Lenham Primary School

Take Pride; Be Proud

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Calculation Policy

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Calculation Policy

Aims of the policy:

- To ensure consistency and progression in our approach to calculation and enable a smooth transition between year groups and phases.
- To ensure that children develop an efficient, reliable, formal written method of calculation for all operations.
- To ensure that children can use these methods accurately with confidence and understanding
- To ensure pupils understand important concepts and make connections within mathematics.
- To ensure pupils show high levels of fluency in performing written and mental calculations.
- To ensure that pupils are ready for the next stage of learning and have been given strong foundations in mental methods, the use of practical equipemtn , allowed to explore jottings in a range of forms and then move onto more formal recording using a strong knowledge of place value, number lines labelled or blank, partitioning before eventually using compact written methods.
- To ensure that pupils are competent in fluency, reasoning and problem solving and can make informed and appropriate choices about the methods they wish to use (mental or written) to solve mathematical problems efficiently and effectively.

Introduction:

The 2014 National Curriculum provides a structured and systematic approach to the teaching of calculation. The aim is for mental calculations and written procedures to be performed efficiently, fluently, and accurately with understanding. Procedures and understanding are to be developed in tandem. End of key stage expectations are explicit in the programme of study.

At Lenham Primary School, we have a consistent approach to the teaching of written calculation methods in order to ensure continuity and progression across the school.

Age related expectations:

This calculation policy is organised according to age appropriate expectations as set out in the National Curriculum 2014, **however it may be more appropriate for pupils to work** at a lower stage, if necessary, until they are secure enough to move on.

Providing a context for calculation:

It is important that any type of calculation is given a real life context or problem solving approach to help build children's understanding of the purpose of calculation, and to help them recognise when to use certain operations and methods. It is also important for children to be confident to use mental and written strategies to explain their thinking**.** This must be a priority within calculation lessons**.** Written methods need to be viewed as tools to enable children to solve problems and record their thinking in an organised way.

Aims:

Children should be able to use an efficient method, mental or written appropriate to the given task, with understanding. By the end of year 6, children will have been taught, and be secure with, a compact standard method for each operation.

To develop efficient written calculation strategies children need:

- Secure mental methods which are developed from early years
- A solid understanding of the number system
- Practical hands on experience including a range of manipulatives
- Visual models and images including number lines and arrays
- Experience of expanded methods to develop understanding and avoid rote learning
- Secure understanding of each stage before moving onto the next.

Before carrying out a calculation, children will be encouraged to consider:

- Can I do it in my head? (using rounding, adjustment)
- The size of an approximate answer (estimation)
- Could I use jottings to keep track of the calculation?
- Do I need to use an expanded or compact written method?

Pre requisite skills for written calculations

Addition and subtraction:

- Do they know all the addition and subtraction facts for all numbers to 20?
- Do they understand place value and can they partition and then re-partition numbers?
- Can they add three single digit numbers mentally?
- Can they add and subtract any pair of two digit numbers mentally?
- Can they explain their mental strategies orally and record them using informal jottings?

Multiplication and Division:

- Do they know the 2, 5 and 10 times tables and corresponding division facts?
- Do they know the result of multiplying by 1 and 0?
- Do they understand 0 as a place holder?
- Can they multiply two and three digit numbers by 10 and 100?
- Can they double and halve two digit numbers mentally?
- Can they use multiplication and division facts they know to derive mentally other multiplication and division facts that they do not know?
- Can they explain their mental strategies orally and record them using informal jottings?

These lists are not exhaustive but are a guide for the teacher as they structure the move from informal to formal methods of calculation. It is vitally important that children's mental methods of calculation continued to be practised and secured alongside their learning and use of an efficient written method for each operation.

A pathway to teaching calculation methods:

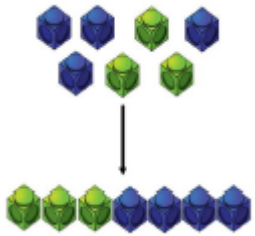
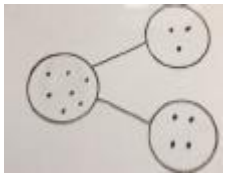
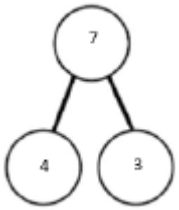
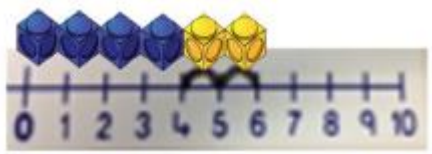
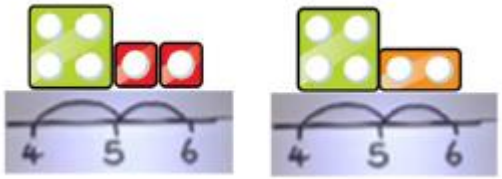
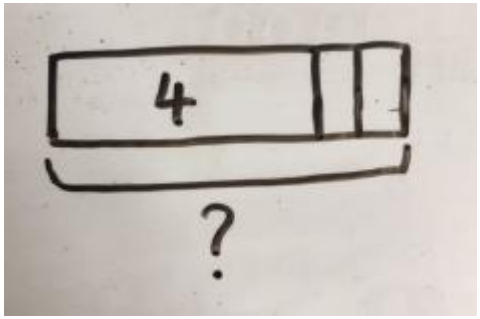
Expanded methods should be viewed as steps towards a standard method and not as methods in themselves.
Before beginning to record in a more refined written format children must have had significant practical work reinforced with appropriate manipulative, models and images.
Teachers will guide pupils to refine their written methods of recording by modelling and asking questions such as "What is the same? What's different?"
Learning will be planned to ensure pupil are encouraged to use and apply what they have learnt to problem solving tasks.

