

# Priory Junior School

# Written Calculation Policy

December 2014



## Introduction

This policy contains the key written calculation methods that will be taught within our school for calculations that are too large to calculate mentally. It has been written to ensure consistency and progression throughout the school, as the children progress and develop a secure knowledge of number.

Although the main focus of the policy is on pencil and paper procedures it is important to recognise that the ability to calculate mentally lies at the heart of all written methods. The Mathematical National Curriculum aim is that children develop fluency in mathematics, this includes the ability to mentally recall number facts. Mental Calculation strategies need to be taught explicitly to children alongside development of rapid recall of number facts, number bonds and times tables.

Mental calculation is not at the exclusion of written recording and should be seen as complementary to and not as separate from it. In every written method there is an element of mental processing. Written recordings help children to clarify their thinking and extend the development of more fluent and sophisticated mental strategies.

This policy concentrates on the use of standard symbols, the use of the empty number line as a jotting to aid mental calculation and on the pencil and paper procedures. It is important that children do not abandon jottings and mental methods once pencil and paper procedures are secure.

Therefore children will always be encouraged to look at a calculation/problem and then decide which the best methods to choose are -

- Mental
- Calculation with or without jottings
- Written methods



## ADDITION - Year 3

### The National Curriculum Statutory requirements:

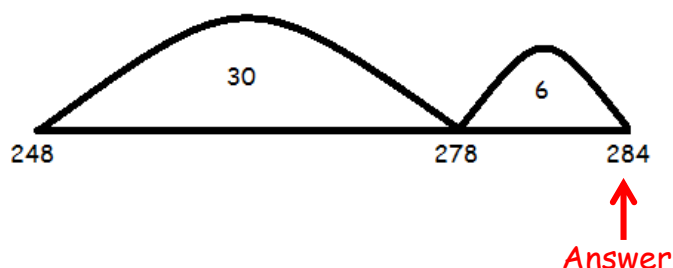
- Add numbers with up to three digits, using formal written methods.
- Estimate the answers to a calculation and use inverse operations to check answers.
- Solve problems, including missing number problems, using number facts, place value, and more complex addition.

Children will start off by using a number line to add numbers together, once they have a secure place value understanding of adding numbers that cross place values they can progress onto the extended column method.

#### Number line method:

- Children should use a ruler to draw their empty number line,
- Place the first number of the calculation at the start of the line,
- Then add the second number by adding the most significant digit first, (counting on in multiples of 100, 10 and 1's).

$$248 + 36 =$$



#### Extended column method:

- Children should write the numbers from the calculation in columns underneath each other under the correct place value,
- Then add together the numbers in each place value column starting with the units,
- Finally add together the numbers in the middle section again starting with the units.

$$248 + 36 =$$

	H	T	U
	2	4	8
+		3	6
		1	4
		7	0
	2	0	0
	2	8	4

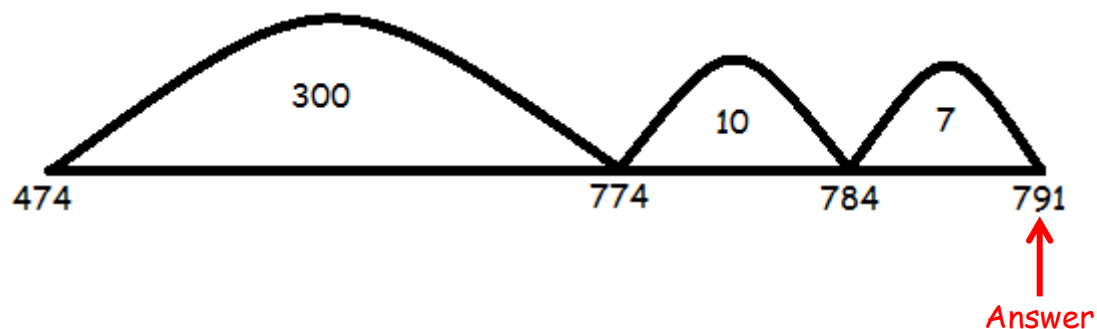
Add mentally starting  
with the smallest value.

Now add the digits from  
the middle section to give  
the answer, again starting  
with the smallest value.



