Ashlands Primary School

Calculation Strategies

A guide for parents

INTRODUCTION

In this booklet you will see a variety of ways of working out different calculations.
The booklet is designed to explain how some of the different methods of calculating are being taught in school.
Although the methods may look different to what you are familiar with, they may be how your child will be learning to calculate at school.
The methods of calculating in this booklet follow on from some of the mental methods of calculating your child may be familiar with.

All calculations should be written horizontally at first, until children are taught informal or formal written methods vertically e.g.

45 + 13 =

NOT vertically

~~45~~
~~+13~~

Children are familiar with the words calculation and calculate. The word 'sum' should only be used when adding numbers together.

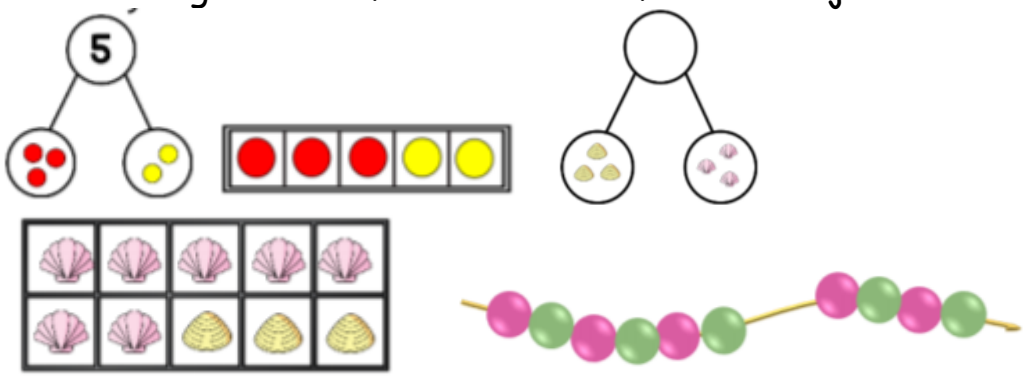
It is important to use the correct words when talking about the numbers in calculations. The numbers are said using the value of the number, for example;

45
+**1**3
58 five add three is eight
forty add **ten** is **fifty**

ADDITION

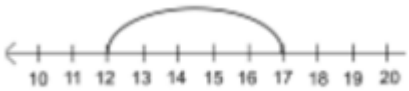
Children will be shown a variety of methods to find answers. This helps to ensure that every child can find an accurate and efficient method that they can use and apply.

Firstly, children are taught to count objects in two groups then put them together to find the total of all the objects.

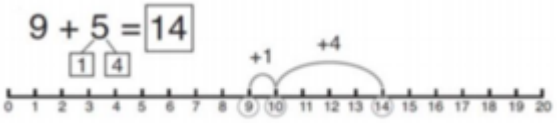


Next children are taught to start at a bigger number and count on.

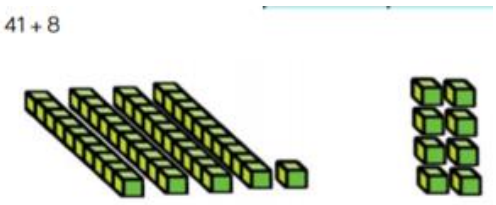
12 + 5 = 17

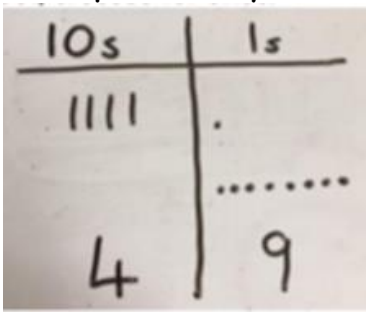


Children then are taught to look for number bonds within numbers to add (7+4…6+4 is 10 add one more), by regrouping.



Children then are taught to add TO and O using tens and one's resources physically and then to represent pictorially.





Once mastered children repeat by adding TO and TO numbers. Again, with concrete resources then pictorially both are linked to the abstract number sentence.
Once this is mastered children work abstract methods: Partitioning the numbers into parts, add the parts and then recombine to find the total.

45 + 13 =

Partition the numbers into tens and ones:

40 + 5 + 10 + 3

Add the tens together:

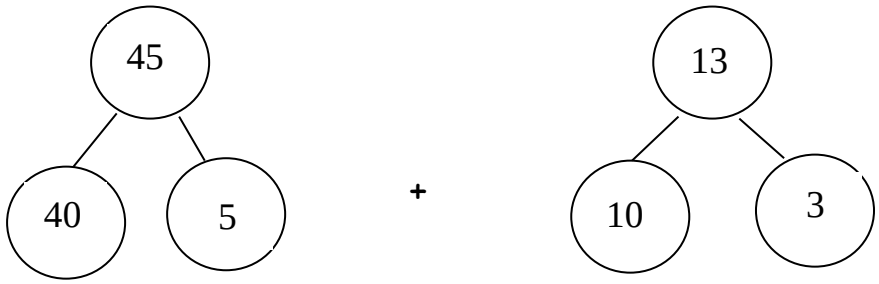
40 + 10 = 50

Add the ones (originally named units) together:

5 + 3 = 8

Recombine the numbers to give the total:

50 + 8 = 58



This knowledge of partitioning can then be used in a vertical calculation:

45
+13
8 Add the ones first **five** add **three**.

