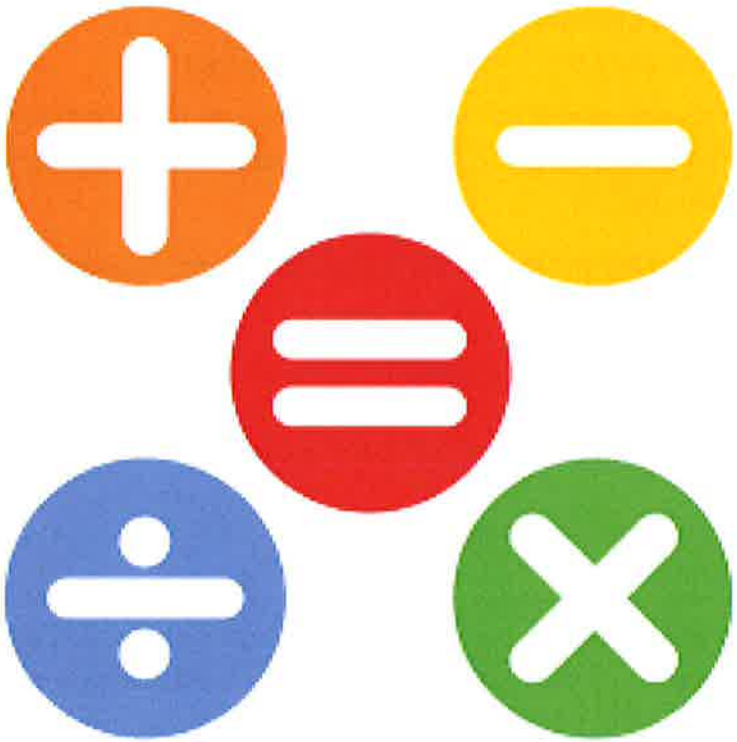
Wallisdean Infant School
Calculation Policy



Wallisdean Infant School Mathematics Calculation Policy

Aims and Rationale

Children are introduced to the processes of calculation through the CPA approach (concrete, pictorial and abstract). As children begin to understand the underlying ideas, they develop ways of:-

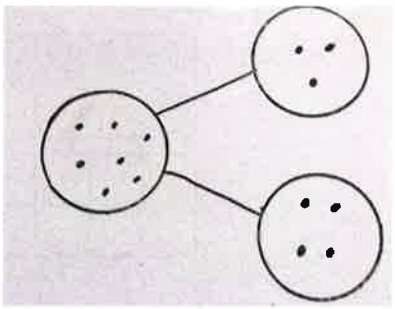
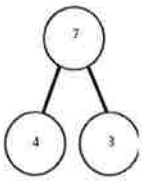
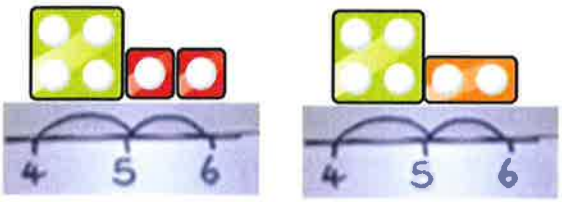
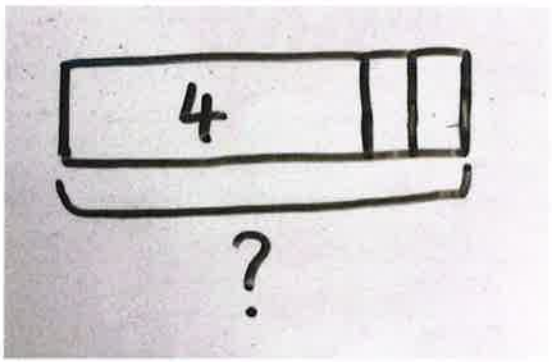
- Recording to support their thinking and calculation methods
- Choosing the most efficient methods/strategies
- Interpreting and using the signs and symbols involved

