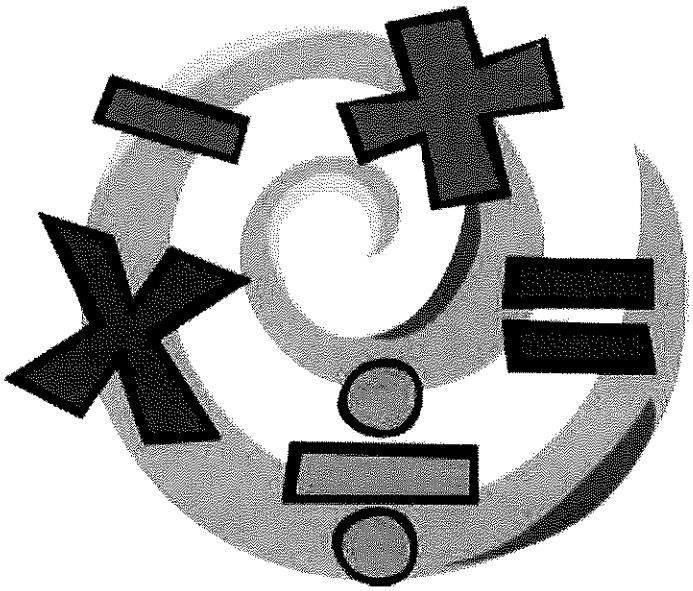
Written Calculation Strategies

A Guide for Parents



Introduction

This booklet explains how children are taught to carry out written calculations for each of the four number operations (add / subtract / multiply / divide). The methods may look different from those that you were taught at school but your child will be familiar with them.

In order to help develop your child's mathematical understanding, each operation is taught according to a clear progression of stages. Generally, children begin by learning how written methods can be used to support mental calculations. They then move on to learn how to carry out and present calculations.

It is extremely important to go through each of these stages in developing calculation strategies. It is also important to use the correct language when talking about the numbers in calculations. The value of the number should be said and not the digit. For example in 45, the '4' is worth forty (four tens).

Mathematical Vocabulary

Listed below are many of the words that your child will learn about at school and which they may use when talking about mathematics at home. Some of them you will be familiar with and some will be completely new – hopefully this will give you some idea of which calculation they are part of so that you can understand and help your child. Many of these words are used throughout these booklets to explain calculations and workings out, either as part of jottings to support mental methods or more formal written methods. Some of the words are repeated in each of the sections - this is because they are a key part of each calculation.

Addition
and, add, addition, plus, more, more than, greater than, bigger than, increase, makes, altogether, sum, total.

Subtraction
take away, take from, subtract, subtraction, minus, less, less than, smaller than, difference, decrease, decomposition, exchange, carry, leaves.

Multiplication
lots of, groups of, times, multiply, multiplied by, multiplication, repeated addition, product, tables, times table, chunks, chunking, array.

Division
share, share equally, group, split, divide, division, divided by, divisible by, divided into, repeated subtraction, leaves, left, left over, remainder, chunks, chunking.

Number bonds
If your child talks about 'number bonds' this is simply another name for finding different ways to make a number. E.g. number bonds to 10 are 2 + 8, 3 + 7, etc.

Inverse

The term "inverse" is used very often in mathematics, with the meaning of opposite operation. Addition is the inverse of subtraction, and vice versa. Multiplication is the inverse of division and vice versa. The children are taught to check their calculations by using the inverse operation.

Sum
The term "sum" is now used only to mean addition during mathematical activities. We therefore use the phrases "number sentences", "calculations" and "questions" instead of the phrase "complete these sums".

Additional vocabulary
equals, makes, calculate, calculation, partition, partitioning

ADDITION

At Key Stage 1 a lot of time is spent teaching number bonds to 10 and 20, so that children know that 7 + 3 make 10 and 17 + 3 make 20. Children are encouraged to think mentally by asking questions like 'can I do this in my head?' If not they are encouraged to do informal jottings. Children are encouraged to use a number line for addition, subtraction, multiplication and division. They are used to support mental calculations and do not need to be drawn to scale. Strategies for teaching mental addition include:

- Putting the largest number first:
5 + 36 is the same as 36 + 5. Start at 36 and count on in ones. 30 + 60 is the same as 60 + 30. Start at 60 and count on in tens

- Partitioning:
14 + 25 = (10 + 4) + (20 + 5)
(10 + 20) = 30
(4 + 5) = 9
The answer is 39

- Compensation:
17 + 9 = 17 + 10 – 1 = 26
26 + 11 = 26 + 10 + 1 = 37

- Doubles or near doubles:
8 + 8 = 16
so 8 + 9 = 8 + 8 + 1 = 17

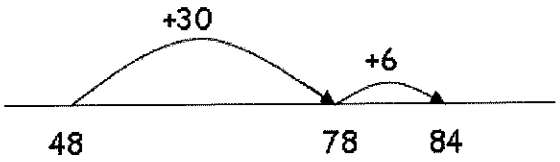
- Bridging through 10, 20 etc.
8 + 7 = (8 + 2) + 5
10 + 5 = 15
15 + 9 = (15 + 5) + 4
20 + 4 = 24

