KINGSMOOR PRIMARY SCHOOL

Guide to Calculation

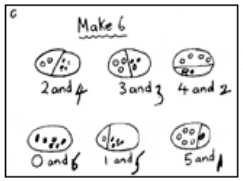
This "Guide to Calculation" was compiled by Mrs S Harris (Maths Coordinator) in collaboration with colleagues from Kingsmoor Primary School to reflect the change in mathematics curriculum from September 2014.

The booklet illustrates the different calculation methods that are taught across the school and how each method builds on skills previously learnt. The booklet also specifies the type of calculation expected by the end of each school year. However it is important to remember that this guide to calculation is a progression of understanding and skills and as a result, children move on to the next stage of calculation when they are ready rather than at a specific age.

Please contact Kingsmoor Primary School with any enquiries about the use of this material.

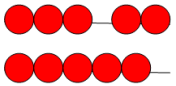
Addition

Addition as combining sets of objects.
Reception



Initially children use objects such as counters, cars etc and put them together for addition. At first they count each object. Then they remember how many are in the first group of objects and count on. They develop ways of recording calculations using pictures.

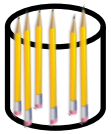
In school we use Numicon to help children picture a number. They can see how the number shapes fit together to make other numbers.

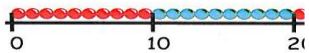


We also use bead strings to combine groups of objects which later leads to the use of a number line.

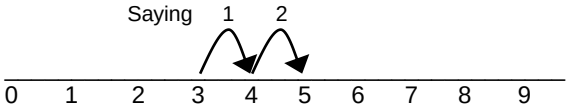
Addition as counting on from a number less than 20
Reception / Year 1

Children use objects, number lines / number tracks and bead strings. They find the largest number and count on from that.

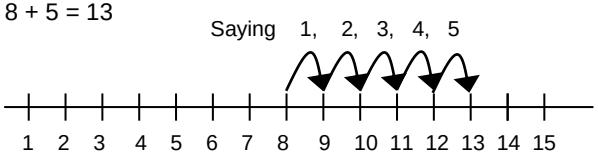




3 + 2 = 5



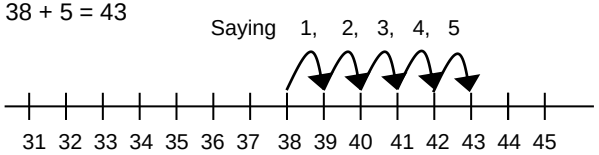
8 + 5 = 13



Addition as counting on from any number
Year 1 / Year 2

Children use a number line to count on. They then draw their own number line to count on in ones from any number to 100.

38 + 5 = 43

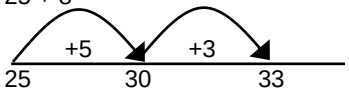


Addition by getting to the next ten and counting on
Year 2

Children need to know pairs of numbers that go together to make any ten e.g. 43 + 7 = 50 and number bonds up to 10 e.g. 3 + 4 = 7. They use this to add numbers by getting to the next ten. A bead string / beaded number line helps to visualise this at first.

Children then begin to record this on an empty number line drawn by themselves.

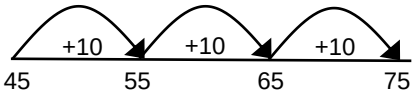
25 + 8



Addition of 2 digit numbers and tens
Year 2

Children first count in tens from any number and use this to add tens to any 2 digit number. They use an empty number line drawn by themselves.

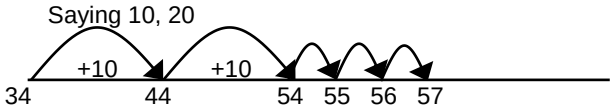
45 + 30



Addition of 2 digit numbers
Year 2

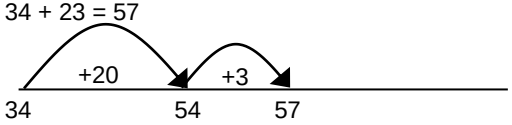
Children use an empty number line to count on in tens from the largest number and then count on in ones.