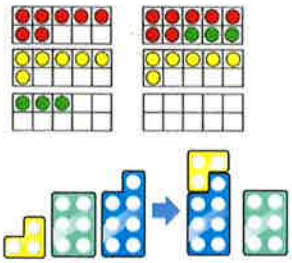
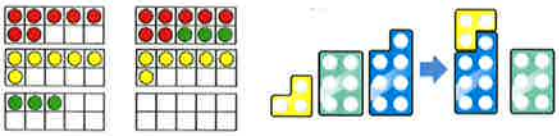
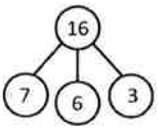
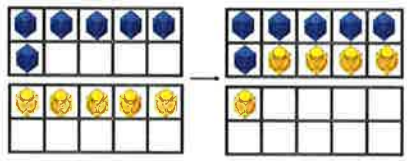
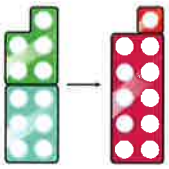
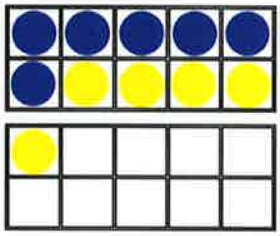
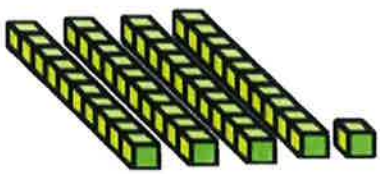
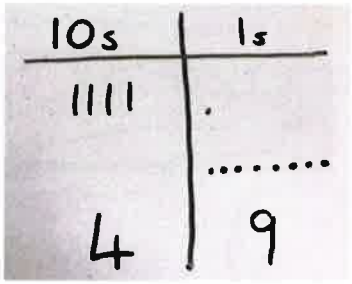
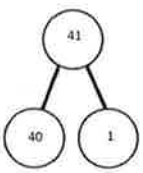
As children's methods are strengthened and refined, so too are their informal written methods. These methods become more efficient and lead to efficient written methods that can be used more generally.

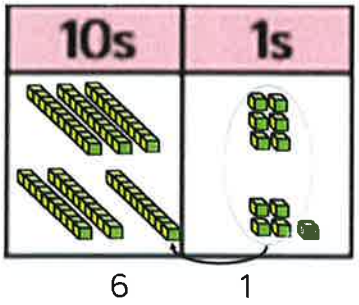
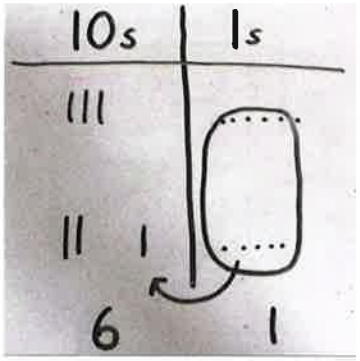
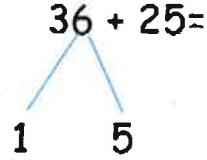
Early practical, pictorial, oral and mental work *must lay the foundations* by providing children with a good understanding of:-

- The number 10, including the composition of each number
- How to subitise
- How the four operations build on efficient counting strategies
- Place value
- Number bonds and number facts

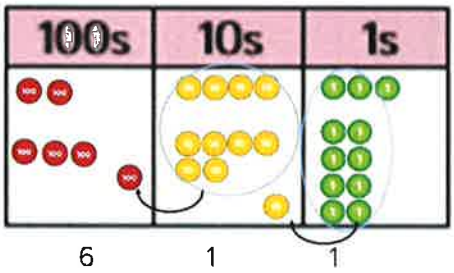
The use of concrete (real objects), pictorial and abstract methods are all equally important in ensuring that children fully understand the process of calculations and what happens to the numbers and why. At the beginning, the children will begin by using concrete and oral methods. They will move towards using pictorial methods alongside these to consolidate their understanding, eventually moving towards abstract written methods. It is important that children go through this process of methods when learning any new topic in mathematics to ensure that they fully understand the process of the calculation. Once the children are familiar with a new topic it is important that the CPA approach is used in a non-linear way to consolidate their understanding. In one lesson you should see opportunities for children to use concrete resources, record pictorially and record in an abstract way.