Number line method:

$$474 + 317 =$$



Extended column method:

$$474 + 317 =$$

	H	T	U
	4	7	4
+	3	1	7
		1	1
		8	0
	7	0	0
	7	9	1

Add mentally starting with the smallest value.

Now add the digits from the middle section to give the answer, again starting with the smallest value.



## ADDITION - Year 4

### The National Curriculum Statutory requirements:

- Add numbers with up to four digits, using formal written methods.
- Estimate and use inverse operations to check answers to a calculation.
- Solve addition two-step problems in contexts, deciding which methods to use and why.

Children will use the extended column method to add numbers together.

- Children should write the numbers from the calculation in columns underneath each other under the correct place value,
- Then add together the numbers in each place value column start with the smallest value,
- Finally add together the numbers in the middle section again starting with the units.

$$587 + 475 =$$

Th	H	T	U
	5	8	7
+	4	7	5
<hr/>			
		1	2
	1	5	0
	9	0	0
<hr/>			
1	0	6	2

Add mentally starting with the smallest value.

Now add the digits from the middle section to give the answer, again starting with the smallest value.

$$7,587 + 1,675 =$$

	Th	H	T	U
	7	5	8	7
+	1	6	7	5
<hr/>				
			1	2
		1	5	0
	1	1	0	0
	8	0	0	0
<hr/>				
	9	2	6	2



## ADDITION - Year 5

### The National Curriculum Statutory requirements:

- Add whole numbers with more than four digits, using formal written methods.
- Use rounding to check answers to calculations and determine, in the context of a problem, levels of accuracy.

Children will use the extended column method to add numbers together, once they have a secure place value understanding of adding larger numbers they can progress onto the carry column method.

#### Extended column method:

- Children should write the numbers from the calculation in columns underneath each other under the correct place value,
- Then add together the numbers in each place value column starting with the units,
- Finally add together the numbers in the middle section again starting with the units.

$$6,748 + 3,486 =$$

	Th	H	T	U
	6	7	4	8
+	3	4	8	6
			1	4
		1	2	0
	1	1	0	0
	9	0	0	0
1	0	2	3	4

Add mentally starting with the smallest value.

Now add the digits from the middle section to give the answer, again starting with the smallest value.

#### Carry column method:

- Children should write the numbers from the calculation in columns underneath each other, under the correct place value,
- Then add together the numbers in each place value column starting with the units, for any place value added that crosses the boundaries you carry the value over to the next place value, writing the number below.

$$6,748 + 3,486 =$$

	Th	H	T	U
	6	7	4	8
+	3	4	8	6
1	0	2	3	4
	1	1	1	



$$724.90 + 497.25 =$$

	H	T	U	.	th	h
	7	2	4	.	9	0
+	4	9	7	.	2	5
			0	.	0	5
			1	.	1	0
		1	1	.	0	0
	1	1	0	.	0	0
1	1	0	0	.	0	0
1	2	2	2	.	1	5

$$724.90 + 497.25 =$$

	H	T	U	.	t	h
	7	2	4	.	9	0
+	4	9	7	.	2	5
1	2	2	2	.	1	5
	1	1	1			



## ADDITION - Year 6

### The National Curriculum Statutory requirements:

- Solve addition multi-step problems in contexts, deciding which methods to use and why.
- Solve problems involving addition.
- Use estimation to check answers to calculations and determine, in the context of a problem, an appropriate degree of accuracy.

Children will use the carry column method to add numbers together; providing they have developed a secure understanding of place value. For any child who has not developed this level of understanding please revert back to the extended column method to add numbers together.

### Carry column method:

- Children should write the numbers from the calculation in columns underneath each other under the correct place value,
- Then add together the numbers in each place value column starting with the units, for any place value added that crosses the boundaries you carry the value over to the next place value, writing the number below, e.g.  
 $2 + 9 = 11$ , 1 is put in the units column and a 1 is put above the tens column. The 1 represents 1 ten (10).

$$685,972 + 472,850 =$$

	H	Th	T	Th	H	T	U
	6	8	5	9	7	2	
+	5	2	6	8	7	9	
	1	2	1	2	8	5	1
	1	1	1	1	1		





$$58,124.90 + 6,307.15 =$$

			H	T	U	.	t	h
	5	8	1	2	4	.	9	0
+		6	3	0	7	.	2	5
	6	4	4	3	2	.	1	5
	1			1	1			



## SUBTRACTION - Year 3

### The National Curriculum Statutory requirements:

- Subtract numbers with up to three digits, using formal written methods.
- Estimate the answers to a calculation and use inverse operations to check answers.
- Solve problems, including missing number problems, using number facts, place value, and more complex subtraction.

