Our Lady of Compassion Primary School

Mathematics Written Calculation Policy

Draft to be agreed by
Governors June 2020

Progression of Calculation

As children begin to understand the underlying ideas of addition, subtraction, multiplication and division, they develop ways of recording these calculations using particular methods, signs and symbols.

Over time, children learn to use a range of recording methods, such as number lines, to support their mental and informal written methods. As their mental methods are strengthened and refined, so too are their informal written methods. These methods become more efficient and succinct and lead to efficient and standard written methods. By the end of Year Six children have been introduced to mental, written and calculator methods that they can use to solve the four number operations. They are then able to decide which method is most appropriate for a particular calculation, to use that method and have strategies to check its accuracy.

At whatever stage in their learning and whatever method is being used, it is vital that children have a secure and appropriate knowledge of number facts. Our aim at Our Lady of Compassion Primary school is that by the time the children are secondary ready, they:

- Have a secure knowledge of number facts and a good understanding of the four operations.
- Are able to use this knowledge and understanding to carry out calculations mentally and to apply general strategies when using one-digit and two-digit numbers and particular strategies to special cases involving larger numbers.
- Make use of diagrams and informal notes, 'jottings', to help record steps and part answers when using mental methods.
- Have an efficient, reliable, compact written method of calculation for each operation that they can apply with confidence when undertaking calculations that they cannot carry out mentally.
- Use a calculator effectively, using their mental skills to monitor the process and check for sense and accuracy.

Mental methods of calculation.

Oral and mental work in mathematics is essential, as early practical, oral and mental work lays the foundations for later written methods. By providing children with a good understanding of how the four operations build on counting strategies and a knowledge of place value and number facts, children will recognise how the operations relate to one another and how the rules of arithmetic can be used and applied.

Ongoing oral and mental work provides practice and consolidation of these ideas. We aim to provide all children with a secure knowledge of numbers i.e.

- Recall number facts instantly – addition and subtraction facts to 20 (Year 2); sums and differences of numbers with up to 3 digits (Year 3); and multiplication facts up to 12 x 12 (Year 4).
- Use taught strategies to work out a calculation – for example, recognise that addition and multiplication could be done in any order but that subtraction and division cannot.
- Understand and use the term 'inverse' – i.e. that addition and subtraction are inverse operations and multiplication and division are inverse operations.

Written methods of calculation.

As children progress through the school they move from informal methods of recording to expanded methods and then to a compact written method for each of the four operations.

The aim is that by the end of Key Stage Two, the children should be able to use an efficient written method for each operation with confidence and understanding. Being able to use these written methods gives children an efficient set of tools they can use when they are unable to carry out the calculation in their heads or do not have access to a calculator.

Written methods for addition.

The aim is that children use mental methods when appropriate, but for calculations they cannot do in their heads they use an efficient written method accurately and with confidence.

To add successfully, children need to be able to:

- Recall all addition pairs to 10 + 10
- Add mentally a series of one-digit numbers, such as 5+8+4
- Add multiples of 10 (60+70) or 100 (600+700) using knowledge of addition facts (6+7) and place value
- Partition two-digit and three-digit numbers into multiples of 100, 10 and 1

Reception.

Here the emphasis is on practical and oral methods. Children will make and count sets of objects and combine them. They will estimate the number of objects and check quantities by counting up to 20. They may record their work using a number sentence, such as 3+5=8 or a method of their own choice using mark making, pictures or symbols. Children are introduced to the addition and equals signs and the vocabulary 'and', 'add', 'plus' and 'altogether'.

I eat 2 cakes and my friend eats 3.

How many cakes did we eat altogether?

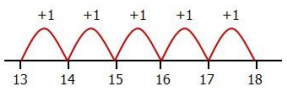
Might be recorded as:

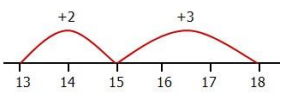
2 + 3 = 5

Year One.

Here children will continue to work in a very practical way using concrete objects and record using pictorial representations. They start to use number lines to record their calculations, at first counting in ones and then using more efficient jumps. They will use vocabulary: 'put together', 'total' and 'more than'.

13 + 5 = 18





Year Two.

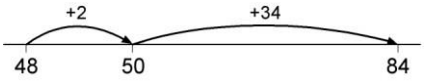
Children are taught that addition of numbers can be done in any order and will explore TO+O, TO+ T, TO+TO and O+O+O. Here children continue to use number lines and adding in 'jumps' of numbers. This is especially so when 'bridging' from one multiple of 10 to another.

