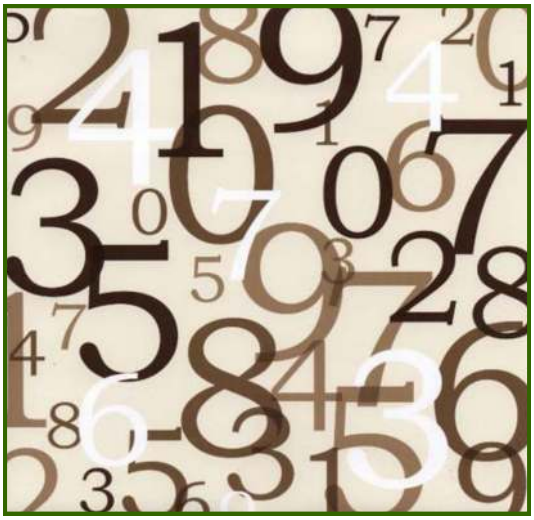
Abbey Schools Cluster Area

Calculation Methods at Key Stage 2



This booklet has been written in order to help you understand how the four rules of addition, subtraction, multiplication and division are taught in our school and to give you some ideas of how to help your child with their work.

What you'll see in your child's maths books

In Key Stage 2 when children look at calculations they will be encouraged to consider the most appropriate method of calculation e.g. a mental method, a mental method with jottings and later a standard written method.

With 7 to 8 year olds the emphasis is on mental work rather than on calculations written down in columns. The aim is for children to do mathematics in their heads but if the numbers are too large, they may use paper and pencil to avoid losing track.

Some children will sketch pictures and diagrams to help them. You may be surprised to see these in your child's mathematics book.

Following on from work in Key Stage 1, many children in Year 3 children will set calculations out like this:

57 + 5 =
42 - 6 =

This will continue into the later part of Key Stage 2 when children are focusing on mental methods.

You will see them keeping track of what they are doing in their head like this:

86 + 57 = 86 + 50 + 7 = 136 + 7 = 143
67 + 24 = (60 + 20) + (7 + 4) = 80 + 11 = 91

In the later primary years, children will be taught conventional written methods, many of which you will recognise. However the route to reach these methods you may not recognise.

We are aiming to develop the children's understanding of the process rather than the process itself.

Addition

A lot of work in Key Stage 1 is done on adding pairs of single digit numbers together mentally so that the children know their number bonds to 10, 20, etc.

Moving on, the children should then be able to add pairs of 2 digit numbers mentally reasonably comfortably and record their **mental** method before being introduced to vertical written methods.

E.g. 13 + 8 = (horizontal)

13
+ 8 (vertical)
——

In Years 3 and 4, children will carry on using horizontal recording of addition and subtraction to support their mental calculations.

The example below shows two ways of adding 76 and 93.

The first splits the numbers into tens and ones (units) then adds the tens followed by the ones to give 169. The second example uses the idea of rounding to 100 by taking 7 from 76 and adding it to the 93 to make it 100 so making the addition easier.

In a school there are 76 boys and 93 girls. How many children are there altogether?

$93 + 76 = 90 + 70 + 3 + 6$
$= 90 + 70 + 9$
$= 160 + 9$
$= 169$

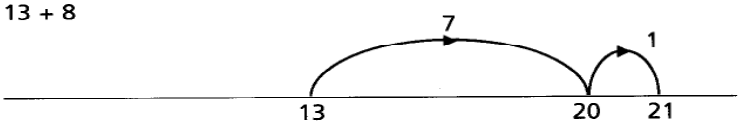
$93 + 76 = 93 + 7 + 76 - 7$
$= 100 + 69$
$= 169$

Children will also continue to use drawings, diagrams and blank number lines to support their thinking, as below. The use of number lines is strongly encouraged by the National Numeracy Strategy, not only for addition but also for subtraction. An example of this is shown over the page.

Addition continued

There are 13 boys and 8 girls in the room. How many altogether?

13 + 8

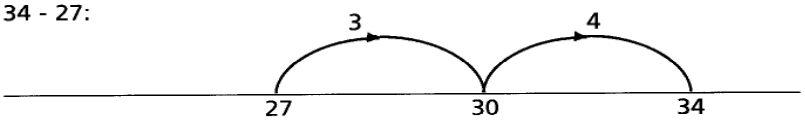


Answer

13 + 8 = 21

There are 34 children in the classroom. 27 go to the hall. How many are left?

34 - 27:



Answer

34—27 = 7

Towards the end of Year 3 and into Year 4, most children will be taught written methods, including vertical addition for those calculations that they can't do 'in their heads'.