34 + 23 = 57



They then do this by using number facts; not just counting in 1s or 10s.

34 + 23 = 57



Children can also use the skill of getting to the next ten to add 2 digit numbers.

Addition of 2 digit numbers using partitioning
Year 2

Children must have a confident understanding of what each digit is worth in a number so that they can split a number into tens and ones. At this stage children should be able to use simple number facts with tens rather than counting (e.g. 30 + 40 using 3 + 4).

34 + 52

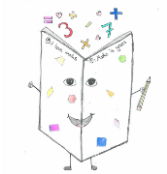
	30	4			
+	50	2			
	80	6	=	86	

Children use the known number fact of 3 + 5 = 8 to work out 30 + 50 = 80.

The same method can be used when the ones total more than 10.

	30	7							
+	50	8							
	80	15	=	80	+	10	+	5	=	95

This can be extended to include addition of 3 digit and 2 digit numbers.



Addition of 2 digit numbers
Year 3

Children must have a confident understanding of what each digit is worth in a number so that they can look at a digit and know whether it is worth hundreds, tens or ones.

They should be able to use number facts with answers up to 20 with multiples of ten (e.g. 70+80=150 using 7+8=15)

```
  6  7
+ 2  4
  1  1
  8  0
  9  1
```

+ the ones first then the tens.

At this stage children record the answer to 7 + 4 as 11 using known number facts without 'carrying' the ten.

Addition in columns
Year 3

At this stage the children begin to use the standard method for addition and so 'carry' the ten.

```
  6  7
+ 2  4
  9  1
  1
```

Estimating

It is important that children use rounding to give them some sense of roughly what the answer should be. When adding 2 digit numbers, the children round to the nearest ten.

67 + 24 estimate 70 + 20 = 90

Addition of 3 digit numbers
Year 3

Initially the children may use the following method to secure their understanding of what each digit is worth in 3 digit numbers before moving on to the more compact method.

443 + 354

```
  400   40   3
+ 300   50   4
  700   90   7   =   797
```

Leading to:

```
  4  4  3
+ 3  5  4
        7
     9  0
  7  0  0
  7  9  7
```

+ the ones first then the tens & then the hundreds.

Again at this stage children record the answers to each sum and write that in the correct columns rather than carrying.

Estimating

When adding 3 digit numbers the children round to the nearest hundred.

267 + 385 estimate 300 + 400 = 700

Addition in columns
Year 4

At this stage the children begin to use the standard method for addition and so 'carry' the ten or hundred.

```
  4  8  6
+ 3  5  7
  8  4  3
  1  1
```

Once they are confident in this method, it is extended to include 4 digit numbers.

```
  3  5  1  7
+ 2  6  5  4
  6  1  7  1
  1     1
```

Estimating

When adding 4 digit numbers the children round to the nearest thousand.

3517 + 2654 estimate 4000 + 3000 = 7000

Addition in columns
Year 5

Children now use the standard method for addition with 4 or more digits and decimal numbers with up to 2 decimal places.

```
  4  8  5  1  7
+ 3  2  9  5  6
  8  1  4  7  3
  1  1     1
```

```
  5  2  .  3  7
+ 3  6  .  7  4
  8  9  .  1  1
     1     1
```

Estimating

When adding decimal numbers children use the whole numbers to decide whether to round to the nearest one, ten, hundred or thousand.

52.37 + 36.74 estimate 50 + 40 = 90

Addition in columns
Year 6

Children now use the standard method for addition with 4 or more digits and decimal numbers with up to 3 decimal places.

```
  3  5  2  .  3  7  5
+ 2  3  6  .  7  4  6
  5  8  9  .  1  2  1
        1     1  1
```

Estimating

When adding decimal numbers children use the whole numbers to decide whether to round to the nearest one, ten, hundred or thousand.

