Stonegate Primary School and Little Acorns Pre-School

Mathematics

Calculation Policy Written Methods

This policy aims to give Stonegate C of E Primary and Pre-School teachers guidance linked to the progression in teaching and learning of written calculations from Nursery to year 6.

The following calculation policy has been devised to meet requirements of the National Curriculum 2014 for the teaching and learning of mathematics, and is also designed to give pupils a consistent and smooth progression of learning in calculations across the school. Please note that early learning in number and calculation in Pre-school and Reception follows the Development Matters EYFS document, and this calculation policy is designed to build on progressively from the content and methods established in the Early Years Foundation Stage.

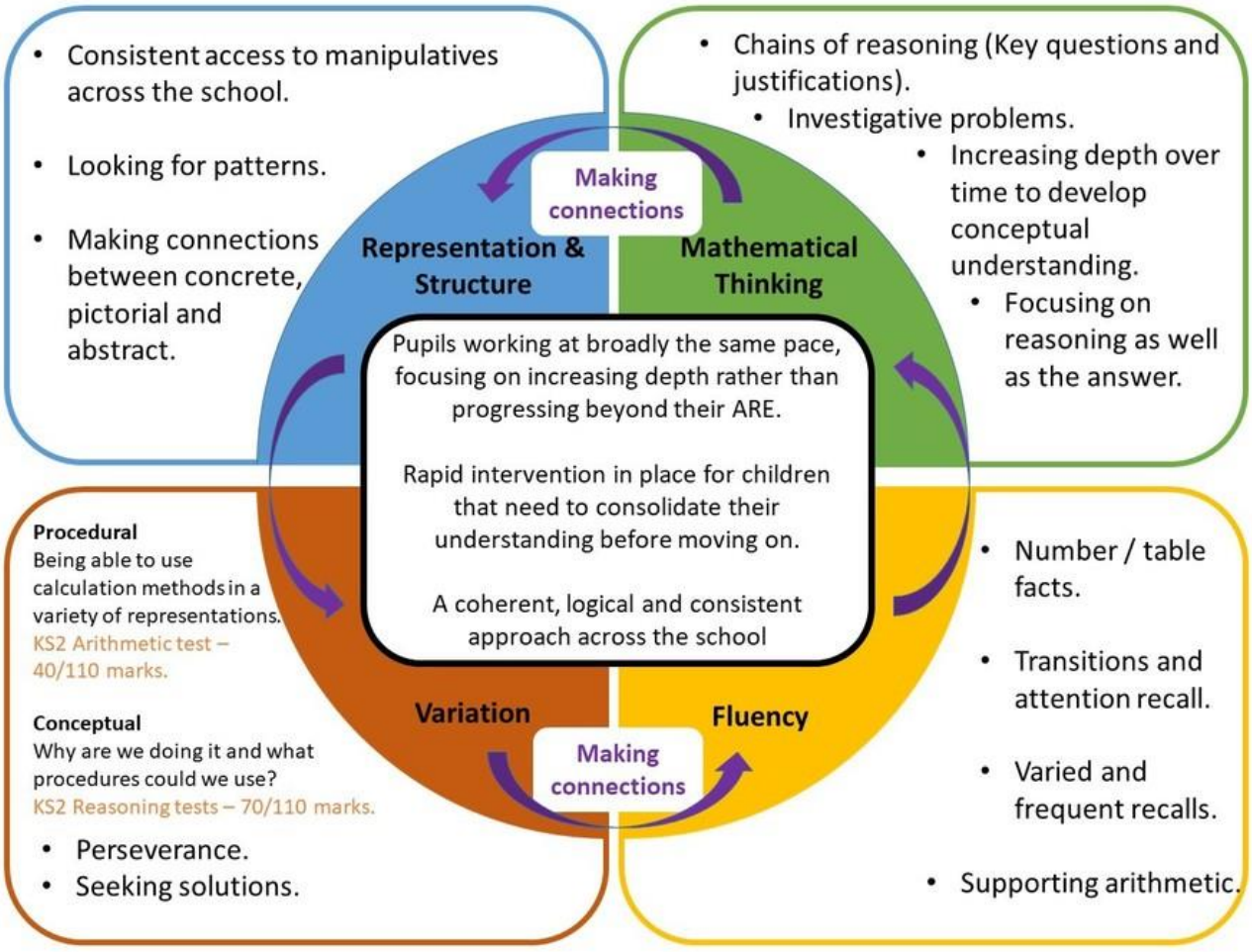
Age stage expectations

The calculation policy is organised according to age stage expectations as set out in the National Curriculum 2014, **however it is vital that pupils are taught according to the stage that they are currently working at,** being moved onto the next level as soon as they are ready, or working at a lower stage until they are secure enough to move on.