Written methods for addition

I. Counting on

A method of adding is to partition one number into parts and count on using a number line for support:

e.g. 48 + 36 =



II. Partitioning and recombining

Another method of adding is to partition both numbers into parts, add the parts and then recombine to find the total:

e.g. 12 + 26 =

Partition the numbers into tens and units and add the tens together and add the units together:

10 + 20 = 30
2 + 6 = 8

Recombine the numbers to give the total:

30 + 8 = 38

III. Expanded written method ('vertical')

This method is used in a vertical calculation with the smallest parts of the number being added first and the largest parts of the numbers added last. It is now vital that children keep digits in the correct columns:

e.g. 148 + 286

```
  286
+ 148
   14
```

add the units first by saying **six** plus **eight** is **fourteen**

```
  286
+ 148
   14
  120
```

add the tens by saying **eighty** plus **forty** is **one hundred and twenty**

```
  286
+ 148
   14
  120
  300
```

add the hundreds by saying **two hundred** plus **one hundred** is **three hundred**

	286	
+	148	total the numbers (14 + 120 + 300)
	14	
	120	
	300	
	434	

IV. Standard compact written method ('vertical & compact')

This can then lead to a more compact method involving carrying between columns where necessary:

e.g. 286 + 148

	148	When children are **confident** working with larger numbers
+	286	using the **previous strategies**, they will be introduced to
	434	'carrying' digits. These methods will be used in Year 5 and
	11	beyond.

SUBTRACTION

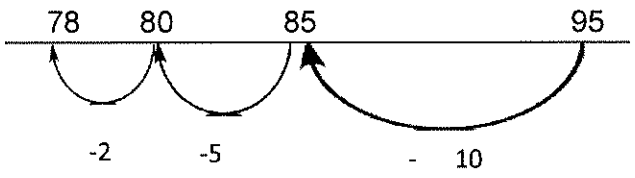
Subtraction can be thought of as finding the difference – which can be subtraction (counting back), but can also be addition (counting on). This is called complimentary addition. It can also be thought of taking away (counting back). Children are encouraged to think mentally by asking questions like 'can I do this in my head?' If not they are encouraged to do informal jottings. For example **45 - 37 = 8** is best solved by counting up. Start at 37, add 3, add 5 (3 + 5 = 8). **262 - 95 = 167** could be done by counting back Subtract 100 then add 5 (95 is 5 less than 100).

Written methods for subtraction

I. Counting back on a number line

A number line can be used when finding the difference to subtract

e.g: 95 – 17 = 78



II. Partitioning the second number

e.g.	63 – 49 =	63 take away 4 tens (forty)
	63 – 40 = 23	which equals 23.

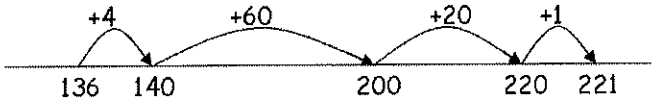
23 – 9 = 14	Then 23 take away 9 units. This will give you an answer of 14

III. Complimentary addition

A number line can be used when finding the difference to subtract by counting up.

e.g. 221 – 136 =

We want to take away 136 from 221. We can then count up from 136 to 221 to find what is left. Counting to the nearest multiple of 10 or 100 makes it easier.



Children can, of course, simply mark the two numbers on the number line and count up to find the answer:

Add the size of each jump, starting with the largest, to find the total and the answer:
60 + 20 + 4 + 1 = 85

This method works equally well with larger and smaller numbers, but is especially efficient with numbers which are close together, or when one of the numbers is close to a multiple of 10, 100 or 1000.

IV. Expanded written method

This method of counting up to find the difference when subtracting can also be recorded vertically:

```
 221
-136
   4  (count up from 136 to make 140)
  60  (count up from 140 to make 200)
  20  (count up from 200 to make 220)
   1  (count up from 220 to make 221)
  85  (add up your totals to give you the answer)
```

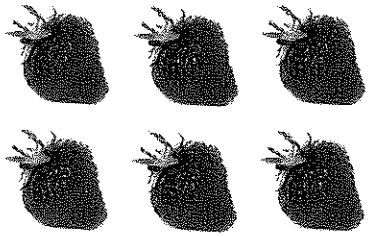
As children become more proficient, they will be able to take fewer, larger jumps leading to a more compact calculation:

```
 221
-136
  64  (to make 200)
  21  (to make 221)
  85
```

MULTIPLICATION

I. Practical representation

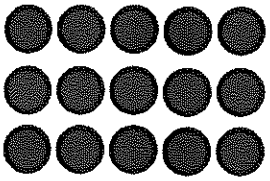
In key stage 1 children will experience equal groups of objects and will begin to count in 2s, 10s and 5s. They work on practical problem solving activities involving equal sets or groups.



