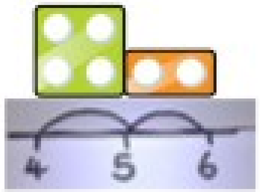
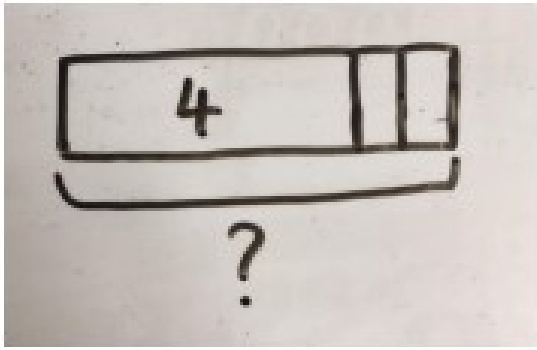
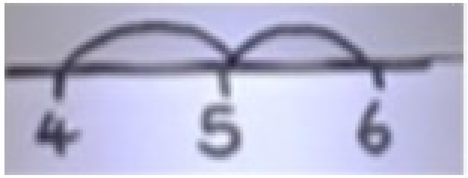
There are fundamental skills that it is important for children to develop the building blocks to future learning in maths, including that linked to calculation. These will be taught initially in EYFS/Year 1 but also revisited throughout KS1 and KS2 to ensure depth of understanding. These skills include:

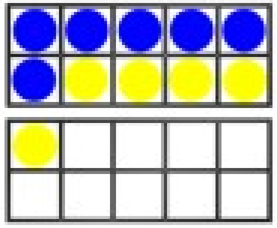
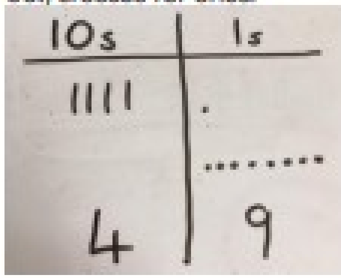
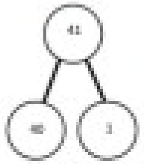
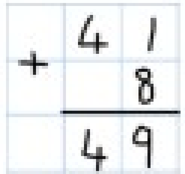
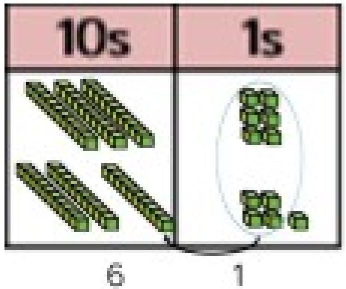
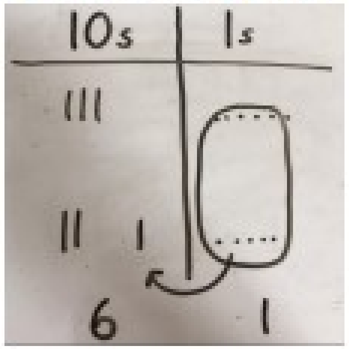
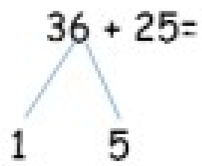
- **Ordinality** – 'the ordering of numbers in relation to one another' – e.g. (1, 2, 3, 4, 5...)
- **Cardinality** – 'understanding the value of different numbers' – e.g. (7 =  17 =  +  12 = 
- **Equality** – 'seven is the same value as four add three' – e.g  = 
- **Subitising** – 'instantly recognizing the number of objects in a small group, without counting them'
  e.g.  → five
- **Conservation of number** – 'recognising that a value of objects are the same, even if they are laid out differently' e.g.
  
- **Counting on and back from any number**
  e.g. 'five add three more totals eight' , 'ten take away three totals seven' 

- **Using apparatus and objects to represent and communicate thinking**
  e.g.