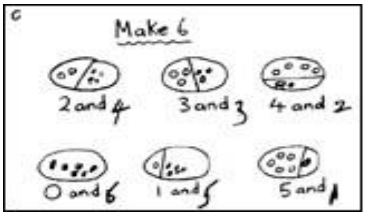
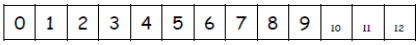
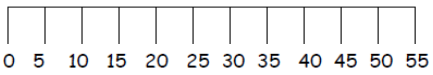
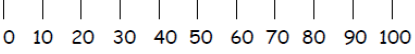
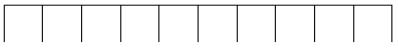
Providing a context for calculation:

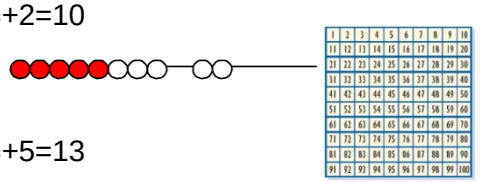
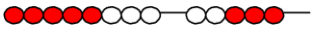
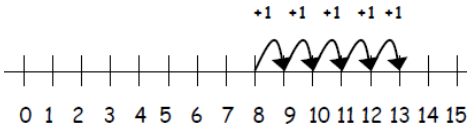
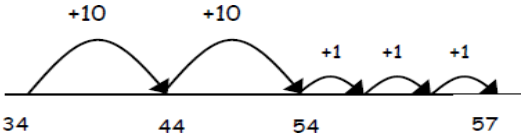
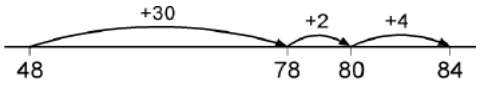
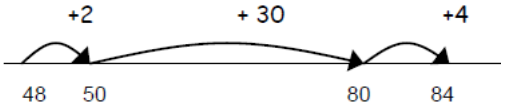
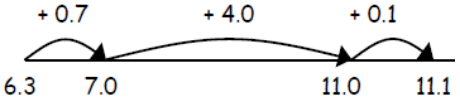
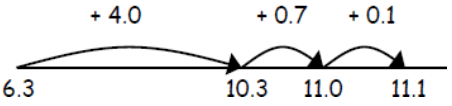
It is important that any type of calculation is given a real life context or problem solving approach to help build children's understanding of the purpose of calculation, and to help them recognise when to use certain operations and methods when faced with problems. This must be a priority within calculation lessons.

Our whole school approach to mathematics:



Addition

Nursery and Reception	**Developing early number skills** Throughout the EYFS, children will develop an understanding of addition through practical opportunities including small world play, role play, singing rhymes and number stories. In practical activities and discussion, children begin to use the vocabulary involved in adding and subtracting (more than, fewer than, same as, equal to).	▪ Children will use an array of concrete, pictorial and abstract apparatus when developing their adding skills. ▪ Construct number sentences verbally or use resources to build and show their working out. ▪ Have a secure understanding of one more and one less and number bonds to ten.   
Reception - year 1	**Recording and developing mental pictures** Children are encouraged to develop a mental picture of the number system in their heads to use for calculation. They continue to experience practical calculation opportunities using a wide variety of equipment, e.g. small world play, role play, counters, cubes, numicon, counting beads & natural resources etc. They develop ways of recording calculations using pictures and images.	  
KS1	**Progression in the use of a number line** To help children develop a sound understanding of numbers and to be able to use them confidently in calculation, there needs to progression in their use of number tracks and number lines.	Number track  Number line, all numbers labelled  Number line, 5s and 10s labelled  Number lines, 10s labelled  Number lines, marked but unlabelled  Empty number line

