Carr Head Primary School

WRITTEN CALCULATIONS POLICY.

Prepare the children of today to flourish in the world of tomorrow through nurturing mind, body and soul.

Introduction:

The overall aim in terms of written calculations is children to leave Carr Head being able to use the most efficient method of calculation for each operation confidently and with understanding. This policy outlines the stages in building up to efficient method for each operation. Children need to be able to decide when a mental calculation is best or when they need to use a written method.

In their maths lessons, children will be introduced to the different aspects of written calculations through the use of concrete (practical), pictorial and abstract methods. Although concrete and pictorial methods will be the main focus early in their mathematical journey, the children will be shown that ALL these methods are appropriate right through the school.

Vocabulary:

In maths, teachers will use the word '**ones**' rather than '**units**.' However, it is recognised that **units** is sometimes used in the end of key stage assessments. To ensure children develop the understanding that **ones** and **units** are the same thing, teachers will regularly remind children that they might see **ones** being referred to as **units.**

Please see Appendix for further vocabulary.

EYFS:

These are the Early Learning Goals for Number from September 2021:

Number:

- have a deep understanding of number to 10, including the composition of each number;
- subitise (recognise quantities without counting) to 5;
- automatically recall (without reference to rhymes, counting or other aids) number bonds up to 5 (including subtraction facts) and some number bonds up to 10, including double facts.

The children are not expected to do any formal recording linked to calculations. If, towards the end of the year, a child is ready to record, the EYFS staff will ensure that any written work links in with the Year 1 part of this policy.

Addition

$+$

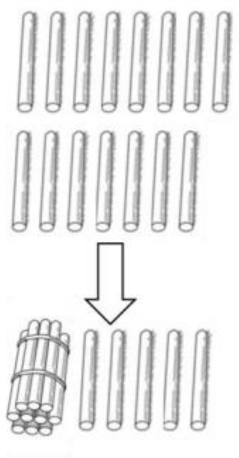
Key Stage 1.

Year 1:

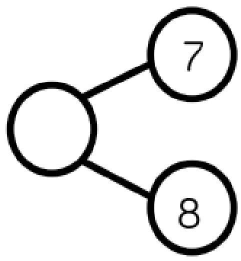
Add one-digit and two-digit numbers to 20, including zero.

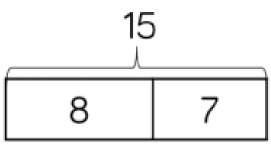
When adding one-digit numbers that cross 10, it must be reinforced to children that ten ones equal one ten. This understanding is crucial when exchanged is introduced in Y2. Two different colours of Base 10 can help the children see this.

8 +7 =



Children can also be introduced to the part-whole model:



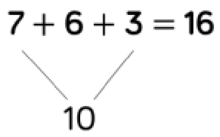


Year 2:

Add numbers using concrete objects, pictorial representation, and mentally, including: a two-digit number and ones; a two-digit number and tens; two two-digit numbers; three one-digit numbers.

When adding three one-digit numbers, children should be encouraged to look for number bonds to 10 or doubles to add the numbers more efficiently.

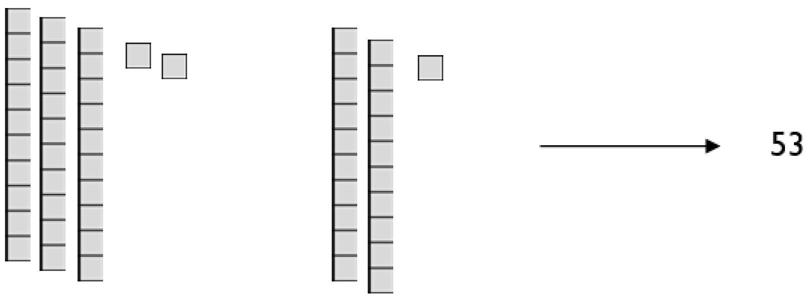
7 + 6 + 3 =



Adding two 2-digit numbers to 100:

Children can use Base 10 to support their calculations:

32 + 21 =

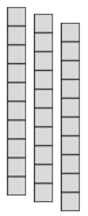


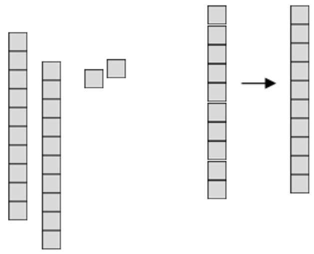
The children should record the calculation even though they are solving it practically.

The idea of exchange is introduced:

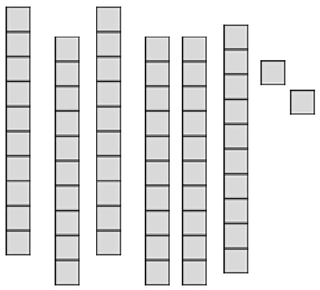
35 + 27 =

In the next stage, the children are shown how to exchange 10 ones for 1 ten:





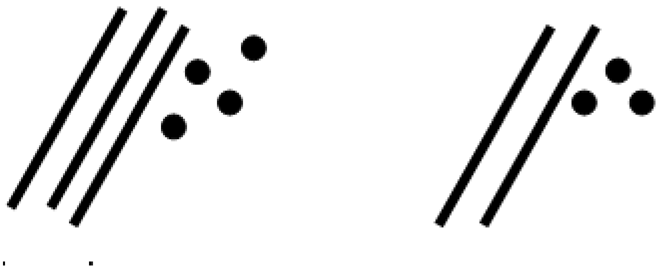
Resulting in:



35 + 27 = 62

The next progression would be the children drawing their own Base 10:

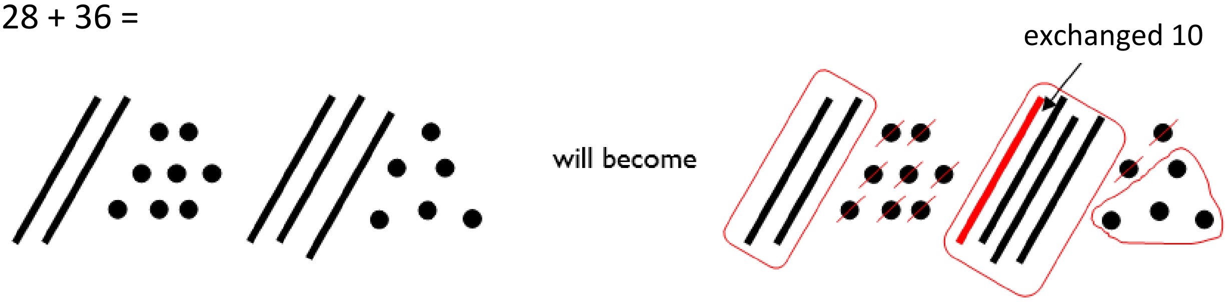
34 + 23 =



Children would then total up the ones and then the tens.