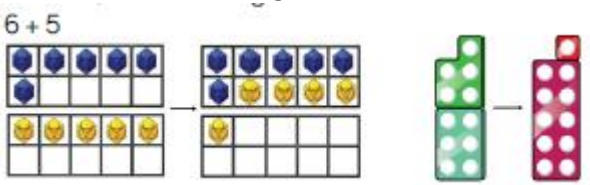
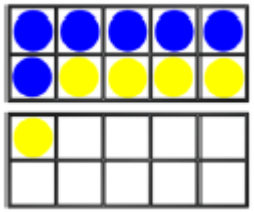
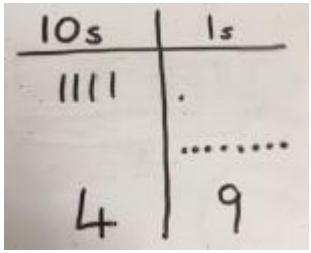
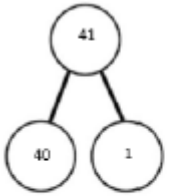
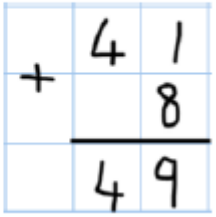
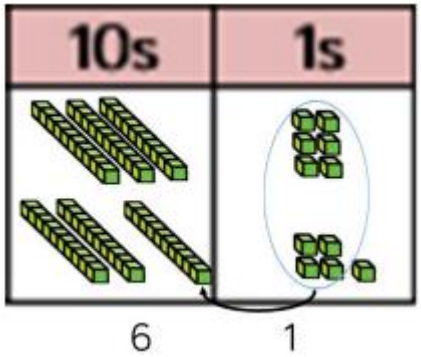
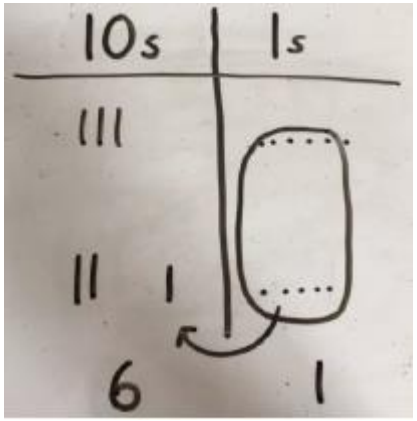
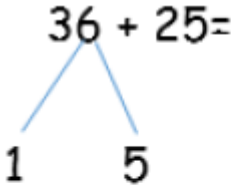
The pathway shown below is for ***guidance.*** As children move along the pathway it is vital that they practice, reinforce, consolidate, use and apply it to mathematical learning and NOT simply move onto the next step.

EYFS

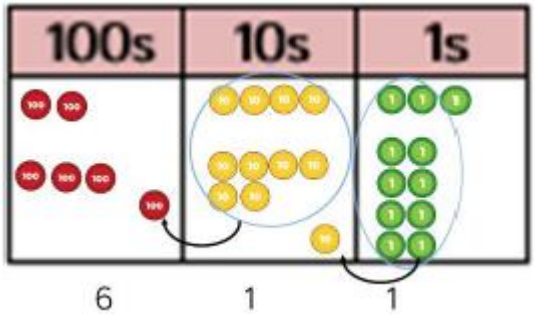
	EYFS/Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Addition	Combining two parts to make a whole: part whole model Starting at the bigger number and counting on – using cubes Regrouping to make 10 using ten frame	Adding three single digits Use of Base 10 to combine two numbers	Column method – regrouping Using place value counters (up to 3 digits)	Column method – regrouping. Using place value counters (up to 4 digits)	Column method – regrouping Use of place value counters for adding decimals	Column method – regrouping. Abstract methods. Place value counters to be used for adding decimal numbers.
Subtraction	Take away ones Counting back Find the difference Part whole model Make 10 using the ten frame	Counting back Find the difference Part whole model Make 10 Use Base 10	Column method with regrouping. (up to 3 digits using place value counters)	Column method with regrouping (up to 4 digits)	Column method with regrouping. Abstract for whole numbers. Start with place value counters for decimals – with the same amount of decimal places.	Column method with regrouping. Abstract methods. Place value counters for decimals – with different amounts of decimal places.
Multiplication	Recognising and making equal groups. Doubling. Counting in multiples. Use cubes, Numicon and other objects in the classroom.	Arrays – showing commutative multiplication.	Arrays 2 digit x 1 digit using base 10	Column multiplication – introduced with place value counters. (2 and 3 digit multiplied by 1 digit)	Column multiplication Abstract only but might need a repeat of year 4 first (up to 4 digit numbers multiplied by 1 or 2 digits)	Column multiplication Abstract methods (multi-digit up to 4 digits by a 2 digit number)

