LGS STONEYGATE

CALCULATIONS POLICY

Last reviewed October 2022

Next review October 2024

Introduction

It is our belief that at LGS Stoneygate pupils gain a deep, long term conceptual understanding of calculation in every concept that is secure and adaptable before moving onto the next. Children are to have experiences that will equip them with skills to be able to calculate efficiently and confidently throughout their lives and fully understand each interlinked concept.

This policy lays out the expectations for both mental and written calculations for the 4 number operations and has been created to support the teaching of a mastery approach to mathematics. This is underpinned by the use of models and images that support conceptual understanding and this policy promotes a range of representations to be used across the primary years. Mathematical understanding is developed through use of representations that are first of all concrete (e.g. Dienes apparatus, Numicon and place value counters), and then pictorial (e.g. bar models) to then facilitate abstract working (e.g. standard written methods).This policy is a guide through an appropriate progression of representations and if at any point a pupil is struggling with the abstract, they should revert to familiar pictorial and/or concrete materials/representations as appropriate

All teachers have access to the schemes of work from the White Rose Maths Hub and other supporting resources. Where appropriate, staff are encouraged to base their planning around these recommended modules. However, it should be emphasised that all planning should take account of the requirements of the pupils in terms of where they are in their learning and how they can achieve successful outcomes. Teachers are responsible for making these judgements.

The White Rose Maths schemes of work provide sequential programmes of study that are underpinned by promoting fluency in number. They emphasise that all pupils must have a thorough grounding in the four basic rules of number before progressing on to the next level. This complete understanding gives pupils more confidence in dealing with number activities and in turn, leads to mastery of the four operations.

Whilst the calculation policy guidance document is separated into year group phases, these are intended to be used only as a guide and it is the teachers' professional judgement as to when the pupils move on to the next phase.

Intent

The main aims of this policy are in line with the new National curriculum 2014 and aim to ensure that all children:

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

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

- can solve problems by applying their mathematics to a variety of routine and non-routine problems with increasing sophistication, including breaking down problems into a series of simpler steps and persevering in seeking solutions. Pupils should make connections across mathematical ideas to develop fluency, mathematical reasoning and competence in solving increasingly sophisticated problems.

Children will be able to:

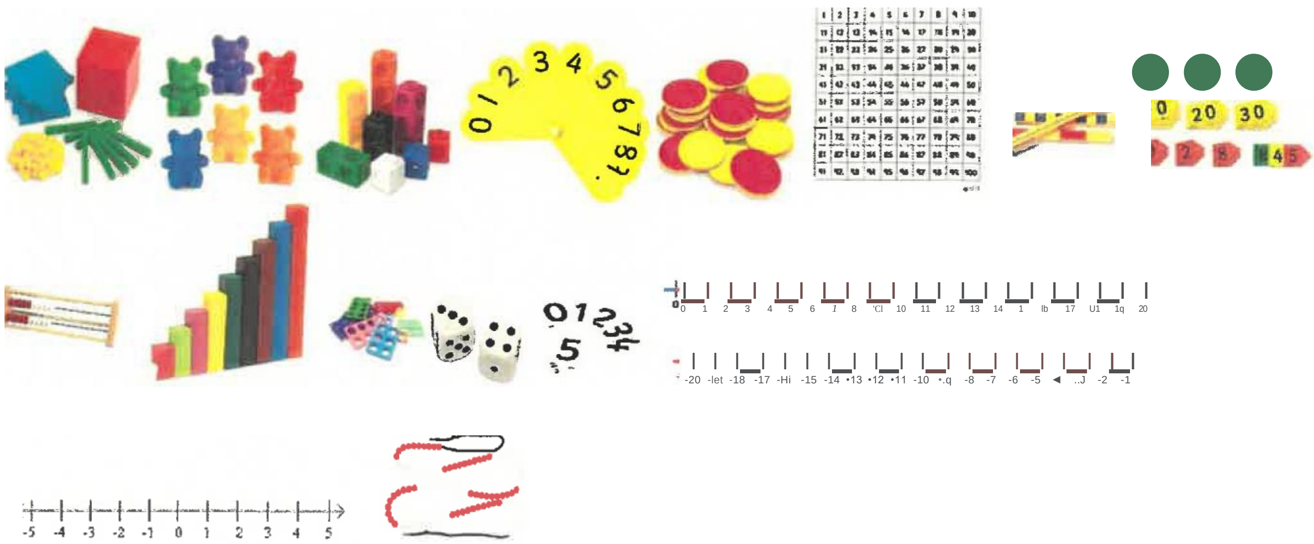
- have a conceptual understanding of methods rather than a set of memorised procedures.
- use mathematical vocabulary correctly to communicate and share mathematical thinking.
- develop their relational understanding of new concepts, making connections through a CPA approach.
- demonstrate procedural and conceptual fluency in mental and written calculations from EYFS to KS2 and develop a depth of understanding. Confidently apply the appropriate method to any given context, be it familiar or unfamiliar, in maths lessons and across the curriculum.