45
+ 13
8
50 Add the tens next by saying **forty** add **ten** is **fifty**.

45
+ 13
8
50
58 Total the numbers

This method can also be used with larger numbers:

62**5**
+4**8**
13 Add the **ones** first

62**5**
+48
13
60 Add the tens by saying **twenty** add **forty** is **sixty**.

625
+48
13
60
600 Add the hundreds, **six hundreds**

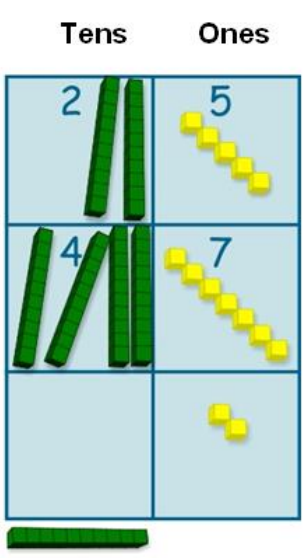
625
+48
13
60
600 Total the numbers – add mentally
673 600 + 60 + 13

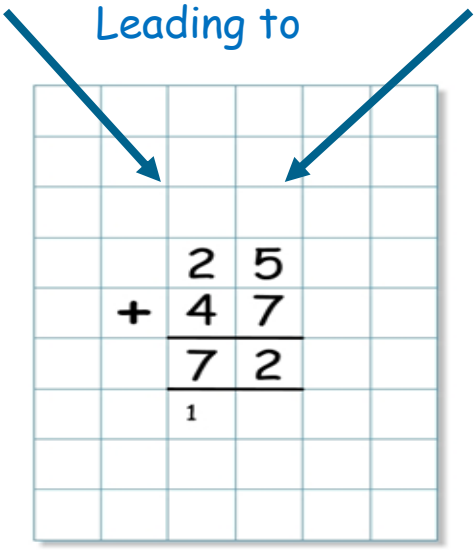
This method can then lead to a more compact method:

625 Add the ones (or units),
+ 47 five add seven is twelve;
2 one ten under the ten's column and
1 2 in the one's column.

625 Add the tens, twenty add forty is
+47 sixty, plus ten underneath, seventy.
72 Put the seventy in the ten's column.
1

625 Add the hundreds, six hundred.
+47 Put the six hundred in the hundreds
672 column.
1

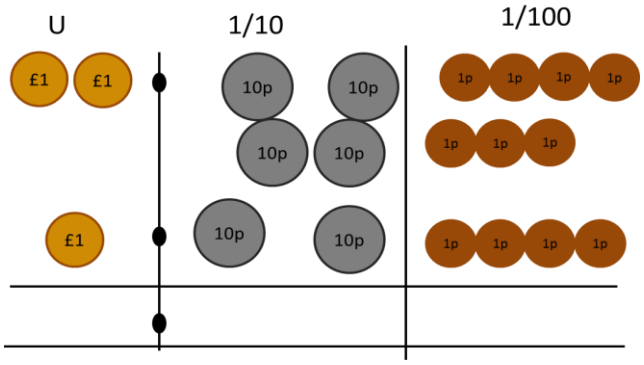




This compact method can also be used with larger numbers:

587 +475 2 1	Add the ones (or units), seven add five is twelve one ten under the ten's column and 2 in the one's column.
587 +475 62 1 1	Add the tens, eighty add seventy is one hundred and fifty plus ten underneath is one hundred and sixty. One hundred under the hundreds column and sixty in the ten's column
587 + 475 1062 11	Add the hundreds, five hundred add four hundred is 9 hundred, plus one hundred underneath is one thousand. One thousand in the thousand's column and zero hundred's in the hundreds column.