Division	Sharing objects into groups. Division as grouping e.g. I have 12 sweets and put them in groups of 3, how many groups? Use cubes and draw round 3 cubes at a time.	Division as grouping. Division within arrays – linking to multiplication Repeated subtraction	Division with a remainder – using lolly sticks, times table facts and repeated subtraction. 2 digit divided by 1 digit using Base 10 or place value counters.	Division with a remainder Short division (up to 3 digits by 1 digit – concrete and pictorial)	Short division (up to 4 digits by a 1 digit number including remainders)	Short division Long division with place value counters (up to 4 digits by a 2 digit number) Children should exchange into the tenths and hundredths column too.

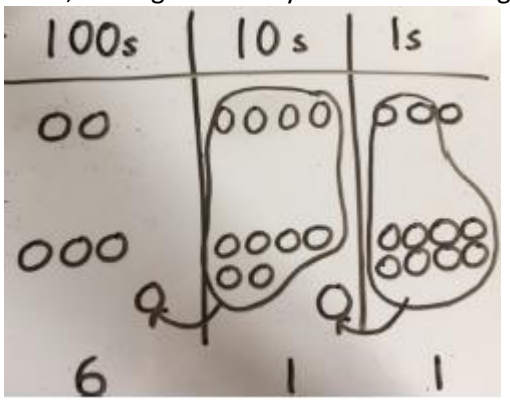
ADDITION		
Key Vocabulary: *sum, total, parts and wholes, plus, add, altogether, more, 'is equal to', 'is the same as'*		
Concrete	**Pictorial**	**Abstract**
Combining two parts to make a whole (use other resources too e.g. eggs, shells, teddy bears, cars) 	Children to represent the cubes using dots 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 7 
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 

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. 35 + 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: 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

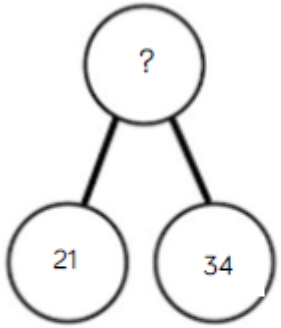


Children to represent the counters in a place value chart, circling when they make an exchange.



$$\begin{array}{r} 243 \\ +368 \\ \hline 611 \\ \hline 1\ 1 \end{array}$$

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



?	
21	34

Word problems:
In year 3, there are 21 children and year 4, there are 34 children.
How many children in total?