Representations

Pupils will have the opportunity to manipulate a wide variety of models and images and resources to choose the best representation for each calculation.

Representations are vitally important in developing conceptual understanding and supporting children's visualisation of the maths. Different concepts can be represented using the same resource/representation depending on the child's age and stage of mathematical development.

These will include Numicon, number lines, number fans, bead strings, counters, counting objects, cubes, Diennes, Cuisenaire rods, multilink, unifix, place value counters and cards etc.



The Number Line

"Developing a number line is one cif the strongest and most useful mental images in helping us to undertake mental calculations." Koshy 1999

In the children's mathematical development, the school will encourage the use ofthe number line as a model and image to support mathematical understanding.

Mental images of number lines support place value and the development of efficient calculation methods, which consequently underpin the use of written calculation methods as stipulated by the NC documentation.

The number line is beneficial in its use as it will:

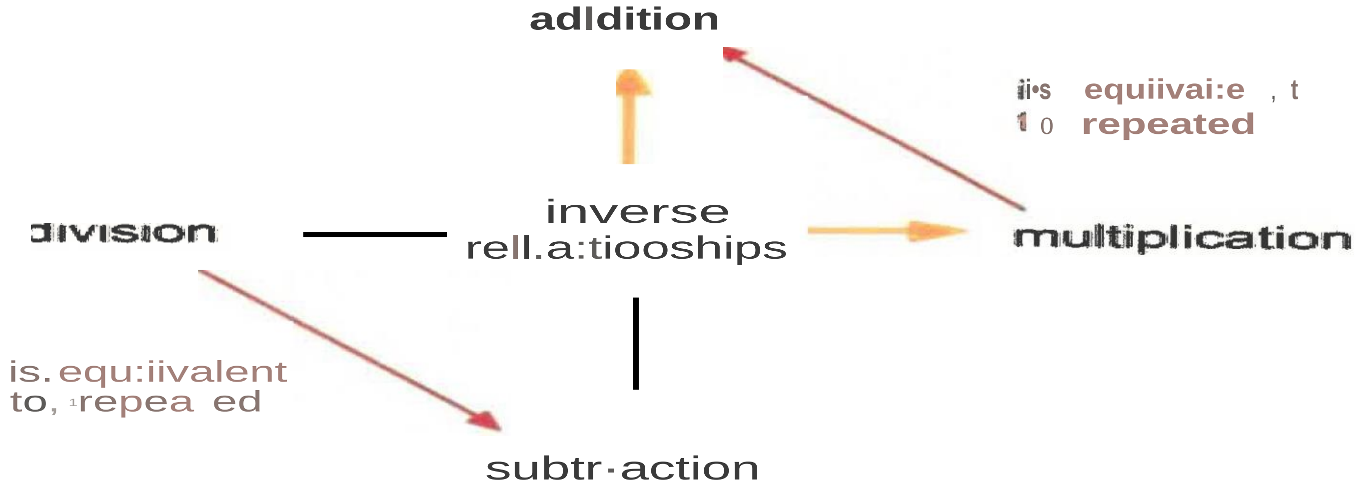
- Develops a child's mental imagery and spatial understanding of number
- Strongly develops sense/relationships of numbers
- Provides a progressive and consistent method of recording calculations
- Underpins children's acquisition of basic facts
- Allows a child to demonstrate a range of calculation strategies
- Enables more efficient methods to be developed

The Four Operations

All four calculations possess very strong links to each other. The basic ideas of addition and subtraction can be used to describe, estimate and calculate the more complex concepts of multiplication and division.

For these reasons it is vitally important that addition and subtraction and multiplication and division are taught alongside each other for the children to make links.

It is vital that all children have a conceptual and deep understanding of the mathematics and that no 'tricks' are taught as short cuts which can cause misconceptions to be embedded. For example, adding a zero when multiplying by ten does not support an understanding of place value.



Vocabulary

Communication of mathematical thinking is a vital skill. Children should be encouraged to verbalise their thinking with correct vocabulary using reasoning skills and sentence stems. For example, the term 'sum' will only be used to refer to an addition calculation

Bar Model

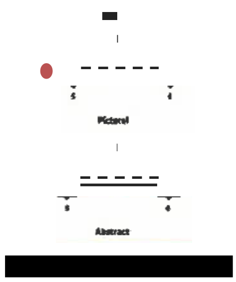
Bar Method - Problem Solving Approaches

The Bar method is a visual representation of a word problem. It allows the children to visualise the structure of the problem making it easierto see which parts of the problem are known and which are unknown. It is not a calculation tool. Once the problem is visualised then the appropriate number operations can be selected to solve it.

This also follows the Concrete - Pictorial -Abstract (CPA) model of conceptual understanding.

Part-whole model for addition and subtraction.