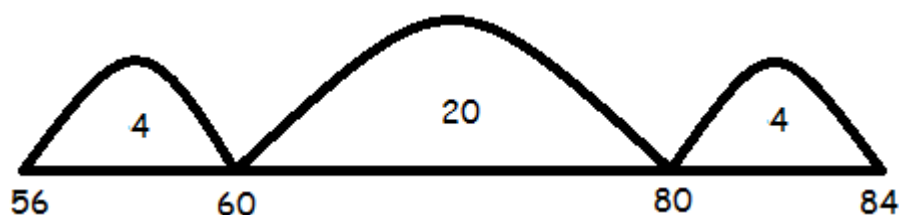
Children will use a number line to subtract numbers.

Children need to understand the vocabulary for Subtraction, especially the importance of knowing that subtraction doesn't mean just take away but also finding the difference.

- Using their understanding of the difference between taking away and finding the difference, children decide which method is the most sufficient to answer the calculation.
- Children should use a ruler to draw their empty number line,
- Find the difference: Place the first number of the calculation at the start of the line and the second number at the end of the line, then calculate the difference between the numbers by rounding to the nearest unit/tens/hundreds/etc number, finally add the jumps together mentally to find the answer.
- Take away: Place the first number of the calculation at the start of the line, then take away the second number.

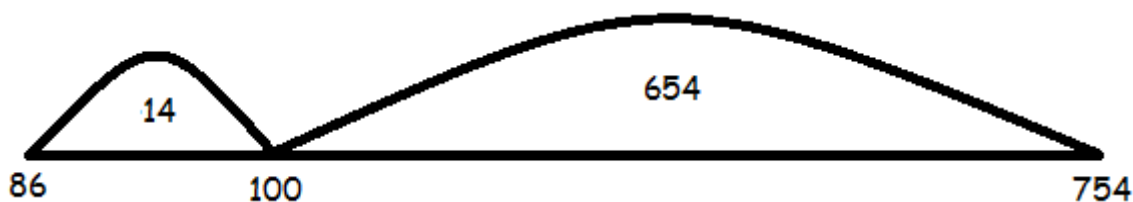
### Finding the difference method:

$$84 - 56 =$$



Children to mentally add up the jumps-  $4 + 20 + 4 = 28$

$$754 - 86 =$$

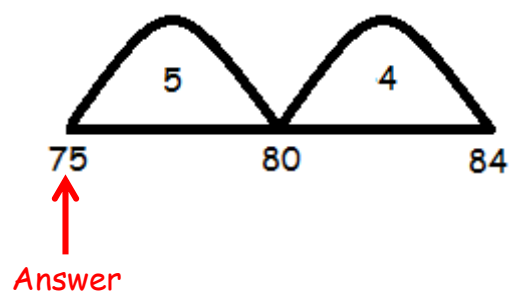


Children to mentally add up the jumps-  $654 + 14 = 668$

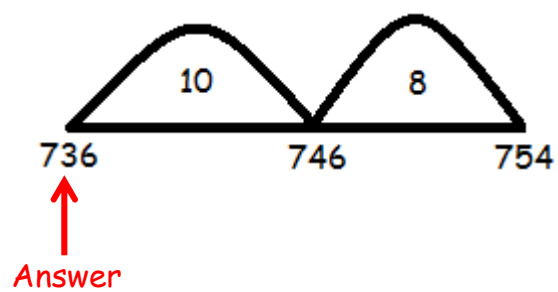


Take away method:

$$84 - 9 =$$



$$754 - 18 =$$





## SUBTRACTION - Year 4

### The National Curriculum Statutory requirements:

- Subtract numbers with up to four digits, using formal written methods.
- Estimate and use inverse operations to check answers to a calculation.
- Solve subtraction two-step problems in contexts, deciding which methods to use and why.

Children will use a number line to subtract numbers.