352.37 + 236.74 estimate 400 + 200 = 600

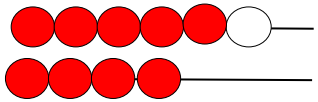
Subtraction

Subtraction as taking objects away.
Reception

Initially children use objects such as counters, cars etc and take some away from a larger group. They count the number of objects, remove some and count what is left. They develop ways of recording calculations using pictures.

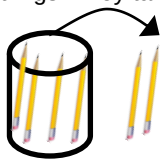
In school we use Numicon to help children picture a number. They cover up parts of a number to picture taking away. 5 – 2 cover up the bottom 2 holes leaving just 3 visible.

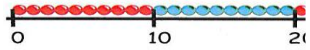
We also use bead strings to take away objects which later leads to the use of a number line.



Subtraction as counting back from a number less than 20
Reception / Year 1

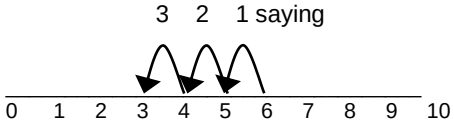
Children use objects, number lines / number tracks and bead strings. They take away objects from a set.



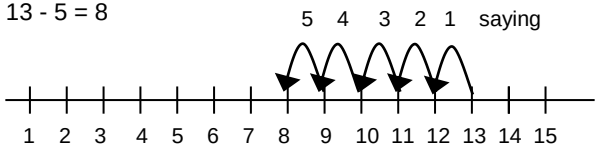


Children use number lines / tracks by finding and saying the largest number and counting back from that. It is important that they count back as they jump.

6 - 3 = 3



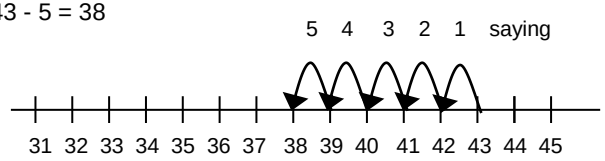
13 - 5 = 8



Subtraction as counting back from any number
Year 1 / Year 2

Children use a number line to count back. They then draw their own number line to count back in ones from any number to 100.

43 - 5 = 38

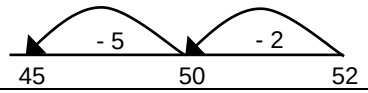


Subtraction by getting to the next ten and counting back

Children need to know pairs of numbers that go together to make any ten e.g. 50 - 7 = 43 and number bonds up to 10 e.g. 7 - 4 = 3. They use this to subtract numbers by getting back to a ten first. A bead string and a beaded number line helps to visualise this.

Children then begin to record this on an empty number line drawn by themselves.

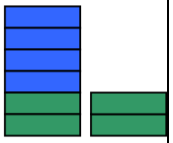
52 - 7 = 45



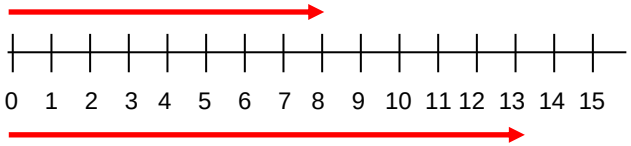
Subtraction as difference
Year 1 / Year 2

Children need to develop an understanding that subtraction can also be seen as finding the difference between 2 numbers and not just take away. The language of more than, less than, fewer than is important.

Children can see difference using towers of bricks / cubes.
How many less than 6 is 2?
How many more than 2 is 6?



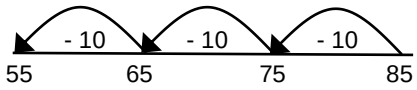
Difference between 13 and 8, 13 - 8. Children would count the gap between the two numbers; count up from 8 to 13.



Subtraction of 2 digit numbers and tens
Year 2

Children first count back in tens from any number and use this to subtract tens from any 2 digit number. They use an empty number line drawn by themselves.

85 - 30

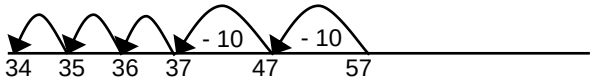


Subtraction of 2 digit numbers
Year 2

Children use an empty number line to count back in tens from the largest number and then count back in ones.