There are 5 apples and 6 oranges. How many pieces of fruit altogether?



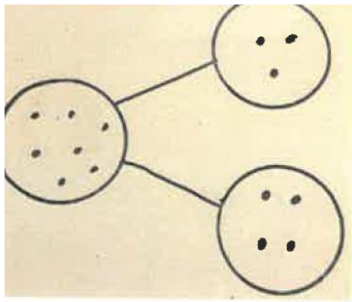
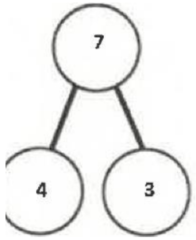
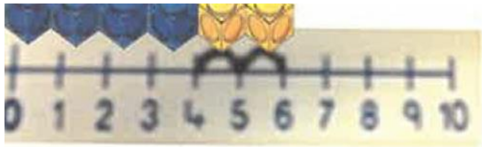
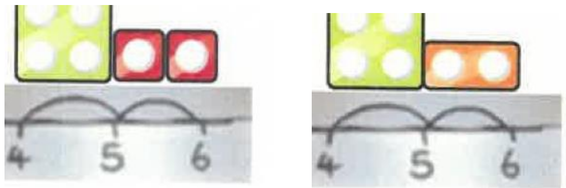
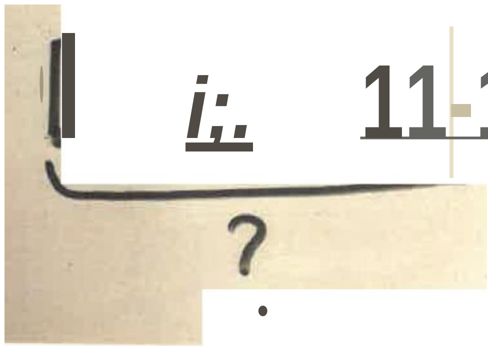
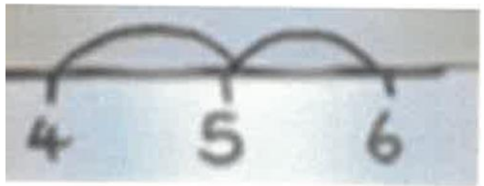
The bar method can also be used to help solve problems relating to multiplication, division, fractions, ratio and proportion. Through representing each part with bars, children can find the parts unknown and solve the problem. In each case, children should start with the concrete model before moving onto a pictorial representation and then finally by using an abstract representation in the form of a bar, or bars.

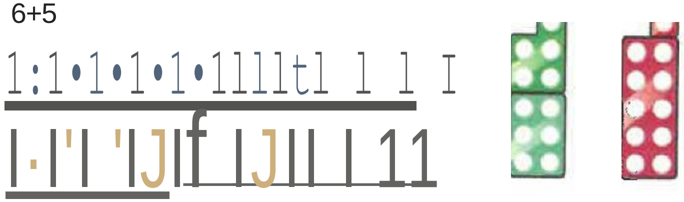
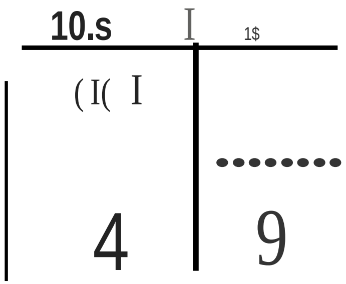
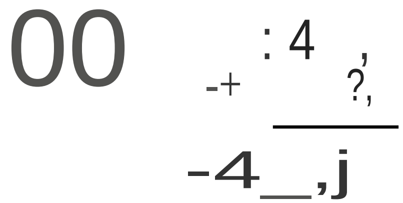
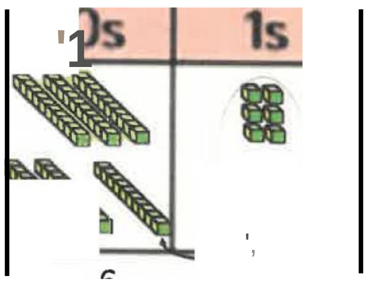
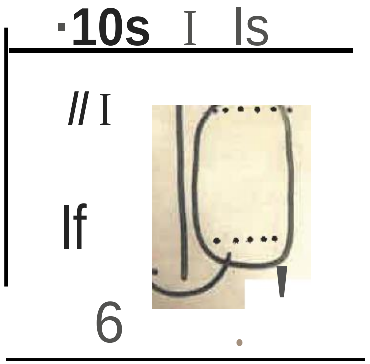
Progression of the calculations

The progression of the calculations in this policy builds up in small steps. They are not year group dependent but dependent on the stage of learning of the individual or group of learners.