  
- **Maths language** – using mathematical words verbally in every-day situations
  e.g. 'climb up to the top' / 'climb down to the bottom'

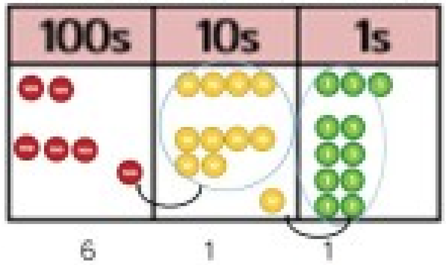
Calculation policy: Addition

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

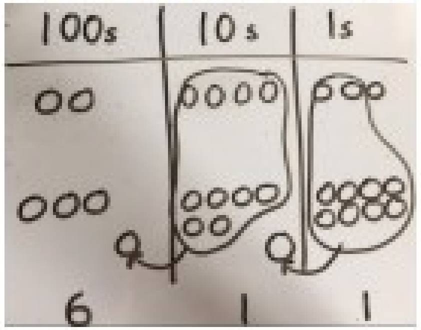
Concrete	Pictorial	Abstract
Combining two parts to make a whole (use other resources too e.g. eggs, shells, teddy bears, cars). 	Children to represent the cubes using dots or crosses. They could put each part on a part whole model too. 	4 + 3 = 7 Four is a part, 3 is a part and the whole is seven. 
Counting on using number lines using cubes or Numicon.   	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 ten frames and counters/cubes or using Numicon. 6 + 5 	Children to draw the ten frame and counters/cubes. 	Children to develop an understanding of equality e.g. 6 + □ = 11 6 + 5 = 5 + □ 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 	Chidlren 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: 36 +25 61 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.




```
  243
+368
  611
   1 1
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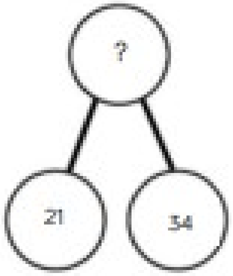
Conceptual variation; different ways to ask children to solve 21 + 34



?	
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
___
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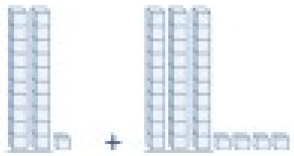
21 + 34 =

☐ = 21 + 34

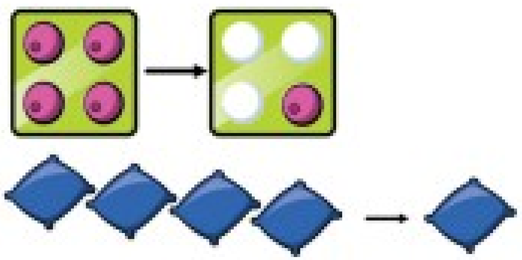
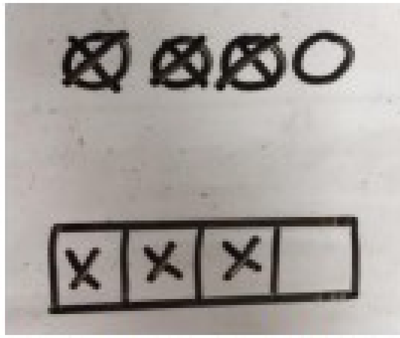
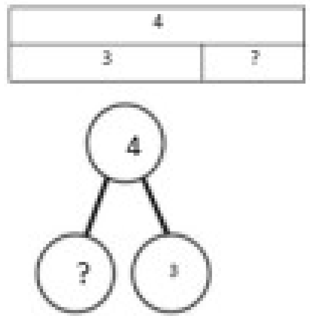
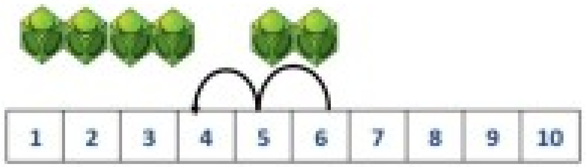
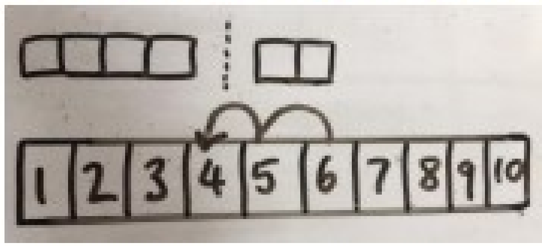
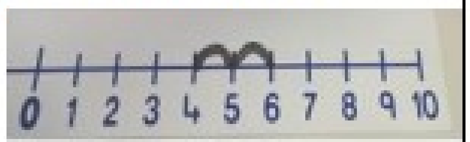
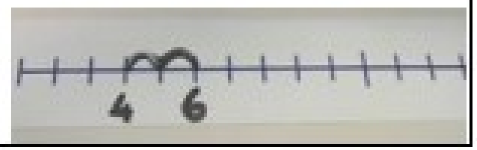
Calculate the sum of twenty-one and thirty-four.