KS1	**The labelled number line** Children begin to use numbered lines to support their calculations counting on in ones. They select the biggest number first and count on the smaller number in ones. Along with the number line, bead strings and the number square can be used to illustrate addition.	8+2=10  8+5=13  8+5=13 
KS1 – Lower KS2	**The empty number line** The mental methods that lead to column addition generally involve partitioning. Children need to be able to partition numbers in ways other than into tens and ones to help them make multiples of ten by adding in steps. The empty number line helps to record the steps on the way to calculating the total. The use of a number line can be extended successfully to deal with the addition of decimal numbers and problems linked to time.	8+7=15 (the 7 is partitioned into 2 and 5)  Counting on in tens and then ones: 34+23=57  Counting on in multiples of 10: 48+36=84  or:  or:  Addition of decimals: 6.3 + 4.8 = 11.1  or 

<table>
<tr>
<td>Additional Methods – for children with developing understanding of place value</td>
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Partitioning

Partitioning and the expanded method lead children to the more compact method in such a way that enables them to understand its structure and efficiency.

The amount of time that should be spent teaching and practicing the expanded method will depend on how secure the children are in their recall of number facts and in their understanding of place value. If children are secure they should move onto the expanded method as soon as possible.

Record steps in addition using partitioning

Partitioning both numbers into tens and ones mirrors the column method where ones are placed under ones and tens under tens. This also links to mental methods.

This method can be extended for TU + HTU and HTU + HTU and beyond; as well as cater for the addition of decimal numbers.

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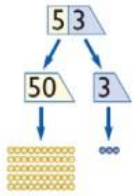
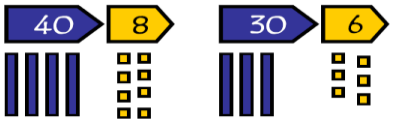


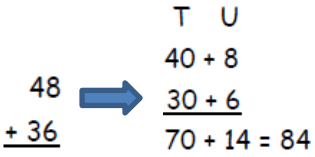
Children should use equipment to support their understanding:



40 + 30 = 70

8 + 6 = 14

70 + 14 = 84



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<td>Lower KS2 - Upper KS2</td>
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Compact column method

Recording is reduced further and becomes more efficient. The digits for the carried values are recorded below the line, using the words ‘carry ten’ or ‘carry one hundred’ etc.

The method is extended when adding more complex combinations such as three two-digit numbers, two three-digit numbers, and problems involving several numbers of different sizes including decimals.

Column addition remains efficient when used with larger whole numbers and decimals. Once learned, the method is quick and reliable.

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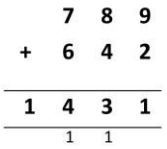
789 + 642 becomes



Answer: 1431

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Subtraction

<table>
<tr>
<td>Nursery and Reception</td>
<td>Developing early number skills

Throughout the EYFS, children will develop an understanding of addition through practical opportunities including small world play, role play, singing rhymes and number stories.

In practical activities and discussion, children begin to use the vocabulary involved in adding and subtracting.</td>
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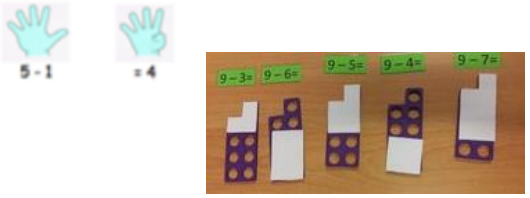
Concrete apparatus are used to relate subtraction to taking away and how many are left (fingers, counters, bricks – anything they choose to count!)
Children are encouraged to read number sentences aloud in different ways “five subtract one leaves four” “four is equal to five subtract/take away one”
Children will record their findings using pictures, words or symbols that represent their thinking.