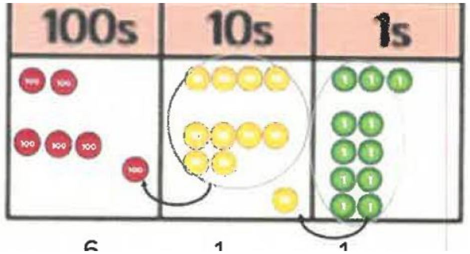
Calculation policy: Addition

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

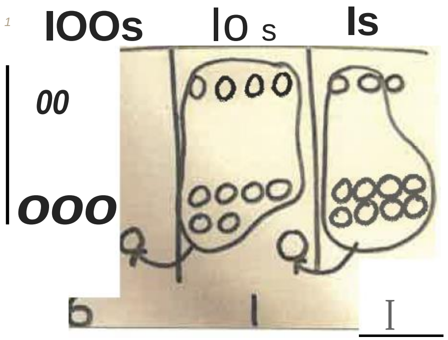
Concrete	Pictorial	Abstract
Combining two parts to make a whole (use other resources too e.g. eggs, shells, teddy bears, cars). 	Children to represent the cubes using dots or crosses. They could put each part on a part whole model too. 	4 + 3 = 7 Four is a part, 3 is a part and the whole is seven. 
Counting 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. $6+\square=11$ $6+5=5+\square$ $6+5=\square+4$
TO+0 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. 36 + 25= 30+20=50 5+5=10 50+10 +1= 61 1 5 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.



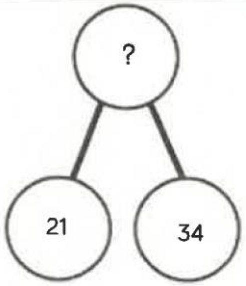
Chidren to represent the counters in a place value chart, circling when they make an exchange.



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

1 1

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



?

21 34

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

21 + 34 = 55. Prove it

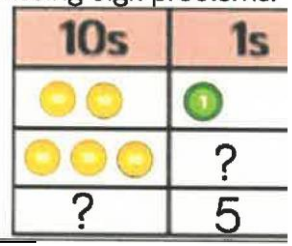
21
+34

21+34=

___ = 21 + 34

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

Missing digit problems:



Calculation policy: Subtraction

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

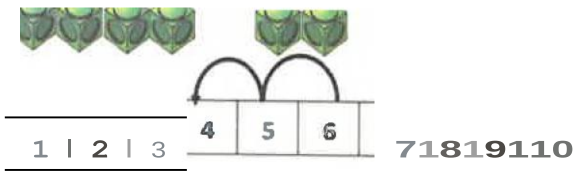
Concrete

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

Counting back (using number lines or number tracks) children start with 6 and count back 2.

6-2=4



Pictorial

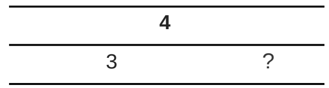
Children to draw the concrete resources they are using and cross out the correct amount. The bar model can also be used.

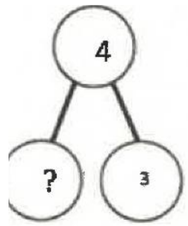
Children to represent what they see pictorially e.g.

Abstract

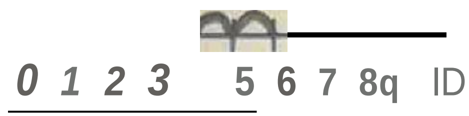
4-3=

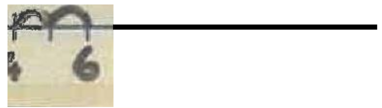
4 - 3

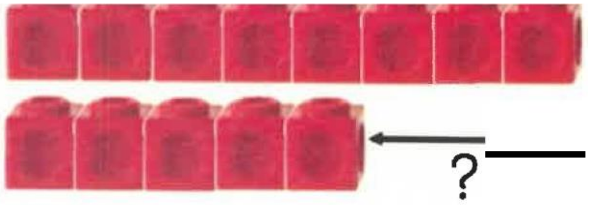
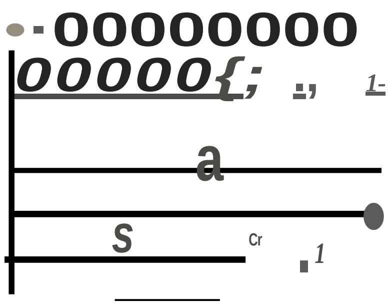
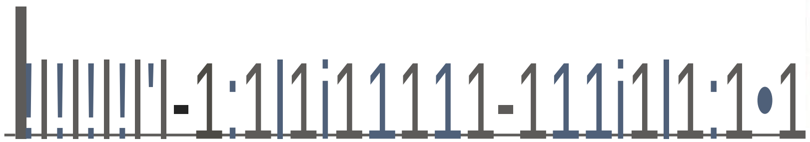
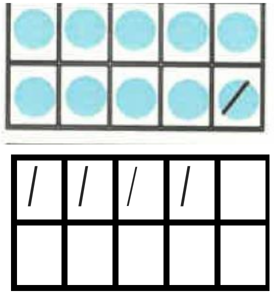
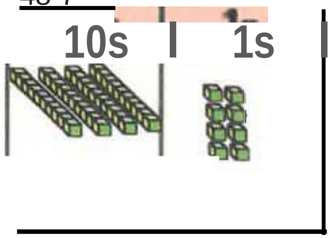
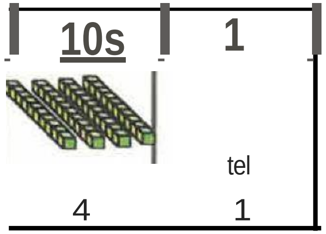
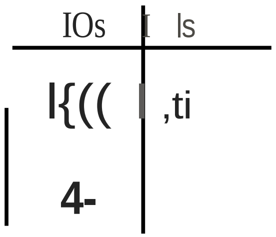
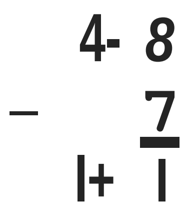