Other models and images that include decimals:



The formal written method of addition is then taught:

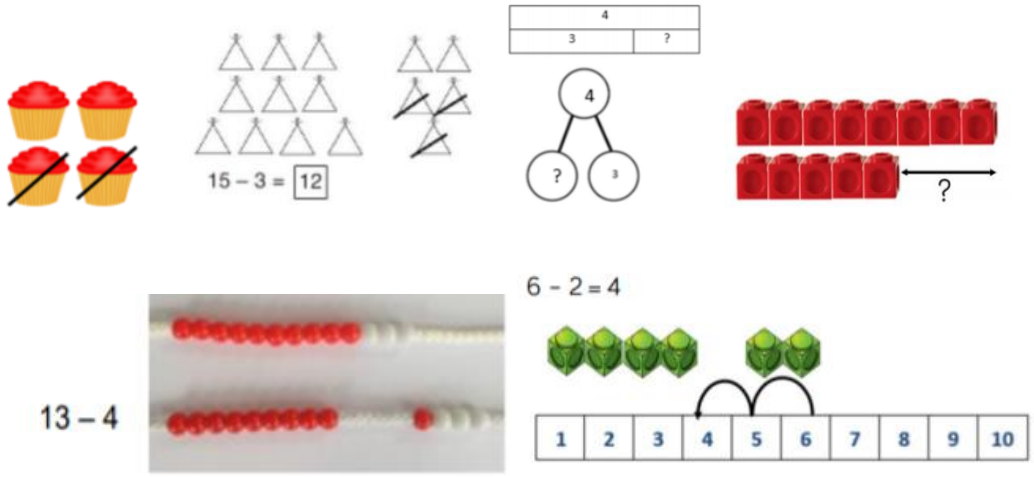
Children should extend the carrying method to numbers with any number of digits.

$$\begin{array}{r} 7648 \\ +\ 1486 \\ \hline 9134 \\ \scriptstyle 1\ 1\ 1 \end{array} \qquad \begin{array}{r} 6584 \\ +\ 5848 \\ \hline 12432 \\ \scriptstyle 1\ 1\ 1 \end{array} \qquad \begin{array}{r} 42 \\ 6432 \\ 786 \\ 3 \\ +\ 4681 \\ \hline 11944 \\ \scriptstyle 1\ 2\ 1 \end{array}$$

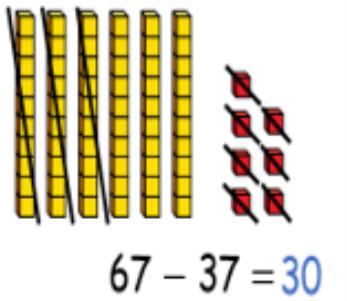
Throughout all of these methods resources and apparatus can be used to help the children create a model/image to represent what they are doing to support their understanding. Or they can pictorially represent what they are doing.

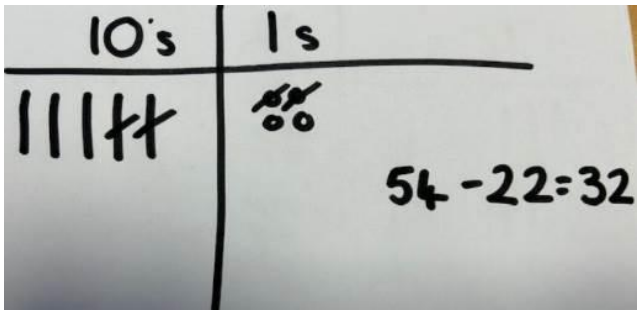
SUBTRACTION

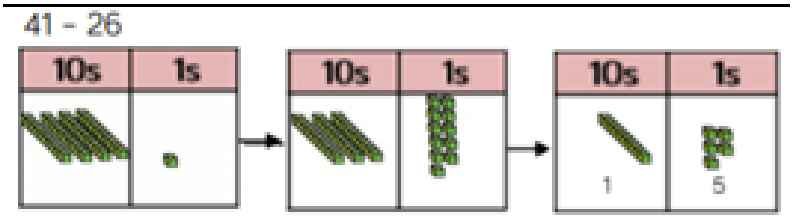
Firstly, the children are taught to get a number of objects and physically take them away. They use a variety of models to support this.

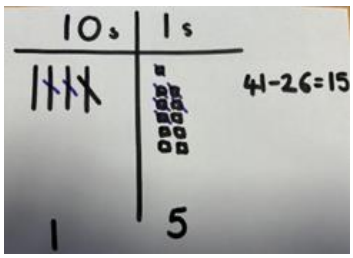


Children are also taught to use tens and ones physically then use drawings to represent subtractions:









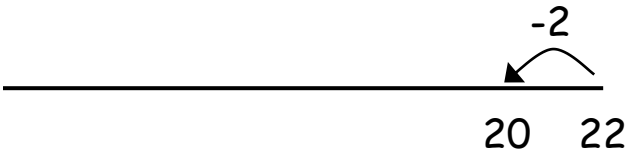
An empty/labelled number line can be used to subtract (take away) two numbers.