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 

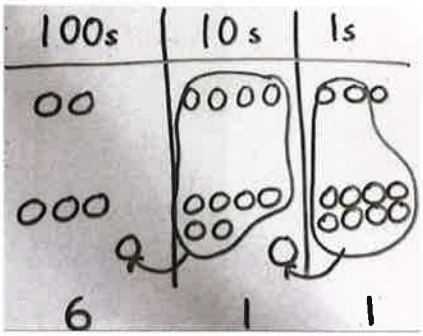
Adding three 1-digit number; using part-part whole models, numicon, or tens frames. 	Children to draw the tens frames, numicon or part-part whole models and counters. 	Children to record numbers and number sentences.  $7 + 6 + 3 = 16$ $7 + 6 + 3 = 16$ 10
Regrouping to make 10; using ten frames and counters/cubes or using Numicon. 6 + 5  	Children to draw the ten frame and counters/cubes. 	Children to develop an understanding of equality e.g. $6 + \square = 11$ $6 + 5 = 5 + \square$ $6 + 5 = \square + 4$
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

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.



Children to represent the counters in a place value chart, circling when they make an exchange.



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

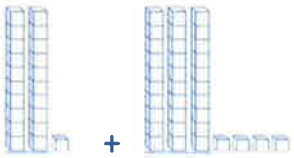
?

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

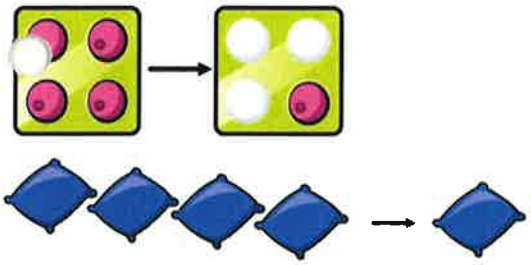
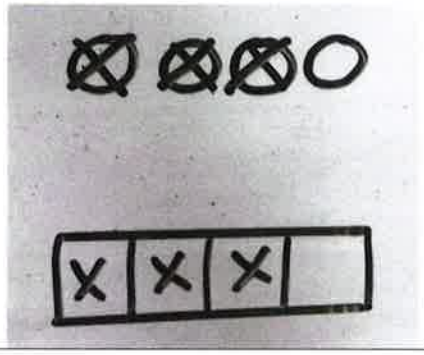
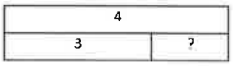
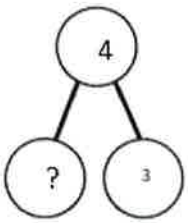
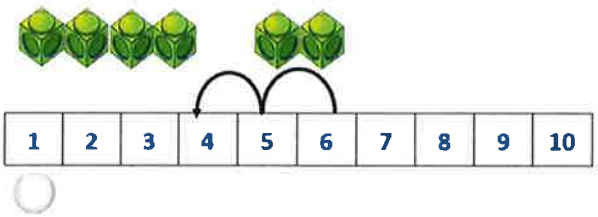
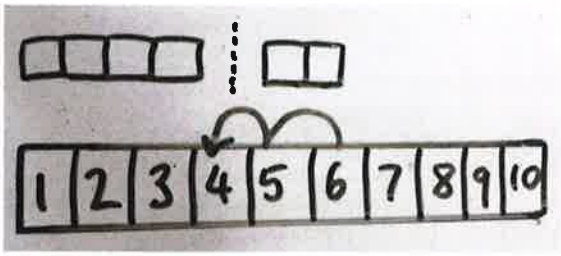