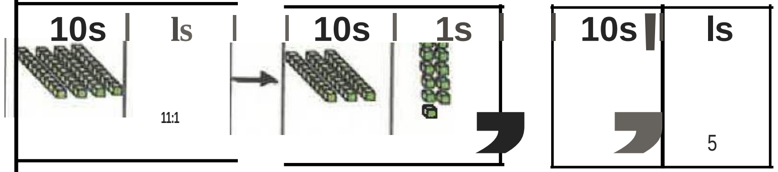
Children to represent the calculation on a number line or number track and show their jumps. Encourage children to use an empty number line



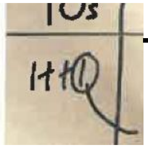


Finding the difference (using cubes, Numicon or Cuisenaire rods, other objects can also be used). Calculate the difference between 8 and 5.  	Children to draw the cubes/other concrete objects which they have used or use the bar model to illustrate what they need to calculate. 	Find the difference between 8 and 5. 8 - 5, the difference is 3 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 - 5 = 9 4 1 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.



ls

5

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

au'\

2 6

' 5

Column method using place value counters.
234 - 88

100s 10s ls
00 90@0

-1:01

Uh 100

:0' Uh lu:1!)-l

4 6

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

,/ OOs.	l O.s	ls
00	00(?)	10000
/	ii-	E,

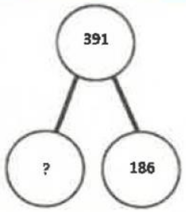
Formal colum method. Children must understand what has happened when they have crossed out digits.

2 4

88

6

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.

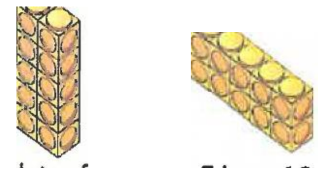
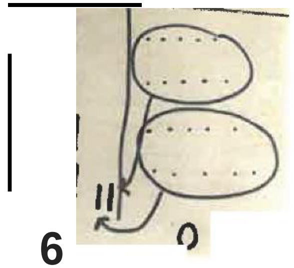
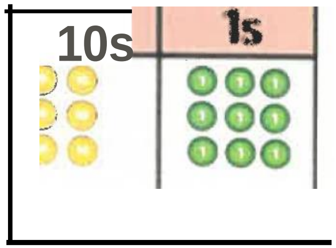
☐ = 391 - 186

391
-186

What is 186 less than 391?

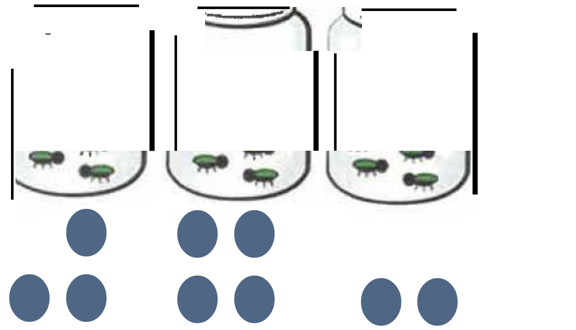
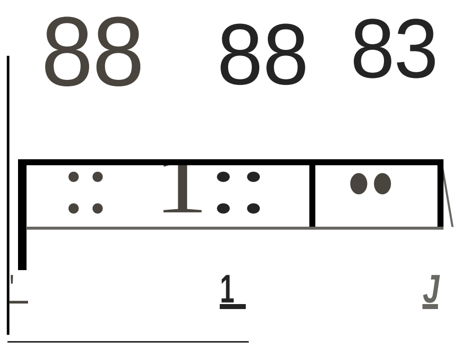
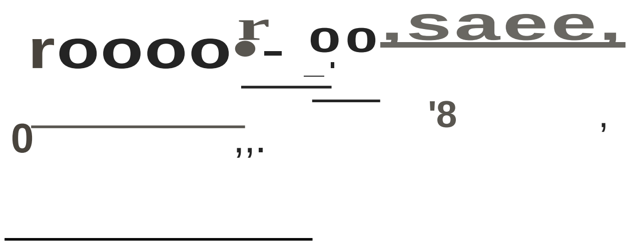
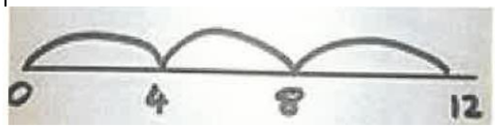
Missing digit calculations