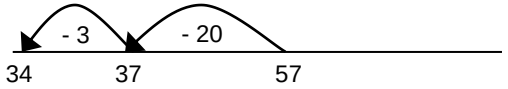
57 - 23 = 34

Saying 10, 20

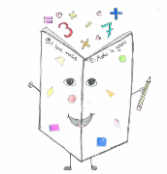


Then using number facts and not just counting in 1s or 10s.

34 - 23 = 57



Children can also use the skill of getting to the next ten to subtract 2 digit numbers.

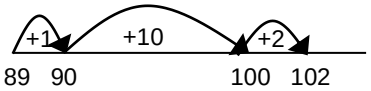


Subtraction as difference
Year 2

At this stage children develop an understanding that subtraction can mean take away or find the difference. The difference is the gap between 2 numbers and can be found by counting on.

Children find the difference when 2 numbers are close to each other.

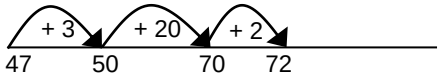
102 - 89 = 13



1 + 10 + 2 = 13

Children also find the difference when you cannot take away the ones.

72 - 47



3 + 20 + 2 = 25

Subtraction as take away using partitioning
Year 2

Children must have a confident understanding of what each digit is worth in a number so that they can split a number into tens and ones. At this stage children should be able to use simple number facts with tens (e.g. 80 - 50 using 8 - 5).

This method is used for numbers where it is possible to take away the ones.

	50	7		
-	20	3		
	30	4	=	34

Subtraction as take away using partitioning
Year 3

This method is only used in Year 3 for numbers where it is possible to take away the ones.

	6	8
-	2	3
	4	5

Where it is not possible to take away the ones for example 63 - 27 children still use a number line to work out the difference between the two numbers.

Subtraction in columns
Year 4

Children now use the standard method for subtraction including exchanging. Initially they apply this method using 2 digit numbers and then use the same method with 3 digit numbers.

	$^{6}\cancel{7}$	$^{1}2$	
-	4	7	
	2	5	

It is important that the children use their understanding of what each digit is worth so that they know the 1 is worth 1 ten and so there are 12 ones

	$^{5}\cancel{6}$	$^{1}\cancel{3}$	^{1}	
-	2	7	8	
	3	6	5	

Estimating

It is important that children use rounding to give them some sense of roughly what the answer should be. When subtracting 2 digit numbers, the children round to the nearest ten. When subtracting 3 digit numbers, they round to the nearest hundred.

67 - 24 estimate 70 - 20 = 50
564 - 238 estimate 600 - 200 = 400

Subtraction in columns
Year 5

Children continue using the standard method for 4 or more digit numbers.

		^{5}	$^{1}2$	^{1}	
	7	$\cancel{6}$	$\cancel{3}$	2	
-	3	4	7	8	
	4	1	5	4	

Estimating

It is important that children use rounding to give them some sense of roughly how big the answer should be. When subtracting 4 digit numbers, the children round to the nearest thousand.

7632 - 3478 estimate 8000 - 3000 = 5000

Subtraction in columns
Year 5

Children continue to use the standard method using decimals up to 2 decimal places.

	$^{7}\cancel{8}$	$^{1}\cancel{5}$	.	$^{1}\cancel{4}$	^{1}	
-	3	6	.	6	8	
	4	8	.	7	6	

Estimating

When subtracting decimal numbers children use the whole numbers to decide whether to round to the nearest one, ten, hundred or thousand.

85.44 - 36.68 estimate 90 - 40 = 50

Subtraction in columns
Year 6

Children continue to use the standard method using decimals up to 3 decimal places.

	$^{7}\cancel{8}$	$^{1}\cancel{6}$	.	$^{1}\cancel{5}$	^{1}	
-	3	9	.	8	9	3
	4	7	.	7	6	2

Estimating

When subtracting decimal numbers children use the whole numbers to decide whether to round to the nearest one, ten, hundred or thousand.

85.44 - 36.68 estimate 90 - 40 = 50

Multiplication

Multiplication as counting objects in groups
Reception and Year 1

Initially children will count groups of objects in 2s and 10s and later 5s.