8+7=15

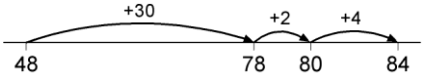
The idea is to add to the next multiple of 10 and then add anything that is left over. With the example below 2 is added to reach 10 and then the remaining 5 is added

48+36=84

First add 2 to reach 50 then add the remaining 34.



Another way of adding using a number line is to add the tens first. The above calculation would therefore be completed as below.



It could also be recorded without the use of a number line: 48+36=84

48+30=78
78+2=80
80+4=84

Partitioning is also introduced in Year Two as a means of adding two-digit numbers. Partitioning involves using place value to split two-digit numbers into the 'tens' and 'ones' that they are made up of, add them separately and then to 'recombine' them to find the total. As confidence grows, children will partition with 3 digit numbers.

47+76=

40+70=110
7+6=13
110+13=123

Towards the end of Year Two children are introduced to recording addition in columns. This expanded method supports their knowledge of place value (by adding the tens and ones separately) and prepares them for formal written methods with larger numbers.

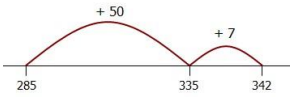
47 + 35 = 82

$$\begin{array}{r} 40 + 7 \\ 30 + 5 \\ \hline 70 + 12 \end{array}$$

Year Three.

Children continue to use columnar methods alongside partitioning and progress to TO+TO, HTO+TO and HTO+HTO. To consolidate understanding they may still use number lines.

Number line 57 + 285 = 342



By the end of Year Three children will be taught the compact column addition method where they start by adding the ones digits and 'carry' tens across to the next column. Digits are 'carried' below the line.

$$\begin{array}{r} 374 \\ +\ 248 \\ \hline 622 \\ {\scriptstyle 1\ 1} \end{array}$$

Years Four, Five and Six

Children continue to use the compact column addition method but gradually extend to larger whole numbers (ThHTO) and decimals up to 3 decimal places.

$$\begin{array}{r} 7\ 8\ 9 \\ +\ 6\ 4\ 2 \\ \hline 1\ 4\ 3\ 1 \\ {\scriptstyle 1\ 1} \end{array}$$

$$\begin{array}{r} 5735 \\ +\ 562 \\ \hline 6297 \\ {\scriptstyle 1} \end{array}$$

$$\begin{array}{r} +48.56 \\ 72.26 \\ \hline \end{array}$$

$$\begin{array}{r} +\ 18.070 \\ 21.313 \\ \hline \end{array}$$

With emphasis on place value, the children should be taught to align decimal points in their calculations. Two lines should be used to indicate the final total.

Written methods for subtraction.

To subtract successfully, children need to be able to:

- Recall all addition and subtraction facts to 20
- Subtract multiples of 10 (such as 160-70) using the related subtraction fact 16-7, and their knowledge of place value.
- Partition two-digit and three-digit numbers into multiples of hundred, ten and one in different ways (e.g. partition 74 into 70+4 or 60+14)

Reception.

Here the emphasis is on practical and oral methods. Children count sets and objects and then 'take away' one or more. They use vocabulary such as 'less than' and can record their work using number sentences such as 8-1=7 as well as pictorial and symbolic representations. They are introduced to the subtraction sign.

I have five cakes. I eat two of them. How many do I have left?

Might be recorded as: *5 – 2 = 3*

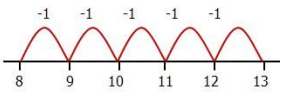
Mum baked 9 biscuits. I ate 5.

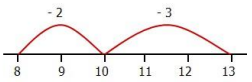
How many were left? [Might be recorded as: *9 – 5 = 4]*

Year One

Again, most work is practical and oral although children will progress to finding 10 less as well as 1 less using their knowledge of place value. They will again record using number sentences and 'take away' using jumps back in ones and then more efficient jumps on number lines.

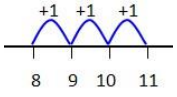
13 –
5=8





Children are also introduced to the idea of 'counting on' to solve subtraction.

11 - 8 = 3



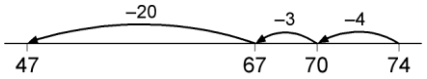
Year Two

As with addition, children in Year Two continue to use number lines to record or explain the steps of their mental calculations. Here the fact that that subtraction of two numbers cannot be done in any order is reinforced. Again the use of bridging is involved and children use the idea of 'counting back.