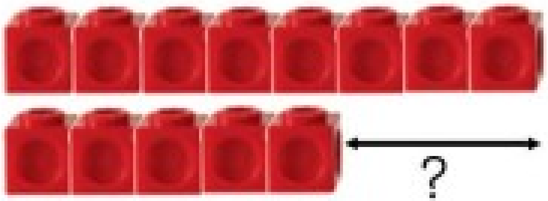
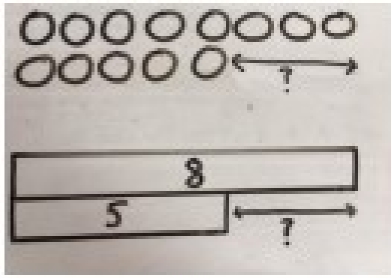
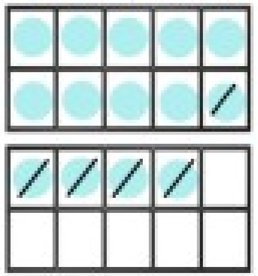
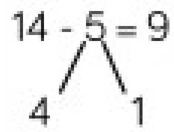
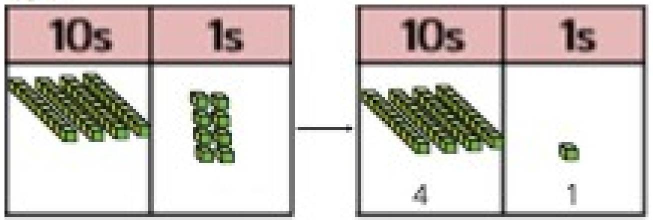
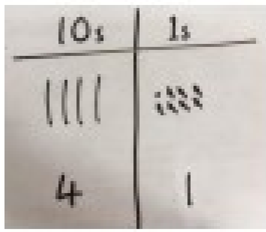
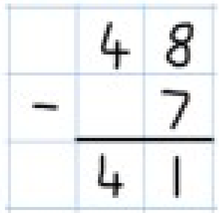


Missing digit problems:

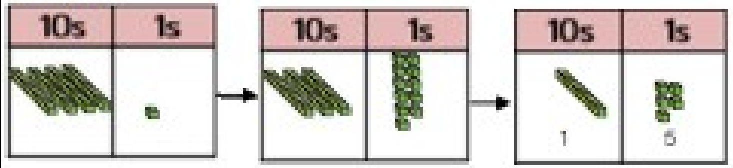
Calculation policy: Subtraction

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

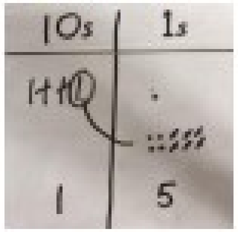
Concrete	Pictorial	Abstract
Physically taking away and removing objects from a whole (ten frames, Numicon, cubes and other items such as beanbags could be used). 4 - 3 = 1 	Children to draw the concrete resources they are using and cross out the correct amount. The bar model can also be used. 	**4- 3 =** **☐ = 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 - 6 = 8 – 5 = 7 – 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 partitioning the subtrahend.  14 – 4 = 10 10 – 1 = 9
Column method using base 10. 48-7 	Children to represent the base 10 pictorially. 	Column method or children could count back 7. 