At this stage these will be 'expanded methods' which are ways of recording that make the process of adding the different digits clear to children. These expanded methods build on the mental methods they have been learning and should help children to understand what is happening as well as reinforcing their understanding of place value by calling the digits by their value e.g. two hundred add one hundred rather than 2 + 1.

Here is an example of adding using an expanded method.

The blue team's score of 287 points is increased by 145 points. What's the new score?

287	**⟶**	**200**	**+ 80**	**+7**
145	**⟶**	**100**	**+ 40**	**+5**
432	**⟵**	**300**	**+120**	**+12**

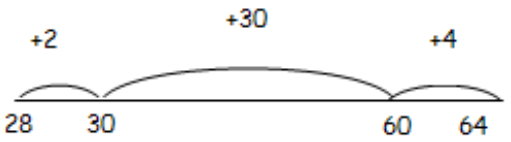
When the number of digits in the numbers is increased or decimals are introduced the children will practice some examples using an expanded method before returning to the compact method.

Subtraction

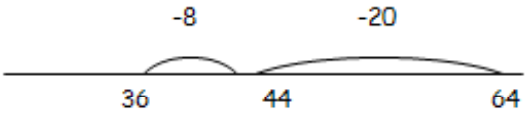
As with addition, the children will need to be able to carry out simple 2 digit from two digit subtractions mentally and record their methods before being introduced to a vertical written method.

e.g. 64-28 or

64-30=34
34+2=36



counting up to find the difference



counting back

They should also be able to partition numbers into tens and units

e.g. 64 = 60 + 4 and a multiple of 10 and a teens number e.g. 64 = 50 + 14.

Subtraction can be recorded using partitioning to write equivalent calculations that can be carried out mentally.

For 74—27 this involves partitioning the 27 into 20 and 7, and then subtracting from 74 the 20 and the 4 in turn.

Some children may need to partition the 70 into 70 + 4 or 60 + 14 to help them carry out the subtraction.

They are then introduced to expanded written methods:

e.g.

		50	1
64 →		~~60~~	4
- 28 →	-	20	8
		30	6

This is later increased to three digit numbers:

		60	1
274	200	~~70~~	4
-157	100	50	7
	100	10	7

Subtraction continued

This is extended to include exchanges from hundreds to tens, and from hundreds to tens to units:

e.g.

	100	20	1
235	~~200~~	~~30~~	5
-176	100	70	6
		50	9

e.g.

	200	9	1
306	~~300~~	0	6
-148	100	40	8
	100	50	8

When this is secure, they will then be introduced to a compact method, initially with and then three digit numbers:

5 1	6 1
~~6~~4	2~~7~~4
-28	-157
36	117

When the number of digits in a question is increased or decimals are introduced the children will work through some examples using the expanded layout before returning to a compact method but they will work with a method that is appropriate for them.

The price of a computer is reduced from £767 to £619. By how much is it reduced?

		50	17
767	700	+ ~~60~~	+7
619	600	+ 10	+9
148	100	+40	+8

It is reduced by £148.

£ 7 6 7
- £ 6 1 9
£ 1 4 8

This shows the same calculation in its 'compact' form and is the method you may recognise.

Multiplication

Children should be reasonably comfortable with multiplying single digit numbers by single digit numbers (they might not have instant recall of all multiplication facts but should be able to work out facts reasonably quickly).

If children know the 2 times table, which is only double the 1 times, then the 4 times is easy because you just double the 2 times. Then you can double the 4 times to get the 8 times.

The 3 times doubles to the 6 times and 12 times, the ten times can be halved to give 5 times and so on.

This uses the knowledge children are developing through addition and subtraction and makes important connections for them. This chart shows how this works for the 2x, 4x and 8x tables.

x	1	2	3	4	5	6	7	8	9	10
2times	2	4	6	8	10	12	14	16	18	20
4times	4	8	12	16	20	24	28	32	36	40
8times	8	16	24	32	40	48	56	64	72	80

The early work children do introduces them to the ideas of multiplication and division. They are counting in different patterns, helping to see how multiplication is repeated addition and division is repeated subtraction, shown how division is the opposite of multiplication and taught to understand place value (that in 234 the 2 is 200, the 3 is 30 and the 4 is 4 ones (units)). This knowledge and understanding, with much of the work being done in their heads, opens up a whole world of facts for them and they don't all have to be memorised. That can make dealing with numbers feel a lot easier.

The children are taught to be able to use single digit multiplication facts

e.g. 3x4 to calculate single digit x multiple of 10 e.g. 30 x 4 and partition numbers into tens and units e.g. 34 = 30 and 4.