With calculations involving exchange:

28 + 36 =



Lower Key Stage 2:

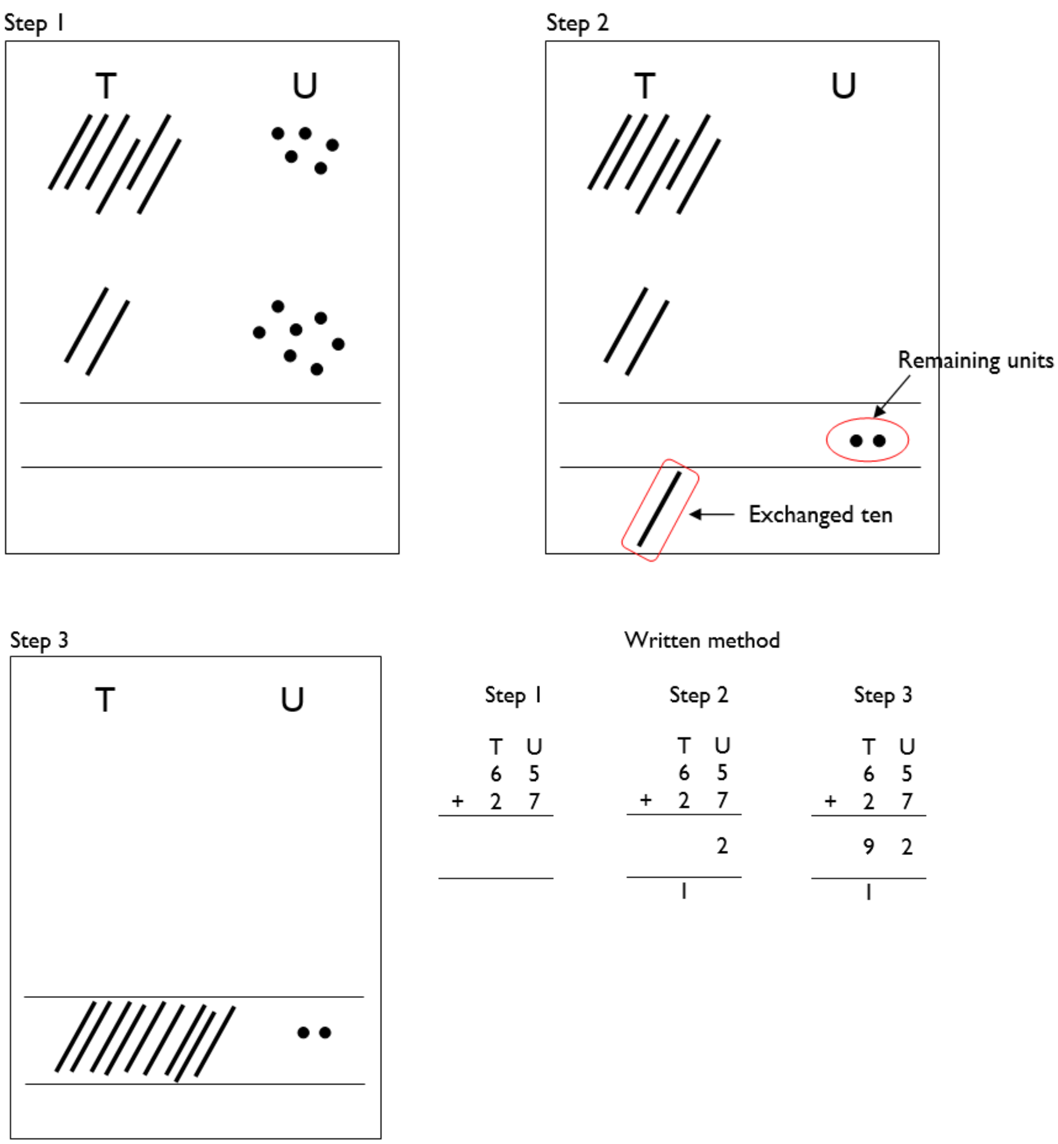
Year 3:

Add numbers with up to 3 digits, using formal written methods of columnar addition.

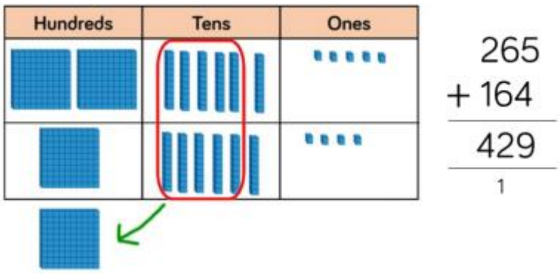
Children will build on their knowledge of using Base 10 equipment from Y2 and continue to develop their understanding of the process of exchange.

Initially, they will work with 2-digit numbers:

65 + 27 =



When confident working with 2-digit numbers, the children will move onto applying their understanding to the addition of 3-digit numbers.



When using Base 10 and / or place value grid, the children should also record the calculation vertically alongside their pictorial representation, so they develop the links between the two.

<u>Year 4:</u>

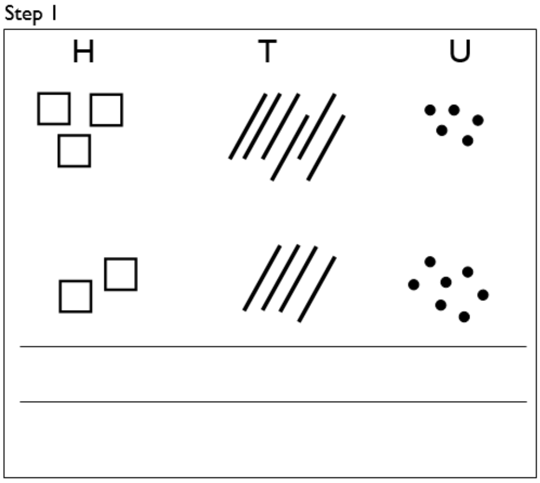
<u>Add numbers with up to 4 digits and decimals with one decimal place using columnar addition where appropriate.</u>

REMEMBER: children will have different starting points depending on their understanding of the addition work covered in Y3.