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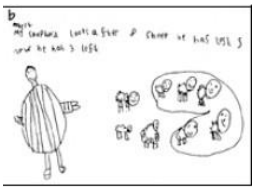
<tr>
<td>Reception – year 1</td>
<td>Recording and developing mental pictures

Children are encouraged to develop a mental picture of the calculation in their heads. They experience practical activities using a variety of equipment and develop ways to record their findings including
models and pictures.</td>
<td>  </td>
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<td>KS1</td>
<td>Progression in the use of a number line

Finding out how many items are left after some have been ‘taken away’ is initially supported with a number track followed by labelled, unlabeled and finally empty number lines, as with addition. Bead strings can be used to illustrate subtraction. A hundred square is an efficient visual resource to support counting on and back in ones and tens.

The labelled number line
The labelled number line is used to support calculations where the result is less objects (i.e. taking away) by counting back.

Difference between
The number line should also be used to make comparisons between numbers, to show that
6 – 3 means the ‘difference in value’ between 6 and 3’ or the ‘difference between 3 and 6’ and how many jumps they are apart.</td>
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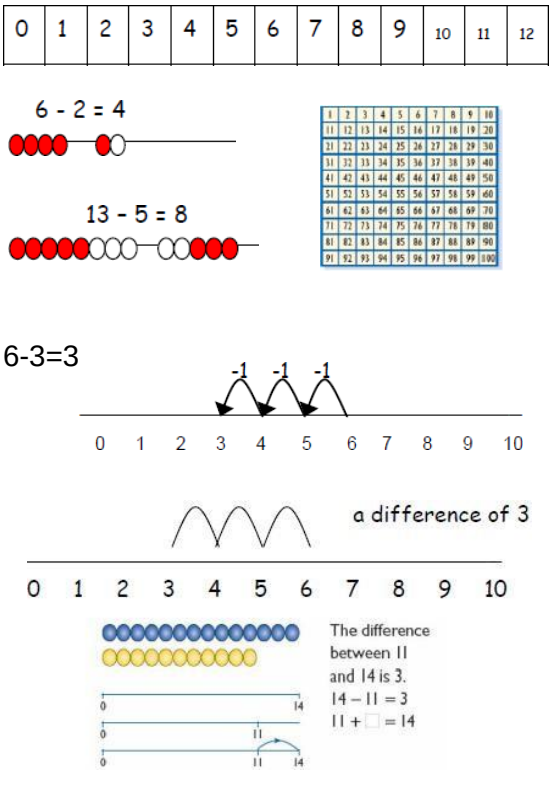

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<td>KS1 – Lower KS2</td>
<td>

The empty number line

The empty number line helps to record or explain the steps in mental subtraction.

Counting back is a useful strategy when the context of the problem results in there being less e.g. Bill has 15 sweets and gives 7 to his friend Jack, how many does he have left?

A calculation like 74 – 27 can be recorded by counting back 27 from 74 to reach 47. The empty number line is a useful way of modelling processes such as bridging through a multiple of ten.

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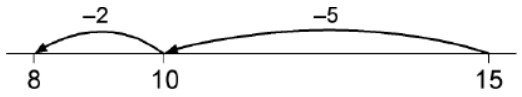
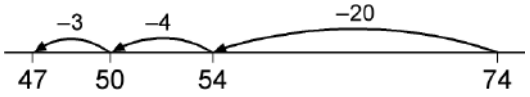
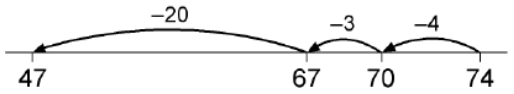
15-7=8
(As in addition, children need to be able to partition numbers e.g. the 7 is partitioned into 5 and 2 to enable counting back to 10.)



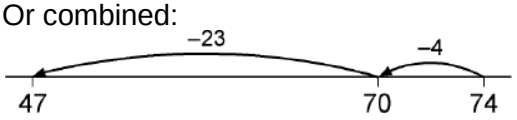
74-27=47 worked out by counting back:



The steps may be recorded in a different order:



Or combined:



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<td>KS1 – Lower KS2</td>
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Counting on from the smaller to the larger number to find the difference, for example by counting up from 27 to 74 in steps totaling 47. This is a useful method when the context asks for comparisons e.g. how much longer, how much smaller; e.g. Jill has knitted 27cm of her scarf, Alex has knitted 74cm.
How much longer is Alex's scarf?

With three-digit numbers, the number of steps can again be varied, enabling children to work out answers to calculations such as 326 – 178 first in small steps and then in fewer step by using their knowledge of complements to 100. The most compact form of recording becomes reasonably efficient.