2+2+2
3 groups of 2

OR

3+3
2 groups of 3



This array is a visual representation

of the multiplication 5 x 3 or 3 x 5

II. The grid method

This method is based on the ability to partition. First the calculation needs to be partitioned and arranged in a grid.

e.g.: 32 x 17

×	30	2	

First, thirty two is partitioned into tens and units and put into a grid;

×	30	2	
10			
7			

Next, seventeen is partitioned into tens and units and added to the grid;

×	30	2	
10	300	20	
7			

Multiply by the tens and write the answers in the correct boxes;

×	30	2	
10	300	20	
7	210	14	

Multiply by the units and write the answers in the correct boxes;

×	30	2	
10	300	20	320
7	210	14	224
			544

Last, add up the total of each row and then add up these totals to get the answer:

32 x 17 = 544

This method can be used to multiply combinations of numbers of any size. All that happens is that the size of the grid changes, you multiply across each row, total each row, and add all the row totals together.

e.g. 324 x 178

×	300	20	4	
100	30,000	2,000	400	32,400
70	21,000	1,400	280	22,680
8	2,400	160	32	2,592
				57,672

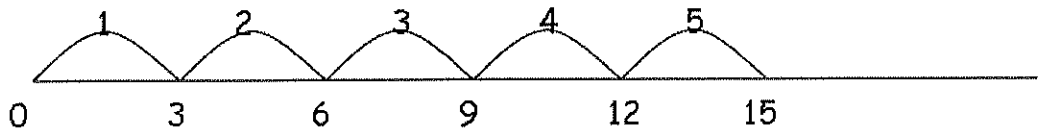
The grid method provides an extremely clear and flexible approach to multiplication and is a much easier for children to understand and apply.

DIVISION

There are two ways of understanding division; sharing and grouping. For example, 15 ÷ 3 can mean 15 **shared** between 3 (3 lots of 5) but it can also mean 15 **grouped** into 3's (5 lots of 3).

I. Division using a number line

For written calculations, it is the idea of division as grouping which is used. To find out how many groups of three are in fifteen, we can use a number line and count forwards or backwards in threes:-



15 ÷ 3 = 5

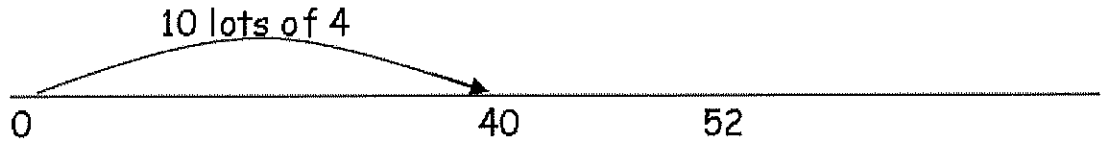
We added the number of jumps to give us the answer of 5. As children become more competent and the numbers they work with get larger, this basic method is refined in certain ways.

II. Chunking using a number line

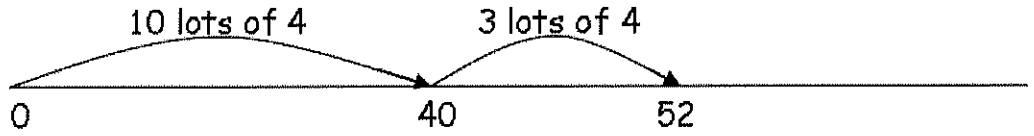
A method known as 'chunking' is introduced when the numbers to be divided start to get larger:

e.g. 52 ÷ 4

Draw a number line and using times table knowledge, start to count up from zero in chunks of 4. Again, it is most useful to use 'chunks' that are multiples of 10 wherever possible:



Work out how many are left and, using table knowledge, work out how many lots of 4 this is equal to:



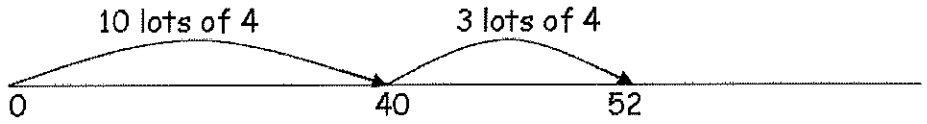
Count up the lots of 4: 10 + 3 52 ÷ 4 = 13

III. More efficient chunking

The method can be written down in a vertical format, though children may continue to need to use a number line, at least initially:

e.g. 52 ÷ 4

52 ÷ 4



40 **10** lots of 4
12 **3** lots of 4
52

Count up the lots of 4: 10 + 3 = 13
This division on a number line has led to a vertical calculation.

IV. Using larger numbers to chunk

As the number to be divided gets even larger, the method needs to be made more efficient by working with larger 'chunks',

e.g. 256 ÷

If 10 lots of 7 are 70, what's the biggest chunk (lot) of 7 I can get from 256? 30 lots of 7 = 210, so I can take off 30 lots of 7

256
- 210 (**30** x 7)
46

How many sevens are there in 46? 6 x 7 = 42, take off 6 lots of 7

256
- 210 (**30** x 7)
46
- 42 (**6** x 7)
4

Count up the chunks of 7: 30 + 6 = 36
The answer is 36 remainder 4 so 256 ÷ 7 = 36 r 4

We hope that this booklet has provided you with a helpful insight into the way calculation strategies are taught in school.

If you have any questions at all, please contact your child's maths teacher.