22 – 7 =

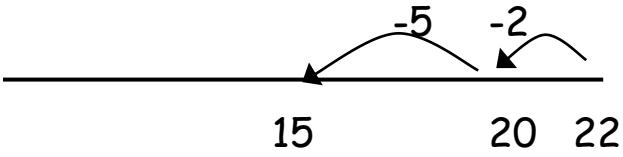
Start by marking 22 on the number line.

It is easier for children to work around the multiples of 10 and 100 when calculating.

Encourage your child to count back to the nearest multiple of 10, which in this example is 20.



How many have you subtracted (counted back)? 2
How many more do you need to subtract (count back)? 5
Count back 5.

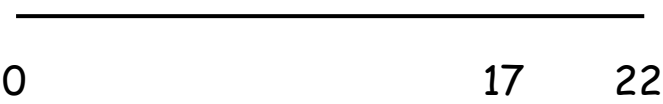


How many have you subtracted (counted back)? 7
What's the answer? The answer is 15.

22 – 7 = 15

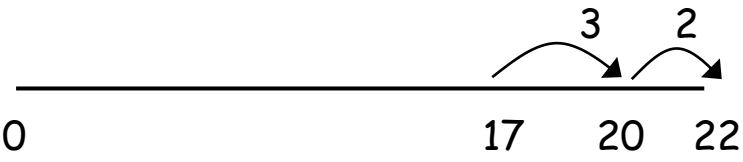
The number line can also be used to subtract by **counting up** from the smaller number to the larger. **(Finding the difference)**

22 – 17 =



Start by marking zero and the two numbers on the number line.
We want to take 17 away.

How many do we have left?
Count up from 17 to the next multiple of 10, which is 20.
Count up from 20 to 22.



Find the total of the jumps to give the answer:

3 + 2 = 5

The answer is 5. 22 – 17 = 5

This method of counting up from the smaller to the larger number is often used when finding the difference between two numbers.

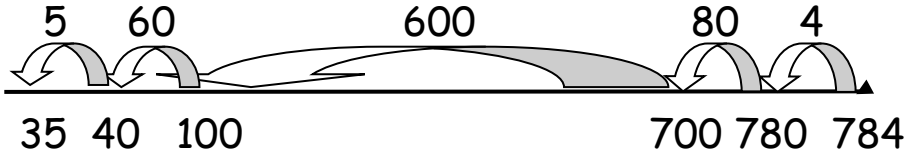
This method can also be used with larger numbers.

784 – 35 =

This can still be started by marking zero and the two numbers on the number line and complete as before:

0 35 784

Or, children can simply mark the two numbers on the number line and count up to find the answer.



Start with the largest number when adding to find the total e.g.
600 + 80 + 60 + 5 + 4 = 749
The answer is 749. 784 – 35 = 749

This method of counting up can also be recorded vertically:

784	
-35	
5	Count up from 35 to make 40
60	Count up from 40 to make 10
600	Count up from 100 to make 700
80	Count up from 700 to make 780
4	Count up from 780 to 784
749	Find the total as before by adding the largest numbers first.

Place value cards can also be used to help partitioning.

This method partitions each number and takes each part of one number away from each part of the other number.
e.g.

784 – 35 =

Each number is partitioned into hundreds, tens and ones and set out in this way:

784	=	700	80	4
-35		-	30	5

Starting with the ones, take 5 away from 4. There isn't enough, we need to exchange one ten for ten ones.
The tens column becomes ten less and the ones column becomes ten more:

700	**70**	**14**
-	30	5

We can now take 5 away from 14:

700	70	**14**
-	30	**5**
		9

Move to the ten's column, can we take thirty from seventy?
Yes.

700	**70**	14
-	**30**	5
	40	9

Move to the hundred's column, can we take no hundreds from seven hundred? Yes.

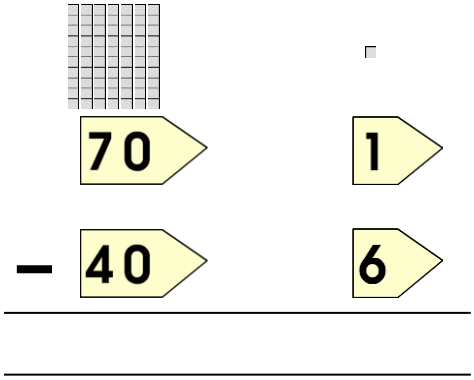
700	70	14
-	30	5
700	40	9

The numbers are put back together (recombined) to give the answer.