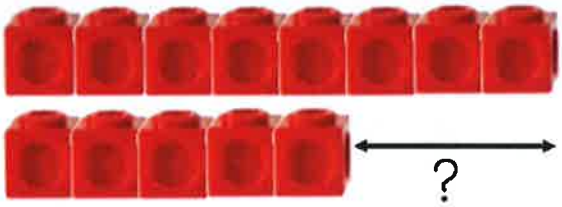
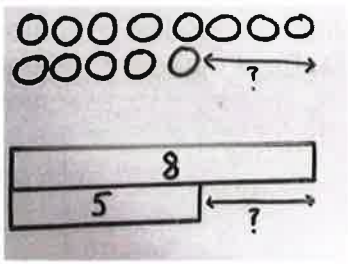
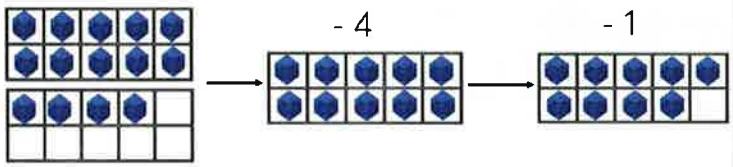
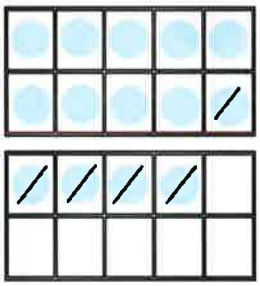
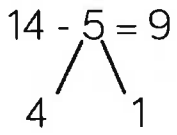
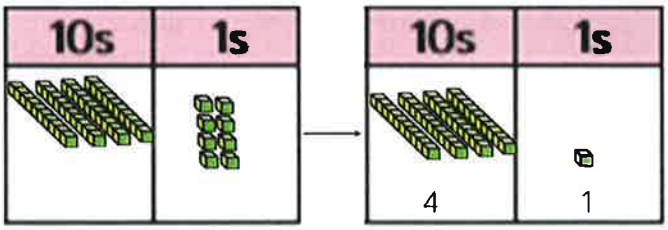
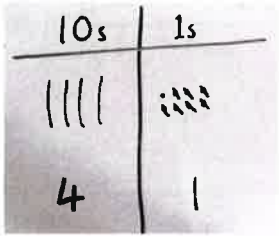
10s	1s
	?
?	5

Missing digit problems:

Calculation policy: Subtraction

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

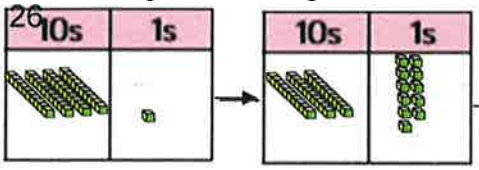
Concrete	Pictorial	Abstract
Physically taking away and removing objects from a whole (ten frames, Numicon, cubes and other items such as beanbags could be used). 4 – 3 = 1 	Children to draw the concrete resources they are using and cross out the correct amount. The bar model can also be used. 	**4- 3 =** **= 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 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. 	

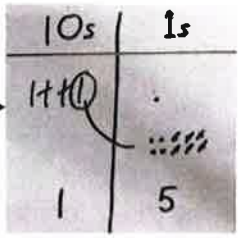
Calculation policy:

Key language: double, times, multiplied by, the product

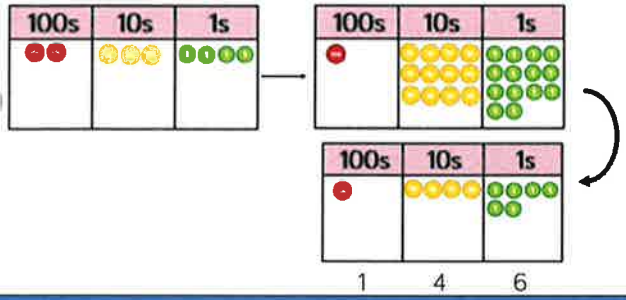
Column method using base 10 and having to exchange. 41 – 26



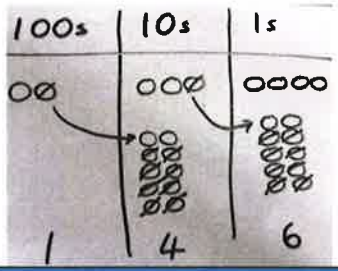
Represent the base 10 pictorially, remembering to show the exchange.



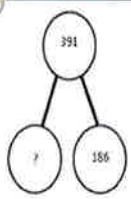
Column method using place value counters. 234 – 88