The method can successfully be used with decimal numbers and problems involving time.

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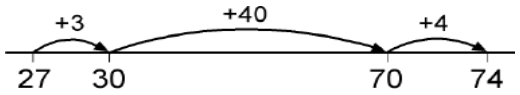
74cm - 27cm = 47cm
The 'jumps' should be added mentally or as a jotting to find the answer = 47cm



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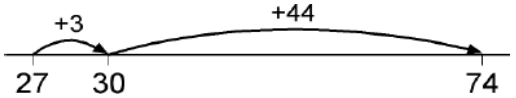
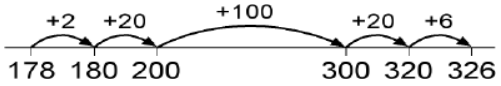


326-178=



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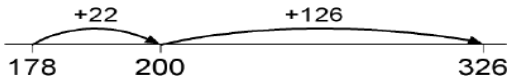
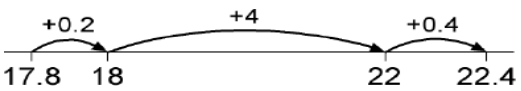


22.4-17.8=4.6



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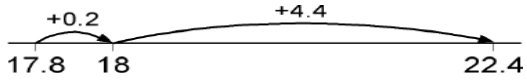

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Additional Methods – for children with developing understanding of place value

Partitioning

These methods can be useful steps towards the most commonly used column method, decomposition. The amount of time that should be spent teaching and practicing the partitioning and expanded methods will depend on how secure the children are in their recall of number facts and with partitioning. These methods should be omitted altogether for children who have a secure understanding of place value and do not need the visual support it provides.

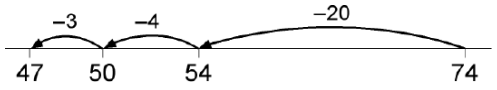
Record steps in subtraction using partitioning
e.g. Bill has £74. A pair of football boots cost £27. How much will he have left? This involves partitioning the 27 into 20 and 7, and then subtracting from 74 the 20 and the 7 in turn.

£74 - £27 =

£74 - £20 = £54

£54 - £7 = £47

This method requires children to subtract a single-digit number or a multiple of 10 from a two-digit number mentally.



This method of recording links to counting back on the number line.

Expanded decomposition

This method requires the partition of numbers and in some cases adjustment. Adjustment involves exchanging quantities of one place value for a lower place value e.g. exchanging a ten for 10 ones or a hundred for 10 tens.

- Partitioned numbers in hundreds, tens and ones/units are written one under the other mirroring the column method, where ones are placed under ones/units and tens under tens etc.
- This does not link directly to mental methods of counting on or back but parallels the partitioning method for addition. It relies on secure mental skills.
- The expanded method leads children to the more compact method in such a way that they understand its structure and efficiency.
- The larger number which is being subtracted from is written above the smaller number.
- Start by subtracting the ones/units and then the tens, hundreds etc.
- Refer to the value or each digit e.g. sixty take away forty, not 6 take away 4.
- Place value headings mat be written above to aid the understanding if the value of each

No adjustment or decomposition: 563 – 241 =

322

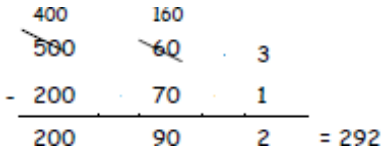
	H	T	U
	500	60	3
−	200	40	1
	300	20	2

Children need to be able to explain how the values are recombined to find the answer 322

Adjustment from the tens to the units: 563-246=317

		50	13	
	500	~~60~~	~~3~~	
-	200	40	6	
	300	10	7	= 317

Adjustment from the hundreds to the tens: 563-271=292

	number. • Where there are insufficent units, adjustment is required, this should be refered to as 'exchanging'. • Children should understand the role of '0' as a place holder.	