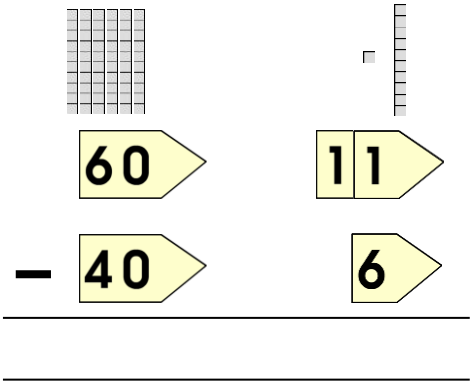
784 – 35 = 749

Another visual example is 71-46

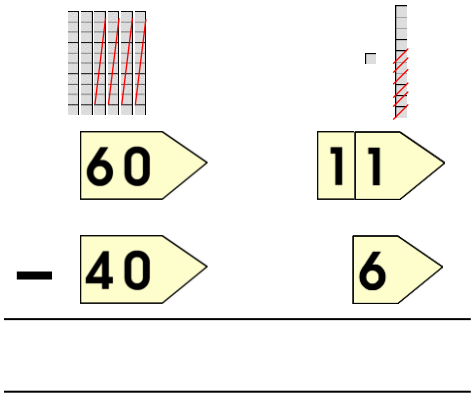
Step 1



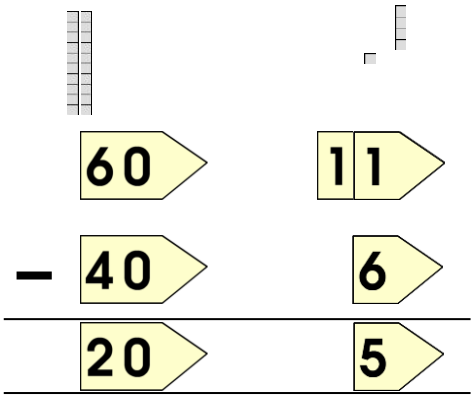
Step 2



Step 3



Step 4



This will be recorded by the children as:

$$\begin{array}{rrr} & {\scriptstyle 60} & \\ & \not{7}0 & {\scriptstyle 1}1 \\ - & 40 & 6 \\ \hline & 20 & 5 \end{array} = 25$$

This method can be used to subtract numbers with different numbers of digits:

347 – 89 =

Partition each number:

$$\begin{array}{rrr} 300 & 40 & 7 \\ & - 80 & 9 \end{array}$$

$$\begin{array}{rrr} 300 & \mathbf{30} & \mathbf{17} \\ & - 80 & 9 \\ \hline & & 8 \end{array}$$

Exchange one ten for ten ones and subtract 9 from 17

$$\begin{array}{rrr} \mathbf{200} & \mathbf{130} & 17 \\ & - 80 & 9 \\ \hline & 50 & 8 \end{array}$$

Exchange one hundred for ten tens and subtract 80 from 130

$$\begin{array}{rrr} 200 & 130 & 17 \\ & - 80 & 9 \\ \hline 200 & 50 & 8 \end{array}$$

Subtract zero hundred from 200

Recombine the numbers to give the answer

347 – 89 = 258

This expanded method then leads to a more compact method.

754 – 286 =

Partition each number:

700 50 4	754
- 200 80 6	- 286

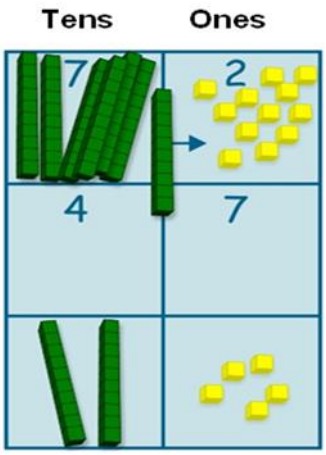
700 40 14	7 4^{1}4	Exchange one ten
-200 80 6	- 2 8 6	
600 140 14	$6^{1}4^{1}$4	Exchange one hundred
-200 80 6	- 2 8 6	
400 60 8	4 6 8	

The formal written calculation: known as decomposition is then taught.

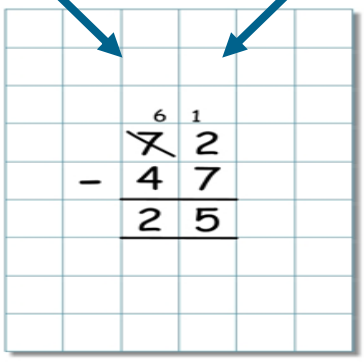
6 14 1	8 12 1
~~7~~ ~~5~~ 4	~~9~~ ~~8~~ 2
- 8 6	- 4 5 7
6 6 8	4 7 5

Including decimal numbers - for example:

7 1
8.~~8~~5
- 4.38
4.47



Leading to



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

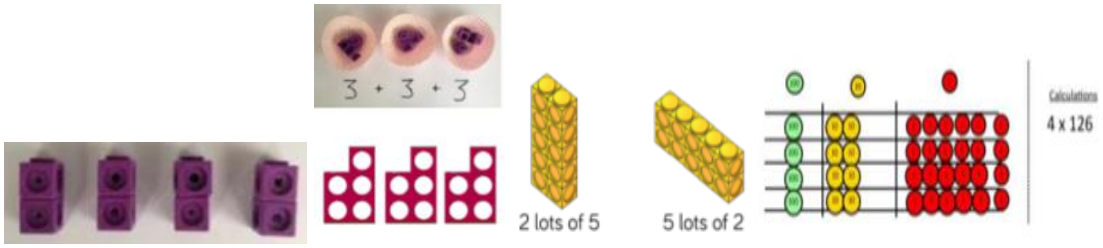
$$\begin{array}{r} {}^{5}\cancel{6}\ {}^{13}\cancel{4}\ {}^{1}3\ 2 \\ -\ 4\ 6\ 8\ 1 \\ \hline 1\ 7\ 5\ 1 \end{array}$$

$$\begin{array}{r} {}^{3}\cancel{4}\ {}^{1}1\ {}^{6}\cancel{7}\ .\ {}^{11}\cancel{2}\ {}^{1}0 \\ -\ \ 3\ 4\ .\ 7\ 1 \\ \hline 3\ 8\ 2\ .\ 4\ 9 \end{array}$$

When subtracting decimals with different numbers of decimal places, children are 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.

Throughout all of these methods resources and apparatus can be used to help the children create a model/image to represent what they are doing to support their understanding. Or they can pictorially represent what they are doing.

MULTIPLICATION



Early multiplication skills begin in reception with counting in different steps.

Learning and recalling multiplication tables begins in Year 2 Spring term.
Children in year 2 are still encouraged to count in twos, fives and tens, and also in threes before this.

A strategy to help children learn multiplication tables facts from counting is to say or show the child a multiplication fact such as:

6 x 2 =

Ask the child to put up six fingers and count across the six fingers in twos.
Six lots of 2 is 12

Also, with 7 x 10 =
Ask the child to put up seven fingers and count across the fingers in tens.
Seven lots of 10 is 70

It is important for children to know that 10 x 7 will give the same answer as 7 x 10, let them show this with their fingers.

There are many different words used for multiplication: times, lots of, product, multiply. The children are taught that all of these words mean the same.

Children use partitioning when multiplying larger numbers.

32 x 3 =

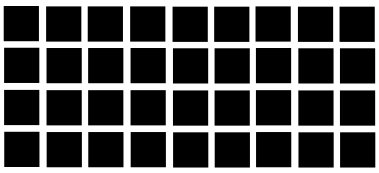
30 x 3 + 2 x 3

Multiply the tens
30 x 3 = 90 (3 x 3 = 9 and 9 x 10 = 90)

Multiply the ones
3 x 2 = 6

Add the totals together
90 + 6 = 96

Children should also be able to model a multiplication calculation using an array. This knowledge will support with the development of the grid method.



4 x 9 = 36

9 x 4 = 36

The grid method (sometimes called the Area Method):
Numbers are partitioned when using the grid method to multiply.

32 x 3 =

Thirty-two is partitioned into tens and ones and put into the grid:

	30	**2**

The multiplying number is then put into the grid

x	30	2
3		

Multiply the largest number first and write the answer in the box underneath:

x	**30**	2
3	90	

Multiply the next number and write the answer in the box underneath:

x	30	**2**
3	90	6

Total the numbers and write the answer at the side:

x	30	2	
3	**90**	**6**	= **96**

The size of the grid increases as the size of the numbers increase:

72 x 38 =

Both numbers are partitioned into tens and ones before multiplying.

Multiply by the tens first

x	**70**	2
30	2100	
8		

x	70	**2**
30	2100	60
8		

Multiply by the ones (units)

x	**70**	2
30	2100	60
8	560	

x	70	**2**
30	2100	6
8	560	16

Total the rows

x	70	2	
30	**2100**	**60**	= **2160**
8	**560**	**16**	= **576**
			2736

Then total the columns to get the answer.

The grids can be used to multiply larger numbers, remembering to multiply across each row, total each row and then add the totals of each row together.

4346 x 8

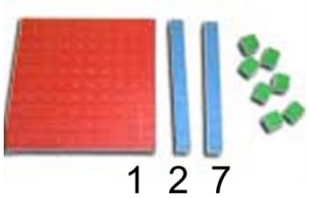
x	4000	300	40	6	
8	32000	2400	320	48	= 34768

372 x 24

x	300	70	2
20	6000	1400	40
4	1200	280	8

7440
+ 1488
8928

Practical equipment such as base ten is used to visualise this:



x	100	20	7
6	600	120	42

1 2 7
X 6
4 2
1 2 0
6 0 0
7 6 2

1 2 7
x 6
1 4
7 6 2

Another way of setting out multiplication is as a vertical calculation.