*Children have learnt that when subtracting a larger number from a number finding the difference on a number line is the most sufficient method.*

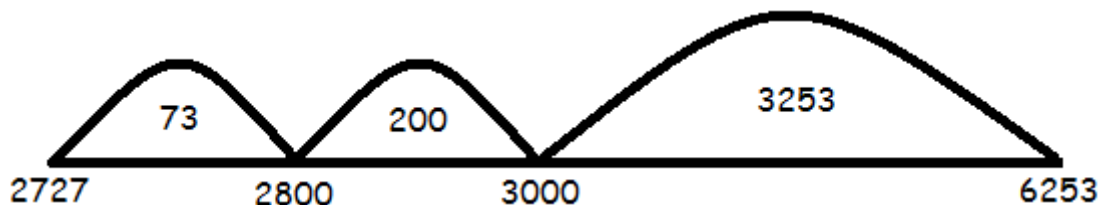
- Children should use a ruler to draw their empty number line,
- Place the first number of the calculation at the start of the line and the second number at the end of the line,
- Then calculate the difference between the numbers by rounding to the nearest unit/tens/hundreds/etc number,
- Finally add the jumps together mentally to find the answer.

$$754 - 386 =$$



*Children to mentally add up the jumps-  $354 + 14 = 368$*

$$6,253 - 2,727 =$$



*Children to mentally add up the jumps-  $3253 + 200 + 73 = 3,526$*



## SUBTRACTION - Year 5

### The National Curriculum Statutory requirements:

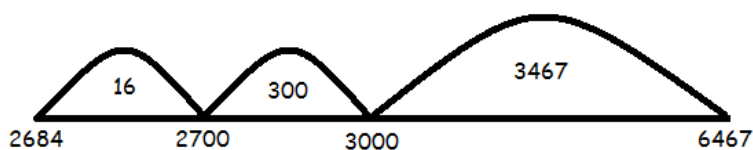
- Subtract whole numbers with more than four digits, using formal written methods.
- Use rounding to check answers to calculations and determine, in the context of a problem, levels of accuracy.
- Solve subtraction multi-step problems in context, deciding methods to use and why.

Children will use the number line method to subtract numbers, once they have a secure place value understanding of subtracting larger numbers they can progress onto the expanded column method.

#### Number line method:

- Children should use a ruler to draw their empty number line,
- Place the first number of the calculation at the start of the line and the second number at the end of the line,
- Then calculate the difference between the numbers by rounding to the nearest unit/tens/hundreds/etc number,
- Finally add the jumps together mentally to find the answer.

$$6,467 - 2,684 =$$



Children to mentally add up the jumps-  $3467 + 300 + 16 = 3,783$

#### Expanded Column method:

- Children should write the numbers from the calculation in columns underneath each other, in full place value (e.g. 34 as 30 and 4), under the correct place value,
- Children to be taught that you subtract the top number from the bottom number, starting with the smallest value,
- Children will also be taught that if subtracting the top number from the bottom results in a negative number then they need to increase the value to give a positive answer instead.
- This is done by taking a unit, ten, hundred, etc, from the next biggest place value.

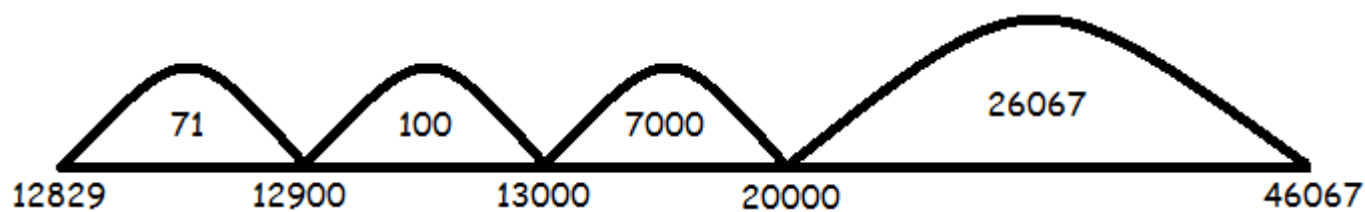
$$6,467 - 2,684 =$$

	5000	1300	160				
	<del>6000</del>	<del>400</del>	<del>60</del>	7			
-	2000	600	80	4			
	3000	700	80	3	=	3783	



Number line method:

$$46,067 - 12,829 =$$



*Children to mentally add up the jumps-  $26067 + 7000 + 100 + 71 = 33238$*

Expanded Column method:

$$46,067 - 12,829 =$$

			5000		50				
	40000	<del>6000</del>	1000	0	<del>60</del>	17			
-	10000	2000	800	20	9				
	30000	3000	200	30	8	= 33238			



## SUBTRACTION - Year 6

### The National Curriculum Statutory requirements:

- Solve subtraction multi-step problems in contexts, deciding which methods to use and why.
- Solve problems involving subtraction.
- Use estimation to check answers to calculations and determine, in the context of a problem, an appropriate degree of accuracy.