If children need to use concrete resources to aid their understanding of the process, make sure they write the calculation alongside so they can see the links to the written column method. Base 10 and / or place value counters are effective concrete resources when working with 4-digit numbers.

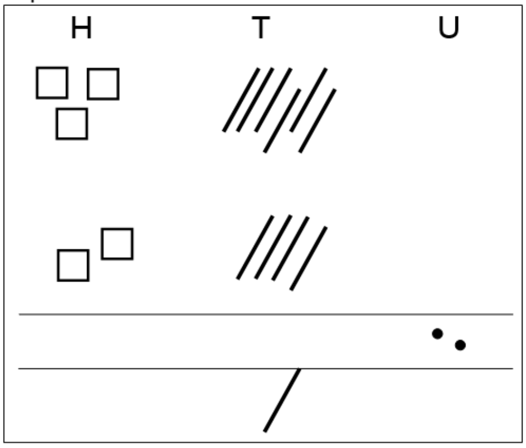
If necessary, children will draw out the Base 10 next to the written calculation. By the end of the year, the majority of children should not need to draw out the concrete resources.

Step 1



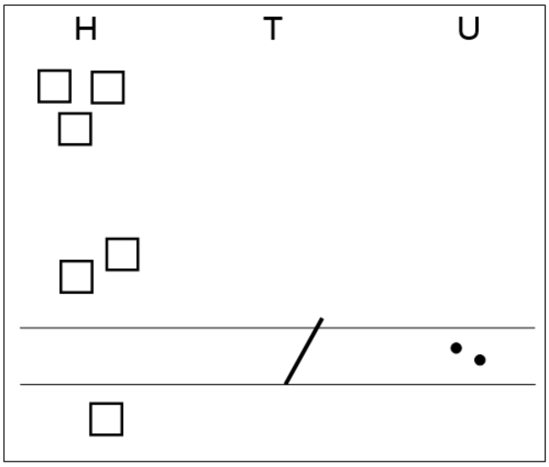
	H	T	U
	3	6	5
+	2	4	7

Step 2



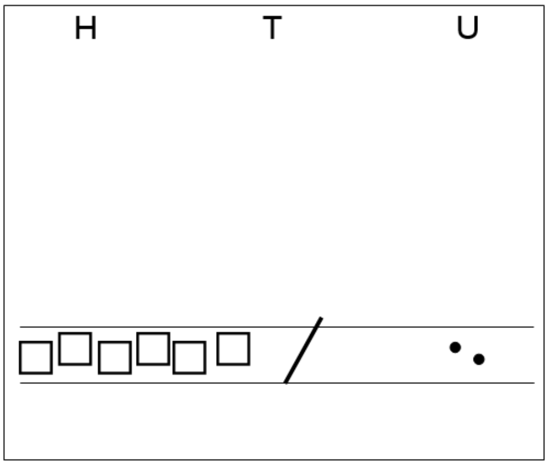
	H	T	U
	3	6	5
+	2	4	7
			2
		1	

Step 3



	H	T	U
	3	6	5
+	2	4	7
		1	2
	1	1	

Step 4



	H	T	U
	3	6	5
+	2	4	7
	6	1	2
	1	1	

Upper Key Stage 2:

Year 5:

Add whole numbers with more than 4 digits and decimals with two decimal places, including formal written methods (columnar addition).

Children should continue to use the carrying method to solve calculations:

```
   3 3 6 4
 +   2 4 7
 ---------
   3 6 1 1
 ---------
     1 1
```

```
   3 1 2 1
       3 7
 +   1 4 8
 ---------
   3 3 0 6
 ---------
     1 1
```

```
     3 . 5 6
 +   2 . 4 7
 -----------
     6 . 0 3
 -----------
         1
```

Year 6:

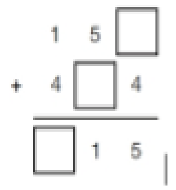
Adding whole numbers and decimals using columnar addition.

Children in Y6 need a secure and thorough understanding of columnar addition. This includes being able to identifying missing numbers in calculations.

```
   4 0 1 . 2 0
     2 6 . 8 5
 +     0 . 7 1
 -------------
   4 2 8 . 7 6
 -------------
       1
```

When adding decimals with different numbers of decimal places, children should be taught and encouraged to make them the same through identification that 2 tenths is the same as 20 hundredths, therefore, 0.2 is the same value as 0.20.

Q1. Write the three missing digits to make this **addition** correct.



The question above allows a child to demonstrate their understanding of columnar addition. They need to realise that the tens digits will total more than 10 tens, in order to have 1 ten in the answer.

Subtraction

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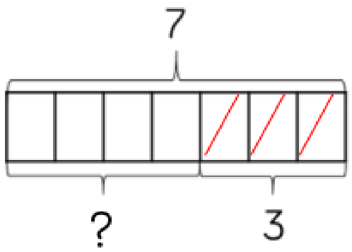
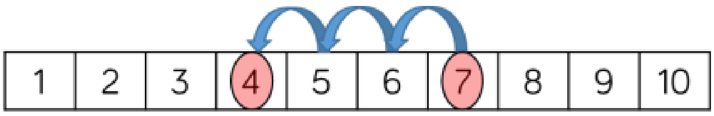
Key Stage 1:

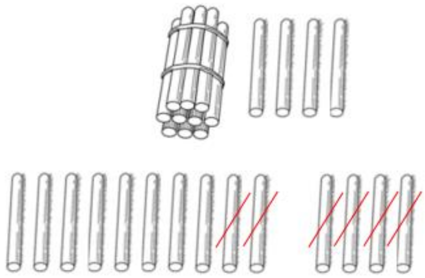
Year 1:

<u>Subtract one and two-digit numbers to 20, including zero, using concrete and pictorial representations.</u>





14 – 6 =



If using Base 10 – only use the ones rather than tens and ones in order to avoid the need for exchange.