2 4 6 8 10

5 10 15 20 25

Children will also count in 2s, 10s and later 5s from zero.

They will also count in 2s, 10s and 5s using coins.

2 4 6 8 10 12

10 20 30 40 50

5 10 15 20 25 30 35

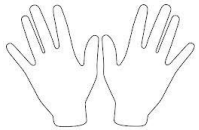
Multiplication as doubling
Reception

Children are introduced to the idea of doubling visually using objects.

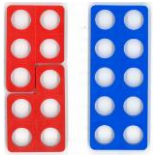
Year 1

Children are first introduced to multiplying by 2 as doubling a number, doing it twice.

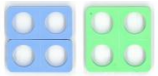
Double 5, 5 + 5, 5 x 2, 5 and 5 more



Numicon is used in school for children to see what doubles look like.



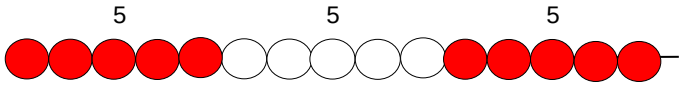
Double 5 is 10



Double 2 is 4

Multiplication as repeated addition
Year 1

Children use objects, pictures and bead strings to count in groups of 2, 10 and 5.

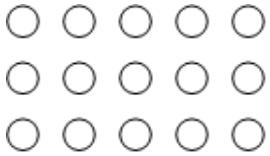


5 5 5

Multiplication as an array
Year 1

Children continue to count in 2s, 10s and 5s and begin to use arrays to show this.

Count in 5s 3 times



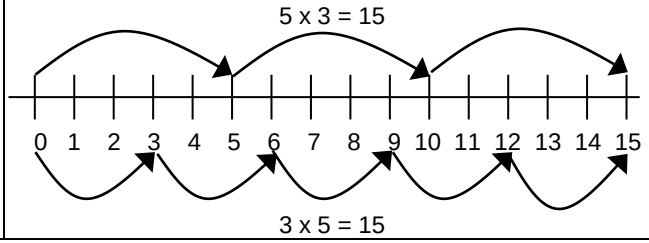
5
10
15

Multiplication as groups of / lots of
Year 2

Children continue to use arrays and are introduced to the idea that multiplication can be done in any order. They link this to jumps on a number line. They use number lines by counting in groups of 2, 10 and 5.

count in 5s 3 times, 5 x 3 = 15

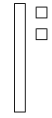
count in 3s 5 times,
3 x 5 = 15



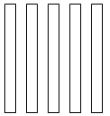
Multiplication of 2 digit numbers using partitioning
Year 2

Children must have a confident understanding of what each digit is worth in a number so that they can split a number into tens and ones.
Partitioning is introduced using Dienes. They multiply the tens and the ones separately.

12 x 5 = 60



12 is 10 + 2



10 x 5 = 5 tens
= 50

2 x 5 = 10

Year 3

	x 8
4	32
30	240
=	272

Children use x table facts and how to make something 10 x larger to multiply by a ten.

Multiplication in columns
Year 3

Children multiply a 2 digit number by a single digit. They use their understanding of what each digit is worth to first multiply the ones and then the tens. At this stage the children record each answer separately and then add them up rather than 'carrying' tens and hundreds.

		3	4
×			8
		3	2
	2	4	0
	2	7	2

Estimating

It is important that children estimate first to give a sense of roughly what the answer will be. The estimate should link to x table knowledge.

34 × 8 estimate 30 × 8 = 240

Multiplication in columns
Year 3

Children then use a standard method for multiplication and carry the tens and hundreds.

		3	4
×			8
	2	7	2
		3	

Multiplication in columns
Year 4

Children use a standard method for multiplication and carry the tens and hundreds.

They multiply a 3 digit number by a single digit.

		3	5	7
×				6
	2	1	4	2
		3	4	

Estimating

It is important that children estimate first to give a sense of roughly what the answer will be. The estimate should link to x table knowledge. For larger numbers children could estimate twice to give an idea of what the answer will lie between.