Children will use the expanded column method to subtract numbers, once they have a secure understanding of subtracting larger numbers by taking from larger units so the answer is not a negative, they can progress onto the combined column method.

#### Expanded Column method:

- Children should write the numbers from the calculation in columns underneath each other, in full place value (e.g. 34 as 30 and 4), under the correct place value,
- Children to be taught that you subtract the top number from the bottom number, starting with the smallest value,
- Children will also be taught that if subtracting the top number from the bottom results in a negative number then they need to increase the value to give a positive answer instead.
- This is done by taking a unit, ten, hundred, etc, from the next biggest place value.

#### Combined Column method:

- Children should write the numbers from the calculation in columns underneath each other,
- Children to be taught that you subtract the top number from the bottom number, starting with the smallest value,
- Children will also be taught that if subtracting the top number from the bottom results in a negative number then they need to increase the value to give a positive answer instead.
- This is done by taking a unit, ten, hundred, etc, from the next biggest place value.



$$267,354 - 59,192 =$$

### Combined Column method:

$$267,354 - 59,192 =$$

Combined Column method:

$$6,303,534 - 3,148,371 =$$

*When children are subtracting a number from 0, encourage the children to combine the number with the next column to the left, e.g.*

*Instead of taking from the larger column twice*

## Priory Junior School



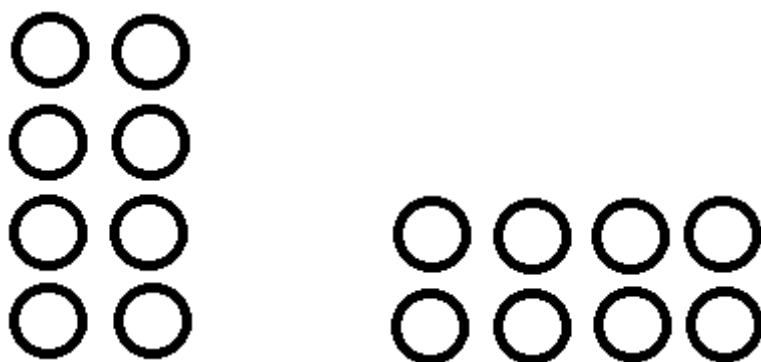


# Multiplication

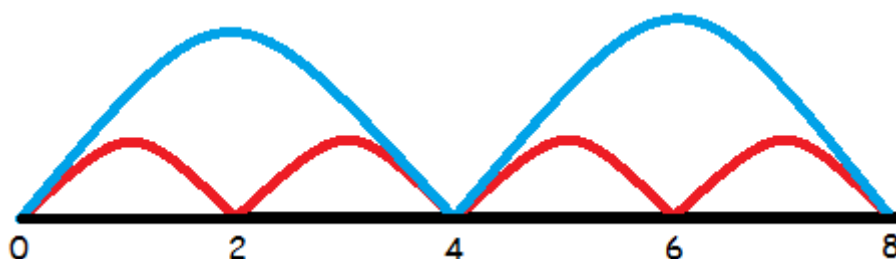
Children have been developing their partitioning skills and using arrays to secure their understanding of multiplication. In Year 2 the children used both arrays and repeated addition to clarify their understanding of multiplication.

Children need lots of practical visual stimulus to support their learning.

$$2 \times 4 = (\text{is the same as}) 4 \times 2 =$$



Displayed as repeated addition:  $2 \times 4$  or  $2 + 2 + 2 + 2 =$



As the children develop a secure knowledge of sharing for multiplication they should begin to see how the sharing method will convert to the grid method.

$$12 \times 4 = 48$$

$\times$	10	2
4		



## MULTIPLICATION - Year 3

### The National Curriculum Statutory requirements:

- Write and calculate mathematical statements for multiplication and *division* using the multiplication tables that they know, including for two-digit numbers times one-digit numbers, using mental and progressing to formal written methods.
- Solve problems, including missing number problems, involving multiplication and *division*, including positive integer scaling problems and correspondence problems in which  $n$  objects are connected to  $m$  objects.