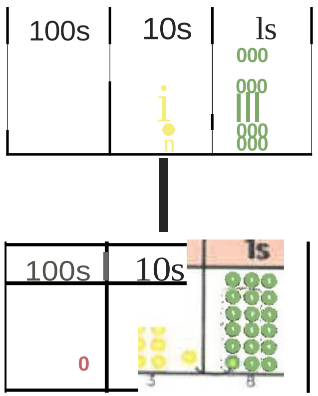
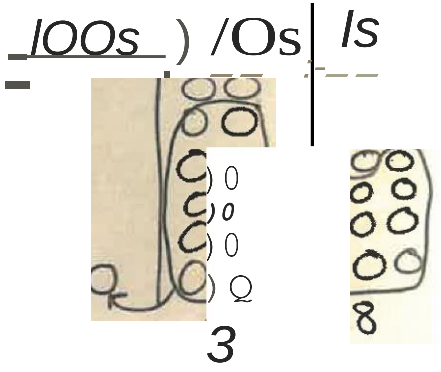
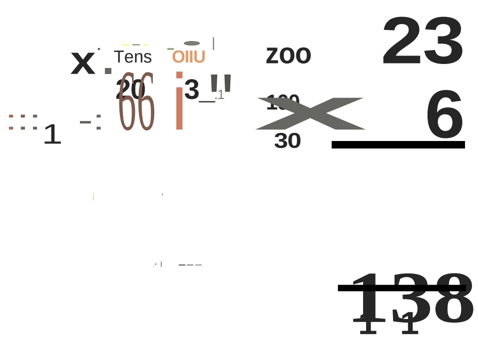
3 ☐ 9
- ☐ 0 6
☐ 0 5

Use arrays to illustrate commutativity counters and other objects can also be used. **2x5=5x2**  2 lots of 5 5 lots of 2	Children to represent the arrays pictorially. 00 00 00 00 ·00 00000 00000	Children to be able to use an array to write a range of calculations e.g. **10 = 2 x 5** **5x2=10** 2+2+2+2+2=10 10=5+5
Partition to multiply using Numicon, base 10 or Cuisenaire rods. **4 x15**  -mm!ilB) 11111	Children to represent the concrete manipulatives pictorially. IOs Is  6	Children to be encouraged to show the steps they have taken. **4x 15** **/\\.** **10 5** **10x 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  6 9	Children to represent the counters pictorially. IOs | Is 00 | 000 00 | 000 oO | 000 6 | q	Children to record what it is they are doing to show understanding. **3 x 23** **3 x 20 = 60** /\\ **3x3= 9** 20 3 60+9=69 **23** x **3** **69**

Calculation policy: Multiplication

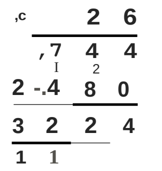
Key language: double, times, multiplied by, the product of, groups of, lots of, equal groups.

Concrete	Pictorial	Abstract
Repeated grouping/repeated addition **3x4** 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 x4** = **12** **4+4** + 4 = 12
Number lines to show repeated groups- **3** x **4**  Cuisenaire rods can be used too.	Represent this pictorially alongside a number line e.g.: 	Abstract number line showing three jumps of four. 3x4=12 

Formal column method with place value counters. 6x23	Children to represent the counters/base 10, pictorially e.g. the image below.	GriJ tl\tkhotl. -F rmal written metho
		6x23 = 

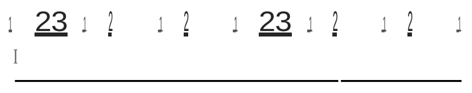
When children start to multiply 3d x 3d and 4d x 2d etc., they should be confident with the abstract:

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

6x23=

= 6x23

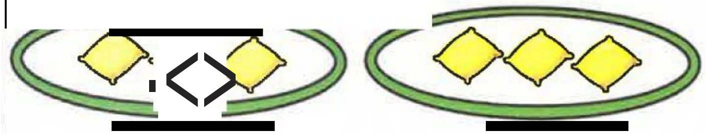
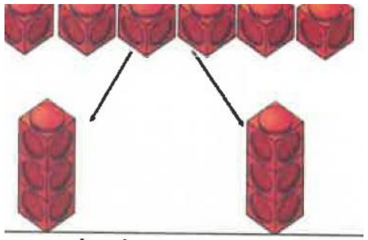
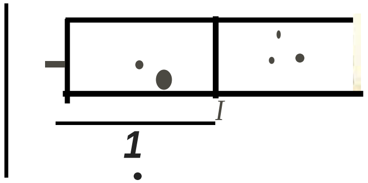
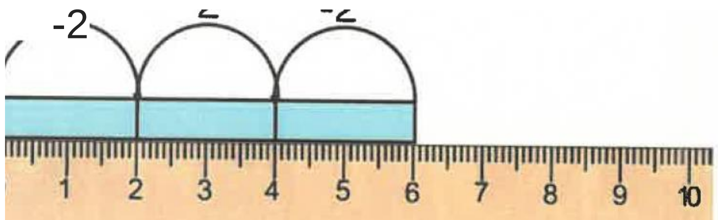
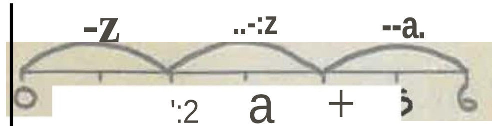
6 x 23

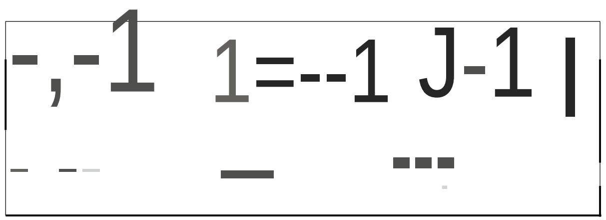
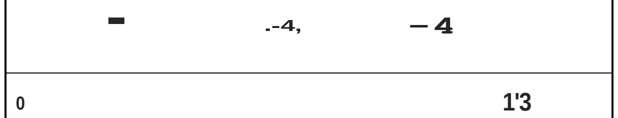
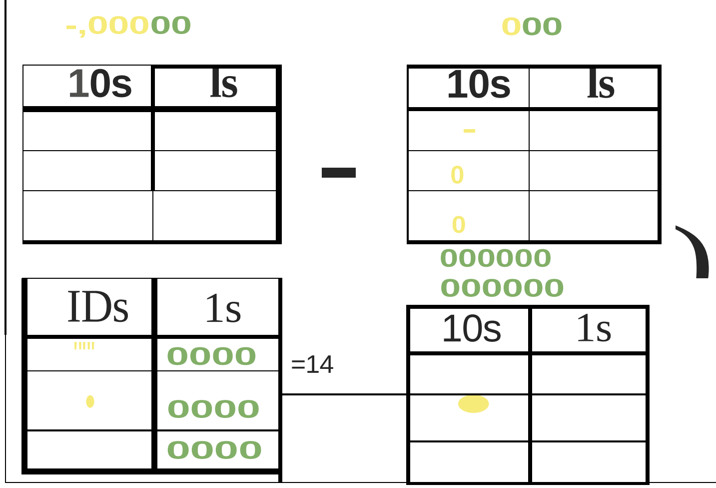
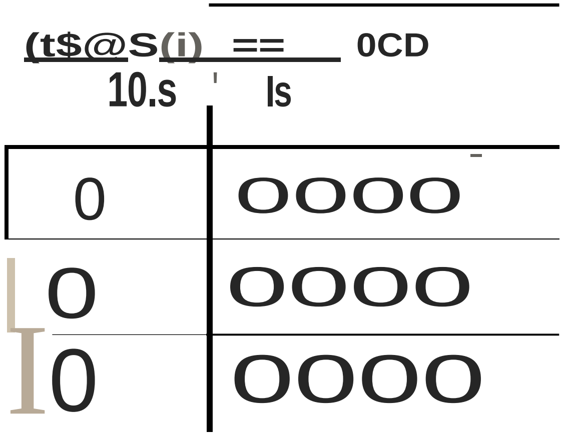
23 x 6

What is the calculation?
What is the product?

Calculation policy: Division

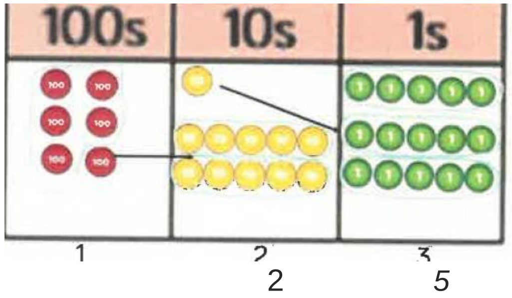
Key language: share, group, divide, divided by, half.