Lower KS2 - Upper KS2	**Standard Compact Method** The most efficient method of subtraction should be taught as soon as children have a secure understanding in place value. This method is also reliable when working with decimal numbers.	No adjustment or decomposition: 874 – 523 becomes 8 7 4 – 5 2 3 3 5 1 Answer: 351 Adjustment from the tens to the units: 5 1 5 6 3 - 2 4 6 3 1 7 Adjustment from the tens to the units and the hundreds to the tens: 932 – 457 becomes 8 12 1 9 3 2 – 4 5 7 4 7 5 Answer: 475

Multiplication

<table>
<tr>
<td>Nursery and Reception</td>
<td>Developing early number skills

Throughout the EYFS, children will develop an understanding of addition through practical opportunities including small world play, role play, singing rhymes and number stories.

In practical activities and discussion, children begin to use the vocabulary involved in adding and subtracting (more than, fewer than, same as, equal to).</td>
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The link between addition and multiplication is introduced through doubling.
Children will be presented with numerous representations of adding the same number, including pictorial and real life contexts.
Counting in 2s, 5s and 10s aloud with objects to support.
Children will be given multiplication problems to solve in real life contexts.




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<tr>
<td>Reception - year 1</td>
<td>Recording and developing mental images

Children will experience equal groups of objects. They will count in 2s, 5s and 10s. They will experience practical calculation opportunities involving equal sets or groups e.g. through small world play, role play, counters, cubes etc.

Children develop ways of recording calculations using pictures, etc. They will see everyday versions of arrays, e.g. egg boxes, baking trays, ice cube trays etc. and use this in their learning answering questions such as; 'How many eggs would we need to fill the egg box? How do you know?'

Children will use repeated addition to carry out multiplication supported by the use of counters/cubes.</td>
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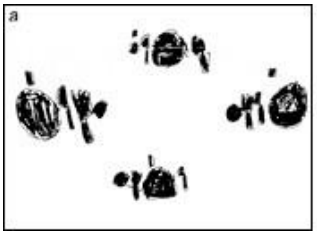

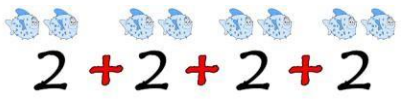

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<td>KS1</td>
<td>The bead string, number line and hundred square

Children continue to use repeated addition to carry out multiplication tasks and represent their counting on a bead string or a number line.

On a bead string: Count out three lots of 5 then count the beads altogether.
On a number line: Count on in groups of 5.
On a hundred square: Children begin pattern work on a 100 square to help them begin to recognise multiples and rules of divisibility.</td>
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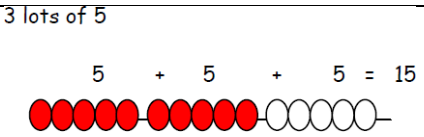
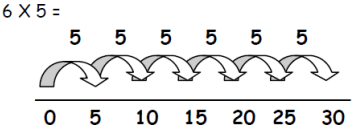





</td>
</tr>
</table>

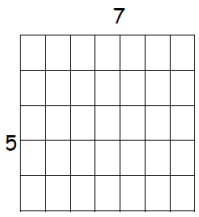
KS1 – Lower KS2

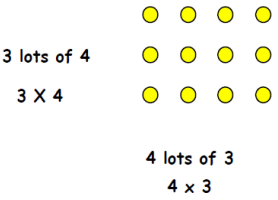
Arrays

Successful written methods depend on visualising multiplication as a rectangular array. It also helps children to understand why 3 X 4 = 4 X 3
The rectangular array gives a good visual model for multiplication.

Children should commit related multiplication facts to memory e.g. know that 7 X 5 is the same as 5 X 7.

7x5= 35
5x7= 35





Additional Method – for children with developing understanding of place value

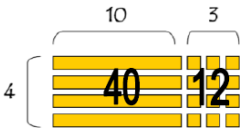
The Grid Method

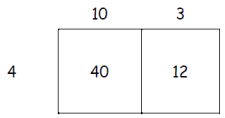
This method can be a useful step towards the most commonly used short multiplication. The amount of time that should be spent teaching and practicing this method will depend on how secure the children are in their recall of times tables. This method should be omitted altogether for children who have a secure understanding of multiplication.

The use of arrays leads on to the grid method of written multiplication beginning with TU x U.
The TU number is partitioned e.g. 13 becomes 10 and 3 and each part of the number is them multiplied by 4.