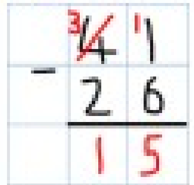
Column method using base 10 and having to exchange.
41 – 26



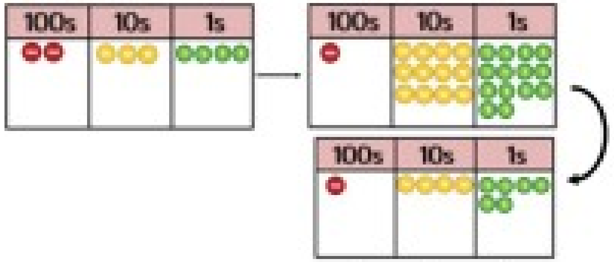
Represent the base 10 pictorially, remembering to show the exchange.



Formal column method. Children must understand that when they have exchanged the 10 they still have 41 because 41 = 30 + 11.

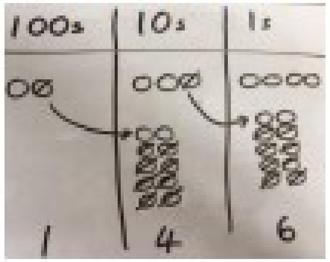


Column method using place value counters.
234 – 88



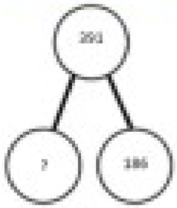
1 4 6

Represent the place value counters pictorially; remembering to show what has been exchanged.



Formal colum method. Children must understand what has happened when they have crossed out digits.

Conceptual variation; different ways to ask children to solve 391 - 186



391	
186	?

Raj spent £391, Timmy spent £186. How much more did Raj spend?

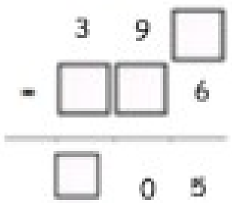
Calculate the difference between 391 and 186.

☐ = 391 – 186

391
-186
___

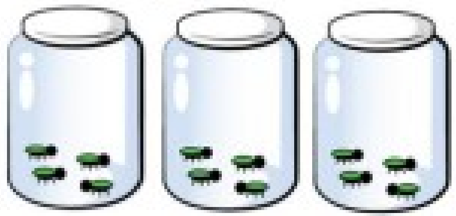
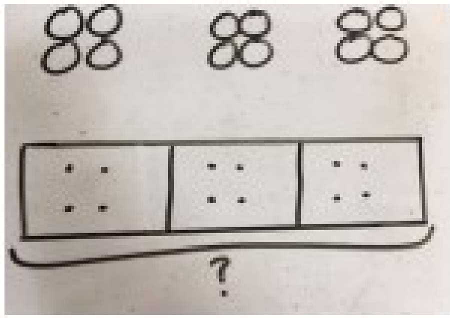
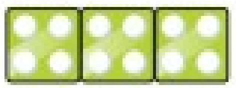
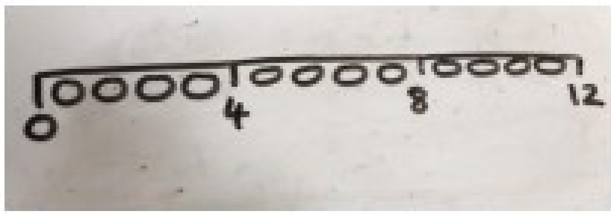
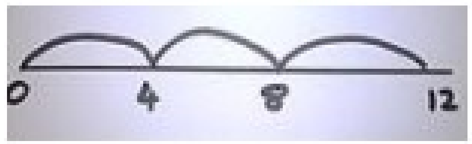
What is 186 less than 391?