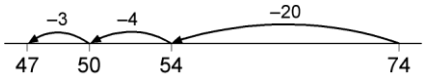
15-7=8

Here 15-5 is done first to reach the multiple of 10 and then the remaining 2 are subtracted.

A calculation like 74-27 can be recorded by counting back using bridging:



Or, by subtracting the 20 first, followed by the 7:



This can also be recorded without the use of a number line:

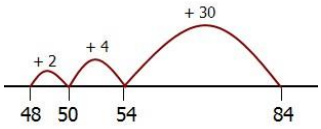
74-27=47

74-20=54

54-4=50

50-3=47

Children continue to develop the concept of 'counting on' :



Counting on 84 - 48 = 36

Towards the end of Year Two children are introduced to recording subtraction in columns. This expanded method supports their knowledge of place value (by subtracting the tens and ones separately) and prepares them for formal written methods with larger numbers.

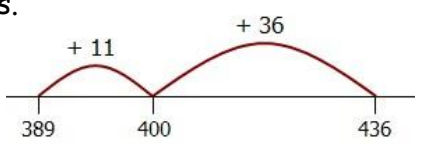
98 - 35 = 63

90	and	8
30	and	5
60	and	3

Year Three.

Children continue to use columnar methods alongside partitioning and progress to TU-TU, HTU-TU and HTU-HTU. They may use the 'taking away' and 'counting on' methods with or without number lines.

Counting on 436 - 389 = 47



Taking away (no number line)

326 - 178 = 148
326 – 100 = 226
226 - 70 = 156
156 - 6 = 150
150 - 2 = 148

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

By the end of Year Three children will be introduced to the adjustment or decomposition method.

$$\begin{array}{r} {\scriptstyle 8\ \ 12\ 1} \\ 9\ \not{3}\ \not{2} \\ -\ 4\ 5\ 7 \\ \hline 4\ 7\ 5 \end{array}$$

Years Four, Five and Six.

Children continue to use the compact column subtraction method but gradually extend to larger whole numbers (ThHTO) and decimals up to 3 decimal places and examples where quite complex adjustment of hundreds, tens and ones are involved.

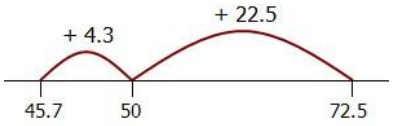
741-367=

$$\begin{array}{r} 700+40+1 \\ -\ 300+60+7 \\ \hline \end{array}$$

$$\begin{array}{r} \overset{600}{\cancel{700}}+\overset{130}{\cancel{40}}+\overset{11}{\cancel{1}} \\ -\ 300+60+7 \\ \hline 300+70+4 \end{array}$$

$$\begin{array}{r} \overset{6}{\cancel{7}}\ \overset{13}{\cancel{4}}\ \overset{11}{\cancel{1}} \\ -\ 3\ 6\ 7 \\ \hline 3\ 7\ 4 \end{array}$$

$$\begin{array}{r} \overset{6}{\cancel{1}}\ 3\ \overset{1}{\cancel{7}}\ 4 \\ -\ 9\ 6\ 8 \\ \hline 4\ 0\ 6 \end{array}$$



$$72.5-45.7$$

$$\begin{array}{r} \overset{6}{\cancel{7}}\ \overset{11}{\cancel{2}}.\overset{1}{5} \\ -\ 4\ 5.7 \\ \hline 2\ 6.8 \end{array}$$

Written methods for multiplication.

To multiply successfully, children need to be able to:

- Recall all multiplication facts to 12x12
- Partition numbers into multiples of one hundred, ten and one
- Work out products such as 70x5, 70x50, 700x5, 700x50 using the related fact 7x5 and their knowledge of place value
- Add two or more single-digit numbers mentally
- Add multiples of 10 or 100 using the related addition fact and their knowledge of place value.

Reception and Year One.

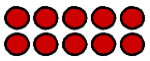
Children are introduced to the concept of multiplication through practical activities that involve counting in steps larger than one. For example in Reception children may count in twos by counting pairs of socks and this continues into Year One where they will count in twos tens and also fives. They will explore doubling, halving and sharing. Children record using pictures and symbols.

How many socks in three pairs? 

There are five cakes in each bag. How many cakes are there in three bags?

5x3

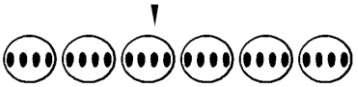
Children are also introduced to arrays as pictorial representations of multiplication.

5x2 or 2x5 

Year Two.