23 x 7

23
x7
(20 x 7) 140 Multiply the tens saying **twenty** times 7
(3 x 7) 21 Multiply the ones
161 Total the columns

This method can also be used with larger numbers:

4346 x 8

	4346	
	x8	
4000 x 8	32000	**4 thousand** multiplied by 8
300 x 8	2400	**3 hundred** multiplied by 8
40 x 8	320	**Forty** multiplied by 8
6 x 8	48	Six multiplied by 8
	34768	Total the columns

72 x 38

	72	
	x 38	
70 x 30	2100	
2 x 30	60	
70x 8	560	
2 x 8	16	
	2736	Total the numbers

Children may be asked to use a more compact method for multiplication.

23 x 7

23	Seven times 3 is twenty-one.
x**7**	Put the **twenty** under the ten's column
1	and the one in the one's column
2	

	23	Seven times **twenty** is one hundred
	x7	and forty plus the **twenty** underneath
	161	makes **one hundred and sixty**.
	2	Put the **sixty** in the ten's column and
		the one **hundred** in the hundreds
		column.

72 x 38

	72	
	x38	
72 x 30	**2160**	30 x 2 = 60 and 30 x 70 = 2100

	72	
	x38	
72 x 30	2160	
72 x 8	**576**	8 x 2 = 16 and 8 x 70 = 560
	2736	Then total the columns.
	1	

This calculation can also be done by multiplying by the ones first and then multiplying by the tens.

Formal written methods are then taught:
Short multiplication method: Start with the ones

2 4 x 6:

	2 4
X	6
	1 4 4
	2

Answer:144

3 4 2 x 7:

	3 4 2
X	7
	2 3 9 4
	2 1

Answer: 2394

2 7 4 1 x 6:

	2 7 4 1
X	6
	1 6 4 4 6
4	2

Answer:16446

Long Multiplication method: Start with the ones

24 x 16:

```
  24
X 16
 144
 240
 384
```

124 x 26:

```
  124
X 26
  744
 2480
 3224
 11
```

Answer:384 Answer: 3224

Children will then move onto multiplying decimals.

4.92 x 3

```
  TU.th
   4.92
 x    3
   0.06   (0.02 x 3)
   2.7    (0.9 x 3)
+ 12       (4 x 3)
  14.76
```

becomes

```
  TU.th
   4.92
 x    3
  14.76
```

DIVISION

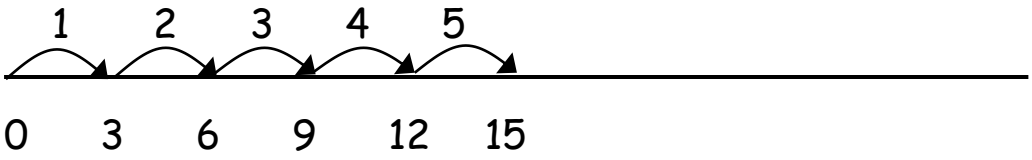
Early division begins with sharing through practical activities.

Children need to recognise that

15 ÷ 3 =

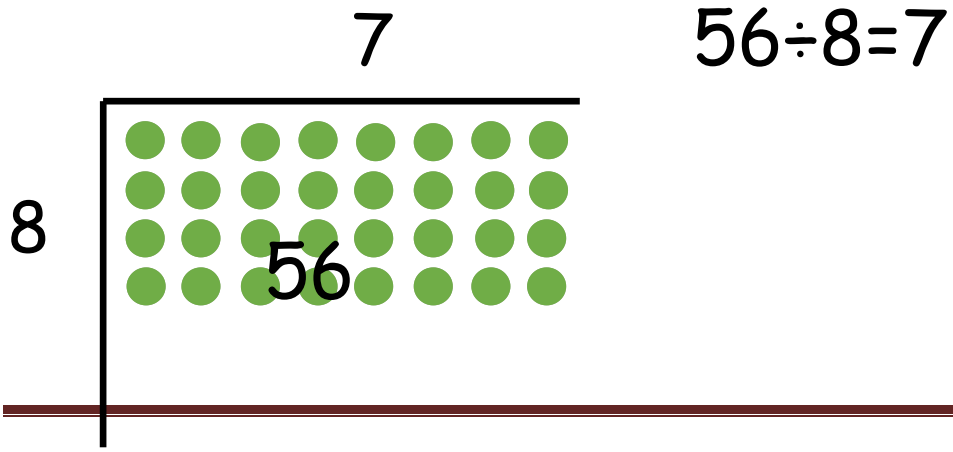
Can mean 15 shared between 3
Or
How many lots of 3 are there in 15?