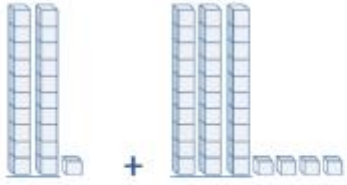
21 + 34 = 55. Prove it

$$\begin{array}{r} 21 \\ +34 \\ \hline \\ \hline \end{array}$$

21 + 34 =

$\square$ = 21 + 34

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

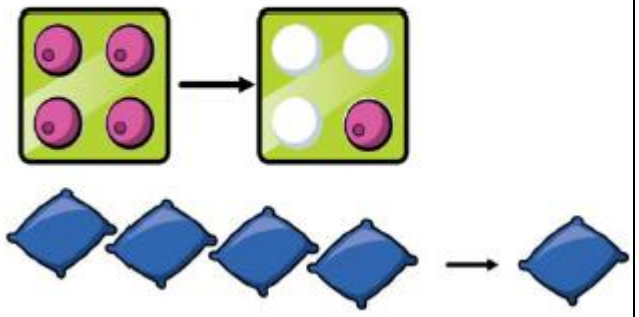
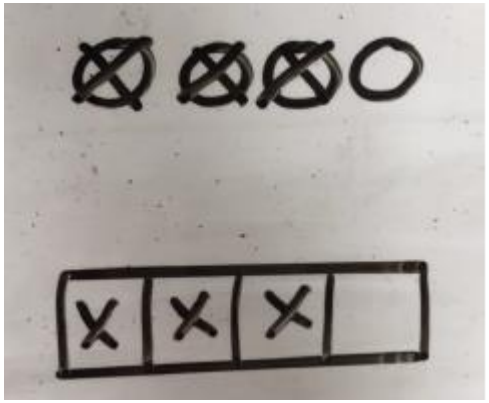
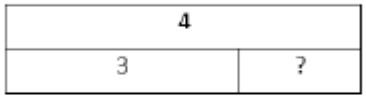
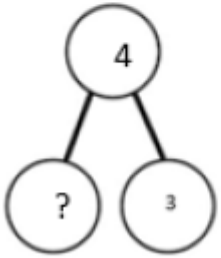
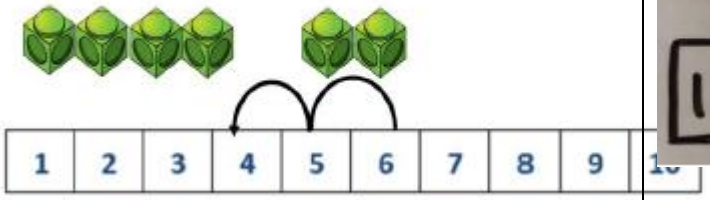
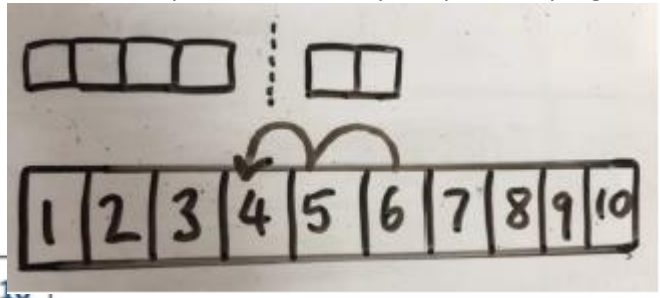
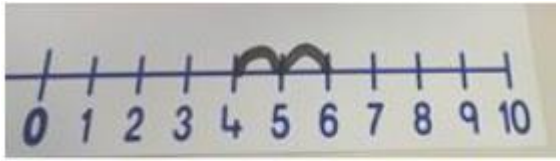
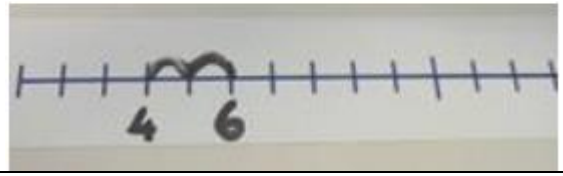


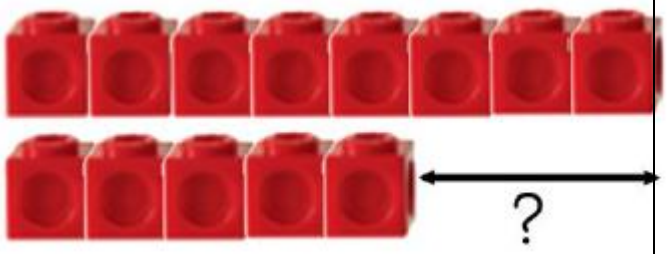
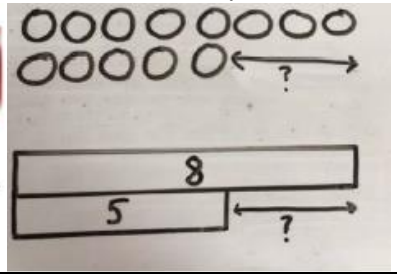
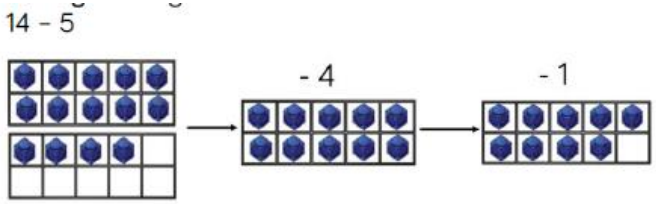
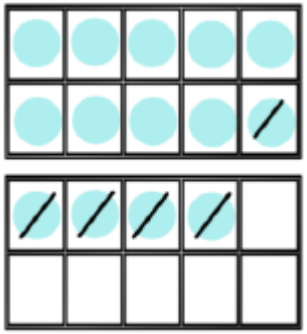
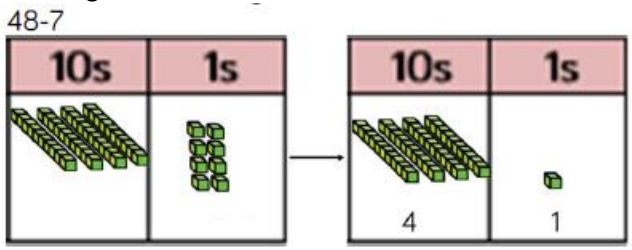
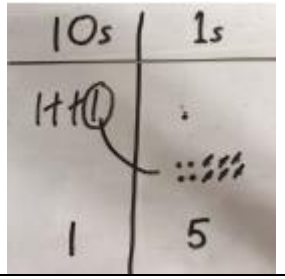
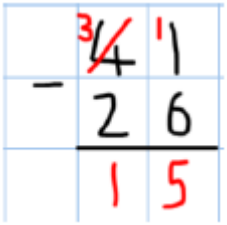
Missing digit problems:

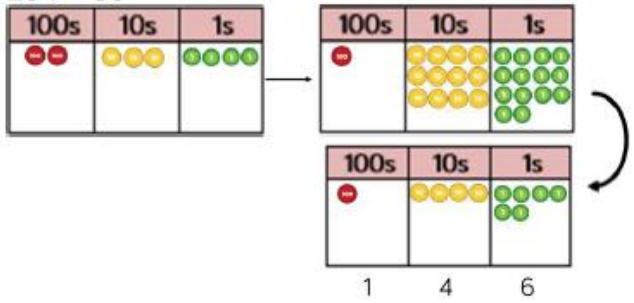
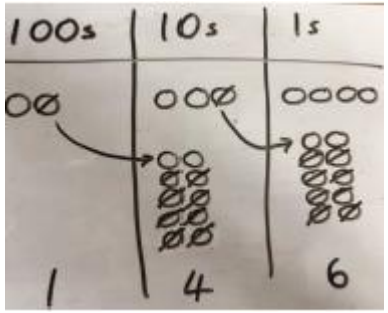
10s	1s
10 10	1
10 10 10	?
?	5

SUBTRACTION

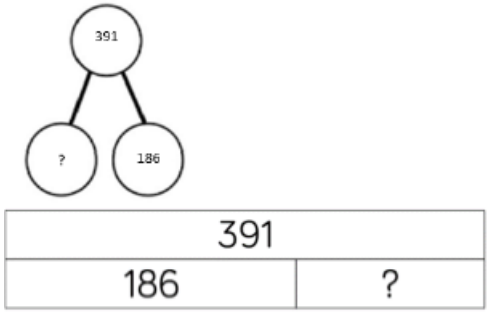
Key Vocabulary: *take away, less than, the difference, subtract, minus, fewer, decrease*

Concrete	Pictorial	Abstract
Physically taking away and removing objects from a whole (ten frames, Numicon, cubes and other items such as beanbag 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 to 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. 	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 - 5 = 9 4 1 14 – 4 = 10 10 – 1 = 9
Column method using Base 10 and having to exchange 	Represent the Base 10 pictorially, remembering to show the exchange. 	Formal column method. Children must understand that when the have exchanged the 10 they still have 41 because 41 = 30 + 11 

Column method using place value counters	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.
234 – 88 		$\begin{array}{r} {}^{2}\not{2}\,{}^{1}\not{3}4 \\ -\ 88 \\ \hline 6 \end{array}$

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



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

Calculate the difference between 391 and 186.

$\square = 391 - 186$

$$\begin{array}{r} 391 \\ -186 \\ \hline \end{array}$$

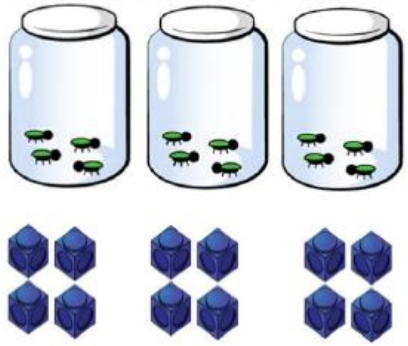
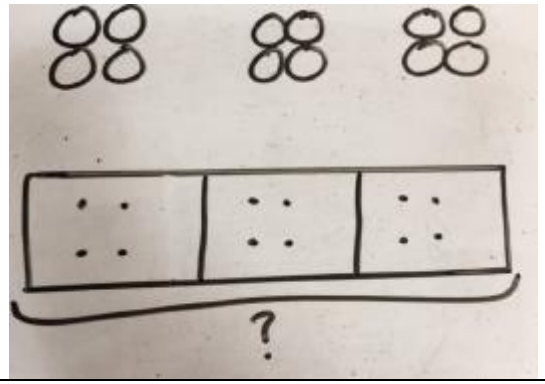
What is 186 less than 391?