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



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

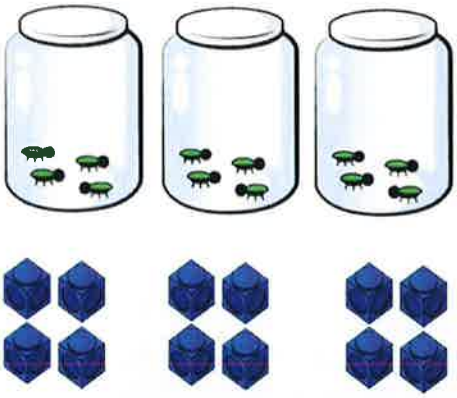
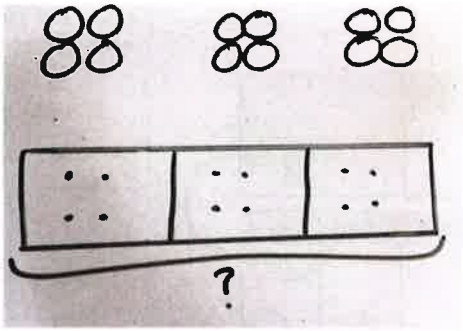
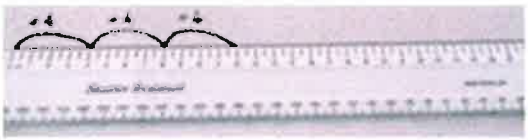
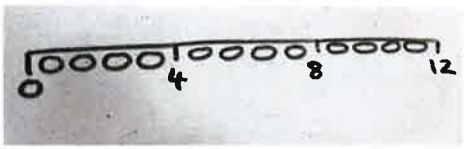
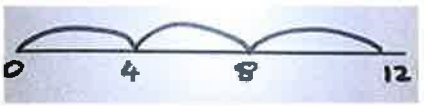
What is 186 less than 391?

Missing digit calculations

3 9 □

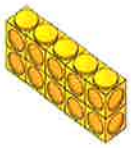
\- □ □ 6

□ 0 5

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 

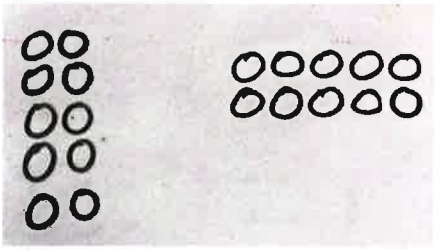
Use arrays to illustrate commutativity counters and other objects can also be used.
2 × 5 = 5 × 2

2 lots of 5



5 lots of 2

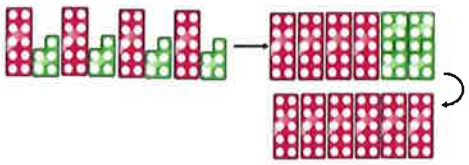
Children to represent the arrays pictorially.



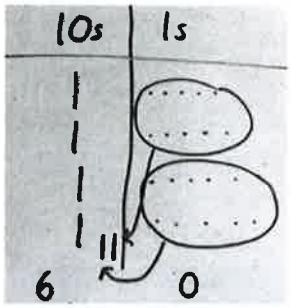
Children to be able to use an array to write a range of calculations e.g.

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.

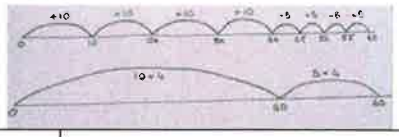


Children to be encouraged to show the steps they have taken.

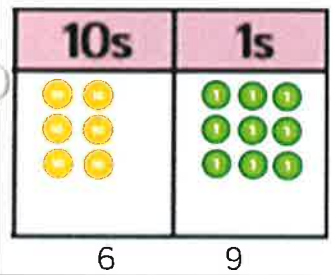
4 × 15
10 5

10 × 4 = 40
5 × 4 = 20
40 + 20 = 60

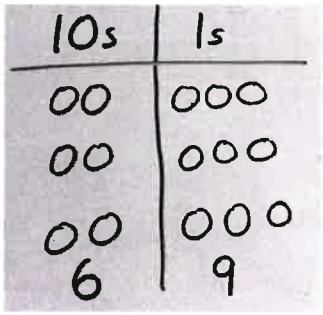
A number line can also be used



Formal column method with place value counters (base 10 can also be used.) 3 × 23

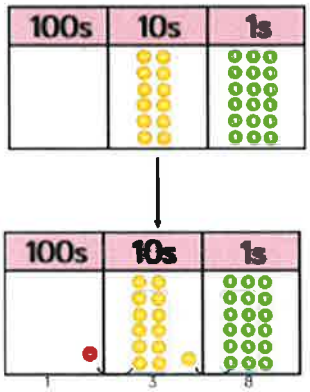


Children to represent the counters pictorially.