357 × 6 estimate 300 × 6 = 1800
estimate 400 × 6 = 2400

The answer will be between 1800 and 2400.

Multiplication in columns
Year 5

Children use a standard method for multiplication and carry the tens, hundreds and thousands.

They multiply a 4 digit number by a single digit.

		5	3	6	4
×					7
	3	7	5	4	8
		2	4	2	

Estimating

It is important that children estimate first to give a sense of roughly what the answer will be. The estimate should link to x table knowledge. For larger numbers children could estimate twice to give an idea of what the answer will lie between.

5364 × 7 estimate 5000 × 7 = 3500
estimate 6000 × 7 = 4200

The answer will be between 3500 and 4200.

Multiplication by a 2 digit number in columns
Year 5

Children use the multiplication method that involves carrying. They first multiply by the ones digit and then by the tens digit.

	1	8	
×	1	3	
	5	4	
	~~2~~		
1	8	0	
2	3	4	
1			

The zero is used to indicate that the numbers are multiplied by a ten.

Year 6

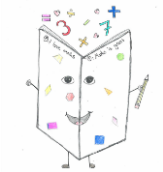
Children use the same method with larger numbers.

		2	6	3
×			3	4
	1	0	5	2
		~~2~~	~~1~~	
	7	8	9	0
	~~1~~			
	8	9	4	2
		1		

Multiplication of decimals in columns
Year 6

Children use the short multiplication method to multiply a decimal number by a single digit. They use up to 3 decimal places.

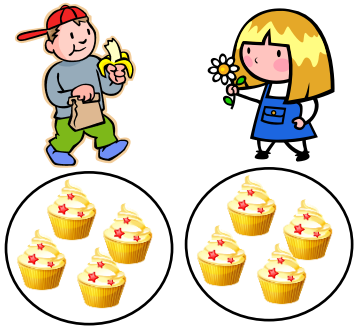
		5	3 .	6	4	5
×			7			
	3	7	5 .	5	1	5
		2	4	3	3	



Division

Division as putting objects in groups or sharing objects
Reception

Initially children put objects into equal groups and share items out in play and problem solving.

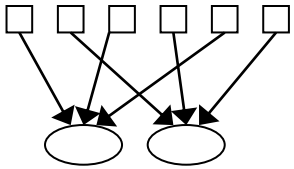


Children are also introduced to the idea of halving using objects.

Division as sharing
Year 1

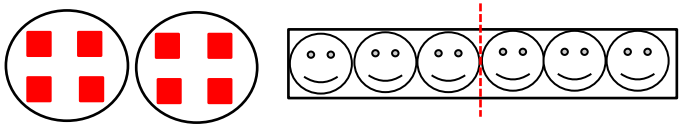
Children use sharing equally to solve division problems. They may use objects or drawings to help them.

6 sweets shared between 2 people, how many do they each get?

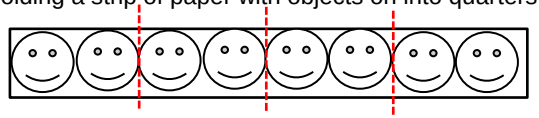


Division as halving
Year 1

Children share objects between 2 people or plates etc to find half. They may also fold in half a strip of paper with objects on.



This can be extended to sharing between 4 to find a quarter or folding a strip of paper with objects on into quarters.

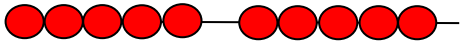


Division as grouping
Year 1

Children put objects into equal groups and then use drawings to help them represent grouping in equal groups.

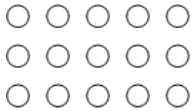
There are 6 sweets, how many people can have 2 sweets each?

Division as grouping can be shown using bead strings saying 1 group of 5, 2 groups of 5 etc. The bead string will help children see 10 ÷ 5 as 'how many 5s make 10?'



Division as arrays
Year 1 and Year 2

An array is used to show objects organised into groups. It is the same image that is used for multiplication to illustrate the link between multiplication and division.