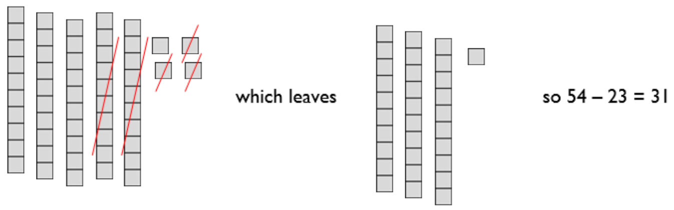
Year 2:

<u>Subtract numbers using concrete objects, pictorial representations, and mentally, including: a two-digit number and ones; a two-digit number and tens; two two-digit numbers.</u>

Base 10 equipment will be used to help develop the children's understanding of subtraction. They need to see that the amount being taken away is not an amount of its own but part of the whole amount they are starting with.

For example:

54 – 23 – the children would use Base 10 to make the 54 and then take 23 out of this amount.



Progression from this would be for the children to draw their own Base 10:

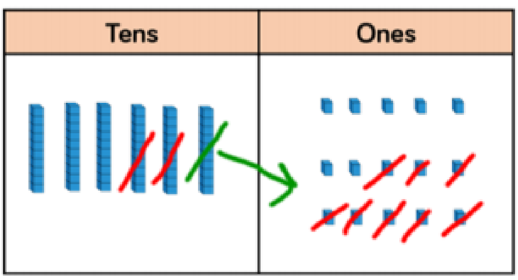
39 – 17 =

When it comes to introducing the idea of exchange, lots of practical activities of exchanging one ten for 10 ones needs to take place.

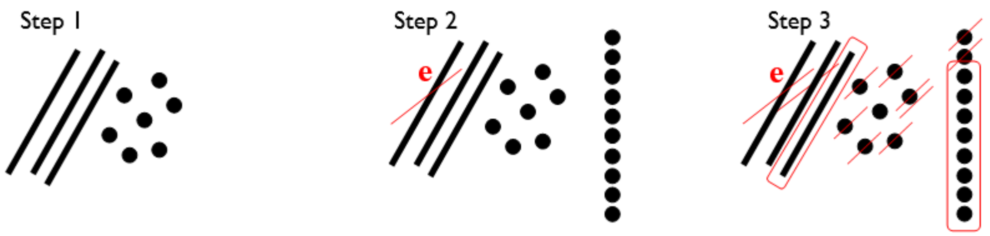
52 – 26 =

The children can now see the 53 represented as 40 and 13, still the same total, but partitioned in a different way, as in step 3 and can go on to take away the 26 from the calculation to leave 27 remaining, as in Step 4.

Place value grids with Base 10 can also be used:



As before, the next step would be for the children to draw their own Base 10:



Circling the tens and units that remain will help children to identify how many remain.

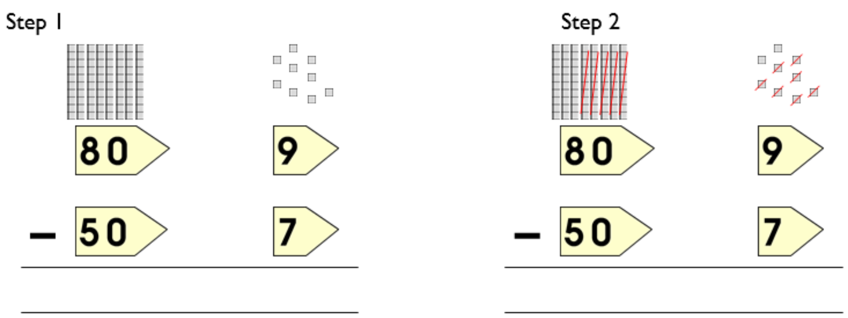
The e is used to indicate the ten that has been exchanged for ten ones so the children understand that this ten as not been subtracted.

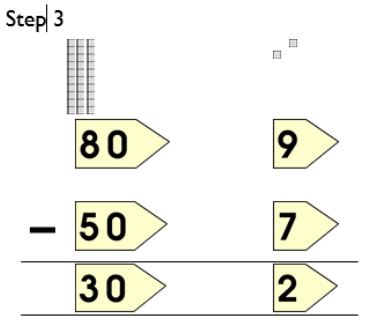
Lower Key Stage 2:

Year 3:

<u>Subtract numbers with up to 3 digits using formal written method of columnar subtraction.</u>

At the start of the year, children will be using Base 10 equipment alongside arrow cards to model calculations.



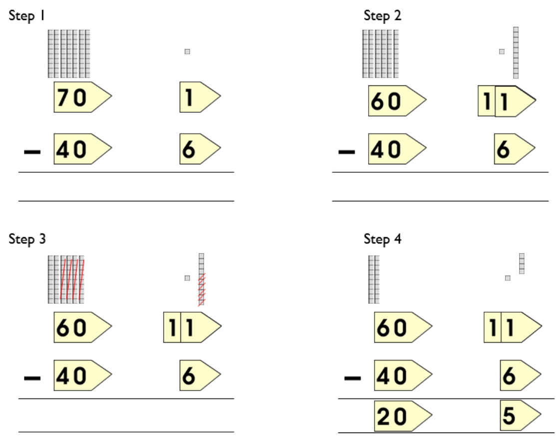


Emphasise that the second (bottom) number is being subtracted from the first (top) number rather than the lesser number from the greater.

This will be recorded by the children as:

```
    80  →  9
-   50  →  7
    30  →  2  =  32
```

The next step will be to complete calculations that involve exchange:

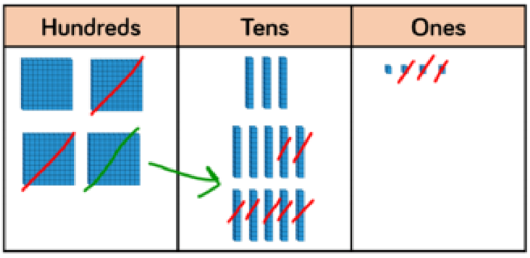


This will be recorded by the children as:

```
    60
    70  →  ¹1
-   40  →  6
    20  →  5  =  25
```

The children will apply this method to 3-digit numbers as their understanding progresses.