Place value apparatus such as Diennes can be used to model the strategy. Place value headings may written above to aid the understanding of the value of the numbers.

4 x 13





40 + 12 = 52
So: 4 x 13 = 52

Lower KS2 – Upper KS2

Short multiplication

The recording is reduced further, with the carried digits recorded below the line.

If, after practice, children cannot use the compact method without making errors, they should return to a previous method.

The model below involves adding 210 and 50 mentally with only the '5' digit for the 50 recorded. This highlights the need for children to be able to add a multiple of 10 to a three digit number mentally before they reach this stage.

38 x 7 Estimate: is approximately 40 x 7 = 280

$$\begin{array}{r} 38 \\ \times\ \ 7 \\ \hline 266 \\ \hline 5 \end{array}$$

24 × 6 becomes

$$\begin{array}{r} 2\ 4 \\ \times\ \ 6 \\ \hline 1\ 4\ 4 \\ \hline 2 \end{array}$$

Answer: 144

342 × 7 becomes

$$\begin{array}{r} 3\ 4\ 2 \\ \times\ \ 7 \\ \hline 2\ 3\ 9\ 4 \\ \hline 2\ 1 \end{array}$$

Answer: 2394

2741 × 6 becomes

$$\begin{array}{r} 2\ 7\ 4\ 1 \\ \times\ \ 6 \\ \hline 1\ 6\ 4\ 4\ 6 \\ \hline 4\ 2 \end{array}$$

Answer: 16 446

Upper KS2

Long Multiplication

This is the most efficient way of multipying large whole numbers.

24 × 16 becomes

$$\begin{array}{r} {\scriptstyle 2} \\ 24 \\ \times\ 16 \\ \hline 240 \\ 144 \\ \hline 384 \end{array}$$

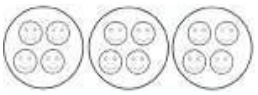
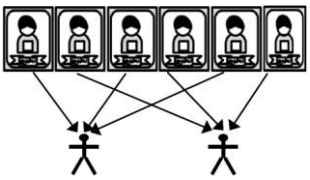
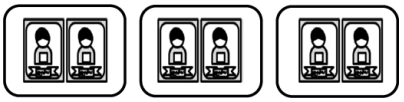
Answer: 384

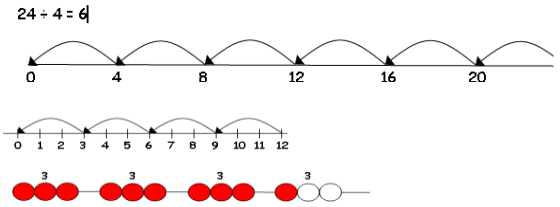
124 × 26 becomes

$$\begin{array}{r} {\scriptstyle 1\ 2} \\ 124 \\ \times\ 26 \\ \hline 744 \\ 2480 \\ \hline 3224 \\ {\scriptstyle 1\ 1} \end{array}$$

Answer: 3224

Division

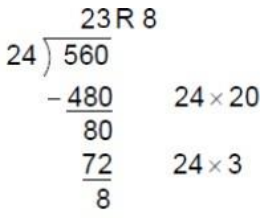
Nursery and Reception	**Developing early number skills** Throughout the EYFS, children will develop an understanding of multiplication through practical opportunities including small world play, role play, singing rhymes and number stories. In practical activities and discussion, children begin to use the vocabulary involved in adding and subtracting.	Division can be highlighted through halving. Children will be exposed to two models: ○ **Grouping**: "Frank has 6 socks, he grouped them into pairs – how many pairs did he have?  ○ **Sharing model:** "Betsy has 10 sweets. She shares them with her friend. How many will they have each?  ○
Reception - year 1	**Recording and developing mental images** Children are encouraged, through practical experiences, to develop physical and mental images They make recordings of their work as they solve problems where they want to make equal groups of items or sharing objects out equally	
KS 1	**Sharing and Grouping** They solve sharing problems by using a 'one for you, one for me' strategy until all of the items have been given out. Children should find the answer by counting how many cards 1 person has got. They solve grouping problems by creating groups of the given number. Children should find the answer by counting out the stickers and finding out how many groups of 2 there are. They will begin to use their own jottings to record division	6 stickers shared between 2 people, how many do they each get?  