Partitioning:

$$12 \times 4 \rightarrow (10\times4) + (2\times4)$$
$$= 40 + 8 = 48$$

$$43 \times 5 \rightarrow (40\times5) \quad (3\times5)$$
$$= 200 + 15 = 215$$

Multiplication continued

Grid layout—this is the same method with a slightly different layout:

17x3 →

x	10	7	
3	30	21	=51

add mentally

This is extended to numbers where the answer goes over 100:

38x6 →

x	30	8	
6	180	48	= 228

add mentally

Pupils then move on to multiplying a 2 digit number by a multiple of 10:

42x30

x	40	2	
30	1200	60	=1260

add mentally

This is then extended to multiplying two 2 digit numbers:

34x27

x	30	4		
20	600	80	→	680
7	210	28	→	238
				918

} add these mentally if possible

Finally children are introduced to a compact method by relating it to the grid layout—this is the same calculation just a different layout:

38 x 6

38
x 6
48 (6 x 8)
180 (6 x 30)
228

38 x 6
38
x6
228

34 x 27

34
x 27
28 (7 x 4)
210 (7 x 30)
80 (20 x 4)
600 (20 x 30)
918

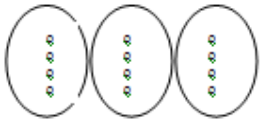
34 x 27
34
x27
238 (7x34)
680 (20x34)
918

Division

Before undertaking written division, children should be able to divide numbers by 10 and 100 mentally, understanding how the digits move. They should be able to halve numbers and be beginning to understand relationship between x and ÷. ie that they are inverse operations and that division facts can be derived from multiplication ones.

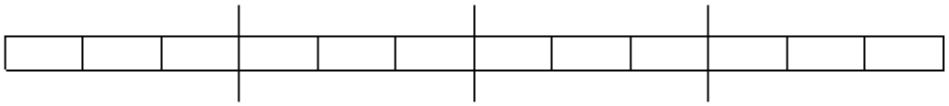
10÷2=5 5x2=10

They will have experience of sharing 12÷3 = 4



and of grouping (repeated subtraction)

12÷3 = how many 3s make 12?



They should be able to work out examples such as 12÷3 by rephrasing as 'how many 3s make 12?' then counting up in multiples of 3 to 12.

3, 6, 9, 12. so 4x3=12

The idea of repeated subtraction e.g. 'how many 3s make 12' is carried through to the written method – 'chunking'. Chunking involves taking away chunks of the same size until you run out. It uses the fact that division is repeated subtraction of the same size group.

For example, 20 ÷ 4 = 5 involves subtracting 4s from 20 until it's been used up. You can do this 5 times.

The children start with simple calculations linked to their mental work and as the size of the numbers increases, the chunking written method is more efficient than counting up. E.g. 73 ÷5 *how many 5's make 73?*

73		
-50	**10**	x 5
23		
-20	**4**	x 5
3		

73 ÷ 5 = 14 r3

Division continued

Children are encouraged to think about 'chunks' they know first – giving a bank of known or derived facts to work from. E.g. 10 x 5 = 50

This enables children to remove larger chunks so: 20x5=100 etc.

Once the children have mastered this, division notation is introduced but the process is retained.

Children then extend to 3 digit numbers –subtracting chunks

```
7 ) 256
   -70   10x7
   186
  -140   20x 7
    46
   -42   6 x 7
     4
```

Answer 36 r4

e.g. 10x7 = 70
20x7 = 140
30x7 = 210

```
7 ) 256
  -210   30x7
    46
   -42   6x7
     4
```

This is compacted by removing larger chunks

Answer 36 r4

```
e.g.  36 ) 972
      - 720   20x36
        252
      - 180   5x36
         72
        -72   2x36
          0
```

Answer 27

By the end of Key Stage 2, this is extended to 3 digit divided by 2 digit:

Division continued

More complex division will involve dividing 3 digit numbers by a 1 digit number and 3 digit numbers by a 2 digit number. With division, as with all calculation, it's important to think about what the actual problem is asking when you come to give an answer.

As they move into Years 5 and 6 children will still be encouraged to choose the most suitable method of calculation, mentally if possible. Where this is not possible they will be using expanded or compact methods and a calculator for more complex and involved work.

Children need to feel confident with numbers and to enjoy playing with them and using them. If you have any questions on any of the issues raised in these notes, please do not hesitate to contact your child's teacher at school.

Further information can be found on the following websites:

www.education.gov.uk and search for 'Help for Parents'.

www.mathsnet.net which includes games and puzzles for children to play.

www.bbc.co.uk/schools/ the schools section of the BBC website has a whole range of fun activities for children to do on the computer. Follow the numeracy link to find activities to help children learn tables, recognize shapes, do simple calculations and even revise for their KS2 SATs.

This document is adapted from a leaflet produced by Brington C of E Primary School

and we would like to thank Peter Allen, for sharing it.