Place value grids can also be used to support learning:



	$^{3}\not{4}\,^{1}35$
−	273
	262

Year 4:

<u>Subtract numbers with up to 4 digits and decimals with one decimal place using columnar subtraction where appropriate.</u>

The starting point for children in Year 4 will be the method they were using at the end of Year 3.

Initially, they will be using the expanded method of subtraction involving decomposition:

Step 1

	700	→	50	→	4
-	200	→	80	→	6

Step 2 (exchanging from tens to units)

	700	→	$\overset{40}{\not{50}}$	→	$^{1}4$
-	200	→	80	→	6

Step 3 (exchanging from hundreds to tens)

	$\overset{600}{\not{700}}$	→	$\overset{140}{\not{50}}$	→	$^{1}4$
-	200	→	80	→	6

Step 4

	$\overset{600}{\not{700}}$	→	$\overset{140}{\not{50}}$	→	$^{1}4$		
-	200	→	80	→	6		
	400	→	60	→	8	=	468

This would be recorded by the children as:

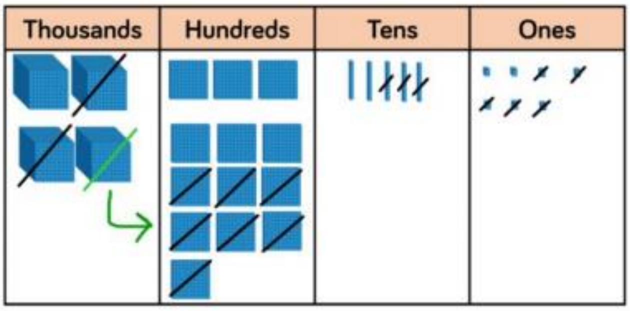
	$\overset{600}{\not{700}}$	→	$\overset{140}{\not{50}}$	→	$^{1}4$		
-	200	→	80	→	6		
	400	→	60	→	8	=	468

From this, the children will move onto the compact method of subtraction:

	4	$\overset{6}{\not{7}}$	$\overset{14}{\not{5}}$	$^{1}4$
-	3	2	8	6
	1	4	6	8

To support understanding, plain counters on a place value grid could be used to support learning:

4357 – 2735 =



Upper Key Stage 2:

Year 5:

<u>Subtract whole numbers with more than 4 digits and decimals with two decimal places using formal written methods.</u>

Children should continue to use the decomposition method to solve calculations such as:

	6		6	
	~~7~~	10	~~7~~	12
-	3	2	2	6
	3	8	4	6

	2		13	
	~~3~~	.	~~4~~	12
-	1	.	7	6
	1	.	6	6

Year 6:

<u>Subtract whole numbers and decimals using formal written methods.</u>

Children should extend the decomposition method and use it to subtract whole numbers and decimals with any number of digits.

	5	13		
	~~6~~	~~4~~	13	2
-	4	6	8	1
	1	7	5	1

	3		6		11	
	~~4~~	11	~~7~~	.	~~2~~	10
-		3	4	.	7	1
	3	8	2	.	4	9

When subtracting decimals with different numbers of decimal places, children should be taught and encouraged to make them the same through identification that 2 tenths is the same as 20 hundredths, therefore, 0.2 is the same value as 0.20.

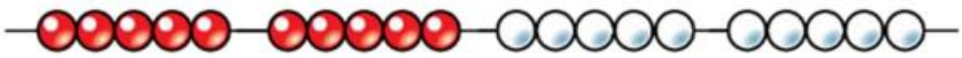
Multiplication

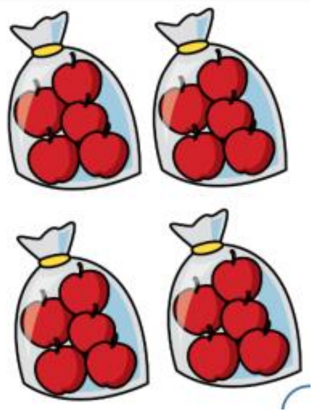
X

KS1:

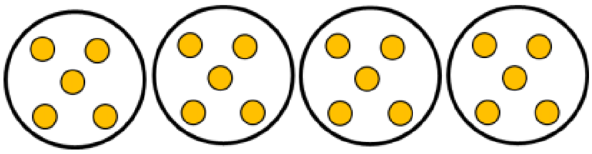
The focus in Y1 and Y2 is on the understanding of multiplication as repeated addition and representing this in many different ways.

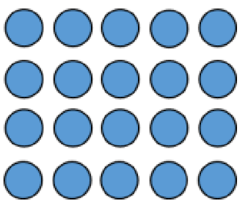
In Y1 the children will use concrete and pictorial representations of the calculations. They do not need to record multiplication formally.





In Y2 the children are introduced to the multiplication symbol. They are shown the repeated addition alongside the multiplication.





$$5 + 5 + 5 + 5 = 20$$

$$4 \times 5 = 20$$

$$5 \times 4 = 20$$

The multiplication for this would be:

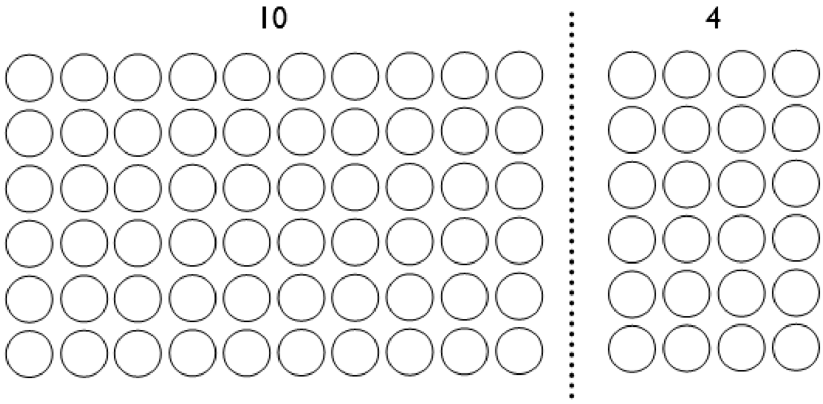
Statements taken from the array.

Year 3:

Multiplying 2-digit number by a single digit.

Start with the grid method.

The grid method can be introduced practically first. In order to fully understand this method, the children need to be confident working with arrays and writing the multiplication statements that are represented by arrays.