KS1	**Bead strings, number lines simple multiples** Using a bead string: To represent division problems. They count back in equal steps based on repeated subtraction. When packing cakes into boxes of three they count in threes – grouping. If the problem requires 12 cakes to be shared between 3 people, the multiple of three is obtained each time all three people have received a cake.	Children will use an empty number line to support their calculation. 24 ÷ 4 = 6  The bead bar will help children with interpreting division calculations such as 10 ÷ 5 as 'how many 5s make 10?'
Lower KS2	**Short Division - without remainders in the final answer** When children are secure in division as grouping and can confidently demonstrate this using numberlines, arrays etc., short division should be introduced. Initallly the numbers should not require the calculating of remainders at all. Once the children demonstrate good understanding of remainders, and also the short division method taught, they can be taught how to use the method when remainders occur within the calculation and be taught to 'carry' the remainding value onto the next digit.	98 ÷ 7 becomes 1 4 7 | 9 (2) 8 Answer: 14
Lower KS2	**Short division <u>with and without</u> remainders in the final answer** 'Short' division of HTU ÷ U can be introduced as an alternative, more compact recording. No chunking is involved since the links are to partitioning, not repeated subtraction. How the reminder is expressed e.g. as a fraction, decimal, value or rounded number, will depend upon the context of the problem. It is therefore vital that real life problem solving contexts are given so that children can decide how best to represent the remainder.	432 ÷ 5 becomes 8 6 r 2 5 | 4 3 (3) 2 Answer: 86 remainder 2 496 ÷ 11 becomes 4 5 r 1 1 1 | 4 9 (5) 6 Answer: $45\frac{1}{11}$

<table>
<tr>
<td>Lower KS2 – Upper KS2</td>
<td>Long division

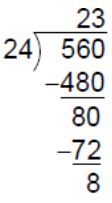
Long division is a versatile and efficient method for handling complex divisions without using a calculator. It is the preferred method when dividing by a number with two or more digits, particularly if the division is not exact. It can be used to calculate a remainder. How the reminder is expressed e.g. as a fraction, decimal, value or rounded number, will depend upon the context of the problem. It is therefore vital that real life problem solving contexts are given so that children can decide how best to represent the remainder.</td>
<td>How many packs of 24 can we make from 560 biscuits?

Start by multiplying 24 by multiples of 10 to get an estimate. As 24 × 20 = 480 and 24 × 30
= 720, we know the answer lies between 20 and 30 packs.



Answer: 23 R 8

In effect, the recording above is the long division method, though conventionally the digits of the answer are recorded above the line as shown below.



Answer: 23 R 8</td>
</tr>
<tr>
<td>Upper KS2</td>
<td>Long division

Each example below shows a different way of setting out the calculation and a different way of representing the result (with a remainder, as a mixed number and as a decimal).</td>
<td>See examples below</td>
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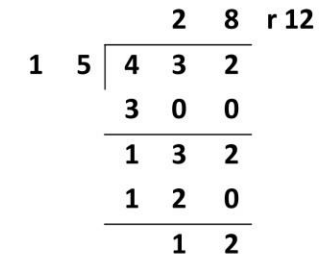
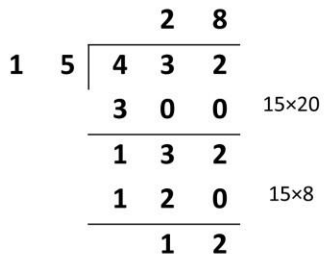
432 ÷ 15 becomes



Answer: 28 remainder 12

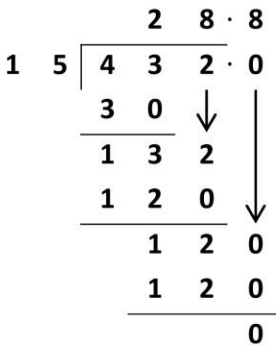
432 ÷ 15 becomes



$\frac{12}{15} = \frac{4}{5}$

Answer: $28\frac{4}{5}$

432 ÷ 15 becomes



Answer: 28·8