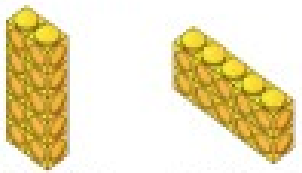
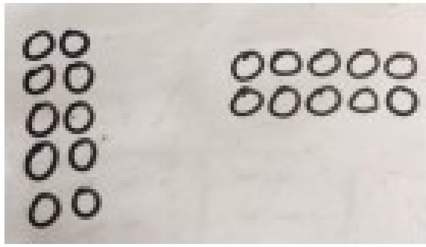
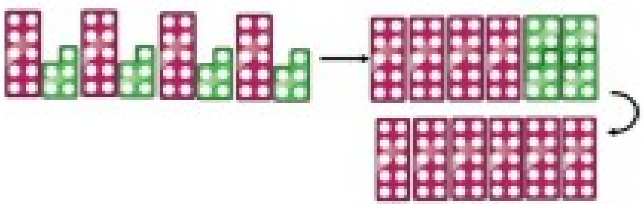
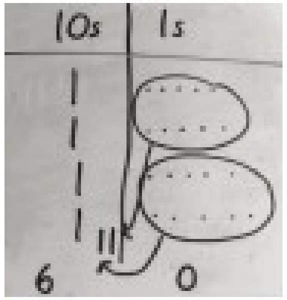
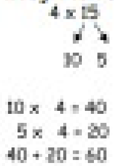
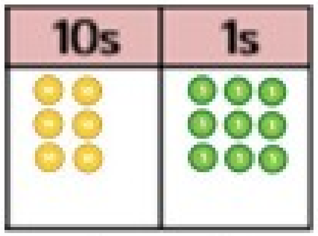
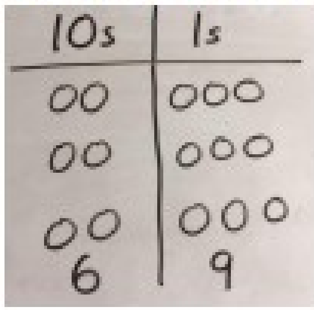
Missing digit calculations



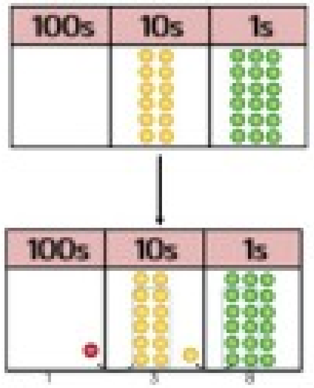
Calculation policy: Multiplication

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

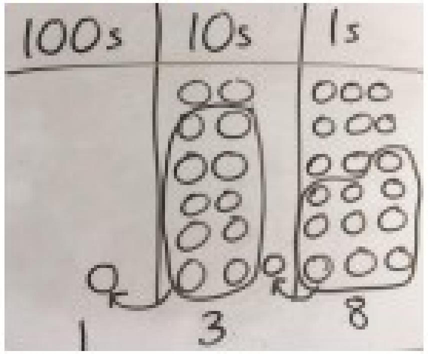
Concrete	Pictorial	Abstract
Repeated grouping/repeated addition 3 × 4 4 + 4 + 4 There are 3 equal groups, with 4 in each group.  	Children to represent the practical resources in a picture and use a bar model. 	3 × 4 = 12 4 + 4 + 4 = 12
Number lines to show repeated groups- 3 × 4   Cuisenaire rods can be used too.	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  2 lots of 5 5 lots of 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.  A number line can also be used 
Formal column method with place value counters (base 10 can also be used.) 3 × 23  6 9	Children to represent the counters pictorially. 	Children to record what it is they are doing to show understanding. 3 × 23 3 × 20 = 60 20 3 3 × 3 = 9 60 + 9 = 69 23 × 3 69

Formal column method with place value counters.