Children will use the grid method to multiply numbers together.

- Children should use a ruler to draw their grid,
- Each number in the calculation is partitioned and put into its own row/column. (The children will understand that when multiplying 2 numbers the calculation can be carried out in either order)
- Each section is separately multiplied together.
- Then add the answers together mentally where possible to give the overall answer.

$$34 \times 5 =$$

x	30	4			
5	150	20		=	170

$$8 \times 32 =$$

x	30	2			
8	240	16		=	256



## MULTIPLICATION - Year 4

### The National Curriculum Statutory requirements:

- Multiply two-digit and three-digit numbers using formal written layout.
- Solve problems involving multiplying and adding, including using the distributive law to multiply two digit numbers by one digit, integer scaling problems and harder correspondence problems such as n objects are connected to m objects.

Children will use the grid method to multiply numbers together.

- Children should use a ruler to draw their grid,
- Each number in the calculation is partitioned and put into its own row/column. (The children will understand that when multiplying 2 numbers the calculation can be carried out in either order)
- Each section is separately multiplied together.
- Then add the answers together mentally where possible to give the overall answer.

$$492 \times 3 =$$

x	400	90	2			
3	1200	270	6	=	1476	

$$13 \times 29 =$$

x	20	9			
10	200	90		290	
3	60	27		+ 87	
				= 377	



## MULTIPLICATION - Year 5

### The National Curriculum Statutory requirements:

- Multiply numbers up to 4 digits by a one- or two-digit number using a formal written method, including long multiplication for two-digit numbers.
- Multiply whole numbers and those involving decimals by 10, 100 and 1000.
- Solve problems involving multiplication and *division* including using their knowledge of factors and multiples, squares and cubes.
- Solve problems involving *addition*, *subtraction*, multiplication and *division* and a combination of these, including understanding the meaning of the equals sign.
- Solve problems involving multiplication and *division*, including scaling by simple fractions and problems involving simple rates.

Children will use the grid method to multiply numbers together.

- Children should use a ruler to draw their grid,
- Each number in the calculation is partitioned and put into its own row/column. (The children will understand that when multiplying 2 numbers the calculation can be carried out in either order)
- Each section is separately multiplied together.
- Then add the answers together mentally where possible to give the overall answer.

$$6864 \times 4 =$$

x	6000	800	60	4			
4	24000	3200	240	16	=	27456	



## MULTIPLICATION - Year 6

### The National Curriculum Statutory requirements:

- Multiply multi-digit numbers up to 4 digits by a two-digit whole number using the formal written method of long multiplication.
- Identify common factors, common multiples and prime numbers.
- Use their knowledge of the order of operations to carry out calculations involving the four operations.
- Solve problems involving *addition*, *subtraction*, multiplication and *division*.
- Use estimation to check answers to calculations and determine, in the context of a problem, an appropriate degree of accuracy.

Children will use the grid method to multiply numbers together; once they have a secure place value understanding and times table recall they can progress onto the long multiplication method.

#### Grid method:

- Children should use a ruler to draw their grid,
- Each number in the calculation is partitioned and put into its own row/column. (The children will understand that when multiplying 2 numbers the calculation can be carried out in either order)
- Each section is separately multiplied together.
- Then add the answers together mentally where possible to give the overall answer.

#### Long multiplication method:

- Children should write the numbers from the calculation in columns underneath each other, under the correct place value,
- Then multiply together the numbers in each place value column starting with the units and write the answer below.
- Finally add the middle section together to get the overall answer.