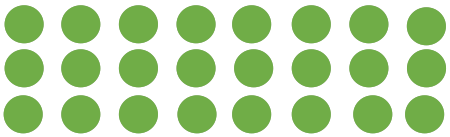
We can use a number line to find out how many threes there are in fifteen, by counting forwards or backwards in threes.



15 ÷ 3 = 5

Arrays can be used:





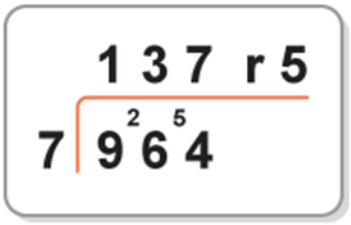
Initially, children will continue to use division by grouping (including those with remainders), where appropriate linked to the multiplication tables that they know (2, 3, 4, 5, 8 and 10), e.g.

43 ÷ 8 =

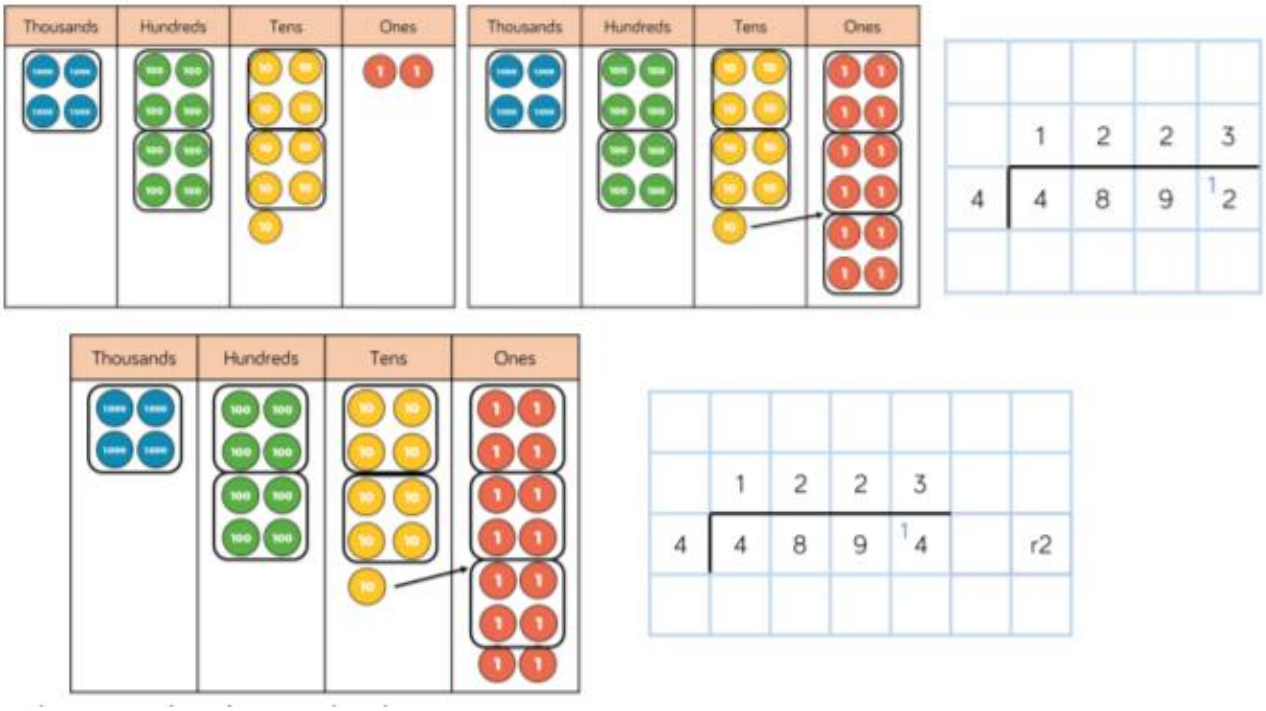
43 ÷ 8 = 5 remainder 3

Then the formal written methods are introduced:

<u>Short division:</u> (sometimes called the bus stop method)



Teachers sometimes use place value counters to support understanding of short division.



Long division:

432÷15 becomes

```
   2 8 r12
15 4 3 2
   3 0 ↓
   1 3 2
   1 2 0
     1 2
```

432÷12 becomes

		0	3	6	
1	2	4	3	2	
	–	3	6	0	(×30)
			7	2	
	–		7	2	(×6)
				0	

7335÷15 becomes

	0	4	8	9	
15	7	3	3	5	
–	6	0	0	0	(×400)
	1	3	3	5	
–	1	2	0	0	(×80)
		1	3	5	
–		1	3	5	(×9)
				0	

372÷15 becomes

			2	4	r	1	2
1	5	3	7	2			
	–	3	0	0			
			7	2			
	–		6	0			
			1	2			