6 x 23



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



Formal written method

6 x 23 =

```
   23
×   6
  138
  1 1
```

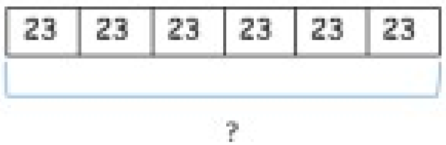
When children start to multiply 3d × 3d and 4d × 2d etc., they should be confident with the abstract:

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

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

Answer: 3224

Conceptual variation; different ways to ask children to solve 6 × 23



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 × 23 =

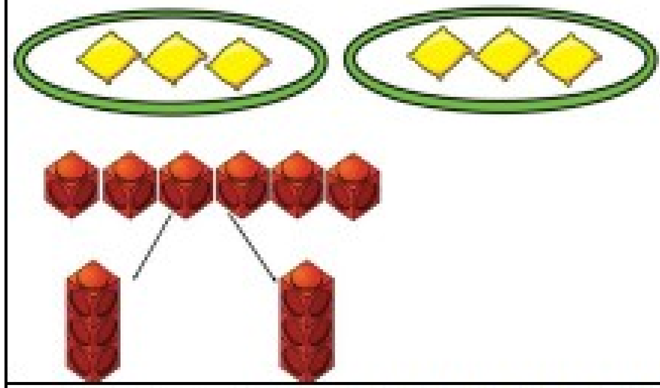
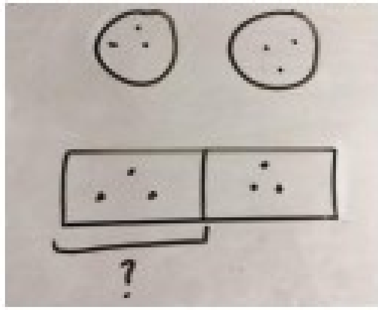
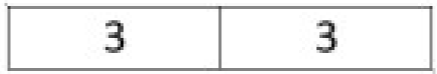
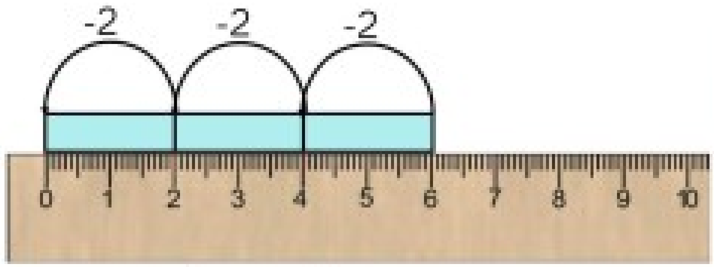
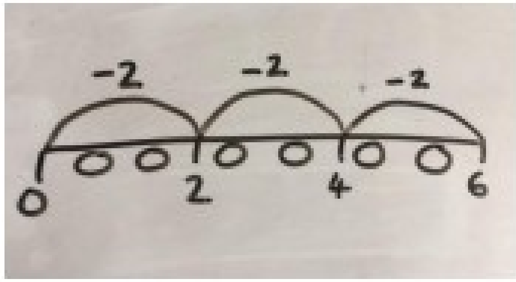
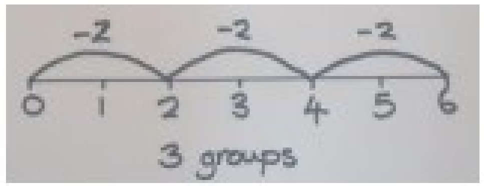
☐ = 6 × 23

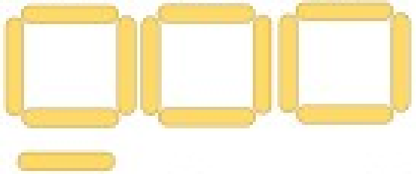
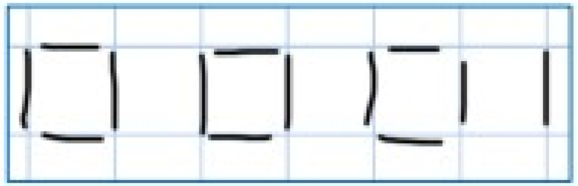
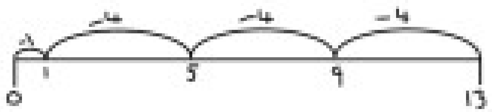