Grid method:

$$5484 \times 26 =$$

x	5000	400	80	4				
20	100000	8000	1600	80		109680		
6	30000	2400	480	24		+ 32904		
						142584		
						1 1		

Long multiplication method:

		6	8	6	4				
x					4				
				1	6	← 4 x	4		
			2	4	0	← 4 x	60		
		3	2	0	0	← 4 x	800		
+	2	4	0	0	0	← 4 x	6000		
	2	7	4	5	6				

	6	8	6	4
x				4
	2	7 <sup>3</sup>	4 <sup>2</sup>	5 <sup>1</sup> 6

*Teacher to model the transition from the grid method to long multiplication method set out as above.*

$$5484 \times 26 =$$

			5	4	8	4
		x			2	6
		3	2 <sup>2</sup>	9 <sup>5</sup>	0 <sup>2</sup>	4
+	1	0	9 <sup>1</sup>	6	8	0
	1	4 <sup>1</sup>	2 <sup>1</sup>	5	8	4



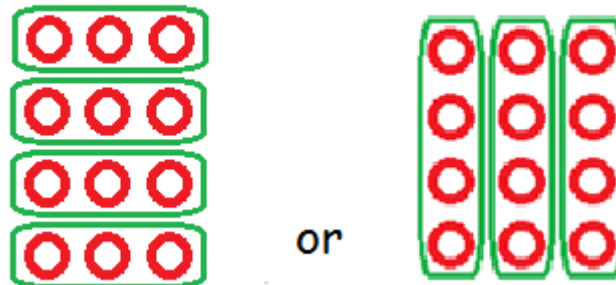
# Division

Children have been developing their grouping and sharing skills for dividing. In Year 2 the children use the number line and images of items being grouped to show their understanding of division.

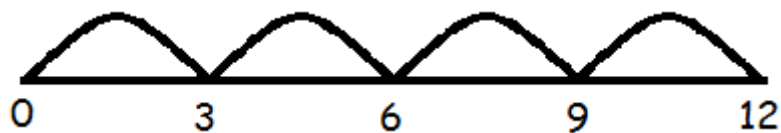
Children need lots of practical visual stimulus to support their learning.

$$12 \div 3 = 4$$

$$12 \div 3 =$$



Children use objects to divide them into equal groups.



Children can then use a number line, starting at 12 and jumping back in 3's each time to 0.



## DIVISION - Year 3

### The National Curriculum Statutory requirements:

- Write and calculate mathematical statements for *multiplication* and division using the multiplication tables that they know, including for two-digit numbers times one-digit numbers, using mental and progressing to formal written methods.
- Solve problems, including missing number problems, involving *multiplication* and division, including positive integer scaling problems and correspondence problems in which  $n$  objects are connected to  $m$  objects.

Children will use a vertical number line to divide by calculating multiplies of the divisor.

- Children should use a ruler to draw their vertical number line,
- Place the first number of the calculation at the top of the number line,
- Then use the divisor number to find multiplies closest to the number at the top of the number line.
- This method requires children to use their mental calculations in line with recording their findings. (e.g. dividing 72 by 3, we know  $3 \times 10 = 30$  but 30 isn't anywhere near 72, so let's go bigger,  $3 \times 20 = 60$  this is near 72, so we write this one down.)
- Having noted down a multiplication, work out how much more is needed to get to the starting number. (72, we have made 60 so we need to make 12.)
- Then circle the numbers that were multiplied by the divisor to get the answer.

$$56 \div 4 =$$

			56
10	$\times 4 =$	40	
		16	
4	$\times 4 =$	16	
		0	
	$= 14$		





$$73 \div 3 =$$

			73
20	x 3 =	60	
		13	
4	x 3 =	12	
		1	
= 24 r 1			



## DIVISION - Year 4

### The National Curriculum Statutory requirements:

- *There is no written division requirements set out in the Year 4 National Curriculum - Number: Multiplication and Division. However division should still be taught this year, giving children opportunity to develop their ability to use the vertical number line to calculate division questions.*

Children will use a vertical number line to divide by calculating multiplies of the divisor.

- Children should use a ruler to draw their vertical number line,
- Place the first number of the calculation at the top of the number line,
- Then use the divisor number to find multiplies closest to the number at the top of the number line.
- This method requires children to use their mental calculations in line with recording their findings. (e.g. dividing 72 by 3, we know  $3 \times 10 = 30$  but 30 isn't anywhere near 72, so let's go bigger,  $3 \times 20 = 60$  this is near 72, so we write this one down.)
- Having noted down a multiplication, work out how much more is needed to get to the starting number. (72, we have made 60 so we need to make 12.)
- Then circle the numbers that were multiplied by the divisor to get the answer.