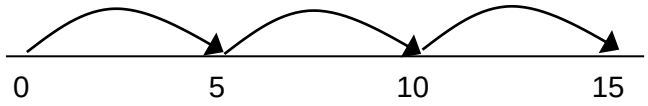
There are 15 circles, count in 5s.
How many 5s are there in 15?
15 ÷ 5 = 3

Division as grouping
Year 2

Division as grouping is also shown on a number line using equal sized jumps. This image is very similar to the image used for multiplication and helps to link division and multiplication together.

15 ÷ 5 = 3 How many jumps of 5 are there in 15?

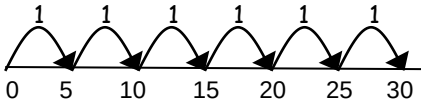
Counting the number of groups of 5 that can be made.



Division as grouping
Year 2

Children draw and use an empty number line to make equal sized jumps.

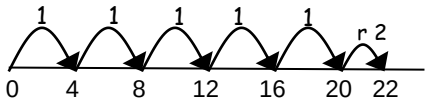
30 ÷ 5 = 5 Saying 1 group of 5, 2 groups of 5 etc

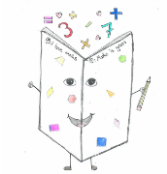


Division with remainders
Year 2

Children continue to use the empty number line drawn by themselves to make equal sized jumps and to show a remainder.

22 ÷ 4 = 5 r 2





Short division
Year 3

In Year 3 children divide a 2 digit number by a single digit and are introduced to the formal method of short division. Initially every number must divide exactly.

```
   3  2
3 | 9  6
```

The children say: “how many 3s in 9?”. They write the answer in the tens column because the 9 is worth 9 tens.

They then say “how many 3s in 6?” and write the answer in the ones column because the 6 is worth 6 ones.

When children are confident in finding a remainder mentally using times table facts, they begin to divide numbers where the first digit does not divide exactly although the whole number will. There should not be a remainder at this stage.

```
   1  8
4 | 7  32
```

The children say “how many 4s in 7?” There is 1 and 3 left so the 3 tens are carried over to make 32. They then ask “how many 4s are there in 32?”

Short division
Year 4

Children divide a 3 digit number by a single digit using the method of short division. Initially the numbers used should not give a remainder.

```
   2  1  8
4 | 8  7  32
```

The children say: “how many 4s in 8?”. They write the answer in the hundreds column because the 8 is worth 8 hundreds.

```
   0  3  7
5 | 1  18 35
```

The children say: “how many 5s in 1?”. They write 0 in the hundreds column and the 1 hundred is carried over into the tens column.
The 0 is used to keep everything in the right place.

Short division
Year 5

Children divide a 4 digit number by a single digit. The numbers used initially do not give a remainder.

```
      6  6  3
8 | 5  53 50 24
```

As children are now more confident with this method, they no longer need to use a 0 to keep everything in the right place.

Short division with a remainder
Year 5

Children are now introduced to short division using a remainder. The remainder can be written as a number, a fraction or a decimal whichever is the most appropriate for the numbers involved.

```
      6  6  3  r 5
8 | 5  53 50 29
```

```
      1  3  2  7  ¼
4 | 5  13 10 29
```

```
      8  6  2  .  8
5 | 4  43 31 14 .  40
```

Short division with a remainder
Year 6

Children divide numbers that are at least 4 digits by a single digit. They continue to find remainders and record them as a number, a fraction or a decimal whichever is the most appropriate for the numbers involved.

```
      8  1  2  .  1  2  5
8 | 6  64 9  17 .  10 20 40
```

Long division
Year 6

This method relies on the children being able to identify multiples of 2 digit numbers. The children list the 4 key facts of 1x, 2x, 5x and 10x to help them identify which multiples to use.

```
         2  7
3  6 | 9  7  2
   -    7  2  0    (20x)
        2  5  2
   -    1  8  0    (5x)
           7  2
   -       7  2    (2x)
              0
```

1 x = 36
2 x = 72
5 x = 180
10 x = 360