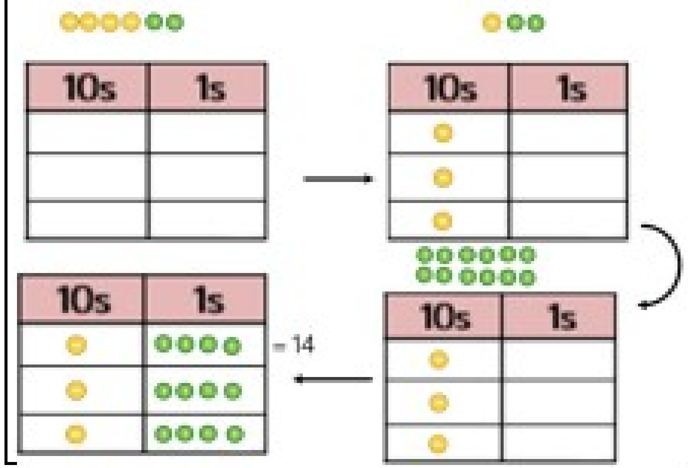
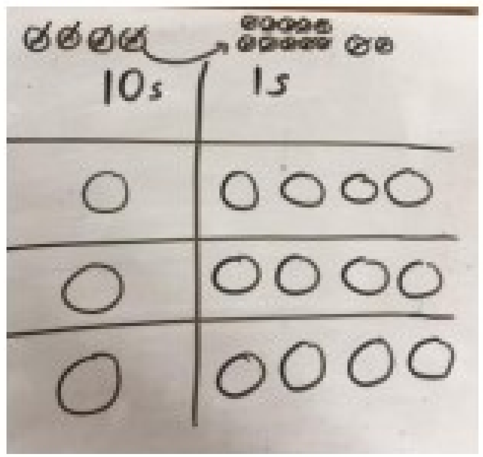
```
   6        23
× 23      ×  6
____      ____
```

What is the calculation?
What is the product?

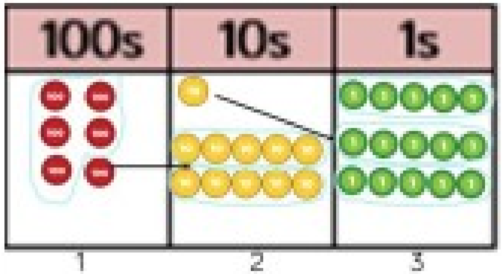
Calculation policy: Division

Key language: share, group, divide, divided by, half.

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. 6 ÷ 2  3 groups of 2	Children to represent repeated subtraction pictorially.  	Abstract number line to represent the equal groups that have been subtracted. 

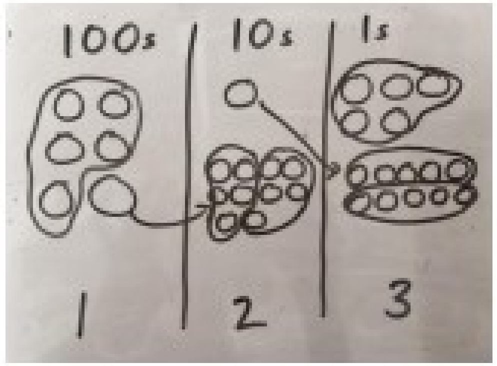
2d ÷ 1d with remainders using lollipop sticks. Cuisenaire rods, above a ruler can also be used. 13 ÷ 4 Use of lollipop sticks to form wholes- squares are made because we are dividing by 4.  There are 3 whole squares, with 1 left over.	Children to represent the lollipop sticks pictorially.  There are 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.