$$96 \div 4 =$$

				96
20	$\times 4 =$			80
				16
4	$\times 4 =$			16
				0

= 24



$$126 \div 6 =$$

			126
20	$\times 6 =$	120	
		6	
1	$\times 6 =$	6	
		0	
	$= 21$		

$$125 \div 4 =$$

			125
30	$\times 4 =$	120	
		5	
1	$\times 4 =$	4	
		1	
	$= 31 \text{ r } 1$		



## DIVISION - Year 5

### The National Curriculum Statutory requirements:

- Divide numbers up to 4 digits by a one-digit number using a formal written method of short division and interpret remainders appropriately for the context.
- Divide whole numbers and those involving decimals by 10, 100 and 1000.
- Solve problems involving *multiplication* and division including using their knowledge of factors and multiples, squares and cubes.
- Solve problems involving *addition, subtraction, multiplication* and division and a combination of these, including understanding the meaning of the equals sign.
- Solve problems involving *multiplication* and division, including scaling by simple fractions and problems involving simple rates.

Children will use the vertical number line to divide by calculating multiplies of the divisor, once they have a secure knowledge of the times tables 0-12 and can mentally recall the answers then they can progress onto the short division method.

#### Vertical number line method:

- Children should use a ruler to draw their vertical number line,
- Place the first number of the calculation at the top of the number line,
- Then use the divisor number to find multiplies closest to the number at the top of the number line.
- This method requires children to use their mental calculations in line with recording their findings. (e.g. dividing 72 by 3, we know  $3 \times 10 = 30$  but 30 isn't anywhere near 72, so let's go bigger,  $3 \times 20 = 60$  this is near 72, so we write this one down.)
- Having noted down a multiplication, work out how much more is needed to get to the starting number. (72, we have made 60 so we need to make 12.)
- Then circle the numbers that were multiplied by the divisor to get the answer.

#### Short division method:

- Children should write the divisor number from the calculation first followed by the number to be divided, and then draw a line between these two numbers and on top of the number to be divided.
- Then take the largest number to be divided and calculate how many times the divisor fits into this number.
- Write the answer above that number in the correct place value column. If there is a remainder write this next to the number on the right.
- Continue until you have completed the calculation.





## DIVISION - Year 6

### The National Curriculum Statutory requirements:

- Multiply multi-digit numbers up to 4 digits by a two-digit whole number using the formal written method of long multiplication.
- Identify common factors, common multiples and prime numbers.
- Use their knowledge of the order of operations to carry out calculations involving the four operations.
- Solve problems involving *addition, subtraction, multiplication and division*.
- Use estimation to check answers to calculations and determine, in the context of a problem, an appropriate degree of accuracy.

Children will use the vertical number line to divide by calculating multiples of the divisor, once they have a secure knowledge of the times tables 0-12 and can mentally recall the answers then they can progress onto the short division method.

#### Vertical number line method:

- Children should use a ruler to draw their vertical number line,
- Place the first number of the calculation at the top of the number line,
- Then use the divisor number to find multiples closest to the number at the top of the number line.
- This method requires children to use their mental calculations in line with recording their findings. (e.g. dividing 72 by 3, we know  $3 \times 10 = 30$  but 30 isn't anywhere near 72, so let's go bigger,  $3 \times 20 = 60$  this is near 72, so we write this one down.)
- Having noted down a multiplication, work out how much more is needed to get to the starting number. (72, we have made 60 so we need to make 12.)
- Then circle the numbers that were multiplied by the divisor to get the answer.

#### Short division method:

- Children should write the divisor number from the calculation first followed by the number to be divided, and then draw a line between these two numbers and on top of the number to be divided.
- Then take the largest number to be divided and calculate how many times the divisor fits into this number.
- Write the answer above that number in the correct place value column. If there is a remainder write this next to the number on the right.
- Continue until you have completed the calculation.



### Vertical number line method:

$$4118 \div 9 =$$

				4118
400	x	9	=	3600
				518
50	x	9	=	450
				68
7	x	9	=	63
				5
<b>= 457 r 5</b>				

$$497 \div 14 =$$

				497
30	x	14	=	420
				77
5	x	14	=	70
				7
<b>= 35 r <math>\frac{7}{14}</math></b>				

### Short division method:

$$4118 \div 9 =$$

		0	4	5	7	r5
9	)	4	1	1	8	

$$497 \div 14 =$$

		0	3	5	r $\frac{7}{14}$
14	)	4	9	7	