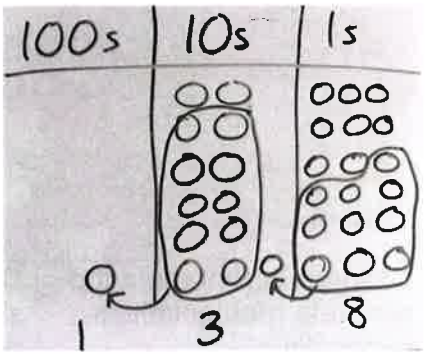


Calculation policy:
Key language: share, group,

Formal column method
with place value counters.
6 x 23



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



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.

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

Answer: 3224

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

23	23	23	23	23	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

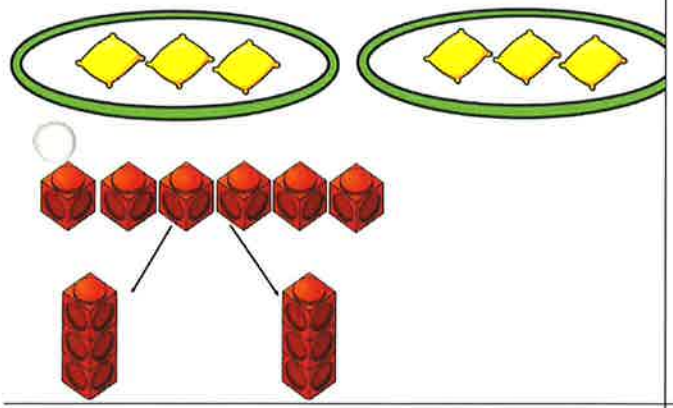
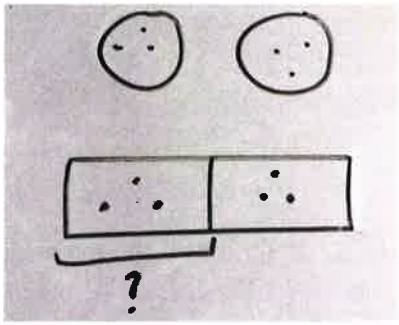
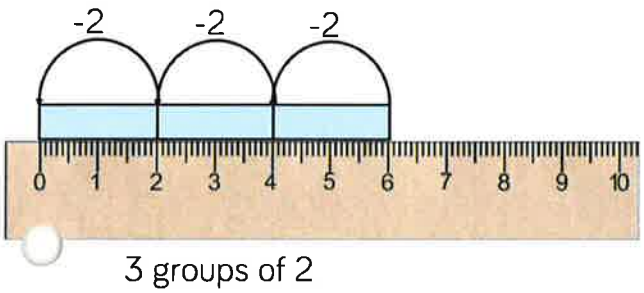
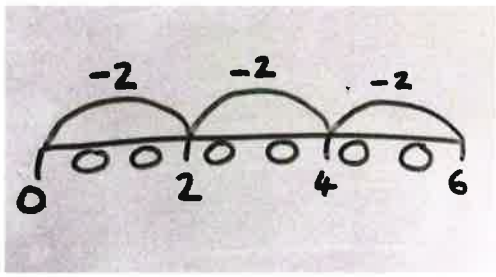
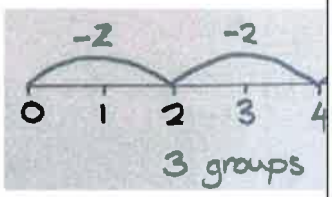
and 23 6 × 23 =

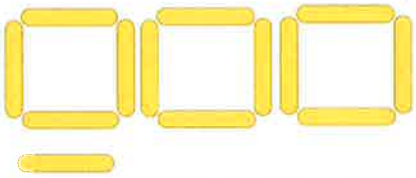
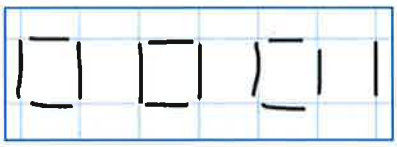
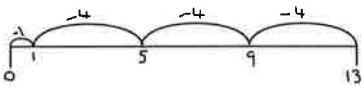
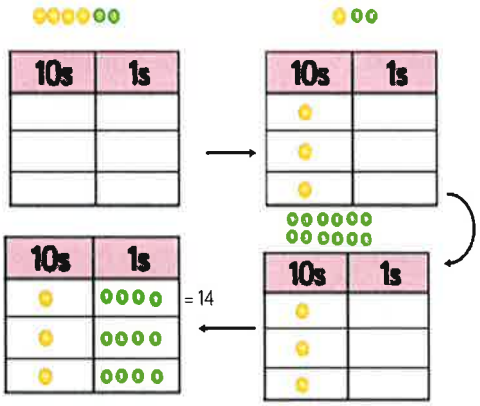
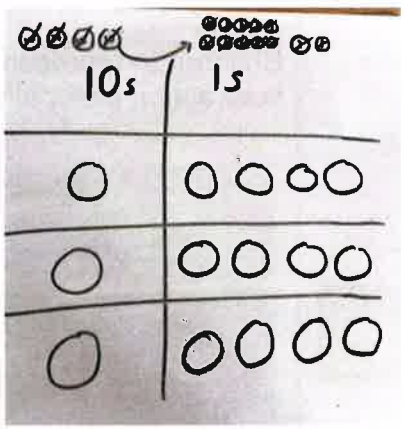
□ = 6 × 23