When ready, the children move onto drawing the grid and not the counters:

13 x 8

x	10	3
8	80	24

$$\begin{array}{r} 80 \\ +\ 24 \\ \hline 104 \\ \hline \end{array}$$

When / if appropriate, the children will move onto the expanded vertical method.

	H	T	O		
		3	4		
×			5		
		2	0	(5 × 4)	
+	1	5	0	(5 × 30)	
	1	7	0		

Year 4:

Multiplying a three-digit number by a single digit:

Children to initially use the grid method and then move onto the vertical method when ready. They might use the expanded method first.

	H	T	O		
		3	4		
×			5		
		2	0	(5 × 4)	
+	1	5	0	(5 × 30)	
	1	7	0		

	H	T	O
	2	4	5
×			4
	9	8	0
	1	2	

Year 5:

Transition from grid method to vertical method.

4-digit number x single digit – compact vertical method. This will depend on the children learning how to use the compact vertical method when multiplying a 3-digit number by a single digit in Year 4.

$1,826 \times 3 = 5,478$

	Th	H	T	O
	1	8	2	6
×				3
	5	4	7	8
	2		1	

Multiplying two 2-digit numbers:

Introduce using grid method, progressing to vertical method when appropriate.

×	20	2
30	600	60
1	20	2

→

	H	T	O
		2	2
×		3	1
		2	2
	6	6	0
	6	8	2

Multiplying 3-digit number by 2-digit.

Again, introduce using grid method and move to vertical method when ready.

×	200	30	4
30	6,000	900	120
2	400	60	8

→

Th	H	T	O
	2	3	4
×		3	2
	4	6	8
${}_{1}7$	${}_{1}0$	2	0
7	4	8	8

Year 6:

<u>Using compact written method confidently.</u>

Multiplying a multi-digit number by a 2-digit number using written method:

TTh	Th	H	T	O
	2	7	3	9
×			2	8
2	1	9	1	2
2	5	3	7	
5	4	7	8	0
1		1		
7	6	6	9	2
		1		

2,739 × 28 = 76,692

Division

÷

KS1:

Year 1:

Division by sharing:

The will be done practically where the children share different objects into equal groups and count how many are in each group. Understanding they have to be equal groups is vital. When ready, the children can move from using concrete objects to drawing their own pictures to show the calculations.

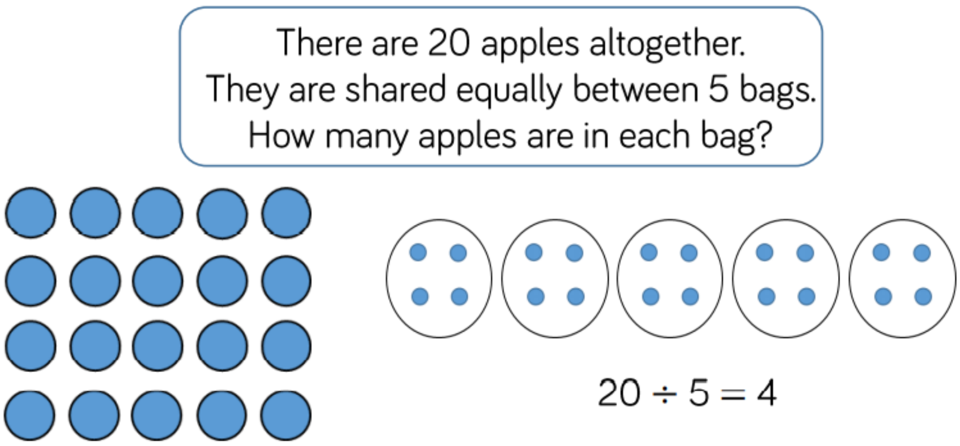
Division by grouping:

Once again keeping it practical**,** the children practise grouping objects and counting the number of groups made. Children will practise counting in multiples.

Year 2:

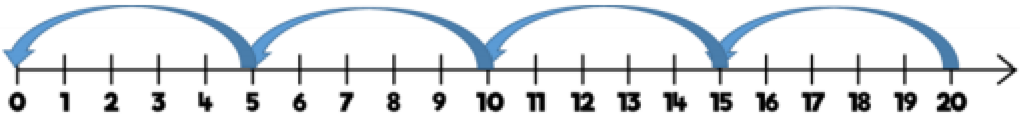
Division by sharing:

Division is thought about in terms of sharing objects into equal groups. Whilst still keeping it practical, the division symbol is introduced in Y2.

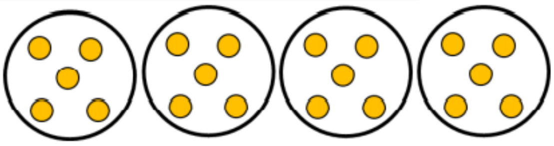


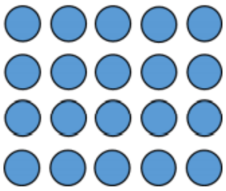
Division by grouping:

Children continue to solve problems involving grouping objects and counting how many groups there are. Children are encouraged to count in multiples and can also use repeated subtraction to support this.



There are 20 apples. They are put into bags of 5. How many bags will there be?





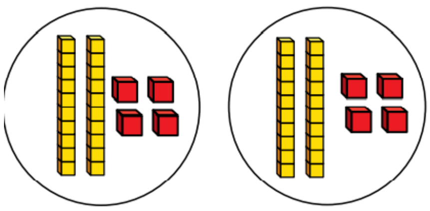
$20 \div 5 = 4$

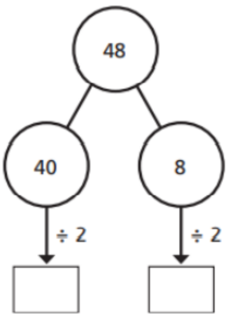
Division of 2-digit numbers using sharing:

Using Base 10 or other resources, the children can partition the number into tens and units and then these are shared into equal groups:

$48 \div 2 =$

Tens	Ones
10 10	1 1 1 1
10 10	1 1 1 1



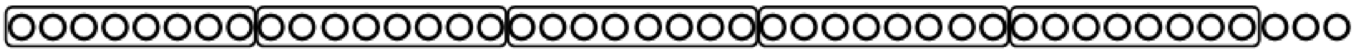


KS2:

Year 3:

Initially, children will continue to practise **division by grouping,** including calculations that give rise to **remainders**. These calculations will be linked to times tables they already know. Children should be doing this practically and/ or pictorially.