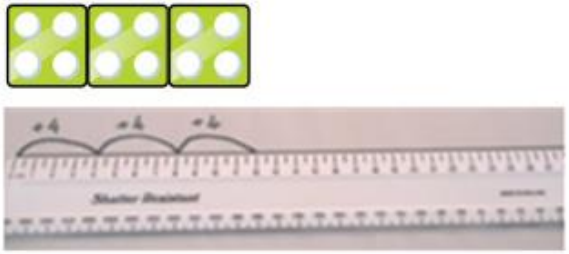
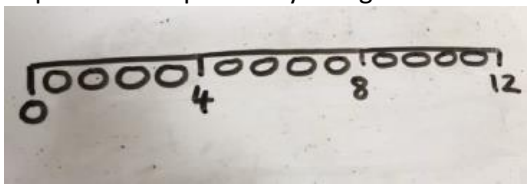
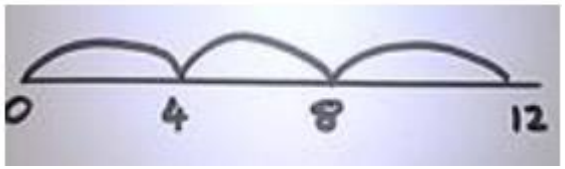
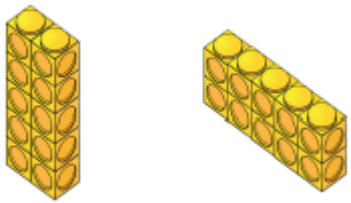
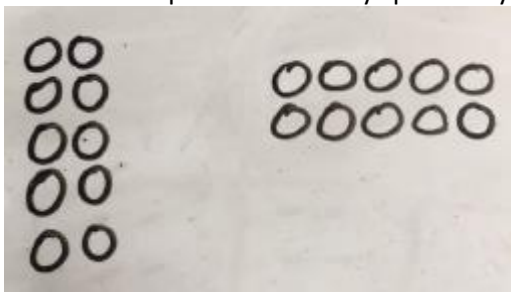
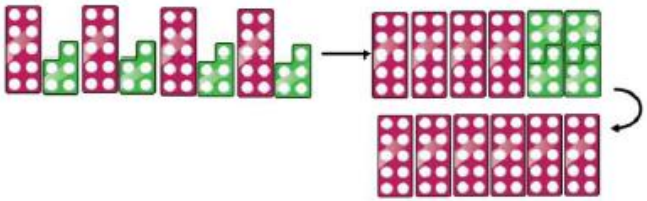
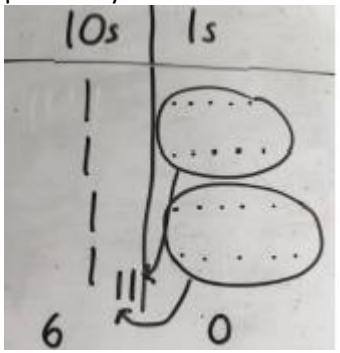
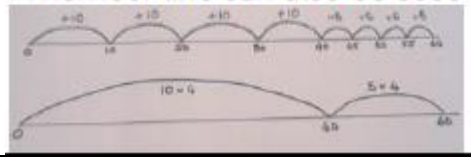
Missing digit calculations

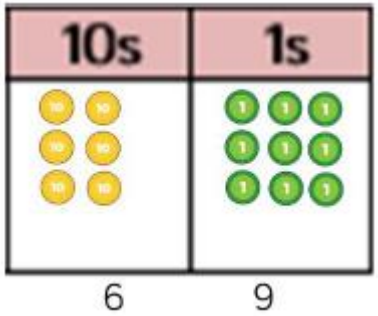
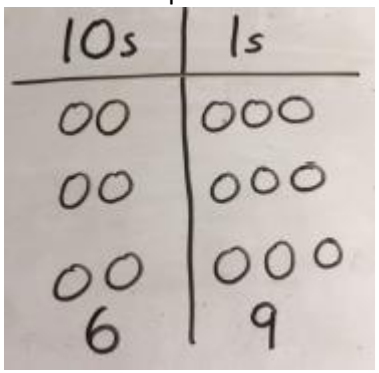
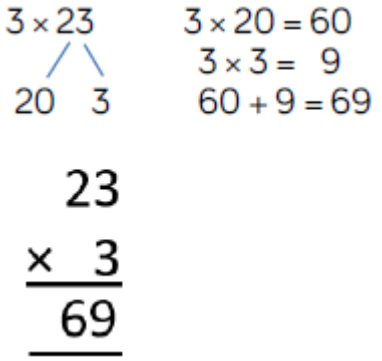
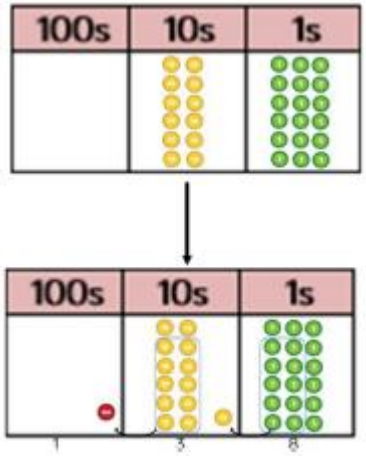
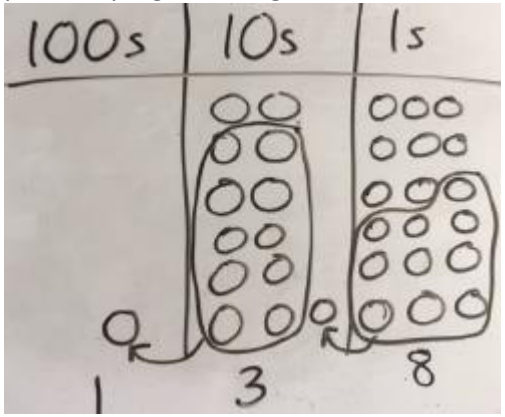
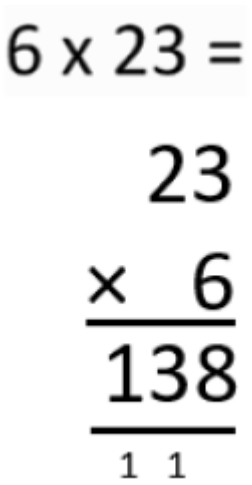
$$\begin{array}{r} 3\ 9\ \square \\ -\ \square\ \square\ 6 \\ \hline \square\ 0\ 5 \end{array}$$