615 ÷ 5



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?

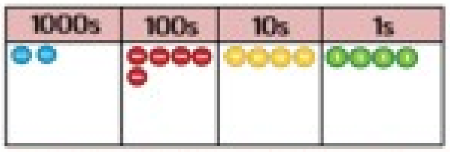
Represent the place value counters pictorially.



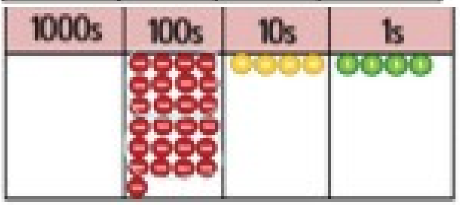
Children to the calculation using the short division scaffold.

123
5 | 6¹1¹5

Long division using place value counters
2544 ÷ 12

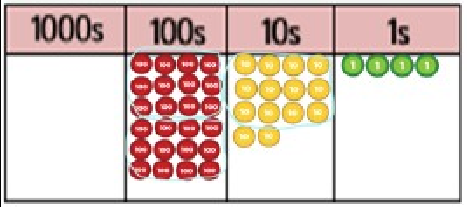


We can't group 2 thousands into groups of 12 so will exchange them.



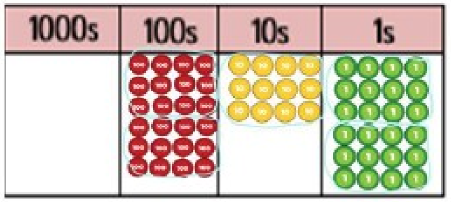
We can group 24 hundreds into groups of 12 which leaves with 1 hundred.

```
   02
12|2544
   24
    1
```



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

```
    0 2 1
12 |2544
    24
     14
     12
      2
```

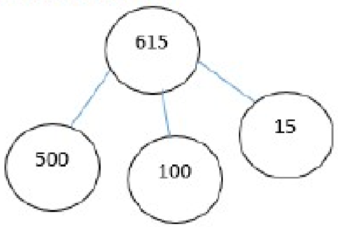


After exchanging the 2 tens, we have 24 ones. We can group 24 ones into 2 group of 12, which leaves no remainder.

```
    0 2 1 2
12 |2544
    24
     14
     12
      24
      24
       0
```

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?



I have £615 and share it equally between 5 bank accounts. How much will be in each account?

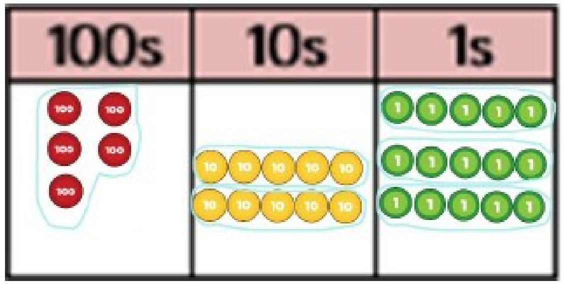
615 pupils need to be put into 5 groups. How many will be in each group?

```
5 |615
```

615 ÷ 5 =

[ ] = 615 ÷ 5

What is the calculation?
What is the answer?



Written by: Jane Merritt (Mathematics Subject Leader)

Date written: January 2023 **Review Date: January 2026**

Policy Agreed by the Governing Body on ………………………………………………………

Signed ………………………………………………… **Chair of Governing Body** **Signed** ………………………………………………… **Headteacher**