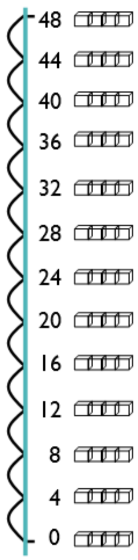
43 ÷ 8 =



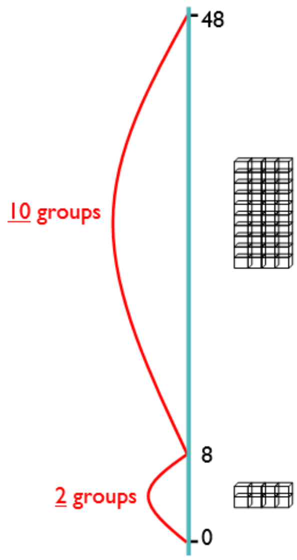
43 ÷ 8 = 5 remainder 3

In preparation for **chunking,** the children will be shown how to use **repeated subtraction** on a number line. Initially they will take of repeated groups of the **divisor.** When ready, they will be shown how to subtract multiples of the divisor (eg 10 groups followed by individual groups).

Stage 1
48 ÷ 4 = 12 (groups of 4)

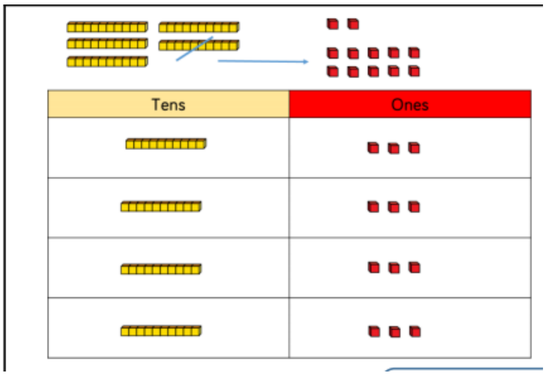


Stage 2
48 ÷ 4 = 10 (groups of 4) + 2 (groups of 4)
= 12 (groups of 4)

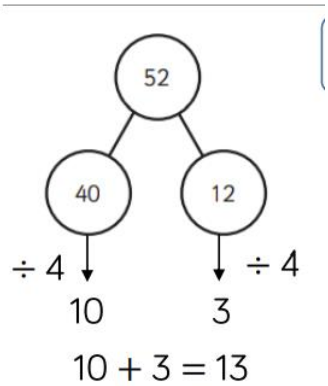


Place value grids can be used when looking at division by sharing. Again, use of Base 10 allows this method to be practised practically.

52 ÷ 4 =

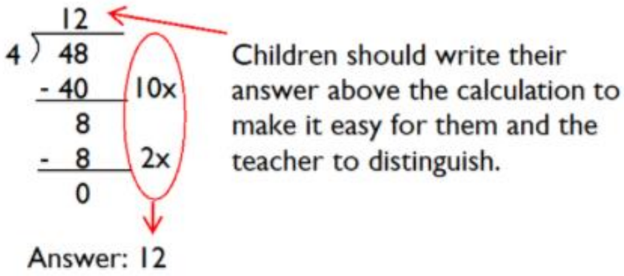


Using knowledge of partitioning and a part – whole model can also be used when dividing 2-digit numbers by a single digit:



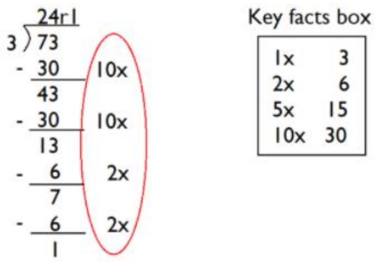
<u>Year 4: Dividing 3-digit numbers by a single digit including calculations that give rise to remainders.</u>

Building on the repeated subtraction work completed in Y3, the children will apply this as they move on to using the 'chunking' method for division.



Children should make use of a key facts box. This will allow them to use known facts to generate related facts.

73 ÷ 3



By the end of the year, the 'chunking' method can be used for 3-digit numbers divided by a single digit:

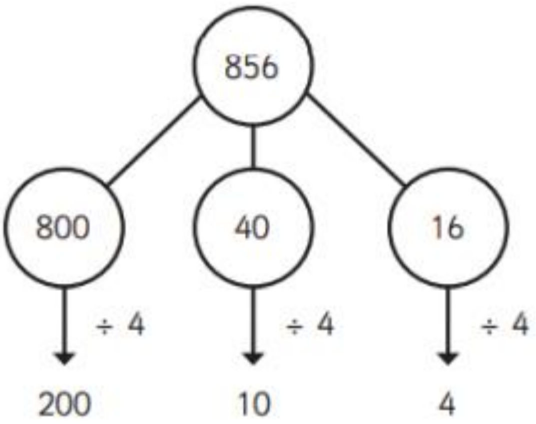
196 ÷ 6

Year 4: Divide a three-digit number by a single digit using sharing:

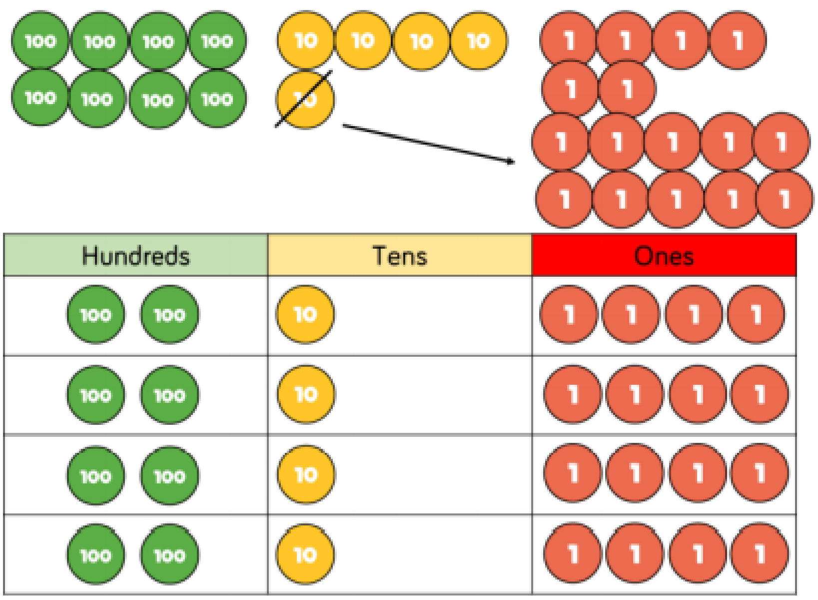
856 ÷ 4 =

If the children are used to using part-whole models they can initially use this method to complete calculations like this:

For this method to be effective, the children need to be used to using it in other areas of maths.