Concrete	Pictorial	Abstract
Sharing using a range of objects **Sharing** using a range of objects. 6-:-2  	Represent the sharing pictorially. 00  1	$6 \div 2 = 3$ 3 3 Children should also be encouraged to use their 2 times tables facts.
peated subtraction using Cuis **Repeated subtraction** using Cuisenaire rods above a ruler. 6-:-2  3 groups of 2	Children to represent repeated subtraction pictorially. -2. -2. -2. roz. ..oo{.	Abstract number line to represent the equal groups that have been subtracted.  3

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

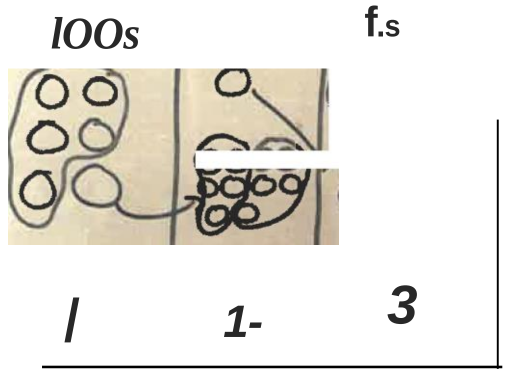
Short division using place value counters to group.

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.

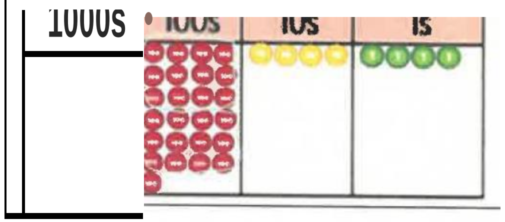
$$\begin{array}{r} 1\;2\;3 \\ 5\,\overline{)\,6\;{}^{1}1\;{}^{1}5} \end{array}$$

long division using place value counters

2544 ÷ 12

Kh

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

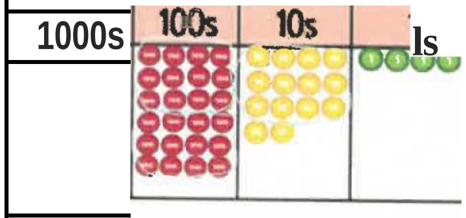


We can group 24 hundreds into groups of 12 which leaves with 1 hundred.

1211 44

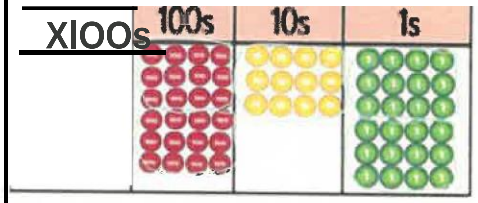
24

1



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

121
24
14
12
2

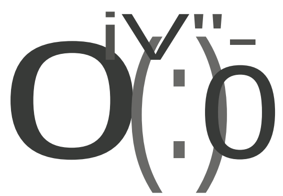


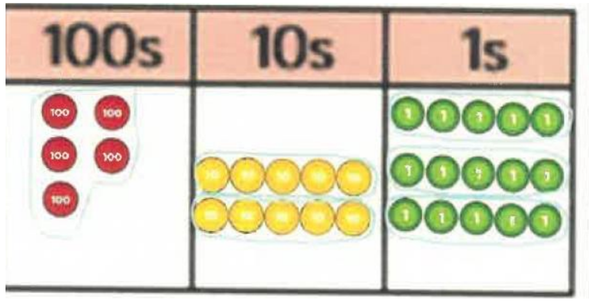
After exchanging the 2 tens, we have 24 ones. We can group 24 ones into 2 group of 12, which leaves no remainder.

0212
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?





[ffl]r;Q@\Jt•t•l•t•llti%.MwmWi.¥J

	EYFS/Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Addition	Saying which no is one more Combining two parts to make a whole Introduce part whole model. Starting at the biggernumber 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 no regrouping	Column method- regrouping. Using place value counters (up to 3 igits).	Column method- regrouping. (up to 4 digits)	C lumn method regrouping (with more than 4 digits) Decimals with the same amount of decimal places. Use of place value counters for adding decimals.	Column method- regrouping. Abstract methods. Decimals with different amounts of decimal Places.
Subtraction	Taking away using objects, drawing and crossing out. Taking away ones Counting back Find the difference Introduce part whole model Make 10 using the ten frame	Counting back Find the difference Part whole model Make 10 Use of base 10	Column.method with regrouping. (up to 3 digits)	Column.method with regrouping. (up to 4 digits)	Column method with regrouping (with more than 4 digits) Decimals with the same amount of decimal places.	Column method with regrouping. 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	Counting in multiples Repeated Addition Arrays to show communicative multiplication Introduce grid multiplication	Column multiplication- introduced with place value counters and abstract methods Continue grid multiplication (column) (2 and 3 digit multiplied by 1 digit)	Column multiplication Grid 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) To include multiplying decimals.
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. Halving and sharing	Division as grouping Division within arrays- inking to multiplicationa Repeated subtraction Halving and sharing	Division with a remainder-using lollipop sticks, times bles facts and repeated subtraction. 2d divided by 1d iusing base 10 or place value counters Division with a remainder Short division	Division with a remainder Short division (up to 3 k:ligits by 1 digit concrete iand 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 e nths and hundredths !Column too