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

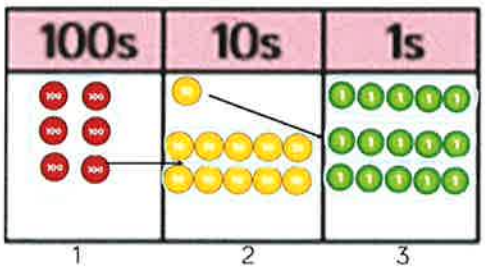
What is the calculation ? What is the product?

100s	10s	1s

Concrete	Pictorial	Abstract
Sharing using a range of objects. 6 ÷ 2 	Represent the sharing pictorially. 	6 ÷ 2 = 3 3 | 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. 

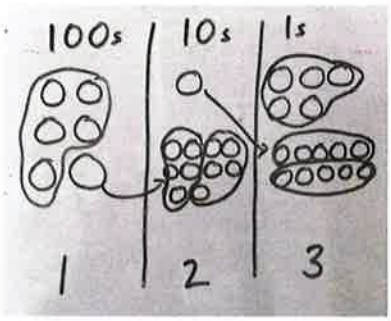
Year 2 **2d ÷ 1d with remainders** using lollipop sticks. Cuisenaire rods, above a ruler can also be used. 13 ÷ 4 Use of lollipop sticks to form wholes- squares are made because we are dividing by 4.  There are 3 whole squares, with 1 left over.	Children to represent the lollipop sticks pictorially.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



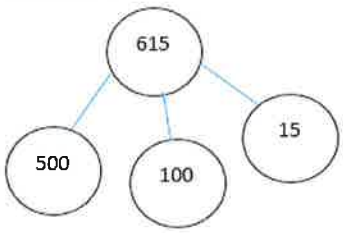
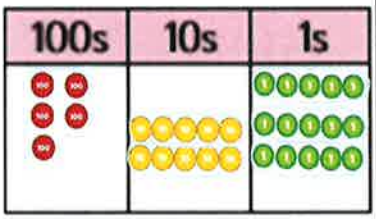
1. Make 615 with place value counters.
2. How many groups of 5 hundreds can you make with 6 hundred counters?
3. Exchange 1 hundred for 10 tens.
4. How many groups of 5 tens can you make with 11 ten counters?
5. Exchange 1 ten for 10 ones.
6. How many groups of 5 ones can you make with 15 ones?

Represent the place value counters pictorially.



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?	615 ÷ 5 = $\square$ = 615 ÷ 5	What is the calculation ? What is the answer? 

Glossary

Addend – A number to be added to another.

Aggregation – combining two or more quantities or measures to find a total.

Augmentation – increasing a quantity or measure by another quantity.

Commutative – numbers can be added in any order.

Difference – the numerical difference between two numbers is found by comparing the quantity in each group.

Exchange – Change a number or expression for another of an equal value.

Equality - a symbolic expression of the fact that two quantities are equal.

Fact Family - a collection of related addition and subtraction facts, or multiplication and division facts, made from the same numbers.

Inverse - the word inverse refers to the opposite of another operation.

Partitioning – Splitting a number into its component parts.

Reduction – Subtraction as take away.

Subitise – Instantly recognise the number of objects in a small group without needing to count.

Subtrahend - a quantity or number to be subtracted from another.

Sum – The result of an addition.

Systematically - according to a fixed plan or system; methodically.

Total – The aggregate or the sum found by addition.