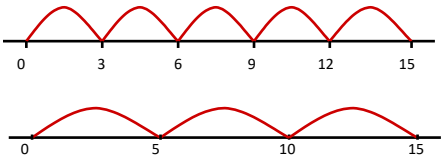
In Year Two children explore the concept of multiplication using the multiplication and equals signs. They record their practical work as repeated addition or as an array. They are also taught that multiplication can be done in any order.

There are four apples in each box. How many apples in six boxes?



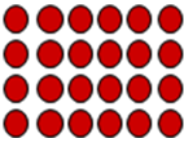
Repeated addition

5 x 3 or 3 x 5



Arrays

6x4 or 4x6



Year Three.

Here children continue to use arrays and start to use partitioning and brackets to help them record multiplication calculations. By partitioning two-digit numbers into tens and ones, these can be multiplied separately to form partial products (Sometimes recorded in a grid – see below). This way, children can use the multiplication facts that they know. These can then be recombined to find the total product.

36x4=144

X	30	6
4	120	24

36x4=144 this leads to

30x4=120

6x4=24

120+24=144

36x4=144 this leads to

36
x 4
(6 x 4) 24
(30 x 4) 120
144

this leads to 36x4=144

36
x 4
144
2

Although the grid method has its place, the preferred method is column multiplication.

Years Four, Five and Six.

Children continue to use formal written short and long multiplication method and extend it to use for TO x O, HTO x O, TO x TO, HTO x TO. 'Carried' digits are recorded under the line. Children also convert between units of measure and multiply one digit numbers with up to two decimal places by whole numbers.

43x6

43
x 6
18 (3 x 6)
240 (40 x 6)
258

24x6=144

2 4
× 6
1 4 4
2

2741x6=16446

```
    2 7 4 1
  ×       6
  ---------
  1 6 4 4 6
    4 2
```

342x7=239

```
    3 4 2
  ×     7
  -------
  2 3 9 4
    2 1
```

124 x 26 =

```
    1 2
    1 2 4
  ×   2 6
  -------
    7 4 4
  2 4 8 0
  -------
  3 2 2 4
  1 1
```

4.7 x 8 =

4.7 × 8

(estimate: 5 × 8 = 40)

```
    4.7
  ×   8
  -----
  37.6
    6
```

Written methods for division.

To divide successfully in their heads, children need to be able to:

- Understand and use the vocabulary of division
- Partition two-digit and three-digit numbers into multiples of 100, 10 and 1
- Recall multiplication and division facts to 12 x 12
- Know how to find a remainder working mentally – for example, find the remainder when 48 is divided by 5.
- Understand and use multiplication and division as inverse operations.

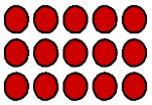
To carry out written methods of division successfully, children also need to be able to:

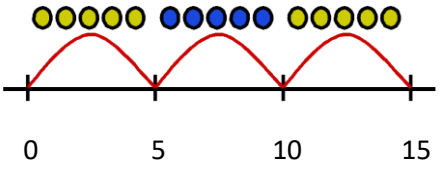
- Understand division as repeated subtraction
- Estimate how many times one number divides into another
- Multiply a two-digit number by a single-digit number mentally
- Subtract numbers using the column method.

Reception, Year One and Year Two.

Children are introduced to the concept of division through practical activities that involve halving, sharing, grouping and making sets including pairs. In Year One children are introduced to the division sign and will use equipment to share and group and record using pictures. They will explore halving numbers and note how division is the opposite (inverse) of doubling. Halving is viewed as splitting into two equal parts, therefore dividing by 2. This is also extended to finding quarters or dividing by 4. The link between multiplication and division is consolidated through the use of arrays and repeated subtraction.

15÷5=3





Year Three

Here children calculate using the multiplication facts that they know and progress to formal written methods for TU÷U.

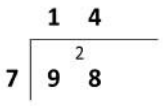
51÷3=17

Practical equipment should be used for support where necessary.

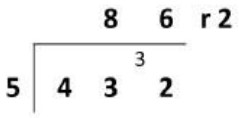
Years Four, Five and Six

Children practice and become more fluent in the formal written methods of short division with TO÷O and HTO÷O. They develop this to interpret remainders appropriately for the context of the question and convert between units of measure. By Year Six they can divide numbers up to 4 digits by a 2 digit number, using short and long division methods and in cases where the answer has up to 2 decimal places.

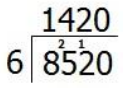
98÷7=14



432÷5=86r2 (estimate 400÷5=80)



8520÷6=1420



43.68÷7=6.24