MULTIPLICATION

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

Concrete	Pictoral	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 	$3 \times 4 = 12$ $4 + 4 + 4 = 12$

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. $3 \times 4 = 12$ 
Use arrays to illustrate commutativity – counters and other objects can also be used. $2 \times 5 = 5 \times 2$  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 $10 = 2 \times 5$ $5 \times 2 = 10$ $2 + 2 + 2 + 2 + 2 = 10$ $10 = 5 + 5$
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.  10 x 4 = 40 5 x 4 = 20 40 + 20 = 60 A number line can also be used 

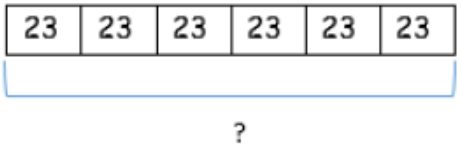
Formal column method with place value counters (base 10 can also be used) 3 x 23 	Children to represent the counters pictorially 	Children o record what it is they are doing to show understanding 
Formal column method with place value counters 6 x 23 	Children to represent the counters/base 10 , pictorially e.g. the image below 	Formal written method 

When children start to multiply 3d x 3d and 4d x 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.

Answer: 3224

Conceptual variation; different ways to ask children to solve 6 x 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

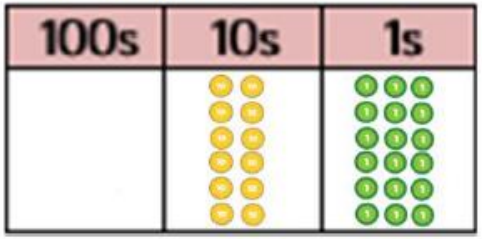
Find the product of 6 and 23

6 × 23 =

□ = 6 × 23

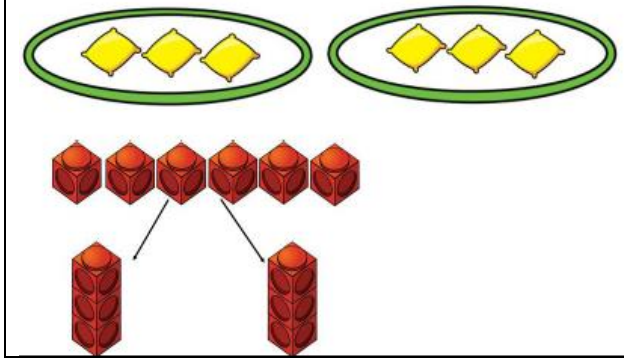
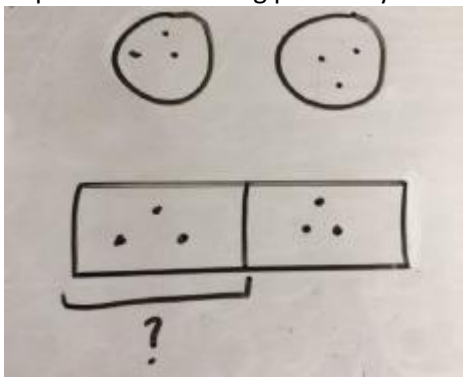
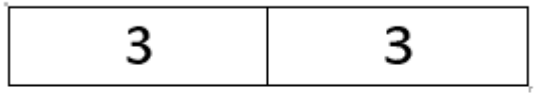
6 × 23 23 × 6