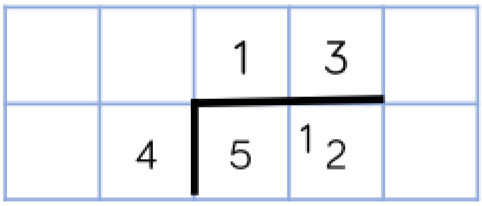
Place value counters and a place value grid could also be used:



This method will also help the children to see remainders.

Combining concrete and abstract approaches like this should help with understanding. We must be mindful not to rush the children onto abstract methods before they are ready.

Year 5 – Dividing two-digit number by single digit using grouping.

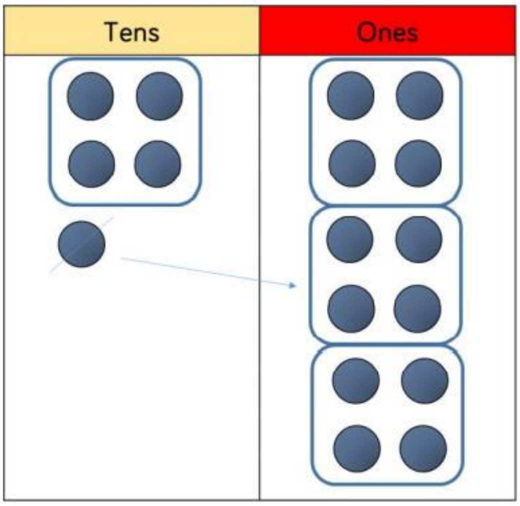


Language is very important when teaching this method.

How many groups of 4 tens can you make out of 5 tens? You can make 1 group and the remaining ten is exchanged for 10 units and put with the 2 units so making 12 units.

How many groups of 4 can you make out of 12? You can make 3 groups of 4.

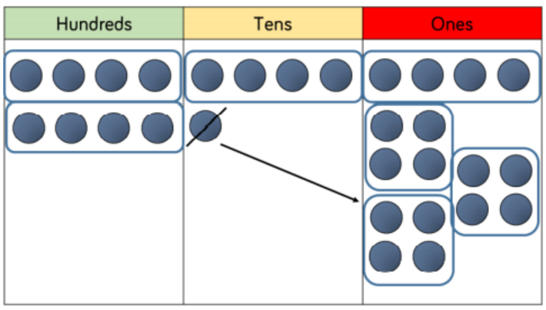
Could also model this alongside a place value grid:



Year 5: Divide 3-digits by a single digit using grouping.

856 ÷ 4 =

Concrete / pictorial approach initially:



Children can draw their own counters if that is preferred.

Progress from this would be onto a short division method:

		2	1	4
	4	8	5	$^{1}6$

Once again, we need to make sure that the language we use when teaching this method reinforces place value knowledge.

How mang groups of 4 hundreds can we make out of 8 hundreds? 2.

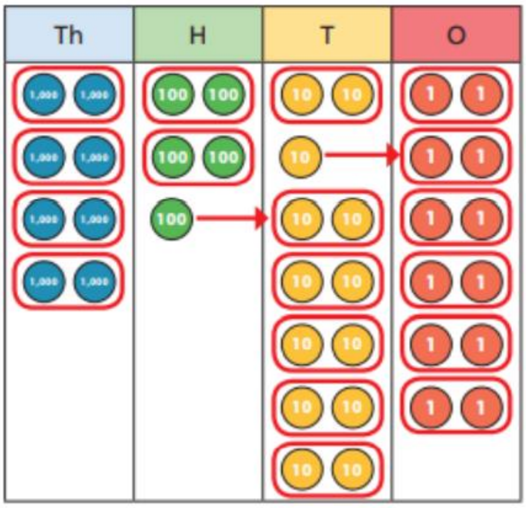
How many groups of 4 tens can we make out of 5 tens? 1.

The 1 ten left will be exchanged for ten units so we then ask how many groups of 4 can we make from 16? 4

Year 5: Dividing 4-digit number by a single digit (grouping).

8532 ÷ 2 =

For those that still need a pictorial method, they could draw their own place value chart and their own counters.



It is appreciated that some children will be able to work this out mentally. The calculation is to illustrate the method.

When ready, the children should move onto the abstract method:

	4	2	6	6
2	8	5	$^{1}3$	$^{1}2$

Language:

How many groups of 2 thousands can you make out of 8 thousand? 4

How many groups of 2 hundreds can you make out of 5 hundred? 2 with 1 hundred remaining. This is exchanged for 10 tens and put with the 3 tens so making 13 tens.

How many groups of 2 tens can you make out of 13 tens? 6 with one ten remaining. This is exchanged for 10 units and put with the 2 units so making 12 units.

How many groups of 2 units can you make out of 12 units? 6

So, the answer is 4266.

Year 6 – divide multi-digit numbers by 2-digit numbers.

432 ÷ 12 =

		0	3	6
	12	4	$^{4}3$	$^{7}2$

By now, the children should be used to the language used when doing this method.

7335 ÷ 15 =

	0	4	8	9
15	7	$^{7}3$	$^{13}3$	$^{13}5$

The children could write out the multiples of 15 to help them with this calculation.

APPENDIX 1:

Calculations vocabulary:

array – an ordered collection of counters or other objects in rows and columns.

commutative – numbers can be added or multiplied in any order without affecting the answer.

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

dividend – the number that is being divided up.

divisor – the number by which another number is divided by.

exchange – change a number or expression for another of equal value.

factor – a whole number that multiples with another to make a product. A whole number that divides equally into another whole number.

partitioning – splitting a number into its component parts.

product – the result of multiplying numbers together.

remainder – the amount left over when the divisor is not a factor of the number being divided.

sum – the result of an addition.

total – the amount found by addition**.**