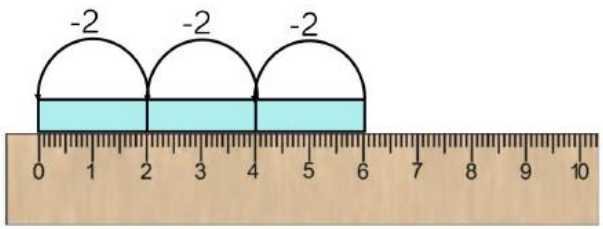
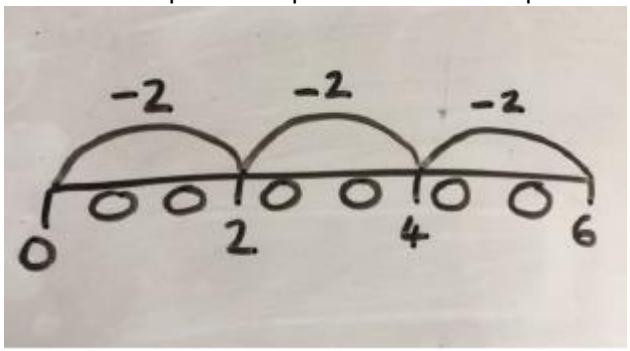
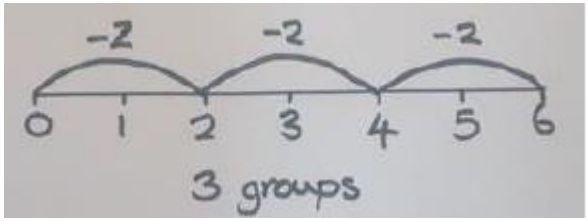
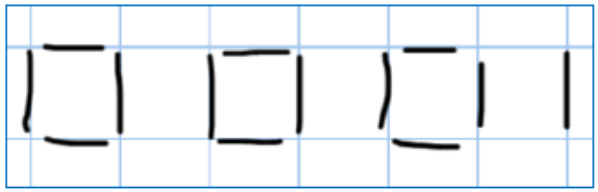
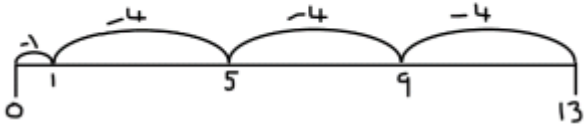
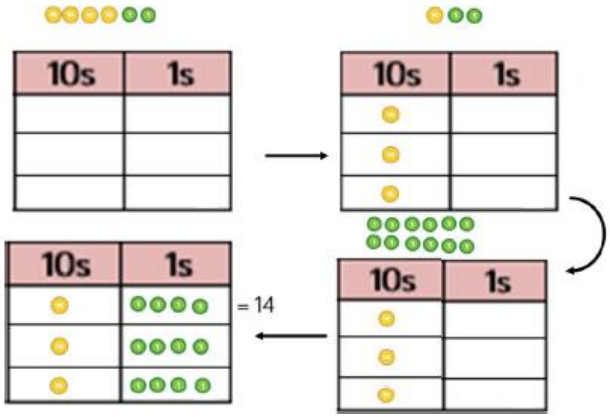
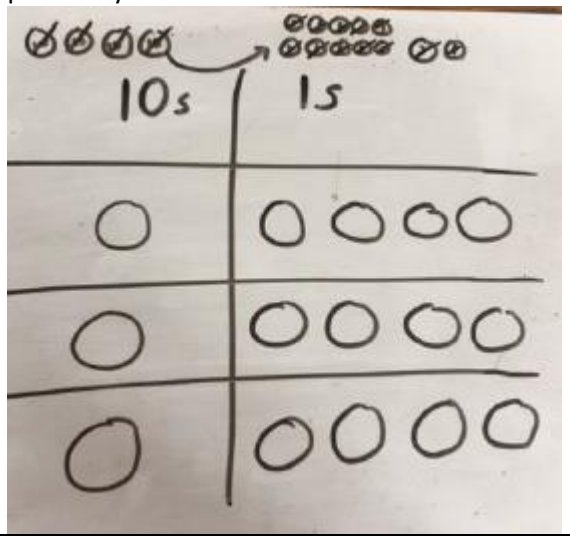
What is the calculation?
What is the product?



DIVISION

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

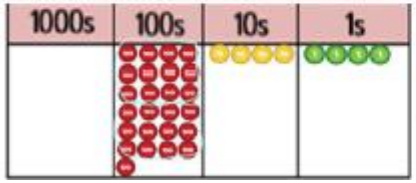
Concrete	Pictorial	Abstract
Sharing using a range of objects 6 ÷ 2 	Represent the sharing pictorially 	6 ÷ 2 = 3  Children should also be encouraged to use their 2 times tables facts.

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. Cuisinaire 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 sue their times table facts; they could alo 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

Long division using place value counters

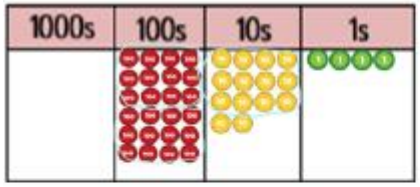
2544 ÷ 12

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



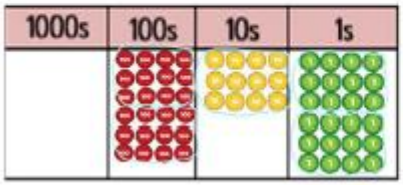
We can group 24 hundreds into groups of 12 which leaves with 1 hundred.

$$\begin{array}{r} 02 \\ 12\overline{)2544} \\ 24 \\ \hline 1 \end{array}$$



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.

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

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?

$$5\overline{)615}$$

615 ÷ 5 =

□ = 615 ÷ 5

What is the calculation?
What is the answer?